The McGraw-Hill Companies

SPECIAL INDIAN EDITION

Sixth Edition

INTRODUCTION TO COMPUTERS

PETER NORTON



For Sale in India, Pakistan, Nepal, Bangladesh, Sri Lanka and Bhutan only

Information contained in this work has been obtained by Tata McGraw-Hill, from sources believed to be reliable. However, neither Tata McGraw-Hill nor its authors guarantee the accuracy or completeness of any information published herein, and neither Tata McGraw-Hill nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that Tata McGraw-Hill and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.



Tata McGraw-Hill

PETER NORTON'S® INTRODUCTION TO COMPUTERS

Indian Adaptation done by arrangement with the McGraw-Hill Companies Inc., New York

Sales territories: India, Pakistan, Nepal, Bangladesh, Sri Lanka and Bhutan.

Ninth reprint 2008
RYXDCDRXRBBYA

Copyright © 2006 by The McGraw-Hill Companies, Inc. All rights reserved. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of The McGraw-Hill Companies, Inc., including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning.

Some ancillaries, including electronic and print components, may not be available to customers outside the United States.

ISBN-13: 978-0-07-059374-9
ISBN-10: 0-07-059374-4

Published by the Tata McGraw-Hill Publishing Company Limited,
7 West Patel Nagar, New Delhi 110 008, typeset in Times at Script Makers,
19, A1-B, DDA Market, Pashchim Vihar, New Delhi 110 063 and printed at
Pashupati Printers, 1/429/16, Gali No. 1, Friends Colony, G.T. Road, Shahdara, Delhi 110 095

Cover Printer: SDR Printers

Cover Design: Kapil Gupta

The McGraw-Hill Companies

Urheberrechtlich geschütztes Material

CONTENTS AT A GLANCE

Chapter 1: Introducing Computer Systems 2
Lesson 1A: Exploring Computers and Their Uses 3
Lesson 1B: Looking Inside the Computer System 24

Chapter 2: Interacting with Your Computer 48
Lesson 2A: Using the Keyboard and Mouse 49
Lesson 2B: Inputting Data in Other Ways 68

Chapter 3: Seeing, Hearing, and Printing Data 86
Lesson 3A: Video and Sound 89
Lesson 3B: Printing 107

Chapter 4: Processing Data 124
Lesson 4A: Transforming Data into Information 125
Lesson 4B: Modern CPUs 146

Chapter 5: Storing Data 164
Lesson 5A: Types of Storage Devices 165
Lesson 5B: Measuring and Improving Drive Performance 197

Chapter 6: Using Operating Systems 204
Lesson 6A: Operating System Basics 205
Lesson 6B: Survey of PC and Network Operating Systems 224

Chapter 7: Networks 242
Lesson 7A: Networking Basics 243
Lesson 7B: Data Communications 267

Chapter 8: Presenting the Internet 284
Lesson 8A: The Internet and the World 285
Lesson 8B: E-Mail and Other Internet Services 312

Chapter 9: Working in the Online World 330
Lesson 9A: Connecting to the Internet 331
Lesson 9B: Doing Business in the Online World 345

Chapter 10: Working with Application Software 362
Lesson 10A: Productivity Software 363
Lesson 10B: Graphics and Multimedia 383

Chapter 11: Database Management 400
Lesson 11A: Database Management Systems 401
Lesson 11B: Survey of Database Systems 420

Chapter 12: Software Programming and Development 438
Lesson 12A: Creating Computer Programs 439
Lesson 12B: Programming Languages and the Programming Process 456

Chapter 13: Protecting Your Privacy, Your Computer, and Your Data 476
Lesson 13A: Understanding the Need for Security Measures 477
Lesson 13B: Taking Protective Measures 497

Appendix A: Creating Your Own Web Page 518
Appendix B: Buying Your First Computer 526
Appendix C: Computer Viruses 532
Appendix D: History of Microcomputers 538
Appendix E: Self-Check Answers 558

Urheberrechtlich geschütztes Material

FEATURE ARTICLES

At Issue

Computerized Disease Management 36
Computer Voting—Is It a Good Thing? 62
Call of the Wild: Bioacoustic Research 102
Cyborgs among Us: Wearable Technology 134
Digital Student Portfolios 192
Controlling Computers with the Mind 228
Catching "Cyberslackers" on the Job 252
Stomping Out Spam 316
On the Beat with Techno-Cops 336
Who Really Owns the Software on Your PC? 372
Play Ball! Baseball Enters the Information Age 414
Hot and Oh-So-Cool: Technology Forecasts the Weather 450
Software Piracy 490

Productivity Tip

Choosing the Right Tool for the Job 12
Saving Time with Keyboard Shortcuts 60
The Care and Feeding of Printers 114
Do You Need More RAM? 140
Backing Up Your Data 174
Do-It-Yourself Tech Support 214
The Telecommuter's Checklist 270
Evaluating the Reliability of Search Results and Web Sites 304
Sharing an Internet Connection 340
Automating Your Work with Macros 376
Database Macros 426
Finding Faster Algorithms 448
Keeping Your PC Up to Date 486

Norton Notebook

The Merging of Media and Meaning 18
Speech Recognition 74
Flat Video Is Anything But 98
What *Is* a Computer Chip? 150
Looking Back, Moving Forward 180
Changing Your PC's Operating System 198
Fighting Hackers 260
Internet Time Travel: The Wayback Machine 294
Business, the Internet, and Everything 352
Why Own When You Can Rent? 390
Data Warehouses 406
Artificial Intelligence: Will Computers Ever Think? 466
Nexus: Converging Technologies 506

Computers In Your Career

Using Computers Outside of the IT Industry 40
Hardware Technician 78
Computer Training Specialist 116
Computer Sales Professional 156
Careers in Outsourcing 194
Help Desk and Technical Support Specialists 234
Careers in Networking 276
Documentation and Online Help System Designer 322
Career Opportunities and the Internet 354
Careers in Multimedia 392
Database Careers 430
Careers in Programming 468
Computer Scientist 510

Urheberrechtlich geschütztes Material

CONTENTS

CHAPTER 1::
Introducing Computer Systems 2
Chapter Contents 2

Lesson 1A:
Exploring Computers and Their Uses 3
Overview: Computers in Our World 3
The Computer Defined 4
Computers for Individual Users 5
Desktop Computers 5
Workstations 6
Notebook Computers 6
Tablet PCs 7
Handheld PCs 7
Smart Phones 7
Computers for Organizations 8
Network Servers 8
Mainframe Computers 9
Minicomputers 10
Supercomputers 10
Computers in Society 11
Productivity Tip: Choosing the Right Tool for the Job 12
Why Are Computers So Important? 12
Home 14
Education 15
Small Business 15
Industry 16
Government 17
Health Care 18
Norton Notebook: The Merging of Media and Meaning 18
Lesson 1A Review 20

Lesson 1B:
Looking Inside the Computer System 24
Overview: Dissecting the Ultimate Machine 24
The Parts of a Computer System 25
Hardware 25
Software 25
Data 25
Users 26
The Information Processing Cycle 26
Essential Computer Hardware 27
Processing Devices 28
Memory Devices 29
Random Access Memory 29
Read-Only Memory 29
Input and Output Devices 30
Storage Devices 31
Magnetic Storage 31
Optical Storage 32
Software Brings the Machine to Life 32
System Software 33
Application Software 33
Computer Data 34
At Issue: Computerized Disease Management 36
Computer Users 38
The User's Role 38
"Userless" Computers 39
Computers In Your Career: Using Computers Outside of the IT Industry 40
Lesson 1B Review 42
Chapter Skills Review 46
Chapter Labs 46
Discussion Questions 47
Research and Report 47
Ethical Issues 47

CHAPTER 2::
Interacting with Your Computer 48
Chapter Contents 48

Lesson 2A:
Using the Keyboard and Mouse 49
Overview: The Keyboard and Mouse 49
The Keyboard 50
The Standard Keyboard Layout 50
The Alphanumeric Keys 50
The Modifier Keys 50

Urheberrechtlich geschütztes Material

The Numeric Keypad 51
The Function Keys 51
The Cursor-Movement Keys 52
Special-Purpose Keys 52
How the Computer Accepts Input from the Keyboard 53
The Mouse 54
Using the Mouse 56
Mouse Button Configurations 58
Variants of the Mouse 58
Trackballs 58
Trackpads 59
Pointers in the Keyboard 59
Productivity Tip: Saving Time With Keyboard Shortcuts 60
Ergonomics and Input Devices 60
Repetitive Stress Injuries 61
Avoiding Keyboard-Related Injuries 62
At Issue: Computer Voting—Is It a Good Thing? 62
Lesson 2A Review 65

Lesson 2B:
Inputting Data in Other Ways 68
Overview: Options for Every Need and Preference 68
Devices for the Hand 69
Pens 69
Touch Screens 70
Game Controllers 70
Optical Input Devices 71
Bar Code Readers 71
Image Scanners and Optical Character Recognition (OCR) 72
Norton Notebook: Speech Recognition 74
Audiovisual Input Devices 74
Microphones 74
Other Types of Audio Input 76
Video Input 77
Digital Cameras 77
Computers In Your Career: Hardware Technician 78
Lesson 2B Review 80
Chapter Skills Review 84
Chapter Labs 84
Discussion Questions 85
Research and Report 85
Ethical Issues 85

CHAPTER 3:
Seeing, Hearing, and Printing Data 86
Chapter Contents 86

Lesson 3A:
Video and Sound 87
Overview: Reaching Our Senses with Sight and Sound 87
Monitors 88
CRT Monitors 89
Flat-Panel Monitors 90
Other Types of Monitors 92
Comparing Monitors 93
Size 94
Resolution 94
Refresh Rate 95
Dot Pitch 96
Video Cards 96
Ergonomics and Monitors 97
Eyestrain 97
Norton Notebook: Flat Video Is Anything But 98
Electromagnetic Fields 98
Data Projectors 100
Sound Systems 100
Sound Cards 100
Headphones and Headsets 102
At Issue: Call of the Wild: Bioacoustic Research 102
Lesson 3A Review 104

Lesson 3B:
Printing 107
Overview: Putting Digital Content in Your Hands 107
Commonly Used Printers 108
Dot Matrix Printers 108
Ink Jet Printers 110
Laser Printers 111
All-In-One Peripherals 112

Urheberrechtlich geschütztes Material

Comparing Printers 112
High-Quality Printers 113
Photo Printers 113
Productivity Tip: The Care and Feeding of Printers 114
Thermal-Wax Printers 114
Dye-Sublimation Printers 115
Plotters 116
Computers In Your Career: Computer Training Specialist 116
Lesson 3B Review 118
Chapter Skills Review 122
Chapter Labs 122
Discussion Questions 123
Research and Report 123
Ethical Issues 123

CHAPTER 4:: Processing Data 124
Chapter Contents 124

Lesson 4A: Transforming Data into Information 125
Overview: The Difference between Data and Information 125
How Computers Represent Data 126
Number Systems 126
Bits and Bytes 127
Text Codes 127
How Computers Process Data 128
The CPU 130
The Control Unit 130
The Arithmetic Logic Unit 130
Machine Cycles 130
Memory 131
Nonvolatile Memory 132
Flash Memory 132
Volatile Memory 132
Factors Affecting Processing Speed 133
Registers 133
At Issue: Cyborgs Among Us: Wearable Technology 134
Memory and Computing Power 134
The Computer's Internal Clock 136
The Bus 136
The Data Bus 136
The Address Bus 137
Bus Standards 137
Cache Memory 138
Productivity Tip: Do You Need More RAM? 140
Lesson 4A Review 142

Lesson 4B: Modern CPUs 146
Overview: The Race for the Desktop 146
A Look Inside the Processor 147
Microcomputer Processors 147
Intel Processors 148
Advanced Micro Devices (AMD) Processors 148
Freescale Processors 149
IBM Processors 149
Comparing Processors 150
Norton Notebook: What Is a Computer Chip? 150
RISC Processors 151
Parallel Processing 151
Extending the Processor's Power to Other Devices 152
Standard Computer Ports 152
Serial and Parallel Ports 153
Specialized Expansion Ports 154
SCSI 154
USB 154
IEEE 1394 (FireWire) 155
Musical Instrument Digital Interface (MIDI) 155
Expansion Slots and Boards 155
Computers In Your Career: Computer Sales Professional 156
PC Cards 156
Plug and Play 157
Lesson 4B Review 158
Chapter Skills Review 162
Chapter Labs 162
Discussion Questions 163
Research and Report 163
Ethical Issues 163

Urheberrechtlich geschütztes Material

CHAPTER 5::
Storing Data 164
Chapter Contents 164

Lesson 5A:
Types of Storage Devices 165
Overview: An Ever-Growing Need 165
Categorizing Storage Devices 166
Magnetic Storage Devices 166
How Data Is Stored on a Disk 166
How Data Is Organized on a Magnetic Disk 168
Tracks and Sectors 168
How the Operating System Finds Data on a Disk 170
Diskettes (Floppy Disks) 171
Hard Disks 173
Removable High-Capacity Magnetic Disks 173
Tape Drives 174
Productivity Tip: Backing Up Your Data 174
Optical Storage Devices 175
CD-ROM 176
DVD-ROM 177
Recordable Optical Technologies 178
Solid-State Storage Devices 179
Flash Memory 179
Norton Notebook: Looking Back, Moving Forward 180
Smart Cards 180
Solid-State Disks 182
Lesson 5A Review 183

Lesson 5B:
Measuring and Improving Drive Performance 187
Overview: The Need for Speed 187
Average Access Time 188
Data Transfer Rate 188
Optimizing Disk Performance 189
Cleaning Up Unneeded Files 189
Scanning a Disk for Errors 190
Defragmenting a Disk 190
File Compression 190
At Issue: Digital Student Portfolios 192
Drive-Interface Standards 192
Enhanced Integrated Drive Electronics (EIDE) 193
Small Computer System Interface (SCSI) 193
USB and FireWire 194
Computers In Your Career: Careers in Outsourcing 194
Lesson 5B Review 196
Chapter Skills Review 200
Chapter Labs 200
Discussion Questions 201
Research and Report 202
Ethical Issues 202

CHAPTER 6::
Using Operating Systems 204
Chapter Contents 204

Lesson 6A:
Operating System Basics 205
Overview: The Purpose of Operating Systems 205
Types of Operating Systems 206
Real-Time Operating Systems 206
Single-User/Single-Tasking Operating Systems 206
Single-User/Multitasking Operating Systems 206
Multi-User/Multitasking Operating Systems 207
Providing a User Interface 208
Graphical User Interfaces 208
Command-Line Interfaces 211
Running Programs 212
Sharing Information 213
Productivity Tip: Do-It-Yourself Tech Support 214
Managing Hardware 215
Processing Interrupts 216
Working with Device Drivers 216
Enhancing an OS with Utility Software 216
Backup Utilities 217
Antivirus 217
Firewall 217
Intrusion Detection 217
Screen Savers 217

Urheberrechtlich geschütztes Material

Norton Notebook: Changing Your PC's Operating System 218
Lesson 6A Review 220

Lesson 6B: Survey of PC and Network Operating Systems 224

Overview: Operating Systems Yesterday and Today 224
PC Operating Systems 225
DOS 225
Windows NT Workstation 225
Windows 9x 226
Windows 2000 Professional 228
Windows XP 228
The Macintosh Operating System 229
UNIX for the Desktop 229
Linux for the Desktop 229
At Issue: Controlling Computers with the Mind 230
Network Operating Systems 230
Windows NT Server 231
Windows 2000 Server 232
Windows Server 2003 232
Novell NetWare 232
UNIX for Servers 233
Linux for Servers 233
Embedded Operating Systems 233
Computers in Your Career: Help Desk and Technical Support Specialists 234
Lesson 6B Review 236
Chapter Skills Review 240
Chapter Labs 240
Discussion Questions 241
Research and Report 241
Ethical Issues 241

CHAPTER 7:: Networks 242

Chapter Contents 242

Lesson 7A: Networking Basics 243

Overview: Sharing Data Anywhere, Anytime 243
The Uses of a Network 244
Simultaneous Access 244
Shared Peripheral Devices 245
Personal Communications 246
Easier Data Backup 247
Common Types of Networks 248
Local Area Networks (LANs) 248
Wide Area Networks (WANs) 248
Hybrid Networks 248
Campus Area Networks (CANs) 249
Metropolitan Area Networks (MANs) 249
Home Area Networks (HANs) 249
Intranets and Extranets 249
How Networks Are Structured 250
Server-Based Networks 250
Client/Server Networks 250
Peer-to-Peer Networks 251
At Issue: Catching "Cyberslackers" on the Job 252
Network Topologies and Protocols 253
Network Media 255
Wire-Based Media 255
Wireless Media 256
Network Hardware 256
Network Interface Cards (NICs) 256
Network Linking Devices 256
Cabling Equipment 258
Norton Notebook: Fighting Hackers 260
Protocols 261
Lesson 7A Review 263

Lesson 7B: Data Communications 267

Overview: The Local and Global Reach of Networks 267
Data Communications with Standard Telephone Lines and Modems 268
Modems 268
Uses for a Modem 270
Productivity Tip: The Telecommuter's Checklist 270
Using Digital Data Connections 271
Broadband Connections 272

Urheberrechtlich geschütztes Material

DSL Technologies 272
Cable Modem Connections 273
ATM 274
Wireless Networks 274
Wireless: 802.11 275
Wireless Access Point 275
Wireless Adapter 275
Computers In Your Career: Careers in Networking 276
Lesson 7B Review 278
Chapter Skills Review 282
Chapter Labs 282
Discussion Questions 283
Research and Report 283
Ethical Issues 283

CHAPTER 8::
Presenting the Internet 284
Chapter Contents 284

Lesson 8A:
The Internet and the World Wide Web 285

Overview: What Is the Internet? 285
The Internet's History 286
The Beginning: A "Network of Networks" 286
Today: Still Growing 287
The Internet's Major Services 288
Understanding the World Wide Web 288
How the Web Works 289
Web Browsers and HTML Tags 290
URLs 291
Helper Applications and Multimedia Content 292
Norton Notebook: Internet Time Travel: The Wayback Machine 294
Using Your Browser and the World Wide Web 295
Launching Your Browser 296
Navigating the Web 296
Using URLs 296
Using Hyperlinks 297
Using the Browser's Navigation Tools 298
Closing Your Browser 298
Getting Help with Your Browser 299
Searching the Web 299
Using a Directory 301
Using a Search Engine 301
Using Boolean Operators in Your Searches 302
Using Advanced Search Options 303
Productivity Tip: Evaluating the Reliability of Search Results and Web Sites 304
Using a Metasearch Engine 306
Sponsored versus Nonsponsored Links 306
Using Site-Specific Search Tools 307
Lesson 8A Review 308

Lesson 8B:
E-Mail and Other Internet Services 312

Overview: Communicating Through the Internet 312
Using E-Mail 313
Understanding E-Mail 313
E-Mail Addresses 313
Listserv Systems 314
Using an E-Mail Program 314
Creating a Message 314
Receiving and Reading a Message 315
At Issue: Stomping Out Spam 316
Using Web-Based E-Mail Services 317
More Features of the Internet 317
News 317
FTP 319
Internet Relay Chat (IRC) and Web-Based Chat 320
Instant Messaging 321
Online Services 321
Peer-to-Peer Services 322
Computers In Your Career: Documentation and Online Help System Designer 322
Lesson 8B Review 324
Chapter Skills Review 328
Chapter Labs 328
Discussion Questions 329
Research and Report 329
Ethical Issues 329

Urheberrechtlich geschütztes Material

CHAPTER 9::
Working in the Online World 330
Chapter Contents 330

Lesson 9A:
Connecting to the Internet 331
Overview: Joining the Internet Phenomenon 331
Connecting to the Internet through Wires 332
Dial-up Connections 332
High-Speed Broadband Connections 332
Integrated Services Digital Network (ISDN) Service 333
Digital Subscriber Line (DSL) Services 333
Cable Modem Service 334
How PC Applications Access the Internet 334
Connecting to the Internet Wirelessly 335
Wireless WAN (WWAN) Connections 335
At Issue: On the Beat with Techno-Cops 336
Satellite Services 336
WLAN Connections 338
Productivity Tip: Sharing an Internet Connection 340
Lesson 9A Review 342

Lesson 9B:
Doing Business in the Online World 345
Overview: Commerce on the World Wide Web 345
E-Commerce at the Consumer Level 346
Online Shopping 346
Online Stores versus Physical Locations 347
Using Online Catalogs 347
Paying for Purchases 348
Getting Customer Service 349
Online Banking and Finance 349
Online Banking 350
Online Finance 350
E-Commerce at the Business Level 350
Business-to-Business (B2B) Transactions 350
Intranets and Extranets 351
Norton Notebook: Business, the Internet and Everything 352
Telecommuters 352
Computers In Your Career: Career Opportunities and the Internet 354
Security 354
Lesson 9B Review 356
Chapter Skills Review 360
Chapter Labs 360
Discussion Questions 361
Research and Report 361
Ethical Issues 361

CHAPTER 10::
Working with Application Software 362
Chapter Contents 362

Lesson 10A:
Productivity Software 363
Overview: Software to Accomplish the Work of Life 363
Acquiring Software 364
Commercial Software 364
Freeware and Public Domain Software 364
Open-Source Software 365
Word Processing Programs 365
The Word Processor's Interface 366
Entering and Editing Text 366
Formatting Text 367
Spreadsheet Programs 368
The Spreadsheet's Interface 368
Entering Data in a Worksheet 369
Presentation Programs 371
At Issue: Who Really Owns the Software on Your PC? 372
The Presentation Program's Interface 372
Creating a Presentation 374
Presenting Slide Shows 375
Productivity Tip: Automating Your Work with Macros 376
Personal Information Managers 376
Lesson 10A Review 379

Lesson 10B:
Graphics and Multimedia 383
Overview: Graphics, Graphics Everywhere 383
Understanding Graphics File Formats 384

Bitmap and Vector Graphics 384
File Formats and Compatibility Issues 384
Getting Images into Your Computer 386
Graphics Software 386
Paint Programs 387
Draw Programs 387
Photo-Editing Programs 387
Computer-Aided Design Programs 388
3-D and Animation Software 389
Norton Notebook: Why Own When You Can Rent? 390
Multimedia Basics 390
Computers In Your Career: Careers in Multimedia 392
Lesson 10B Review 394
Chapter Skills Review 397
Chapter Labs 397
Discussion Questions 397
Research and Report 398
Ethical Issues 398

CHAPTER 11::
Database Management 400
Chapter Contents 400

Lesson 11A:
Database Management Systems 401
Overview: The Mother of All Computer Applications 401
Databases and Database Management Systems 402
The Database 402
Flat-File and Relational Database Structures 405
The DBMS 405
Norton Notebook: Data Warehouses 406
Working with a Database 406
Creating Database Tables 407
Understanding Field Types 407
Entering Data in a Table 409
Viewing Records 409
Sorting Records 410
Querying a Database 412
Generating Reports 413
At Issue: Play Ball! Baseball Enters the Information Age 414
Lesson 11A Review 416

Lesson 11B:
Survey of Database Systems 420
Overview: When Applications Grow Huge 420
Enterprise Software 421
Meeting the Needs of Many Users 421
Databases at Work 423
Databases in Business 423
Databases on the Internet 425
Databases for Individuals 425
Productivity Tip: Database Macros 426
Common Corporate Database Management Systems 428
Oracle 428
DB2 429
SQL Server 429
MySQL 429
Computers In Your Career: Database Careers 430
Lesson 11B Review 432
Chapter Skills Review 436
Chapter Labs 436
Discussion Questions 436
Research and Report 437
Ethical Issues 437

CHAPTER 12::
Software Programming and Development 438
Chapter Contents 438

Lesson 12A:
Creating Computer Programs 439
Overview: What Is a Computer Program? 439
What Is a Computer Program? 440
Hardware/Software Interaction 441
Code 441
Machine Code 442
Programming Languages 442

Compilers and Interpreters 443
Planning a Computer Program 444
How Programs Solve Problems 445
Program Control Flow 445
Algorithms 445
Heuristics 446
Productivity Tip: Finding Faster Algorithms 448
Structured and Object-Oriented Programming 448
Programming Structures 449
At Issue: Hot and Oh-So-Cool: Technology Forecasts the Weather 450
Object-Oriented Programming 450
Lesson 12A Review 452

Lesson 12B: Programming Languages and the Programming Process 456

Overview: The Keys to Successful Programming 456
The Evolution of Programming Languages 457
Categories of Programming Languages 457
Machine and Assembly Languages 458
Higher-Level Languages 458
Third-Generation Languages 459
Fourth-Generation Languages 460
Fifth-Generation Languages 461
World Wide Web Development Languages 461
Scripting Languages 464
The Systems Development Life Cycle for Programming 465
Norton Notebook: Artificial Intelligence: Will Computers Ever Think? 466
Computers In Your Career: Careers in Programming 468
Lesson 12B Review 470

Chapter Skills Review 474

Chapter Labs 474
Discussion Questions 475
Research and Report 475
Ethical Issues 475

CHAPTER 13:: Protecting Your Privacy, Your Computer, and Your Data 476

Chapter Contents 476

Lesson 13A: Understanding the Need for Security Measures 477

Overview: The Need for Computer Security 477
Basic Security Concepts 478
Threats 478
Degrees of Harm 478
Countermeasures 478
Threats to Users 479
Identity Theft 479
Loss of Privacy 480
Public Records on the Internet 480
Internet Monitoring, Profiling, and Spying 481
Online Spying Tools 481
Cookies 481
Web Bugs 482
Spyware 482
Spam 483
Computer-Related Injuries 484
Threats to Hardware 484
Power-Related Threats 485
Theft and Vandalism 485
Natural Disasters 486
Productivity Tip: Keeping Your PC Up to Date 486
Threats to Data 488
Malware, Viruses, and Malicious Programs 488
Cybercrime 488
Hacking 489
Common Hacking Methods 489
At Issue: Software Piracy 490
Cyberterrorism 492
Lesson 13A Review 493

Lesson 13B: Taking Protective Measures 497

Overview: Keeping Your System Safe 497
Protecting Yourself 498
Avoiding Identity Theft 498
Managing Your Papers 498
Guarding Personal Information 499

Looking at the Big Picture 499
Protecting Your Privacy 499
Keeping Marketers at Bay 499
Knowing Your Rights 500
Managing Cookies, Spyware, and Other "Bugs" 501
Dealing with Cookies 501
Removing Web Bugs and Spyware 502
Evading Spam 502
Keeping Your Data Secure 503
Restricting Access to Your System 504
Limiting Physical Access 504
Using a Firewall 505
Backing Up Data 505
Norton Notebook: Nexus: Converging Technologies 506
Safeguarding Your Hardware 508
Using Automated Warnings 508
Handling Storage Media 508
Storing Computer Equipment 509
Keeping Your Computer Clean 509
Computers In Your Career: Computer Scientist 510
Lesson 13B Review 512
Chapter Skills Review 516
Chapter Labs 516
Discussion Questions 516
Research and Report 517
Ethical Issues 517
Appendix A: Creating Your Own Web Page 518
Appendix B: Buying Your First Computer 526
Appendix C: Computer Viruses 532
Appendix D: History of Microcomputers 538
Appendix E: Self-Check Answers 558
Glossary 559
Photo Credits 591
Index 593

Urheberrechtlich geschütztes Material

PREREQUISITES

What You Should Know Before Using This Book

This book assumes that you have never used a computer before or that your computer experience has been very brief. If so, you may need to learn some basic computer skills before proceeding with this course. This Prerequisites section introduces basic skills, using illustrations to help you recognize and remember the hardware or software involved in each skill. Some of these skills are covered in greater detail in other units of this book. In such cases, you will find references that point you to more information.

Equipment Required for This Book's Exercises

- IBM-compatible personal computer
- Keyboard
- Two-button mouse
- Windows 98 or higher
- Internet connection
- Web browser

Turning the Computer On and Off

Turning the Computer On

As simple as it may sound, there is a right way to turn a computer's power on and off. If you perform either of these tasks incorrectly, you may damage the computer's components or cause problems for the operating system, programs, or data files.

1. Before turning on your computer, make sure that all the necessary cables (such as the mouse, keyboard, printer, modem, etc.) are connected to the system unit. Also make sure that the system's power cords are connected to an appropriate power source.
2. Make sure that there are no diskettes in the computer's diskette drive, unless you must boot the system from a diskette. (The term *booting* means starting the computer.) If you must boot the system from a diskette, ask your instructor for specific directions.
3. Find the On/Off switch on each attached device (the monitor, printer, etc.) and place it in the ON position. A device's power switch may not be on the front panel. Check the sides and back to find the On/Off switch if the switch is not located on the front panel.







Urheberrechtlich geschütztes Material



4. Find the On/Off switch on the computer's system unit—its main box into which all other components are plugged—and place it in the ON position.

Most computers take a minute or two to start. Your computer may display messages during the start-up process. If one of these messages prompts you to perform an action (such as providing a network user ID and password), ask your instructor for directions. After the computer has started, the Windows desktop will appear on your screen.

Turning the Computer Off

In Windows-based systems, it is critical that you shut down properly, as described here. Windows creates many temporary files on your computer's hard disk when running. By shutting down properly, you give Windows the chance to erase those temporary files and do other "housekeeping" tasks. If you simply turn off your computer while Windows or other programs are running, you can cause harm to your system.



:: *For more information on Windows and other operating systems, see Chapter 6, "Using Operating Systems."*

Note: The illustration shows the shut-down process in Windows 98. The process, menus, and dialog boxes are the same in all versions of Windows except Windows XP, as noted in the following instructions.

1. Remove any disks from the diskette and CD-ROM drives and make sure that all data is saved and all running programs are closed. (For help with saving data and closing programs, ask your instructor.)
2. Using your mouse pointer, click the Start button, which is located on the taskbar. The Start menu will appear. On the Start menu, click Shut Down. (If you use Windows XP, click the Turn Off Computer option.) The Shut Down Windows dialog box will appear. (In Windows XP, the Turn Off Computer dialog box will appear.)



Urheberrechtlich geschütztes Material

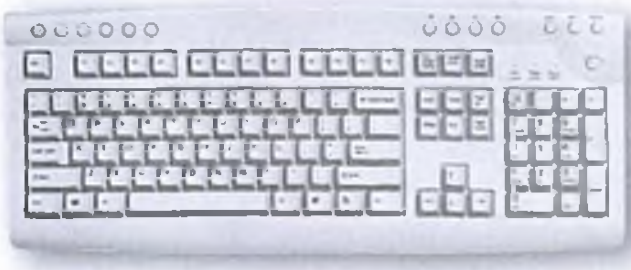
Windows will begin the shut-down process. Windows may display a message telling you that it is shutting down. Then it may display the message "It is now safe to turn off your computer." When this message appears, turn off the power to your system unit, monitor, and printer.

In some newer computers, the system unit will power down automatically after Windows shuts down. If your computer provides this feature, you need to turn off only your monitor and other devices.



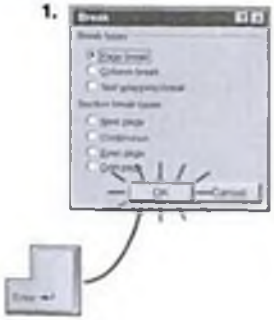
Using the Keyboard

If you know how to type, then you can easily use a computer keyboard. The keyboard contains all the alphanumeric keys found on a typewriter, plus some keys that perform special functions.



The keyboard is covered in detail in Lesson 2A, "Using the Keyboard and Mouse."

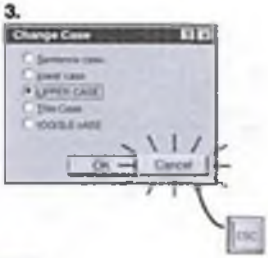
1. In Windows, the ENTER key performs two primary functions. First, it lets you create paragraph ("hard") returns in application programs such as word processors. Second, when a dialog box is open, pressing ENTER is like clicking the OK button. This accepts your input and closes the dialog box.



2. The SHIFT, CTRL (control), and ALT (alternate) keys are called modifier keys. You use them in combination with other keys to issue commands. In many programs, for example, pressing CTRL+S (hold the CTRL key down while pressing the S key) saves the open document to disk. Used with all the alphanumeric and function keys, the modifier keys let you issue hundreds of commands.



3. In Windows programs, the ESC (escape) key performs one universal function. That is, you can use it to cancel a command before it executes. When a dialog box is open, pressing ESC is like clicking the CANCEL button. This action closes the dialog box and ignores any changes you made in the dialog box.



4. Depending on the program you are using, the function keys may serve a variety of purposes or none at all. Function keys generally provide shortcuts to program features or commands. In many Windows programs, for example, you can press F1 to launch the online help system.

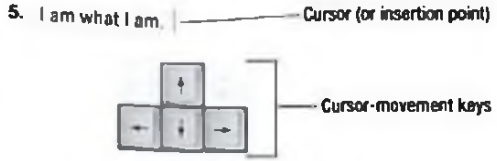


5. In any Windows application, a blinking bar—called the cursor or the insertion point—shows you where the next character will appear as you type. You can use the cursor-movement keys to move the cursor to different

Urheberrechtlich geschütztes Material

positions. As their arrows indicate, these keys let you move the cursor up, down, left, and right.

6. The DELETE key erases characters to the right of the cursor. The BACKSPACE key erases characters to the left of the cursor. In many applications, the HOME and END keys let you move the cursor to the beginning or end of a line, or farther when used with a modifier key. PAGE UP and PAGE DOWN let you scroll quickly through a document, moving back or ahead one screen at a time.





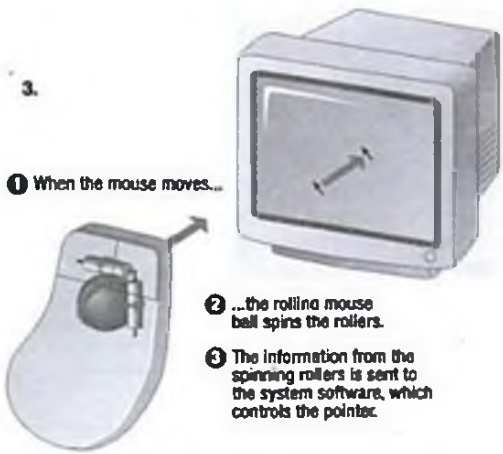
Using the Mouse

The mouse makes your computer easy to use. In fact, Windows and Windows-based programs are mouse-oriented, meaning their features and commands are designed for use with a mouse.

1. This book assumes that you are using a standard two-button mouse. Usually, the mouse's left button is the primary button. You click it to select commands and perform other tasks. The right button opens special "shortcut menus," whose contents vary according to the program you are using.
2. You use the mouse to move a graphical pointer around on the screen. This process is called pointing.
3. The pointer is controlled by the mouse's motions across your desktop's surface. When you push the mouse forward (away from you), the pointer moves up on the screen. When you pull the mouse backward (toward you), the pointer moves down. When you move the mouse to the left or right, or diagonally, the pointer moves to the left, right, or diagonally on the screen.



:: *The mouse is covered in greater detail in Lesson 2A, "Using the Keyboard and Mouse."*



Urheberrechtlich geschütztes Material

4. To click an object, such as an icon, point to it on the screen, then quickly press and release the left mouse button one time. Generally, clicking an object selects it, or tells Windows that you want to do something with the object.
5. To double-click an object, point to it on the screen, then quickly press and release the left mouse button twice. Generally, double-clicking an object selects and activates the object. For example, when you double-click a program's icon on the desktop, the program launches so you can use it.
6. To right-click an object, point to it on the screen, then quickly press and release the right mouse button one time. Generally, right-clicking an object opens a shortcut menu that provides options for working with the object.
7. You can use the mouse to move objects around on the screen. For example, you can move an icon to a different location on the Windows desktop. This procedure is often called drag-and-drop editing. To drag an object, point to it, press and hold down the left mouse button, drag the object to the desired location, then release the mouse button.



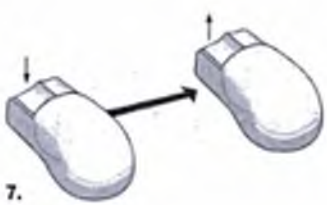
4.



5.



6.


7.

Urheberrechtlich geschütztes Material

Effective Learning Tools

This pedagogically rich book is designed to make learning easy and enjoyable. It will help you develop the skills and critical thinking abilities that will enable you to understand computers and computer technology, troubleshoot problems, and possibly lead you into an IT career.



Self-check quizzes keep the students engaged and test their understanding of the lesson topics.

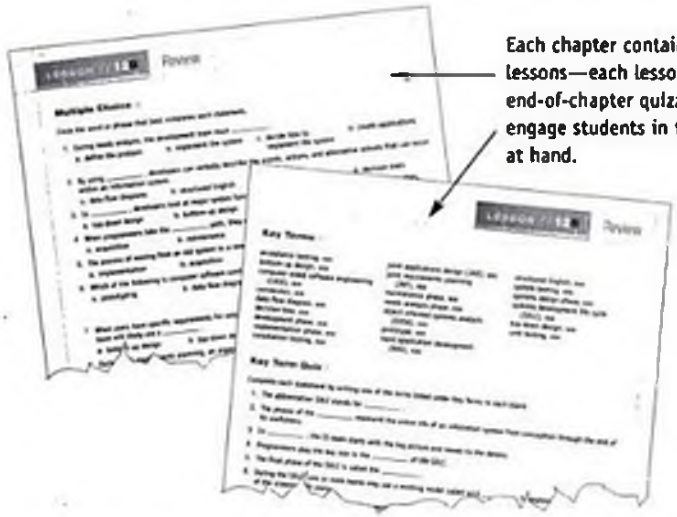


Productivity Tips, Computers In Your Career, and other feature articles offer students a more in-depth discussion of today's technology and how it affects their everyday lives.

Each chapter includes . . .

- **Learning objectives** that set measurable goals for lesson-by-lesson progress
- **Illustrations** that give you a clear picture of the technologies
- **More review materials at the end of each chapter *and* lesson:** Key terms quiz, multiple choice questions, short answer review questions, lab activities, discussion questions, research and report assignments, and ethical issue discussions

Urheberrechtlich geschütztes Material



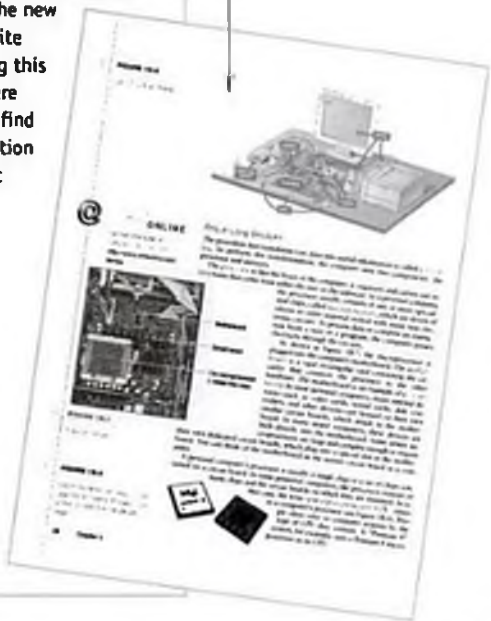
Each chapter contains two lessons—each lesson offers end-of-chapter quizzes that engage students in the topics at hand.

Important Technology Concepts

Information technology (IT) offers many career paths leading to occupations in such fields as PC repair network administration, telecommunications, Web development, graphic design, and desktop support. To become competent in any IT field you need certain basic computer skills. *Peter Norton's Introduction to Computers,* 6e, builds a foundation for success in the IT field by introducing you to fundamental technology concepts and giving you essential computer skills.

Your IT career starts here!

This book is full of detailed IT concepts and current photographs of the latest technologies. Norton Online sidebars point students to the new Norton web site accompanying this textbook where students can find more information on IT-specific topics.



- **Self-check quizzes** in each lesson (two per chapter) help students apply their knowledge as they work through the lesson

Feature articles

- **Norton Notebooks** offer insightful thoughts about emerging technologies and computers in our society.
- **At Issue** articles spotlight trends in information technology and offer a compelling look at how technology is used to help people enhance their lives.
- **Computers In Your Career** offer students a "human face" into IT professions by providing IT interviews and ideas for where an IT career might take today's students.
- **Productivity Tips** cover topics such as adding RAM, printer maintenance, and sharing Internet connections.

Urheberrechtlich geschütztes Material



PETER NORTON'S

Introduction to Computers

Urheberrechtlich geschütztes Material



CHAPTER 1

Introducing Computer Systems

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **1A:**
Exploring Computers and Their Uses

- The Computer Defined
- Computers for Individual Users
- Computers for Organizations
- Computers in Society

Lesson **1B:**
Looking Inside the Computer System

- The Parts of a Computer System
- The Information Processing Cycle
- Essential Computer Hardware
- Software Brings the Machine to Life
- Computer Data
- Computer Users



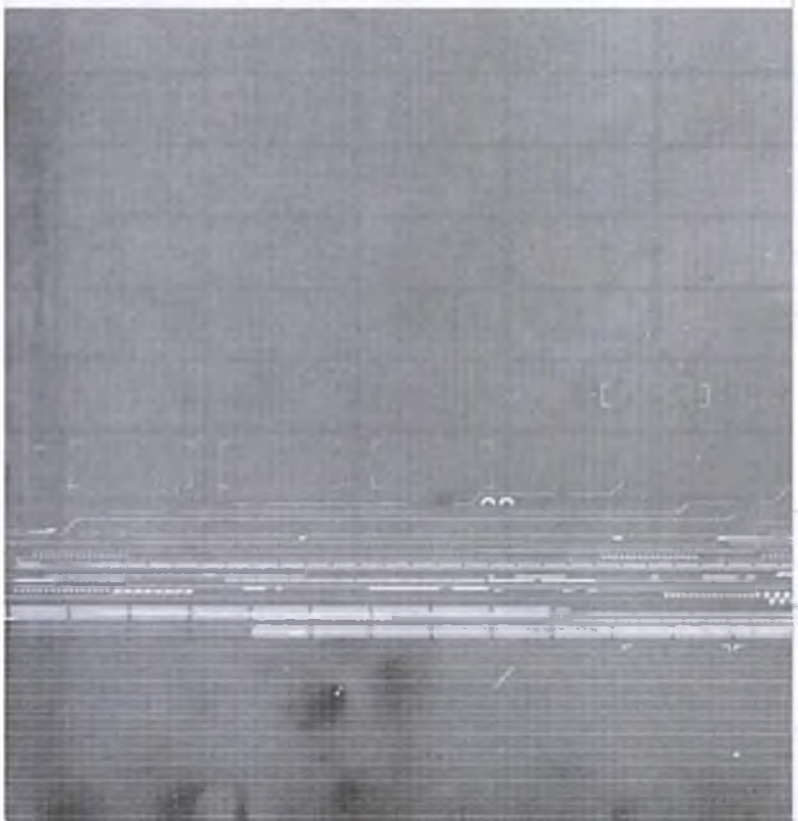
Exploring Computers and Their Uses

Overview: Computers in Our World

Consider this sentence: "Computers are everywhere." Does it sound like an overstatement? A cliché? No matter how you perceive the impact of computers, the statement is true. Computers *are* everywhere. In fact, you can find them in some pretty unlikely places, including your family car, your home appliances, and even your alarm clock!

In the past two decades, computers have reshaped our lives at home, work, and school. The vast majority of businesses now use computerized equipment in some way, and most companies are networked both internally and externally. More than half of all homes in the United States have at least one computer, and most of them are connected to the Internet. Workers who once had little use for technology now interact with computers almost every minute of the workday.

This lesson examines the many types of computers that are in common use today. Although this class will focus on personal computers (the ones that seem to sit on every desktop), you will first learn about the wide variety of computers that people use, and the reasons they use them. As your knowledge of computers grows, you will understand that all computers—regardless of their size or purpose—are basically similar. That is, they all operate on the same fundamental principles, are made from the same basic components, and need instructions to make them run.



OBJECTIVES ::

- In basic terms, define the word *computer*.
- Discuss various ways computers can be categorized.
- Identify six types of computers designed for individual use.
- Identify four types of computers used primarily by organizations.
- Explain the importance of computers in today's society.
- Describe how computers are used in various sectors of our society.

Urheberrechtlich geschütztes Material

The Computer Defined

In basic terms, a computer is an electronic device that processes data, converting it into information that is useful to people. Any computer—regardless of its type—is controlled by programmed instructions, which give the machine a purpose and tell it what to do.

The computers discussed in this book—and which are everywhere around you—are digital computers (see Figure 1A.1). As you will learn in Chapter 4, "Processing Data," digital computers are so called because they work "by the numbers." That is, they break all types of information into tiny units, and use numbers to represent those pieces of information. Digital computers also work in very strict sequences of steps, processing each unit of information individually, according to the highly organized instructions they must follow.

A lesser-known type of computer is the analog computer, which works in a very different way from digital computers. The earliest computers were analog systems, and today's digital systems owe a great deal to their analog ancestors. Analog and digital computers differ in many respects, but the most important distinction is the way they represent data. Digital systems represent data as having one distinct value or another, with no other possibilities. Analog systems, however, represent data as variable points along a continuous spectrum of values. This makes analog computers somewhat more flexible than digital ones, but not necessarily more precise or reliable. Early analog computers were mechanical devices, weighing several tons and using motors and gears to perform calculations (see Figure 1A.2). A more manageable type of analog computer is the old-fashioned slide rule (see Figure 1A.3).

Computers can be categorized in several ways. For example, some computers are designed for use by one person, some are meant to be used by groups of people, and some are not used by people at all. They also can be categorized by their power, which means the speed at which they operate and the types of tasks they can handle. Within a single category, computers may be subcategorized by price, the types of hardware they contain, the kinds of software they can run, and so on.

Norton ONLINE

For more information on digital computers, analog computers, and the history of computers, visit **http://www.mhhe.com/petemorton.**

simnet™



FIGURE 1A.1

The personal computer is an example of a digital computer.



FIGURE 1A.2

This early analog computer, created by Vannevar Bush in the late 1920s, was called a "differential analyzer." It used electric motors, gears, and other moving parts to solve equations.



FIGURE 1A.3

Although analog computers have largely been forgotten, many of today's computer scientists grew up using slide rules—a simple kind of analog computer.

Urheberrechtlich geschütztes Material

Computers for Individual Users

simnet™

Most computers are meant to be used by only one person at a time. Such computers are often shared by several people (such as those in your school's computer lab), but only one user can work with the machine at any given moment (see Figure 1A.4).

The six primary types of computers in this category are

- Desktop computers
- Workstations
- Notebook computers
- Tablet computers
- Handheld computers
- Smart phones



FIGURE 1A.4

Many kinds of computers can be shared by multiple users but can be used by only one person at a time.

These systems are all examples of personal computers (PCs)—a term that refers to any computer system that is designed for use by a single person. Personal computers are also called microcomputers, because they are among the smallest computers created for people to use. Note, however, that the term *personal computer* or *PC* is most often used to describe desktop computers, which you will learn about in the following section.



FIGURE 1A.5

Networking is a key task for today's computers, especially portable systems that allow users to connect to their home or office even when they are traveling.

Although personal computers are used by individuals, they also can be connected together to create networks (see Figure 1A.5). In fact, networking has become one of the most important jobs of personal computers, and even tiny handheld computers can now be connected to networks. You will learn about computer networks in Chapter 7, "Networks."

Desktop Computers

The most common type of personal computer is the desktop computer—a PC that is designed to sit on (or under) a desk or table. These are the systems you see all around you, in schools, homes, and offices, and they are the main focus of this book.

Today's desktop computers are far more powerful than those of just a few years ago, and are used for an amazing array of tasks. Not only do these machines enable people to do their jobs with greater ease and efficiency, but they can be used to communicate, produce music, edit photographs and videos, play sophisticated games, and much more. Used by everyone from preschoolers to nuclear physicists, desktop computers are indispensable for learning, work, and play (see Figure 1A.6).

Norton ONLINE

For more information on desktop computers, visit **http://www.mhhe.com/petemorton.**

FIGURE 1A.6

Desktop PCs are a familiar item in homes, schools, and workplaces.



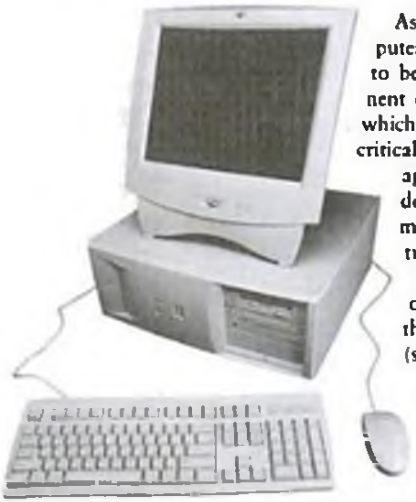




Urheberrechtlich geschütztes Material

FIGURE 1A.7

This desktop PC follows the traditional design, with the monitor stacked on top of the system unit.

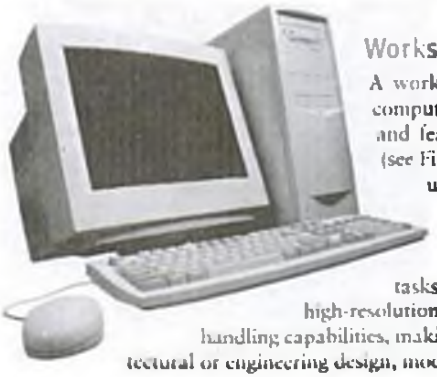


As its name implies, a desktop computer is a full-size computer that is too big to be carried around. The main component of a desktop PC is the system unit, which is the case that houses the computer's critical parts, such as its processing and storage devices. There are two common designs for desktop computers. The more traditional desktop model features a horizontally oriented system unit, which usually lies flat on the top of the user's desk. Many users place their monitor on top of the system unit (see Figure 1A.7).

Vertically oriented tower models have become the more popular style of desktop system (see Figure 1A.8). This design allows the user to place the system unit next to or under the desk, if desired.

FIGURE 1A.8

This desktop PC has a "tower" design, with a system unit that sits upright and can be placed on either the desk or the floor.



Workstations

A workstation is a specialized, single-user computer that typically has more power and features than a standard desktop PC (see Figure 1A.9). These machines are popular among scientists, engineers, and animators who need a system with greater-than-average speed and the power to perform sophisticated tasks. Workstations often have large, high-resolution monitors and accelerated graphics-handling capabilities, making them suitable for advanced architectural or engineering design, modeling, animation, and video editing.

Norton ONLINE

For more information on workstations, visit **http://www.mhhe.com/petermorton.**

FIGURE 1A.9

Workstation computers are favored by engineers and designers who need a high-performance system.



Notebook Computers

Notebook computers, as their name implies, approximate the shape of an 8.5-by-11-inch notebook and easily fit inside a briefcase. Because people frequently set these devices on their lap, they are also called laptop computers. Notebook computers can operate on alternating current or special batteries. These amazing devices generally weigh less than eight pounds, and some even weigh less than three pounds! During use, the computer's lid is raised to reveal a thin monitor and a keyboard. When not in use, the device folds up for easy storage. Notebooks are fully functional microcomputers; the people who use them need the power of a full-size desktop computer wherever they go (see Figure 1A.10). Because of their portability, notebook PCs fall into a category of devices

Norton ONLINE

For more information on notebook computers, visit **http://www.mhhe.com/petermorton.**

Urheberrechtlich geschütztes Material

called mobile computers—systems small enough to be carried by their user.

Some notebook systems are designed to be plugged into a docking station, which may include a large monitor, a full-size keyboard and mouse, or other devices (see Figure 1A.11). Docking stations also provide additional ports that enable the notebook computer to be connected to different devices or a network in the same manner as a desktop system.



FIGURE 1A.10

Notebook computers have the power and features of desktop PCs but are light and portable.

Tablet PCs

The tablet PC is the newest development in portable, full-featured computers (see Figure 1A.12). Tablet PCs offer all the functionality of a notebook PC, but they are lighter and can accept input from a special pen—called a stylus or a digital pen—that is used to tap or write directly on the screen. Many tablet PCs also have a built-in microphone and special software that accepts input from the user's voice. A few models even have a fold-out keyboard, so they can be transformed into a standard notebook PC. Tablet PCs run specialized versions of standard programs and can be connected to a network. Some models also can be connected to a keyboard and a full-size monitor.

Norton ONLINE

For more information on tablet PCs, visit **http://www.mhhe.com/petemorton**.



FIGURE 1A.11

A docking station can make a notebook computer feel like a desktop system, by adding a full-size monitor, keyboard, and other features.

Handheld PCs

Handheld personal computers are computing devices small enough to fit in your hand (see Figure 1A.13). A popular type of handheld computer is the personal digital assistant (PDA). A PDA is no larger than a small appointment book and is normally used for special applications, such as taking notes, displaying telephone numbers and addresses, and keeping track of dates or agendas. Many PDAs can be connected to larger computers to exchange data. Most PDAs come with a pen that lets the user write on the screen. Some handheld computers feature tiny built-in keyboards or microphones that allow voice input.

Many PDAs let the user access the Internet through a wireless connection, and several models offer features such as cellular telephones, cameras, music players, and global positioning systems.

Norton ONLINE

For more information on handheld PCs, visit **http://www.mhhe.com/petemorton**.

Norton ONLINE

For more information on smart phones, visit **http://www.mhhe.com/petemorton**.



FIGURE 1A.12

Tablet PCs are gaining in popularity among professionals who need to take lots of notes and deal with hand-drawn documents, such as architects.

Smart Phones

Some cellular phones double as miniature PCs (see Figure 1A.14). Because these phones offer advanced features not typically found in cellular phones, they are sometimes

Urheberrechtlich geschütztes Material



FIGURE 1A.13

Devices such as PDAs put a computer in your pocket and can be used in many different ways.

called smart phones. These features can include Web and e-mail access, special software such as personal organizers, or special hardware such as digital cameras or music players. Some models even break in half to reveal a miniature keyboard.

Computers for Organizations

Some computers handle the needs of many users at the same time. These powerful systems are most often used by organizations, such as businesses or schools, and are commonly found at the heart of the organization's network.

Generally, each user interacts with the computer through his or her own device, freeing people from having to wait their turn at a single keyboard and monitor (see Figure 1A.15). The largest organizational computers support thousands of individual users at the same time, from thousands of miles away. While some of these large-scale systems are devoted to a special purpose, enabling users to perform only a few specific tasks, many organizational computers are general-purpose systems that support a wide variety of tasks.

simnet™

Norton ONLINE

For more information on network servers, visit **http://www.mhhe.com/petemorton**

Network Servers

Today, most organizations' networks are based on personal computers. Individual users have their own desktop computers, which are connected to one or more centralized computers, called network servers. A network server is usually a powerful personal computer with special software and equipment that enable it to function as the primary computer in the network.

PC-based networks and servers offer companies a great deal of flexibility. For example, large organizations may have dozens or hundreds of individual servers working together at the heart of their network (see Figure 1A.16). When set up in such groups—sometimes called *clusters* or *server farms*—network servers may not even resemble standard PCs. For example, they may be mounted in large racks or reduced to small units called "blades," which can be slid in and out of a case. In these large networks, different groups of servers may have different purposes, such as supporting a certain set of users, handling printing tasks, enabling Internet communications, and so on.

A PC-based server gives users flexibility to do different kinds of tasks (see Figure 1A.17). This is because PCs are general-purpose machines, designed to be used in many ways. For example, some users may rely on the server for e-mail access, some may use it to perform accounting tasks, and others may use it to perform word-processing or database-management jobs. The server can support these processes, and many others, while storing information and programs for many people to use.



FIGURE 1A.14

New cellular phones, like the Nokia 9500 Communicator, double as tiny computers, offering many of the features of PDAs.



FIGURE 1A.15

In many companies, workers use their desktop systems to access a central, shared computer.

Urheberrechtlich geschütztes Material

Depending on how the network is set up, users may be able to access the server in multiple ways. Of course, most users have a standard desktop PC on their desk that is permanently connected to the network. Mobile users, however, may be able to connect a notebook PC or a handheld device to the network by wireless means. When they are away from the office, users may be able to use the Internet as a means of connecting to the company's network servers (see Figure 1A.18).



FIGURE 1A.16

Large corporate networks can use hundreds of servers.

Mainframe Computers

Mainframe computers are used in large organizations such as insurance companies and banks, where many people frequently need to use the same data. In a traditional mainframe environment, each user accesses the mainframe's resources through a device called a terminal (see Figure 1A.19). There are two kinds of terminals. A *dumb terminal* does not process or store data; it is simply an input/output (I/O) device that functions as a window into a computer located somewhere else. An *intelligent terminal* can perform some processing operations, but it usually does not have any storage. In some mainframe environments, however, workers can use a standard personal computer to access the mainframe.



FIGURE 1A.17

These workers may be connected to the same network server, yet using it for very different tasks.

Mainframes are large, powerful systems (see Figure 1A.20). The largest mainframes can handle the processing needs of thousands of users at any given moment. But what these systems offer in power, they lack in flexibility. Most mainframe systems are designed to handle only a specific set of tasks. In your state's Department of Motor Vehicles, for example, a mainframe system is probably devoted to storing information about drivers, vehicles, and driver's licenses, but little or nothing else. By limiting the number of tasks the system must perform, administrators preserve as much power as possible for required operations.

You may have interacted with a mainframe system without even knowing it. For example, if you have ever visited an airline's Web site to reserve a seat on a flight, you probably conducted a transaction with a mainframe computer.



FIGURE 1A.18

Many users can access their organization's network no matter where they go.

Norton ONLINE

For more information on mainframe computers, visit **http://www.mhhe.com/petemorton**.

Urheberrechtlich geschütztes Material

FIGURE 1A.19

Hundreds, even thousands, of mainframe users may use terminals to work with the central computer.



FIGURE 1A.20

Mainframe computers are often housed alone in special rooms, away from their users.





Norton **ONLINE**

For more information on minicomputers, visit **http://www.mhhe.com/peternorton.**

Minicomputers

First released in the 1960s, minicomputers got their name because of their small size compared to other computers of the day. The capabilities of a minicomputer are somewhere between those of mainframes and personal computers. For this reason, minicomputers are often called midrange computers.

Like mainframes, minicomputers can handle much more input and output than personal computers can. Although some "minis" are designed for a single user, the most powerful minicomputers can serve the input and output needs of hundreds of users at a time. Users can access a central minicomputer through a terminal or a standard PC.

Supercomputers

Supercomputers are the most powerful computers made, and physically they are some of the largest (see Figure 1A.21). These systems can process huge

SELF-CHECK ::

Circle the correct answer for each question.

1. Any computer is controlled by _____.
   a. hardware b. information c. instructions
2. Which of these is a powerful type of personal computer, favored by professionals such as engineers?
   a. workstation b. notebook c. mainframe
3. Which type of computer will you most likely encounter at the Department of Motor Vehicles?
   a. smart phone b. mainframe c. supercomputer

Urheberrechtlich geschütztes Material

amounts of data, and the fastest supercomputers can perform more than one trillion calculations per second. Some supercomputers can house thousands of processors. Supercomputers are ideal for handling large and highly complex problems that require extreme calculating power. For example, supercomputers have long been used in the mapping of the human genome, forecasting weather, and modeling complex processes like nuclear fission.



FIGURE 1A.21

Supercomputers are most common in university and research settings, but a few government agencies and very large businesses use them as well.

Norton ONLINE

For more information on supercomputers, visit **http://www.mhhe.com/petemorton.**

Computers in Society

How important are computers to our society? People often talk in fantastic terms about computers and their impact on our lives. You probably have heard or read expressions such as "computers have changed our world" or "computers have changed the way we do everything" many times. Such statements may strike you as exaggerations, and sometimes they are. But if you stop and really think about the effect computers have had on our daily lives, you still may be astonished.

One way to gauge the impact of computers is to consider the impact of other inventions. Can you imagine, for instance, the many ways in which American life changed after the introduction of the automobile (see Figure 1A.22)? Consider a few examples:

- Because of the car, people were able to travel farther and cheaper than ever before, and this created huge opportunities for businesses to meet the needs of the traveling public.
- Because vehicles could be mass-produced, the nature of manufacturing and industry changed and throngs of people began working on assembly lines.
- Because of road development, suburbs became a feasible way for people to live close to a city without actually living in one.
- Because of car travel, motels, restaurants, and shopping centers sprang up in places where there had previously been nothing.

FIGURE 1A.22

At the beginning of the 20th century, few could envision how the automobile would change the world. Today, the same holds true for computers and other forms of technology.





Urheberrechtlich geschütztes Material

Productivity Tip

Choosing the Right Tool for the Job

Buying a computer is a lot like buying a car because there are so many models and options from which to choose! Before deciding which model is best for you, identify the type of work for which you want to use the computer.

Depending on your job, you may need to use a computer on a limited basis. A handheld system is great if you want to

- **Manage Your Schedule on a Daily or Hourly Basis.** Handheld computers are popular for their calendar and schedule-management capabilities, which enable you to set appointments, track projects, and record special events.
- **Manage a List of Contacts.** If you need to stay in touch with many people and travel frequently, personal digital assistants provide contact-management features.
- **Make Notes on the Fly.** Some PDAs feature small keyboards, which are handy for tapping out quick notes. Others feature pens, which enable the user to "write" directly on the display screen. Many newer handheld systems also provide a built-in microphone, so you can record notes digitally.
- **Send Faxes and E-Mail.** Most popular handheld PCs have fax and e-mail capabilities and a port that lets them exchange data with a PC.

If your job requires you to travel, but you still need a full-featured computer, you may consider using a laptop or notebook computer. This option is the best choice if you want to

- **Carry Your Data with You.** If you need to make presentations on the road or keep up with daily work while traveling, portable PCs are ideal. Laptop systems offer as much RAM and storage capacity as desktop models. Many portables have built-in CD-ROM or DVD drives; others accept plug-in CD-ROM, DVD, and hard drives, which can greatly increase their capacity.
- **Be Able to Work Anywhere.** Portable PCs run on either rechargeable batteries or standard current.
- **Communicate and Share Data from Any Location.** Most portable computers have built-in modems or slots for plugging in a modem.

Think of other great inventions and discoveries, such as electricity, the telephone, or the airplane. Each, in its own way, brought significant changes to the world, and to the ways people lived and spent their time. Today, still relatively soon after its creation, the computer is only beginning to make its mark on society.

Why Are Computers So Important?

People can list countless reasons for the importance of computers (see Figure 1A.23). For someone with a disability, for example, a computer may offer freedom to communicate, learn, or work without leaving home. For a sales professional, a PC may mean the ability to communicate whenever necessary, to track leads, and to manage an ever-changing schedule. For a researcher, a computer may be the workhorse that does painstaking and time-consuming calculations.

But if you took all the benefits that people derive from computers, mixed them together, and distilled them down into a single element, what would you have? The answer is simple: *information*.

Computers are important because information is so essential to our lives. And information is more than the stuff you see and hear on television. Facts in a textbook or an encyclopedia are information, but only one kind. Mathematical formulas and their results are information, too, as are the plans for a building or the recipe for a cake. Pictures, songs, addresses, games, menus, shopping lists, resumes—the list goes on and on. All these things and many others can be thought of as information, and they can all be stored and processed by computers. (Actually,

Urheberrechtlich geschütztes Material

If you work in one place and need to perform various tasks, a desktop computer is the best choice. Choose a desktop computer if you want to

- **Work with Graphics-Intensive or Desktop Publishing Applications.** Complex graphics and page-layout programs require a great deal of system resources, and a desktop system's large monitor reduces eye fatigue.
- **Design or Use Multimedia Products.** Even though many portable computers have multimedia features, you can get the most for your money with a desktop system. Large screens make multimedia programs easier to see, and stereo-style speakers optimize sound quality.
- **Set Up Complex Hardware Configurations.** A desktop computer can support multiple peripherals—including printers, sound and video sources, and various external devices—at the same time. If you want to swap components, or perform other configuration tasks, a desktop system will provide many options.



Portable computers enable you to work almost anywhere.







FIGURE 1A.23

The benefits of using computers are as varied as the people who use them.

computers store these things as *data*, not as information, but you'll learn the difference between the two later in this book.) So, when you consider the importance of computers in our society, think instead about the importance of information. As tools for working with information, and for creating new information, computers may be one of humanity's most important creations.

Urheberrechtlich geschütztes Material

FIGURE 1A.24

E-mail software and Internet connections make it easy for people to keep in touch.





Norton ONLINE

For more information on computers in the home, visit **http://www.mhhe.com/petermorton**

Home

In many American homes, the family computer is nearly as important as the refrigerator or the washing machine. People cannot imagine living without it. In fact, a growing number of families have multiple PCs in their homes; in most cases, at least one of those computers has an Internet connection. Why do home users need their computers?

- **Communications.** Electronic mail (e-mail) continues to be the most popular use for home computers, because it allows family members to communicate with one another, and to stay in contact with friends and coworkers (see Figure 1A.24).
- **Business Work Done at Home.** Thanks to computers and Internet connections, more people are working from home than ever before. It is possible for many users to connect to their employer's network from home and do work that could not be done during regular business hours. Computers also are making it easier for people to start their own home-based businesses.
- **Schoolwork.** Today's students are increasingly reliant on computers, and not just as a replacement for typewriters. The Internet is replacing printed books as a reference tool (see Figure 1A.25), and easy-to-use software makes it possible for even young users to create polished documents.
- **Entertainment.** If you have ever played a computer game, you know how enjoyable they can be. For this reason, the computer has replaced the television as the entertainment medium of choice for many people. As computer, audio, video, and broadcast technologies converge, the computer will someday be an essential component of any home entertainment center.
- **Finances.** Computers and personal finance software can make balancing your checkbook an enjoyable experience. Well, almost. At any rate, they certainly make it easier, and home users rely on their PCs for bill paying, shopping, investing, and other financial chores (see Figure 1A.26).

Urheberrechtlich geschütztes Material



FIGURE 1A.25

The Internet is a tremendous resource for study, offering thousands of authoritative Web sites where students can find information and help on all kinds of subjects.



FIGURE 1A.26

Many banks now offer their services online. If you have an account with such a bank, you can access your accounts, pay bills, and conduct other transactions online.

Education

More and more schools are adding computer technology to their curricula, not only teaching pure computer skills, but incorporating those skills into other classes. Students may be required to use a drawing program, for example, to draw a plan of the Alamo for a history class, or use spreadsheet software to analyze voter turnouts during the last century's presidential elections.

Educators see computer technology as an essential learning requirement for all students, starting as early as preschool. Even now, basic computing skills such as keyboarding are being taught in elementary school classes (see Figure 1A.27). In the near future, high school graduates will enter college not only with a general diploma, but with a certification that proves their skills in some area of computing, such as networking or programming.

Norton ONLINE

For more information on computers in education, visit **http://www.mhhe.com/pelernorton**

Small Business

Many of today's successful small companies simply could not exist without computer technology. Each year, hundreds of thousands of individuals launch businesses based from their homes or in small-office locations. They rely on inexpensive computers and software not only to perform basic work functions, but to manage and grow their companies.

Norton ONLINE

For more information on computers in small business, visit **http://www.mhhe.com/pelernorton**

Urheberrechtlich geschütztes Material

Norton ONLINE

For more information on computers in industry, visit http://www.mhhe.com/petermorton



FIGURE 1A.27

Basic computer skills are now being taught to early learners, who quickly pick up mouse and keyboard use.

These tools enable business owners to handle tasks—such as daily accounting chores, inventory management, marketing, payroll, and many others—that once required the hiring of outside specialists (see Figure 1A.28). As a result, small businesses become more self-sufficient and reduce their operating expenses.

Industry

Today, enterprises use different kinds of computers in many combinations. A corporate headquarters may have a standard PC-based network, for example, but its production facilities may use computer-controlled robotics to manufacture products.

Here are just a few ways computers are applied to industry:

- **Design.** Nearly any company that designs and makes products can use a computer-aided design or computer-aided manufacturing system in their creation (see Figure 1A.29).
- **Shipping.** Freight companies need computers to manage the thousands of ships, planes, trains, and trucks that are moving goods at any given moment. In addition to tracking vehicle locations and contents, computers can manage maintenance, driver schedules, invoices and billing, and many other activities.
- **Process Control.** Modern assembly lines can be massive, complex systems, and a breakdown at one point can cause chaos throughout a company. Sophisticated process-control systems can oversee output, check the speed at which a machine runs, manage conveyance systems, and look at parts inventories, with very little human interaction.

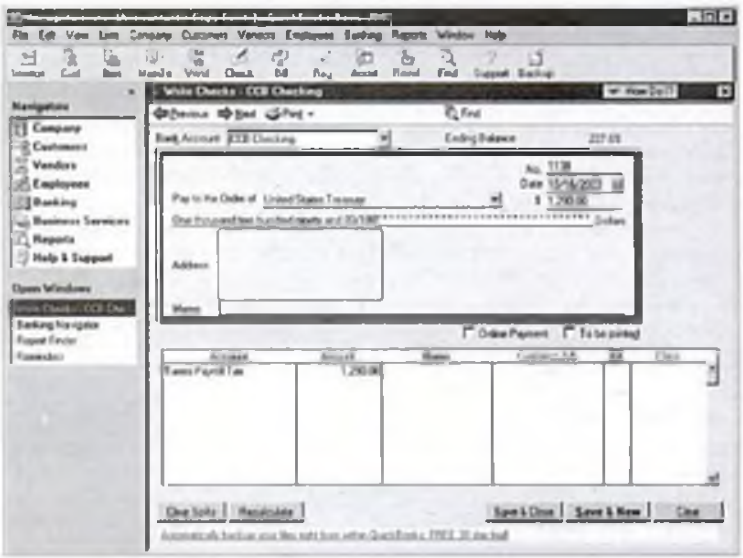


FIGURE 1A.28

Easy-to-use accounting programs such as QuickBooks allow business owners to manage their finances, even if they do not have any accounting expertise.

Urheberrechtlich geschütztes Material

Government

Not only are governments big consumers of technology, but they help to develop it as well. As you will learn in Chapter 8, "Presenting the Internet," the U.S. government played a key role in developing the Internet. Similarly, NASA has been involved in the development of computer technologies of all sorts. Today, computers play a crucial part in nearly every government agency:

- **Population.** The U.S. Census Bureau was one of the first organizations to use computer technology, recruiting mechanical computers known as "difference engines" to assist in tallying the American population in the early 20th century.
- **Taxes.** Can you imagine trying to calculate Americans' tax bills without the help of computers? Neither could the Internal Revenue Service. In fact, the IRS now encourages taxpayers to file their tax returns online, via the Internet.
- **Military.** Some of the world's most sophisticated computer technology has been developed primarily for use by the military. In fact, some of the earliest digital computers were created for such purposes as calculating the trajectory of missiles. Today, from payroll management to weapons control, the armed forces use the widest array of computer hardware and software imaginable.
- **Police.** When it comes to stocking their crime-fighting arsenals, many police forces consider computers to be just as important as guns and ammunition (see Figure 1A.30). Today's police cruisers are equipped with laptop computers and wireless Internet connections that enable officers to search for information on criminals, crime scenes, procedures, and other kinds of information.



FIGURE 1A.29

Computer-aided design programs allow engineers to design and test new products, and even to control the machines that manufacture them.

Norton ONLINE

For more information on computers in government, visit **http://www.mhhe.com/petermorton**



FIGURE 1A.30

Portable computers are now among police officers' weapons of choice.

Urheberrechtlich geschütztes Material

Norton Notebook

The Merging of Media and Meaning



I imagine that you have been aware of personal computers for some time. Even if you or your family has never owned a PC—and even if this course is your first opportunity to use one—you're probably at least peripherally aware of the prominent place we've given to PCs in our lives. As a matter of fact, it's only been over the course of our lives, yours and mine, that PCs have earned their place on desks in homes and places of business, if *earned* is the right word. Personal computers' slow start has accelerated to a staggering pace as we humans have done what we always do: Take a new tool and exploit its every possible use.

For many of us, the 30-year evolution of uses for the PC has been no less *revolutionary* than was the introduction of electricity to the home a century ago. What began as a simple, if seemingly miraculous, light to read by has become the center of most everything we do at home. Why, even many fireplaces—yesterday's reading light—ignite today by electric power. Personal computers started life similarly, as humble things, miraculous for their multipurpose ability to work with words *and* numbers, yet able to display virtually nothing but text in response to typed commands, barely able to print anything usefully, and closed—unable to communicate "outside of the box," as it were.

A huge industry developed to support personal computers and expand their potential use as a tool. And for roughly the first five years of the PC's existence, the greatest innovations came from within the world of computing—people researching specifically to improve video performance, to reduce the cost of increasingly massive data storage, to connect computers together over world-shrinking distances. The creativity of these folks was staggering. When faced with the question, "I can talk around the world on the telephone; why can't my computer?" for example, they literally gave the computer a voice. That's what a modem does: it turns a computer's digital signals into audible sound that the plain old telephone system can handle. If you like, you can think of this as being somewhat analogous to the early years of electricity when pioneers such as Thomas Edison and George Westinghouse worked tirelessly to improve the potential of their original innovation and make an arguably honest buck. Other industries—automotive, electronics, and entertainment, to name a prominent few—adopted the technology developed for and made economically feasible by computing's growing popularity.

Gradually, this relationship became more symbiotic, and the PC started to benefit from technology originally developed for other purposes. Consider the compact disc. Introduced in 1980, by 1983 it was just beginning to gain a foothold in the music world. Six years later, CD-ROMs appeared on personal computers and ushered in a second



Norton ONLINE

For more information on computers in health care, visit http://www.mhhe.com/petermorton

Health Care

Pay a visit to your family doctor or the local hospital, and you'll find yourself surrounded by computerized equipment of all kinds. Computers, in fact, are making health care more efficient and accurate while helping providers bring down costs. Many different health care procedures now involve computers, from ultrasound and magnetic resonance imaging, to laser eye surgery and fetal monitoring (see Figure 1A.31).

Surgeons now can use robotic surgical devices to perform delicate operations, and even to conduct surgeries remotely. New virtual-reality technologies are being used to train new surgeons in cutting-edge techniques, without cutting an actual patient.

But not all medical computers are so high-tech. Clinics and hospitals use standard computers to manage schedules, maintain patient records, and perform billings. Many transactions between physicians, insurance companies, and pharmacies are conducted by computers, saving health care workers time to devote to more important tasks.

Urheberrechtlich geschütztes Material



generation of PC possibilities. PCs by then had evolved sophisticated graphical user interfaces and detailed displays. Combining the CD's digital sound with these visual technologies went a long way toward making computer experiences *interactive*—something that previously only people and unpopular toys had been. The PC world increasingly became a place where many other worlds met, particularly the varied worlds of information and entertainment—an interactive, *multimedia* world.

This is today's world. It's a world in which we expect our computers to toot, whistle, plunk, and boom; to speak to us and to listen when we dictate; to remember what we forget and to distract us so we will forget. Having spent much of the late 1990s forgetting that a technology company must actually *produce* something useful in order to realize a profit, the computing world turned back to substance with a renewed focus on the PC as the center of media. As I write this, a new generation of media PCs is appearing on the market. These systems can blend virtually every media technology in existence into a seamless, single experience. The traditional capabilities of PCs, CD and DVD players, DVD recorders, televisions, VCRs, surround-sound music systems can all be provided by one device—or two, if you add the possibilities of printing and film. What's really new about these systems is their power—practical video editing has been the private world of a wealthy few until the latest advances in processor, memory, and massive storage all came together in affordable systems that put these capabilities into homes and small offices.

This means that you can produce your own DVD movies with just a consumer video camera and a media PC (fast-talking agents are now entirely optional). In a band? Record and distribute albums of your music directly or through a Web site that software almost automatically designs for you. Paint? Create your own online gallery. Write? Self-publish on demand while promoting your creations through an existing online bookseller. Walt Disney said, "If you can dream it, you can do it." Technology has helped prove him right. Today the "you" who can "do it" means more people from more cultures and backgrounds than ever before.



FIGURE 1A.31

Computers make many health care procedures more accurate and more comfortable for patients.

Urheberrechtlich geschütztes Material

Summary ::

- A computer is an electronic device that processes data, converting it into information that is useful to people.
- There are two basic types of computers: analog and digital. The computers commonly used today are all digital computers.
- Computers can be categorized by the number of people who can use them simultaneously, by their power, or by other criteria.
- Computers designed for use by a single person include desktop computers, workstations, notebook computers, tablet computers, handheld computers, and smart phones.
- The terms personal computer (PC) and microcomputer can be used when referring to any computer meant for use by a single person.
- The desktop computer is the most common type of personal computer. This computer is designed to sit on top of a desk or table, and comes in two basic styles.
- A workstation is a specialized, single-user computer that typically has more power and features than a standard desktop PC.
- Notebook computers are full-featured PCs that can easily be carried around.
- A tablet PC is another type of portable PC, but it can accept handwritten input when the user touches the screen with a special pen.
- Handheld personal computers are computing devices that fit in your hand; the personal digital assistant (PDA) is an example of a handheld computer.
- Smart phones are digital cellular phones that have features found in personal computers, such as Web browsers, e-mail capability, and more.
- Some types of computers—such as network servers, mainframes, minicomputers, and supercomputers—are commonly used by organizations and support the computing needs of many users.
- A network server is a powerful personal computer that is used as the central computer in an organization's network.
- Mainframes are powerful, special-purpose computers that can support the needs of hundreds or thousands of users.
- Minicomputers support dozens or hundreds of users at one time.
- Supercomputers are the largest and most powerful computers made.
- Many families have at least one computer and an Internet connection in their home and use their PC for tasks such as communication, work, schoolwork, and personal finances.
- Computer technology is playing an ever-growing role in schools, where students are being taught computer skills at younger ages and asked to incorporate computers into their daily work assignments.
- Computers enable small businesses to operate more efficiently by allowing workers to do a wider variety of tasks.
- In industries of all kinds, computers play vital roles in everything from personnel management, to product design and manufacturing, to shipping.
- Governments not only use a great deal of computer technology, but also contribute to its development.
- Computers are involved in nearly every aspect of the health care field, from managing schedules and handling billing, to making patient diagnoses and performing complex surgery.

Urheberrechtlich geschütztes Material

Key Terms

computer, 4
desktop computer, 5
digital pen, 7
docking station, 7
handheld personal computer, 7
input/output (I/O) device, 9
laptop computer, 6
mainframe, 9
microcomputer, 5
midrange computer, 10
minicomputer, 10
mobile computer, 7
network server, 8
notebook computer, 6
personal computer (PC), 5
personal digital assistant (PDA), 7
smart phone, 8
stylus, 7
supercomputer, 10
system unit, 6
tablet PC, 7
terminal, 9
workstation, 6

Key Term Quiz

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. The _____ is the case that holds the computer's critical components.
2. A(n) _____ is a specialized, single-user computer that typically has more power than a standard PC.
3. When not in use, a(n) _____ computer folds up for easy storage.
4. A tablet PC lets you use a(n) _____ to tap or write directly on the screen.
5. A popular type of handheld computer is the _____ .
6. A(n) _____ is usually a powerful personal computer that functions as the primary computer in a network.
7. In a traditional mainframe environment, each user accesses the mainframe through a device called a(n) _____ .
8. A terminal is an example of a(n) _____ device.
9. The capabilities of a(n) _____ are somewhere between mainframes and personal computers.
10. _____ are the most powerful computers made.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A computer converts data into this.
   a. information b. charts c. software d. input/output
2. The earliest computers were _____ systems.
   a. digital b. paper c. analog d. slide rule
3. Most computers are meant to be used by only one _____ at a time.
   a. company b. program c. organization d. person
4. Personal computers are also called _____ .
   a. minicomputers b. microcomputers c. maxicomputers d. supercomputers
5. Many scientists, engineers, and animators use specialized computers, called _____ .
   a. personal digital assistants b. minicomputers c. workstations d. networks
6. Notebook PCs fall into a category of devices called _____ .
   a. mobile computers b. small computers c. handheld computers d. minicomputers
7. Some notebook systems can be plugged into one of these devices, which give the computer additional features.
   a. port station b. network station c. workstation d. docking station
8. Some tablet PCs can be connected to a keyboard and a full-size _____ .
   a. computer b. monitor c. PDA d. workstation
9. Network servers are sometimes set up in groups that may be called _____ or server farms.
   a. units b. workgroups c. clusters d. racks
10. A(n) _____ terminal can perform some processing operations.
    a. system b. input/output c. computing d. intelligent

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What is a computer?
2. Explain a few of the different ways in which computers can be categorized.
3. List six types of computers that are designed for use by a single person.
4. Describe the two common designs for desktop computers.
5. How much do notebook computers typically weigh?
6. List four types of computers that are designed for use by organizations, and are commonly used by multiple people at the same time.
7. Why are mainframe systems usually limited in the number of tasks they perform?
8. What is the most popular use for home computers?
9. How are computer technologies used by the military?
10. How are computer technologies being used to train surgeons?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. During the course of a normal day, keep a list of your encounters with computers of various kinds. Your list should show the place and time of the encounter, the type of interaction you had with the technology, and the results of that interaction. (Remember, computers can take many sizes and forms, so be alert to more than just PCs.) Share your list with the class.
2. Pay a visit to any business or government office in your town, and observe the people working there. Are they using computers? Simply by watching, can you tell what kinds of computers they are using and what types of work they are performing? In a single paragraph, list your findings and explain the reasoning behind them. Be prepared to share your findings with the class.

Urheberrechtlich geschütztes Material

LESSON // 1B

Looking Inside the Computer System

OBJECTIVES ::

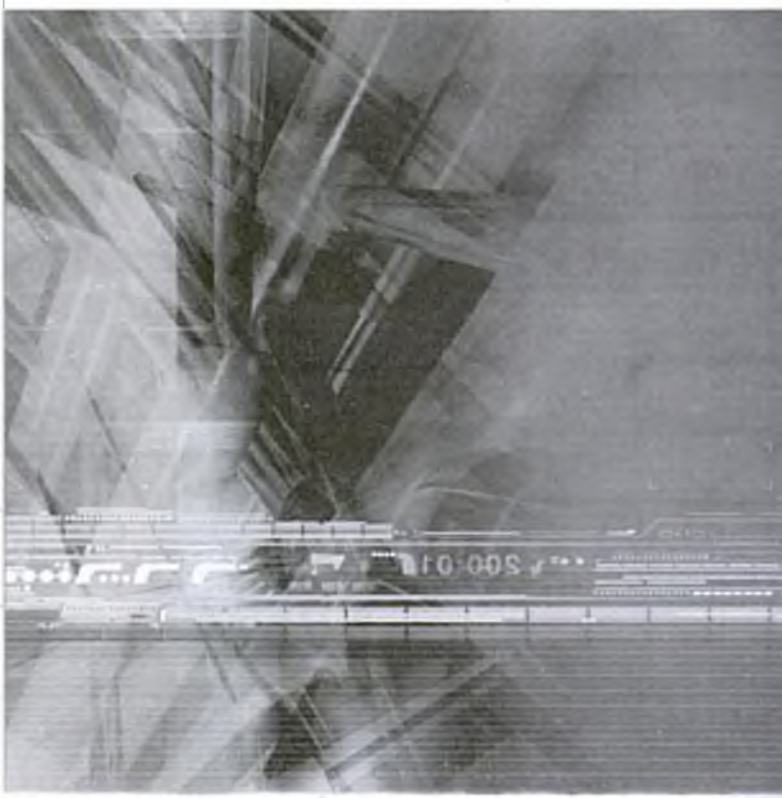
- List the four parts of a complete computer system.
- Name the four phases of the information processing cycle.
- Identify four categories of computer hardware.
- List four units of measure for computer memory and storage.
- Name the two most common input and output devices.
- Name and differentiate the two main categories of storage devices.
- Name and differentiate the two main categories of computer software.
- Explain the difference between data, information, and programs.
- Describe the role of the user, when working with a personal computer.

Overview: Dissecting the Ultimate Machine

Most people believe that computers must be extremely complicated devices, because they perform such amazing tasks. To an extent, this is true. As you will learn later in this book, the closer you look at a computer's operation, the more complex the system becomes.

But like any machine, a computer is a collection of parts, which are categorized according to the kinds of work they do. Although there are many, many variations on the parts themselves, there are only a few major categories. If you learn about those families of computer components and their basic functions, you will have mastered some of the most important concepts in computing. As you will see, the concepts are simple and easy to understand.

This lesson gives you a glimpse inside a standard desktop computer and introduces you to its most important parts. You will learn how these components work together and allow you to interact with the system. You also will discover the importance of software, without which a computer could do nothing. Finally, you will see that the user is (in most cases, at least) an essential part of a complete computer system.



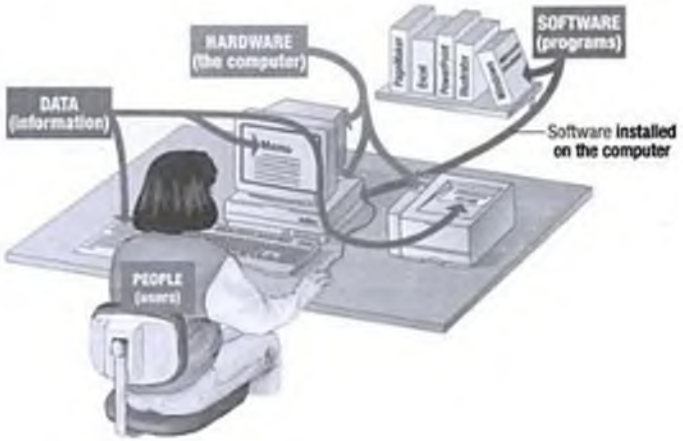


FIGURE 1B.1

A complete computer system.

The Parts of a Computer System

simnet™

As you saw in Lesson 1A, computers come in many varieties, from the tiny computers built into household appliances, to the astounding supercomputers that have helped scientists map the human genome. But no matter how big it is or how it is used, every computer is part of a system. A complete computer system consists of four parts (see Figure 1B.1):

- Hardware
- Software
- Data
- User

Hardware

The mechanical devices that make up the computer are called hardware. Hardware is any part of the computer you can touch (see Figure 1B.2). A computer's hardware consists of interconnected electronic devices that you can use to control the computer's operation, input, and output. (The generic term device refers to any piece of hardware.)



FIGURE 1B.2

Whether it's a keyboard, a printer, or a PDA, if you can touch it, it is hardware.

Software

Software is a set of instructions that makes the computer perform tasks. In other words, software tells the computer what to do. (The term program refers to any piece of software.) Some programs exist primarily for the computer's use to help it perform tasks and manage its own resources. Other types of programs exist for the user, enabling him or her to perform tasks such as creating documents. Thousands of different software programs are available for use on personal computers (see Figure 1B.3).

Data

Data consist of individual facts or pieces of information that by themselves may not make much sense to a person. A computer's primary job is to process these tiny pieces of data in various ways, converting them into useful information. For

Urheberrechtlich geschütztes Material



FIGURE 1B.3

A visit to any software store reveals a dizzying variety of products.

example, if you saw the average highway mileages of six different cars, all the different pieces of data might not mean much to you. However, if someone created a chart from the data that visually compared and ranked the vehicles' mileages, you could probably make sense of it at a glance (see Figure 1B.4). This is one example of data being processed into useful information.

Users

People are the computer operators, also known as users. It can be argued that some computer systems are complete without a person's involvement; however, no computer is totally autonomous. Even if a computer can do its job without a person sitting in front of it, people still design, build, program, and repair computer systems. This lack of autonomy is especially true of personal computer systems, which are the focus of this book and are designed specifically for use by people.

The Information Processing Cycle

Using all its parts together, a computer converts data into information by performing various actions on the data. For example, a computer might perform a mathematical operation on two numbers, then display the result. Or the computer might perform a logical operation such as comparing two numbers, then display that result. These operations are part of a process called the information processing cycle, which is a set of steps the computer follows to receive data, process the data according to instructions from a program, display the resulting information to the user, and store the results (see Figure 1B.5).

Norton ONLINE

For more information on the information processing cycle, visit **http://www.mhhe.com/petemorton.**

simnet™

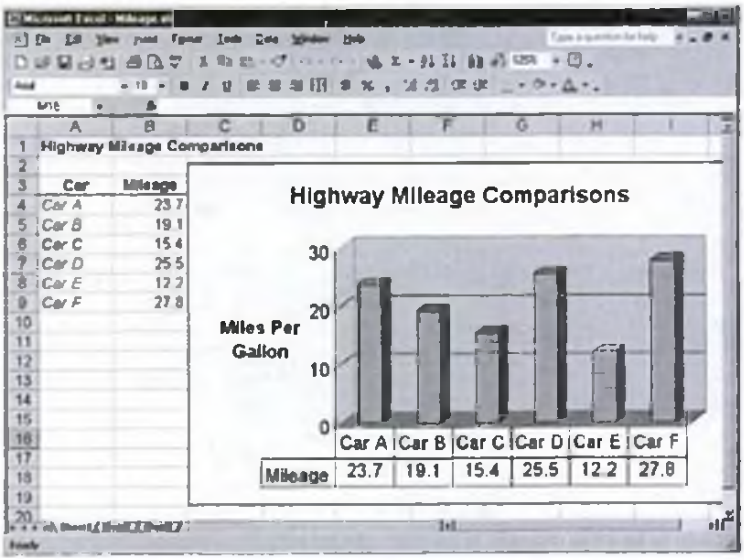


FIGURE 1B.4

Converting pieces of data into useful information is a key task of computers.

Urheberrechtlich geschütztes Material

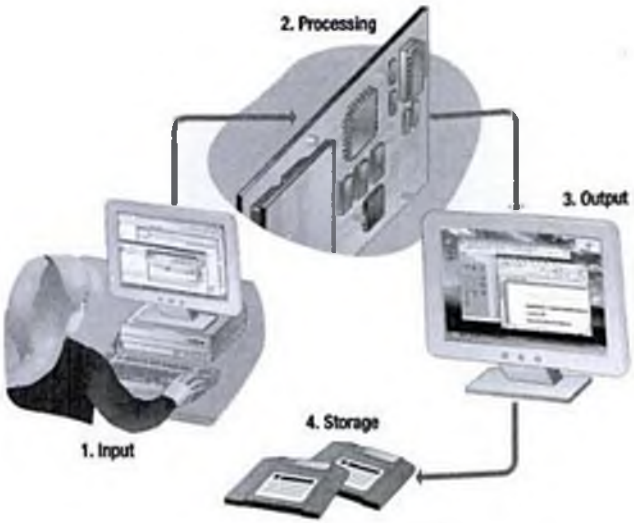


FIGURE 1B.5

The information processing cycle.

The information processing cycle has four parts, and each part involves one or more specific components of the computer:

- **Input.** During this part of the cycle, the computer accepts data from some source, such as the user or a program, for processing.
- **Processing.** During this part of the cycle, the computer's processing components perform actions on the data, based on instructions from the user or a program.
- **Output.** Here, the computer may be required to display the results of its processing. For example, the results may appear as text, numbers, or a graphic on the computer's screen or as sounds from its speaker. The computer also can send output to a printer or transfer the output to another computer through a network or the Internet. Output is an optional step in the information processing cycle but may be ordered by the user or program.
- **Storage.** In this step, the computer permanently stores the results of its processing on a disk, tape, or some other kind of storage medium. As with output, storage is optional and may not always be required by the user or program.

Essential Computer Hardware

simnet™

A computer's hardware devices fall into one of four categories (see Figure 1B.6):

1. Processor
2. Memory
3. Input and output
4. Storage

While any type of computer system contains these four types of hardware, this book focuses on them as they relate to the personal computer, or PC.

Urheberrechtlich geschütztes Material

FIGURE 1B.6

Types of hardware devices



Norton ONLINE

For more information on computer processors, visit http://www.mhhe.com/petemorton.

Processing Devices

The procedure that transforms raw data into useful information is called processing. To perform this transformation, the computer uses two components: the processor and memory.

The processor is like the brain of the computer; it organizes and carries out instructions that come from either the user or the software. In a personal computer, the processor usually consists of one or more specialized chips, called microprocessors, which are slivers of silicon or other material etched with many tiny electronic circuits. To process data or complete an instruction from a user or a program, the computer passes electricity through the circuits.



FIGURE 1B.7

Processing devices

As shown in Figure 1B.7, the microprocessor is plugged into the computer's motherboard. The motherboard is a rigid rectangular card containing the circuitry that connects the processor to the other hardware. The motherboard is an example of a circuit board. In most personal computers, many internal devices—such as video cards, sound cards, disk controllers, and other devices—are housed on their own smaller circuit boards, which attach to the motherboard. In many newer computers, these devices are built directly into the motherboard. Some newer microprocessors are large and complex enough to require their own dedicated circuit boards, which plug into a special slot in the motherboard. You can think of the motherboard as the master circuit board in a computer.

A personal computer's processor is usually a single chip or a set of chips contained on a circuit board. In some powerful computers, the processor consists of many chips and the circuit boards on which they are mounted. In either case, the term central processing unit (CPU) refers to a computer's processor (see Figure 1B.8). People often refer to computer systems by the type of CPU they contain. A "Pentium 4" system, for example, uses a Pentium 4 microprocessor as its CPU.

FIGURE 1B.8

Early PC microprocessors were not much larger than a thumbnail. Processors such as Intel's Pentium 4 are considerably larger.



Urheberrechtlich geschütztes Material

Memory Devices

In a computer, memory is one or more sets of chips that store data and/or program instructions, either temporarily or permanently. Memory is a critical processing component in any computer. Personal computers use several different types of memory, but the two most important are called random access memory (RAM) and read-only memory (ROM). These two types of memory work in very different ways and perform distinct functions.

Norton ONLINE

For more information on computer memory, visit **http://www.mhhe.com/petemorton**

Random Access Memory

The most common type of memory is called random access memory (RAM). As a result, the term *memory* is typically used to mean RAM. RAM is like an electronic scratch pad inside the computer. RAM holds data and program instructions while the CPU works with them. When a program is launched, it is loaded into and run from memory. As the program needs data, it is loaded into memory for fast access. As new data is entered into the computer, it is also stored in memory—but only temporarily. Data is both written to and read from this memory. (Because of this, RAM is also sometimes called *read/write memory*.)

Like many computer components, RAM is made up of a set of chips mounted on a small circuit board (see Figure 1B.9).

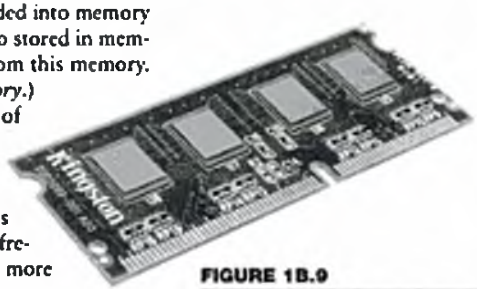


FIGURE 1B.9

Random access memory (RAM).

RAM is volatile, meaning that it loses its contents when the computer is shut off or if there is a power failure. Therefore, RAM needs a constant supply of power to hold its data. For this reason, you should save your data files to a storage device frequently, to avoid losing them in a power failure. (You will learn more about storage later in this chapter.)

RAM has a tremendous impact on the speed and power of a computer. Generally, the more RAM a computer has, the more it can do and the faster it can perform certain tasks. The most common measurement unit for describing a computer's memory is the byte—the amount of memory it takes to store a single character, such as a letter of the alphabet or a numeral. When referring to a computer's memory, the numbers are often so large that it is helpful to use terms such as kilobyte (KB), megabyte (MB), gigabyte (GB), and terabyte (TB) to describe the values (see Table 1B.1).

Today's personal computers generally have at least 256 million bytes (256 MB) of random access memory. Many newer systems feature 512 MB or more.

TABLE 1B.1

Units of Measure for Computer Memory and Storage

Unit	Abbreviation	Pronounced	Approximate Value (bytes)	Actual Value (bytes)
Kilobyte	KB	KILL-uh-bite	1,000	1,024
Megabyte	MB	MEHG-uh-bite	1,000,000 (1 million)	1,048,576
Gigabyte	GB	GIG-uh-bite	1,000,000,000 (1 billion)	1,073,741,824
Terabyte	TB	TERR-uh-bite	1,000,000,000,000 (1 trillion)	1,099,511,627,776

Read-Only Memory

Unlike RAM, read-only memory (ROM) permanently stores its data, even when the computer is shut off. ROM is called nonvolatile memory because it never loses its contents. ROM holds instructions that the computer needs to operate. Whenever the computer's power is turned on, it checks ROM for directions that help it start up, and for information about its hardware devices.

Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on input and output devices, visit **http://www.mhhe.com/peternorton.**

Input and Output Devices

A personal computer would be useless if you could not interact with it because the machine could not receive instructions or deliver the results of its work. Input devices accept data and instructions from the user or from another computer system (such as a computer on the Internet). Output devices return processed data to the user or to another computer system.

The most common input device is the keyboard, which accepts letters, numbers, and commands from the user. Another important type of input device is the mouse, which lets you select options from on-screen menus. You use a mouse by moving it across a flat surface and pressing its buttons. Figure 1B.10 shows a personal computer with a keyboard, mouse, and microphone.

A variety of other input devices work with personal computers, too:

- The trackball and touchpad are variations of the mouse and enable you to draw or point on the screen.
- The joystick is a swiveling lever mounted on a stationary base that is well suited for playing video games.
- A scanner can copy a printed page of text or a graphic into the computer's memory, freeing you from creating the data from scratch.
- A digital camera can record still images, which you can view and edit on the computer.
- A microphone enables you to input your voice or music as data.

FIGURE 1B.10

The keyboard, mouse, and microphone are common input devices.



The function of an output device is to present processed data to the user. The most common output devices are the monitor and the printer. The computer sends output to the monitor (the display screen) when the user needs only to see the output. It sends output to the printer when the user requests a paper copy—also called a *hard copy*—of a document.

Just as computers can accept sound as input, they can use stereo speakers or headphones as output devices to produce sound. Figure 1B.11 shows a PC with a monitor, printer, and speakers.



FIGURE 1B.11

The monitor, printer, and speakers are common output devices.

Urheberrechtlich geschütztes Material

Some types of hardware can act as both input and output devices. A touch screen, for example, is a type of monitor that displays text or icons you can touch. When you touch the screen, special sensors detect the touch and the computer calculates the point on the screen where you placed your finger. Depending on the location of the touch, the computer determines what information to display or what action to take next.

Communications devices are the most common types of devices that can perform both input and output. These devices connect one computer to another—a process known as networking. The most common kinds of communications devices are modems, which enable computers to communicate through telephone lines or cable television systems, and network interface cards (NICs), which let users connect a group of computers to share data and devices.

Storage Devices

A computer can function with only processing, memory, input, and output devices. To be really useful, however, a computer also needs a place to keep program files and related data when they are not in use. The purpose of storage is to hold data permanently, even when the computer is turned off.

You may think of storage as an electronic file cabinet and RAM as an electronic worktable. When you need to work with a program or a set of data, the computer locates it in the file cabinet and puts a copy on the table. After you have finished working with the program or data, you put it back into the file cabinet. The changes you make to data while working on it replace the original data in the file cabinet (unless you store it in a different place).

Novice computer users often confuse storage with memory. Although the functions of storage and memory are similar, they work in different ways. There are three major distinctions between storage and memory:

- There is more room in storage than in memory, just as there is more room in a file cabinet than there is on a tabletop.
- Contents are retained in storage when the computer is turned off, whereas programs or the data in memory disappear when you shut down the computer.
- Storage devices operate much slower than memory chips, but storage is much cheaper than memory.

There are two main types of computer storage: magnetic and optical. Both are covered in the following sections.

Magnetic Storage

There are many types of computer storage, but the most common is the magnetic disk. A disk is a round, flat object that spins around its center. (Magnetic disks are almost always housed inside a case of some kind, so you can't see the disk itself unless you open the case.) Read/write heads, which work in much the same way as the heads of a tape recorder or VCR, are used to read data from the disk or write data onto the disk.

The device that holds a disk is called a disk drive. Some disks are built into the drive and are not meant to be removed; other kinds of drives enable you to remove and replace disks (see Figure 1B.12). Most personal computers have at least one nonremovable hard disk (or hard drive). In addition, there is also a diskette drive, which allows you to use removable diskettes (or floppy disks). The hard disk serves as the computer's primary filing cabinet because it can store far more data than a diskette can contain. Diskettes are used to load data onto the hard disk, to trade data with other users, and to make backup copies of the data on the hard disk.

Norton ONLINE



For more information on storage devices, visit http://www.mhhe.com/petermorton

Urheberrechtlich geschütztes Material

FIGURE 1B.12

Standard PCs have a built-in hard disk and a diskette drive.



Optical Storage

In addition to magnetic storage, nearly every computer sold today includes at least one form of optical storage—devices that use lasers to read data from or write data to the reflective surface of an optical disc.

The CD-ROM drive is the most common type of optical storage device. Compact discs (CDs) are a type of optical storage, identical to audio CDs. Until recently, a standard CD could store about 74 minutes of audio or 650 MB of data. A newer breed of CDs can hold 80 minutes of audio or 700 MB of data (see Figure 1B.13). The type used in computers is called Compact Disc Read-Only Memory (CD-ROM). As the name implies, you cannot change the information on the disc, just as you cannot record over an audio CD.



FIGURE 1B.13

Software makers commonly sell their products on CD because of the disc's high storage capacity.

If you purchase a CD-Recordable (CD-R) drive, you have the option of creating your own CDs. A CD-R drive can write data to and read data from a compact disc. To record data with a CD-R drive, you must use a special CD-R disc, which can be written on only once, or a CD-ReWritable (CD-RW) disc, which can be written to multiple times, like a floppy disk.

An increasingly popular data storage technology is the Digital Video Disc (DVD), which is revolutionizing home entertainment. Using sophisticated compression technologies, a single DVD (which is the same size as a standard compact disc) can store an entire full-length movie. DVDs can hold a minimum of 4.7 GB of data and as much as 17 GB. Future DVD technologies promise much higher storage capacities on a single disc. DVD drives also can locate data on the disc much faster than standard CD-ROM drives.

DVDs require a special player (see Figure 1B.14). Many DVD players, however, can play audio, data, and DVD discs, freeing the user from purchasing different players for each type of disc. DVD drives are now standard equipment on many new personal computers. Users not only can install programs and data from their standard CDs, but they also can watch movies on their personal computers by using a DVD.

simnet™

Norton ONLINE

For more information on computer software, visit **http://www.mhhe.com/petermorton**

Software Brings the Machine to Life

The ingredient that enables a computer to perform a specific task is software, which consists of instructions. A set of instructions that drive a computer to perform specific tasks is called a program. These instructions tell the machine's physical components what to do; without the instructions, a computer could not do anything at all. When a computer uses a particular program, it is said to be running or executing that program.

Although the array of available programs is vast and varied, most software falls into two major categories: system software and application software.

Urheberrechtlich geschütztes Material

System Software

System software is any program that controls the computer's hardware or that can be used to maintain the computer in some way so that it runs more efficiently. There are three basic types of system software:

- An operating system tells the computer how to use its own components. Examples of operating systems include Windows, the Macintosh Operating System, and Linux (see Figure 1B.15). An operating system is essential for any computer, because it acts as an interpreter between the hardware, application programs, and the user.

  When a program wants the hardware to do something, it communicates through the operating system. Similarly, when you want the hardware to do something (such as copying or printing a file), your request is handled by the operating system.
- A network operating system allows computers to communicate and share data across a network while controlling network operations and overseeing the network's security.
- A utility is a program that makes the computer system easier to use or performs highly specialized functions (see Figure 1B.16). Utilities are used to manage disks, troubleshoot hardware problems, and perform other tasks that the operating system itself may not be able to do.



FIGURE 1B.14

DVD players are now standard on many PCs and are found in many home entertainment centers.

Application Software

Application software tells the computer how to accomplish specific tasks, such as word processing or drawing, for the user. Thousands of applications are available for many purposes and for people of all ages. Some of the major categories of these applications include

- Word processing software for creating text-based documents such as newsletters or brochures (see Figure 1B.17).
- Spreadsheets for creating numeric-based documents such as budgets or balance sheets.



FIGURE 1B.15

Windows is the most popular of all PC operating systems, running on about 90 percent of all personal computers.

Unterrechtlich geschütztes Material



FIGURE 1B.16

There are hundreds of utility programs available for personal computers. This one, called PartitionMagic, helps you manage your hard disk to get the most from it.

simnet™

- Database management software for building and manipulating large sets of data, such as the names, addresses, and phone numbers in a telephone directory.
- Presentation programs for creating and presenting electronic slide shows (see Figure 1B.18).
- Graphics programs for designing illustrations or manipulating photographs, movies, or animation.
- Multimedia authoring applications for building digital movies that incorporate sound, video, animation, and interactive features.
- Entertainment and education software, many of which are interactive multimedia events.
- Web design tools and Web browsers, and other Internet applications such as newsreaders and e-mail programs.
- Games, some of which are for a single player and many of which can be played by several people over a network or the Internet.

Computer Data

You have already seen that, to a computer, data is any piece of information or fact that, taken by itself, may not make sense to a person. For example, you might think of the letters of the alphabet as data. Taken individually, they do not mean a lot. But when grouped into words and sentences, they make sense; that is, they become information (see Figure 1B.19). Similarly, basic geometric shapes may not have much meaning by themselves, but when they are grouped into a blueprint or a chart, they become useful information.

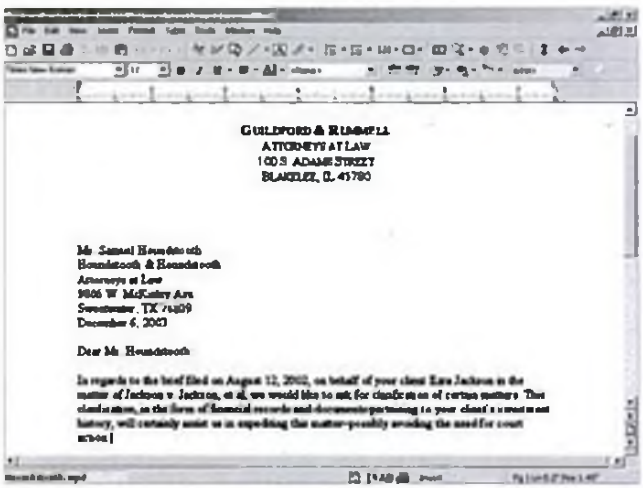


FIGURE 1B.17

Word processing software is designed for creating documents that consist primarily of text, but also lets you add graphics and sounds to your documents. It also provides layout features that let you create brochures, newsletters, Web pages, and more.

Urheberrechtlich geschütztes Material

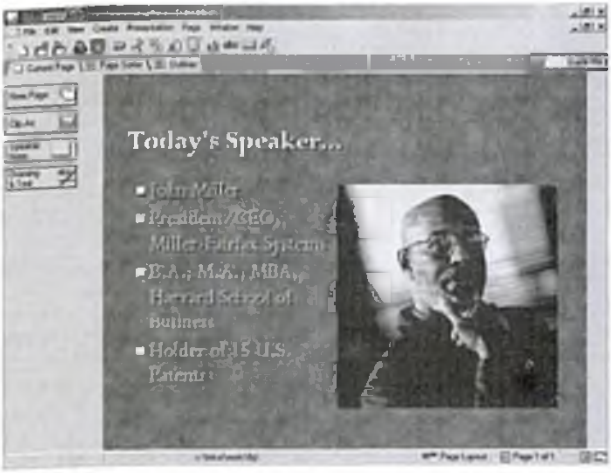


FIGURE 1B.18

Presentation software is most often used for creating sales presentations, although it can be effective for any type of electronic slide show.

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P
Q	R	S	T
U	V	W	X
Y	Z		

Data = Piece of information without context

RESUME

Johnathon Smith
1512 N. Main Street
Troy, NC 28265

704-555-5555
smith@try.net
www.jon.com

Objective

A career as a sales associate with a leading grocery chain

Education

- Ph.D. Nuclear Physics, *Massachussetts Institute of Technology*, 1998.
- M.S., Physics, *Duke University*, 1996
- B.S., Chemistry/Physics, *Center College*, 1994

Maintained average GPA of 3.8 during collegiate career.

Experience

2000 – Present. Head Bag Boy, *Tom's QuickShop*, Cambriage City, IN
1999 – 2000. Bag Boy, *The Village Pantry*, Nitro, W.V.
1998 – 1999. Assistant Janitor, *McCreary County Jail*, Whitley City, KY

Special Skills

- Expert in the programming of differential analysers
- Proficient at operation of particle accelerators
- Developed method for creating anti-matter in standard household bathroom

References

Available on request.

Information = Data placed in context

FIGURE 1B.19

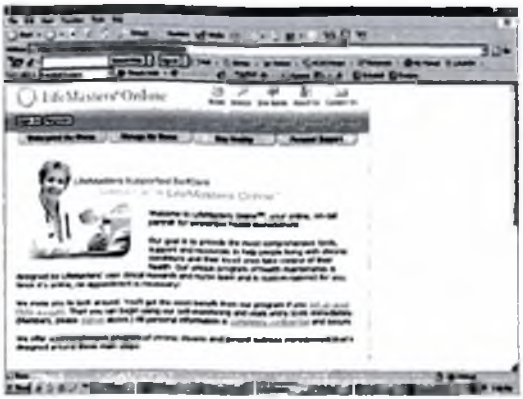
A piece of data, like a letter of the alphabet, has little meaning by itself. When pieces of data are combined and placed in some sort of context, such as a resume, they become meaningful information.

Urheberrechtlich geschütztes Material

LifeMasters Online offers health management tools and content similar to those offered through LifeMasters' caregiver-supervised model, but it is available free to the general public. Here, users enter their own vital-sign and symptom information via the Web site or through a Touch-Tone phone. The information goes into a database and, when the data indicate that medical intervention is required, the patient's physician is notified.

Patients have access to support groups and medical information on a 24 × 7 basis. LifeMasters Online also provides self-directed health education and behavior modification modules addressing health concerns such as diet, exercise, and smoking cessation.

"We built this for the future," says Christobel Selecky, LifeMasters CEO. "As the Baby Boom generation ages and develops chronic diseases, we're going to need to use technology tools to help physicians and their patients manage their health care more effectively and efficiently than in traditional ways."



computer how to perform tasks. Like data, these instructions exist as strings of numbers so the computer can use them. But the resemblance ends there. You can think of the difference between data and programs this way: data is for people to use, but programs are for computers to use.

Within the computer, data is organized into files. A file is simply a set of data that has been given a name. A file that the user can open and use is often called a document. Although many people think of documents simply as text, a computer document can include many kinds of data (see Figure 1B.21). For example, a computer document can be a text file (such as a letter), a group of numbers (such as a budget), a video clip (which includes images and sounds), or any combination of these items. Programs are organized into files as well; these files contain the instructions and data that a program needs in order to run and perform tasks.

```
0001010010110101010101010111
1110110101010101010110110001
0011010110001010101011100010
1010100001101101110010110l
0101010011001100100l011010
0101010010101010001011001O
1011001010101000101011101O
1101001111000010101011101O
0100101101001011010011011O
```

FIGURE 1B.20

If you could see data as the computer does, it would look something like this.

Urheberrechtlich geschütztes Material

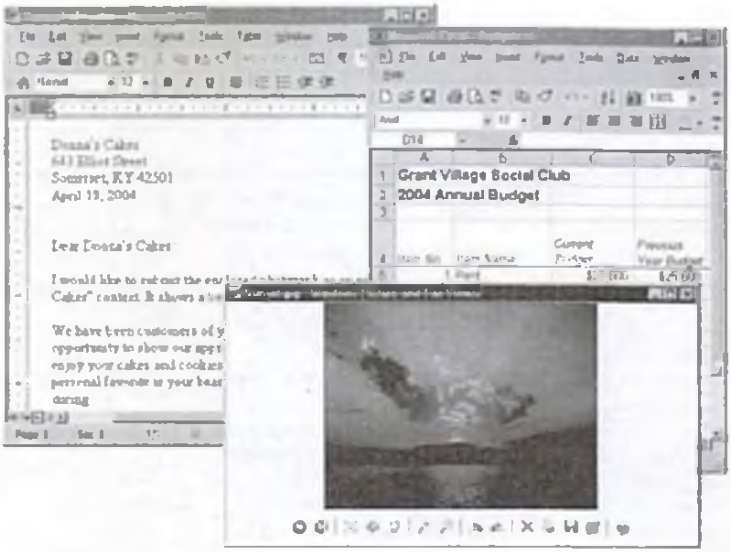


FIGURE 1B.21

A letter, a budget, a picture—each one is an example of a document that a person can use.



FIGURE 1B.22

Even the most powerful computers require human interaction to perform their tasks.

Computer Users

Personal computers, which are the focus of this book, are designed to work with a human user. In fact, the user is a critical part of a complete computer system, especially when a personal computer is involved.

This may seem surprising, since we tend to think of computers as intelligent devices, capable of performing amazing tasks. People also sometimes believe that computers can think and make decisions, just like humans do. But this is not the case. Even the most powerful supercomputers require human interaction—if for no other reason than to get them started and tell them which problems to solve (see Figure 1B.22).

The User's Role

When working with a personal computer, the user can take on several roles, depending on what he or she wants to accomplish:

- **Setting up the System.** Have you ever bought a new PC? When you got it home, you probably had to unpack it, set it up, and make sure it worked as expected (see Figure 1B.23). If you want to change something about the system (a process called configuration), you will likely do it yourself, whether you want to add a new hardware device, change the way programs look on your screen, or customize the way a program functions.
- **Installing Software.** Although your new computer probably came with an operating system and some applications installed, you need to install any other programs you want to use. This may involve loading software from a disk or downloading it from a Web site. Either way, it is usually the user's responsibility to install programs, unless the computer is used at a school or business. In that case, a system administrator or technician may be available to do the job.

Urheberrechtlich geschütztes Material

» **Running Programs.** Whenever your computer is on, there are several programs running in the background, such as the software that runs your mouse and printer. Such programs do not need any user input; in fact, you may not even be aware of them. But for the most part, if you want to use your computer to perform a task, you need to launch and run the software that is designed for the task. This means installing the program, learning its tools, and working with it to make sure it gives you the results you want.

» **Managing Files.** As you have already learned, a computer saves data in files. If you write a letter to a friend, you can save it as a file, making it available to open and use again later. Pictures, songs, and other kinds of data are stored as files. But it is the user's job to manage these files, and this means setting up a logical system for storing them on the computer. It also means knowing when to delete or move files, or copy them to a disk for safekeeping.

» **Maintaining the System.** System maintenance does not necessarily mean opening the PC and fixing broken parts, as you would repair a car's engine. But it could! In that case, you might call a qualified technician to do the job, or roll up your sleeves and tackle it yourself. PC maintenance, however, generally means running utilities that keep the disks free of clutter and ensure that the computer is making the best use of its resources.



FIGURE 1B.23

Setting up a new computer is usually the user's job.

"Userless" Computers

Of course, there are many kinds of computers that require no human interaction, once they have been programmed, installed, and started up. For example, if you own a car that was built within the last decade, it almost certainly has an on-board computer that controls and monitors engine functions (see Figure 1B.24). Many new home appliances, such as washers and dryers, have built-in computers that monitor water usage, drying times, balance, and other operations. Sophisticated userless computers operate security systems, navigation systems, communications systems, and many others.

Userless computers are typically controlled by their operating systems. In these devices, the operating system may be installed on special memory chips rather than a disk. The operating system is programmed to perform a specific set of tasks, such as monitoring a function or checking for a failure, and little else. These systems are not set up for human interaction, except as needed for system configuration or maintenance.



FIGURE 1B.24

A car's on-board computer not only controls some engine functions, but communicates with diagnostic systems to help technicians identify and repair problems with the vehicle.

Urheberrechtlich geschütztes Material

Computers In Your Career

Using Computers Outside of the IT Industry

Few hardwood products manufacturers can boast an e-commerce-enabled Web site where customers view catalogs, place orders, track orders, and review their account history 24 hours a day, seven days a week. Even fewer can offer customers a solution that uses computer modeling and simulation techniques to recreate "real world" projects in a virtual environment.

Thanks to the efforts of Richard Enriquez, Enkeboll Designs of Carson, California, can boast that and more in an industry where manufacturing and related processes remain largely manual and labor-intensive. "No one else offers e-commerce capabilities in our category," said Richard Enriquez, director of marketing, who envisions a time when the firm's woodcarvers will be able to use a computer to go from concept to finished product without ever having to touch a piece of wood or a chisel.

Having worked in the software development industry for 15 years, Enriquez aspires to use technology to bring more value to the customers while also making Enkeboll Designs' architectural woodcarving manufacturing process more efficient and productive. In 2003, for example, he spearheaded the conversion of the entire product line into three-dimensional formats that can be used in conjunction with commercial and residential previsualization applications to minimize specification errors.

Enriquez, who earned a Bachelor of Science degree from DeVry University, handles myriad tasks at Enkeboll Designs, including managing internal and external staff associated with marketing and new product development, evaluating technologies, reviewing strategic relationships, and overseeing the development of the company's Web site. He works 50 to 55 hours a week and enjoys the challenge of incorporating technology into a company that has traditionally conducted business utilizing traditional methods.

"When the company wanted to start leveraging technology, they hired me," says Enriquez. "Before I came on board, the company was very traditional and didn't believe, for example, in putting e-commerce capabilities on the Web site." One year later, Enriquez says the naysayers wouldn't have it any other way. "It all boils down to results."

Enriquez says opportunities for IT professionals in the non-IT space are plentiful. One need only look around the business world to see how technology is making an impact in the most unlikely occupations, such as

» **Restaurant and Grocery Store Managers.** Restaurants, grocery stores, and retail outlet managers use computer systems of all kinds—from handheld units to mainframes—to monitor inventories, track transactions, and manage product pricing.

Urheberrechtlich geschütztes Material

» **Courier Dispatchers.** Courier services of all types use computerized terminals to help dispatchers schedule deliveries, locate pickup and drop-off points, generate invoices, and track the location of packages.

» **Construction Managers.** Construction managers and estimators use specialized software to analyze construction documents and to calculate the amount of materials and time required to complete a job.

» **Automotive Mechanics.** Automotive mechanics and technicians use computer systems to measure vehicle performance, diagnose mechanical problems, and determine maintenance or repair strategies.

Each of the following chapters in this textbook features a discussion of computers in the professional world. Each discussion focuses on the type of technology introduced in that unit and is designed to help you understand how that particular technology is used in one or more professions.



Urheberrechtlich geschütztes Material

Summary

- A complete computer system includes hardware, software, data, and users.
- Hardware consists of electronic devices, the parts you can touch.
- Software (programs) consists of instructions that control the computer.
- Data can be text, numbers, sounds, and images that the computer manipulates.
- People who operate computers are called users.
- To manipulate data, the computer follows a process called the information processing cycle, which includes data input, processing, output, and storage.
- A computer's hardware devices fall into four categories: processing, memory, input and output (I/O), and storage.
- The processing function is divided between the processor and memory.
- The processor, or CPU, carries out instructions from the user and software.
- Random access memory (RAM) holds data and program instructions as the CPU works with them.
- The most common units of measure for memory are the byte, kilobyte, megabyte, gigabyte, and terabyte.
- Read-only memory (ROM) is another important type of memory, which holds instructions that help the computer start up and information about its hardware.
- The role of input devices is to accept instructions and data from the user or another computer.
- Output devices present processed data to the user or to another computer.
- Communications devices perform both input and output functions, allowing computers to share information.
- Storage devices hold data and programs permanently, even when the computer is turned off.
- The two primary categories of storage devices are magnetic storage and optical storage.
- The two primary categories of software are system software and application software.
- The operating system tells the computer how to interact with the user and how to use the hardware devices attached to the computer.
- Application software tells the computer how to accomplish tasks the user requires.
- In a computer, data consists of small pieces of information that, by themselves, may not make sense to a person. The computer manipulates data into useful information.
- Program instructions are different from data, in that they are used only by the computer and not by people.
- A user is an essential part of a complete personal computer system. Generally, the user must perform a wide range of tasks, such as setting up the system, installing software, managing files, and other operations that the computer cannot do by itself.
- Some computers are designed to function independently, without a user, but these systems are not personal computers.

Urheberrechtlich geschütztes Material

Key Terms

application software, 33
byte, 29
CD-Recordable (CD-R), 32
CD-ReWritable (CD-RW), 32
CD-ROM drive, 32
central processing unit (CPU), 28
circuit board, 28
communications device, 31
compact disc (CD), 32
Compact Disc Read-Only Memory (CD-ROM), 32
computer system, 25
data, 25
device, 25
digital, 36
digital camera, 30
Digital Video Disc (DVD), 32
disk drive, 31
diskette, 31
diskette drive, 31
document, 37
execute, 32
file, 37
floppy disk, 31
gigabyte (GB), 29
hard disk, 31
hard drive, 31
hardware, 25
information processing cycle, 26
input device, 30
joystick, 30
keyboard, 30
kilobyte (KB), 29
magnetic disk, 31
megabyte (MB), 29
memory, 29
microphone, 30
microprocessor, 28
monitor, 30
motherboard, 28
mouse, 30
network operating system, 33
nonvolatile, 29
operating system, 33
optical storage, 32
output device, 30
printer, 30
processing, 28
processor, 28
program, 25
random access memory (RAM), 29
read/write head, 31
read-only memory (ROM), 29
run, 32
scanner, 30
software, 25
storage, 31
system software, 33
terabyte (TB), 29
touch screen, 31
touchpad, 30
trackball, 30
user, 26
utility, 33
volatile, 29

Key Term Quiz

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. A complete _____ refers to the combination of hardware, software, data, and people.
2. A(n) _____ is a set of data or program instructions that has been given a name.
3. A(n) _____ is a device that holds a disk.
4. Electronic instructions that tell the computer's hardware what to do are known as _____ .
5. The generic term _____ refers to a piece of hardware.
6. Data and program instructions are temporarily held in _____ while the processor is using them.
7. The _____ includes four stages: input, processing, output, and storage.
8. One _____ is roughly equivalent to one million bytes of data.
9. Operating systems fall into the category of _____ software.
10. In a magnetic disk drive, a special device called the _____ reads data from and writes data to a disk's surface.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. Which of the following devices stores instructions that help the computer start up?
   a. joystick b. RAM c. ROM d. monitor
2. A _____ can perform both input and output functions.
   a. trackball b. microphone c. communications device d. CPU
3. Which type of software would you use to make the computer perform a specific task, such as writing a letter or drawing a picture?
   a. application software b. utility software c. operating system software d. system software
4. Which of the following units represents the largest amount of data?
   a. kilobyte b. terabyte c. gigabyte d. megabyte
5. You can use this output device when you need only to see information.
   a. printer b. speaker c. monitor d. communications
6. Generally, a _____ cannot be removed from the computer.
   a. mouse b. keyboard c. diskette d. hard disk
7. A file that the user can open and use is called a(n) _____ .
   a. application b. document c. program d. data
8. Because computer data has been reduced to numbers, it is described as being _____ .
   a. digital b. numeric c. information d. processed
9. Which type of disk can store up to 17 gigabytes of data?
   a. floppy disk b. compact disc c. optical disc d. digital video disc
10. Which type of software is used for creating slide shows?
    a. Web design software b. presentation software c. word-processing software d. spreadsheet software

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. List the four parts of a complete computer system.
2. What are the four phases of the information processing cycle?
3. Identify four categories of computer hardware.
4. List four units of measure for computer memory and storage, not including the byte.
5. What are the two most common input and output devices?
6. Name and differentiate the two main categories of storage devices.
7. Name and differentiate the two main categories of computer software.
8. What is the difference between data and information?
9. What is a fundamental difference between data and programs?
10. List five tasks a user may be responsible for, when working with a personal computer.

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. What type of computer system do you use in class or in the lab? How much can you tell about the system by looking at it? List as much information as you can about the computer. Is it a desktop or tower model? What brand is it? What type of processor does it have? What are the model and serial numbers? What external devices does it have? Is it connected to a network or printer?
2. What kind of software is installed on your computer? To find out, all you have to do is turn on your computer. After it starts, you should see a collection of icons—small pictures that represent the programs and other resources on your computer. List the icons that appear on your screen and the names of the software programs they represent.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Get some help. If you do not know how to perform a task on your computer, turn to its online help system for answers and assistance. Browse your operating system's help system to learn more about your computer. (This activity assumes you use Windows XP. If you use a different operating system, ask your instructor for assistance.)
   a. Click the Start button on the Windows taskbar to open the Start menu.
   b. On the Start menu, click Help and Support. The Help and Support Center window opens.
   c. Under Pick a Help Topic, click the Windows Basics link. When the list of Windows basics topics appears in the next window, click any two of the topics and read the information that appears on your screen.
   d. Close the Help window by clicking the Close button (with an X on it) in the upper-right corner of the window.
2. Explore your disk. Once you are familiar with your computer's hardware, it is time to see the folders and files that reside on its hard disk. To see what is on your disk, take these steps:
   a. Minimize or close all running program windows, so you can see the Windows desktop.
   b. On the desktop, double-click the My Computer icon. The My Computer window opens, listing all the disks on your computer.
   c. Double-click the icon labeled LOCAL DISK (C:) to open a window displaying that disk's contents.
   d. Double-click at least five of the folders and review the contents of each one. Can you tell which files are data files and which are program files?
   e. When you finish exploring your disk, close all open windows.
3. Learn more about browsers. There are many different Web browsers available, and you may decide you like one of the lesser-known browsers better than the most popular ones. The following Web sites can provide information about browsers:
   - Microsoft. Visit http://www.microsoft.com/windows/ie/default.asp for information about Microsoft Internet Explorer.
   - Netscape. Visit http://channels.netscape.com/ns/browsers/default.jsp for information about Netscape Navigator.
   - Opera Software. Visit http://www.opera.com for information about Opera.
   - Ubvision. Visit http://www.ultrabrowser.com for information about UltraBrowser.

Urheberrechtlich geschütztes Material

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Home computers are used more extensively than ever for tasks such as banking, investing, shopping, and communicating. Do you see this trend as having a positive or a negative impact on our society and economy? Do you plan to use a computer in these ways? Why or why not?
2. Describe your experience with computers so far. Have you worked with (or played with) computers before? If so, why? Has your past experience with computers influenced your decision to study them?

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- The world's smallest computer.
- The use of supercomputers in mapping the human genome.
- The history of computer operating systems.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

Computer skills can make a difference in a person's employability. With this thought in mind, discuss the following questions in class.

1. A factory is buying computerized systems and robots to handle many tasks, meaning fewer laborers will be needed. The company needs people to run the new equipment but wants to hire new workers who already have computer skills. Is the company obligated to keep the workers with no computer skills and train them to use the equipment? Are workers obligated to learn these new skills if they want to keep their jobs?
2. You are a skilled drafter with 15 years of experience. You have always done your drafting work using traditional methods (using pen and paper). Now you want to move to a different city and have sent resumes to several drafting firms there. You learn, however, that none of those firms will consider you for employment because you have no experience drafting on a computer. Is this fair? Why or why not? What would you do?

Urheberrechtlich geschütztes Material



CHAPTER 2

Interacting with Your Computer

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **2A:**
Using the Keyboard and Mouse

- The Keyboard
- The Mouse
- Variants of the Mouse
- Ergonomics and Input Devices

Lesson **2B:**
Inputting Data in Other Ways

- Devices for the Hand
- Optical Input Devices
- Audiovisual Input Devices



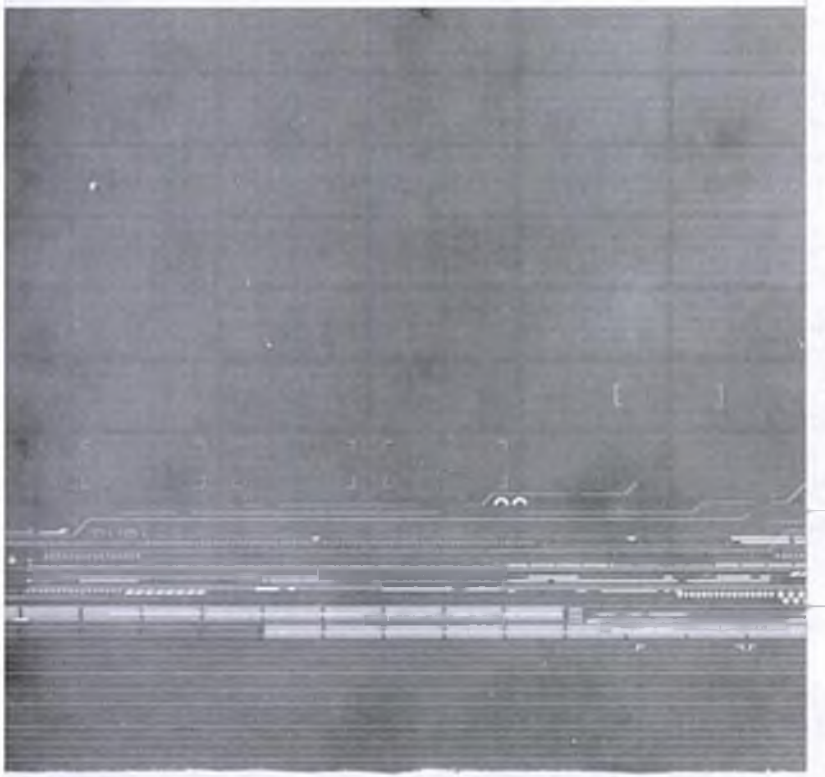
Using the Keyboard and Mouse

Overview: The Keyboard and Mouse

If you think of the CPU as a computer's brain, then you might think of the input devices as its sensory organs—the eyes, ears, and fingers. From the user's point of view, input devices are just as important as the CPU, perhaps even more important. After you buy and set up the computer, you may take the CPU for granted because you interact directly with input devices and only indirectly with the CPU. But your ability to use input devices is critical to your overall success with the whole system.

An input device does exactly what its name suggests: it enables you to enter information and commands into the computer. The most commonly used input devices are the keyboard and the mouse. If you buy a new personal computer today, it will include a keyboard and mouse unless you specify otherwise. Other types of input devices are available as well, such as variations of the mouse and specialized "alternative" input devices such as microphones and scanners.

This lesson introduces you to the keyboard and the mouse. You will learn the importance of these devices, the way the computer accepts input from them, and the many tasks they enable you to perform on your PC.



OBJECTIVES ::

- Identify the five key groups on a standard computer keyboard.
- Name six special-purpose keys found on all standard computer keyboards.
- List the steps a computer follows when accepting input from a keyboard.
- Describe the purpose of a mouse and the role it plays in computing.
- Identify the five essential techniques for using a mouse.
- Identify three common variants of the mouse.
- Describe five steps you can take to avoid repetitive stress injuries from computer use.

Urheberrechtlich geschütztes Material

The Keyboard

The keyboard was one of the first peripherals to be used with computers, and it is still the primary input device for entering text and numbers. A standard keyboard includes about 100 keys; each key sends a different signal to the CPU.

If you have not used a computer keyboard or a typewriter, you will learn quickly that you can use a computer much more effectively if you know how to type. The skill of typing, or keyboarding, is the ability to enter text and numbers with skill and accuracy. Certainly, you can use a computer without having good typing skills. Some people claim that when computers can interpret handwriting and speech with 100 percent accuracy, typing will become unnecessary. But for now and the foreseeable future, keyboarding remains the most common way to enter text and other data into a computer.

Norton ONLINE

For more information on computer-based keyboard tutorials, visit **http://www.mhhe.com/petemorton**

simnet™

Norton ONLINE

For more information on computer keyboards and keyboard manufacturers, visit **http://www.mhhe.com/petemorton**

The Standard Keyboard Layout

Keyboards come in many styles. The various models differ in size, shape, and feel; except for a few special-purpose keys, most keyboards are laid out almost identically. Among IBM-compatible computers, the most common keyboard layout is the IBM Enhanced Keyboard. It has about 100 keys arranged in five groups, as shown in Figure 2A.1. (The term IBM-compatible computer refers to any PC based on the first personal computers, which were made by IBM. Today, an IBM-compatible PC is any PC other than a Macintosh computer.)

The Alphanumeric Keys

The alphanumeric keys—the area of the keyboard that looks like a typewriter's keys—are arranged the same way on almost every keyboard. Sometimes this common arrangement is called the QWERTY (pronounced KWER-tee) layout because the first six keys on the top row of letters are Q, W, E, R, T, and Y.

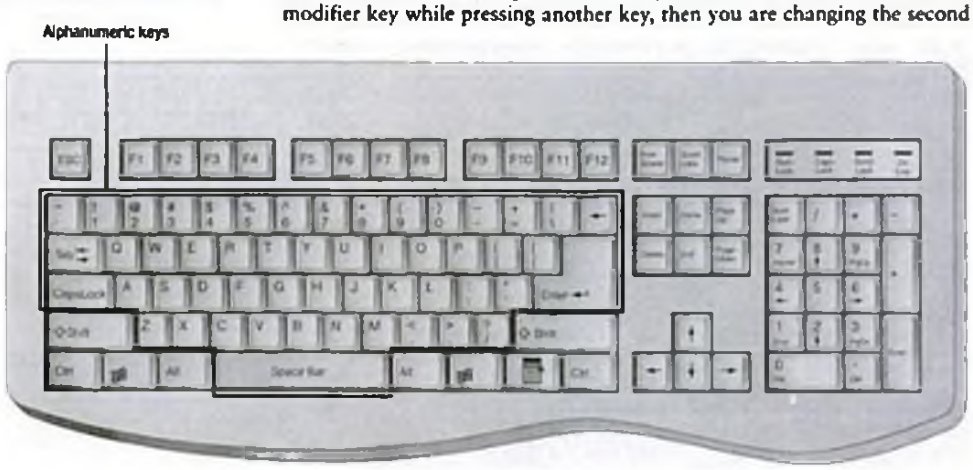
Along with the keys that produce letters and numbers, the alphanumeric key group includes four keys having specific functions. The TAB, CAPS LOCK, BACKSPACE, and ENTER keys are described in Figure 2A.2.

The Modifier Keys

The SHIFT, ALT (Alternate), and CTRL (Control) keys are called modifier keys because they modify the input of other keys. In other words, if you hold down a modifier key while pressing another key, then you are changing the second key's

FIGURE 2A.1

Most IBM-compatible PCs use a keyboard like this one. Many keyboards feature a number of specialized keys, and keyboards can vary in size and shape. But nearly all standard PC keyboards include the keys shown here.



Urheberrechtlich geschütztes Material

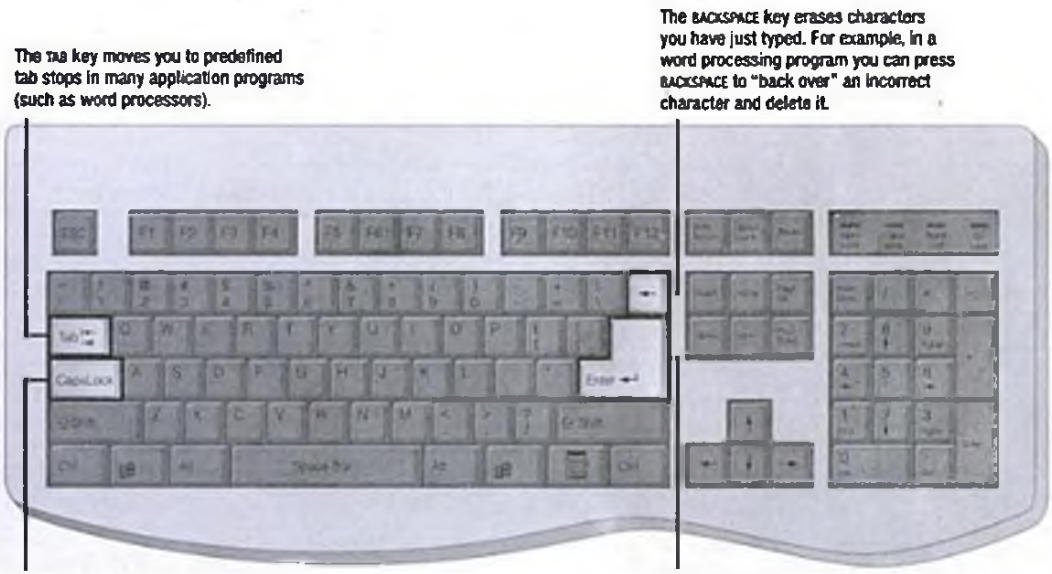


FIGURE 2A.2

Functions of the TAB, CAPS LOCK, BACKSPACE, and ENTER keys

input in some way. For example, if you press the J key, you input a small letter *j*. But if you hold down the SHIFT key while pressing the J key, you input a capital *J*. Modifier keys are extremely useful because they give all other keys multiple capabilities. Figure 2A.3 describes the modifier keys and their uses.

The Numeric Keypad

The numeric keypad is usually located on the right side of the keyboard, as shown in Figure 2A.1. The numeric keypad looks like a calculator's keypad, with its 10 digits and mathematical operators (+, -, *, and /). The numeric keypad also features a NUM LOCK key, which forces the numeric keys to input numbers. When NUM LOCK is deactivated, the numeric keypad's keys perform cursor-movement control and other functions.

The Function Keys

The function keys, which are labeled F1, F2, and so on (as shown in Figure 2A.1), are usually arranged in a row along the top of the keyboard. They allow you to input commands without typing long strings of characters or navigating menus or dialog boxes. Each function key's purpose depends on the program you are using. For example, in most programs, F1 is the help key. When you press it, a special window appears to display information about

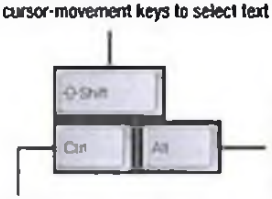


FIGURE 2A.3

Functions of the SHIFT, CTRL, and ALT keys.

Urheberrechtlich geschütztes Material

the program you are using. Most IBM-compatible keyboards have 12 function keys. Many programs use function keys along with modifier keys to give the function keys more capabilities.

The Cursor-Movement Keys

Most standard keyboards also include a set of cursor-movement keys, which let you move around the screen without using a mouse. In many programs and operating systems, a mark on the screen indicates where the characters you type will be entered. This mark, called the cursor or insertion point, appears on the screen as a blinking vertical line, a small box, or some other symbol to show your place in a document or command line. Figure 2A.4 describes the cursor-movement keys and Figure 2A.5 shows an insertion point in a document window.

Special-Purpose Keys

In addition to the five groups of keys described earlier, all IBM-compatible keyboards feature six special-purpose keys, each of which performs a unique function. Figure 2A.6 describes these special-purpose keys.

Since 1996, nearly all IBM-compatible keyboards have included two additional special-purpose keys designed to work with the Windows operating systems (see Figure 2A.7):

- START. This key, which features the Windows logo (and is sometimes called the Windows logo key), opens the Windows Start menu on most computers. Pressing this key is the same as clicking the Start button on the Windows taskbar.
- SHORTCUT. This key, which features an image of a menu, opens an on-screen shortcut menu in Windows-based application programs.

One of the latest trends in keyboard technology is the addition of Internet and multimedia controls. Microsoft's Internet Keyboard and MultiMedia Keyboard, for example, feature buttons that you can program to perform any number of tasks. For example, you can use the buttons to launch a Web browser, check e-mail,

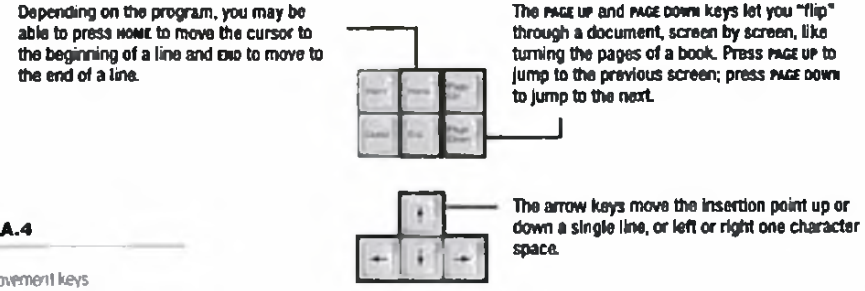


FIGURE 2A.4

The cursor-movement keys

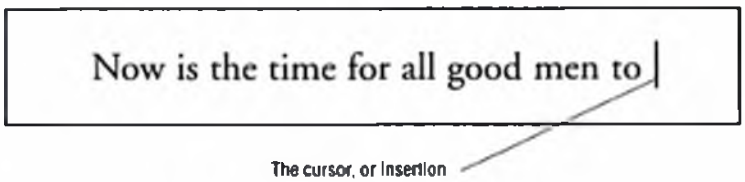


FIGURE 2A.5

The cursor, or insertion point, shows where the next letter typed will appear.

Urheberrechtlich geschütztes Material

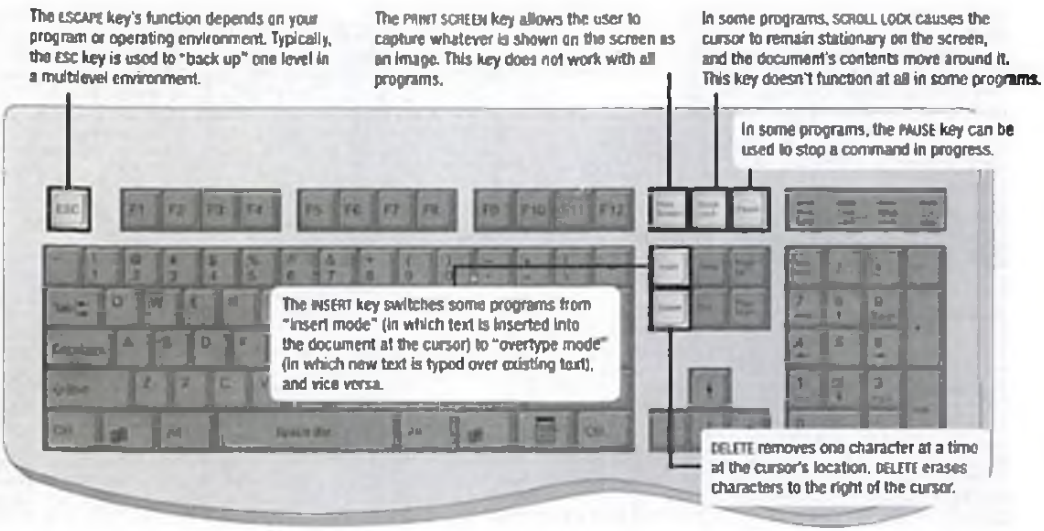


FIGURE 2A.6

Special-purpose keys on most standard keyboards



FIGURE 2A.7

The START key and the SHORTCUT key appear frequently on the newer keyboards that are sold with Windows-based computers.

and start your most frequently used programs. Multimedia buttons let you control the computer's CD-ROM or DVD drive and adjust the speaker volume. Many keyboard makers offer such features on newer models (see Figure 2A.8).

How the Computer Accepts Input from the Keyboard

You might think the keyboard simply sends the letter of a pressed key to the computer—after all, that is what appears to happen. Actually, the process of accepting input from the keyboard is more complex, as shown in Figure 2A.9.

When you press a key, a tiny chip called the keyboard controller notes that a key has been pressed. The keyboard controller places a code into part of its memory,

Urheberrechtlich geschütztes Material



FIGURE 2A.8

Internet and multimedia features are commonplace on newer keyboards.

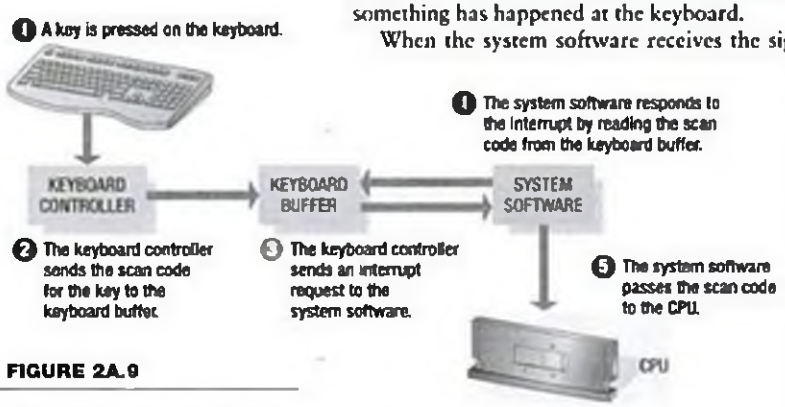


FIGURE 2A.9

How input is received from the keyboard



FIGURE 2A.10

Most modern personal computers are equipped with a mouse.

called the keyboard buffer, to indicate which key was pressed. (A buffer is a temporary storage area that holds data until it can be processed.) The keyboard controller then sends a signal to the computer's system software, notifying it that something has happened at the keyboard.

When the system software receives the signal, it determines the appropriate response. When a keystroke has occurred, the system reads the memory location in the keyboard buffer that contains the code of the key that was pressed. The system software then passes that code to the CPU.

The keyboard buffer can store many keystrokes at one time. This capability is necessary because some time elapses between the pressing of a key and the computer's reading of that key from the keyboard buffer. With the keystrokes stored in a buffer, the program can react to them when it is convenient. Of course, this all happens very quickly. Unless the computer is very busy handling multiple tasks, you notice no delay between pressing keys and seeing the letters on your screen.

In some computers, the keyboard controller handles input from the computer's keyboard and mouse and stores the settings for both devices. One keyboard setting, the repeat rate, determines how long you must hold down an alphanumeric key before the keyboard will repeat the character and how rapidly the character is retyped while you press the key. You can set the repeat rate to suit your typing speed. (You will learn how to check your keyboard's repeat rate in the lab exercises at the end of this chapter.)

The Mouse

A personal computer that was purchased in the early 1980s probably included a keyboard as the only input device. Today, every new PC includes a pointing device as standard equipment, as shown in Figure 2A.10. Full-size PCs usually include a mouse as the pointing device. A mouse is an input device that you can move around on a flat surface (usually on a desk or keyboard tray) and controls the pointer. The pointer (also called the *mouse pointer*) is an on-screen object, usually an arrow, that is used to select text; access menus; and interact with programs, files, or data that appear on the screen. Figure 2A.11 shows an example of a pointer in a program window.

Urheberrechtlich geschütztes Material

The mechanical mouse is the most common type of pointing device. A mechanical mouse contains a small rubber ball that protrudes through a hole in the bottom of the mouse's case (see Figure 2A.12). The ball rolls inside the case when you move the mouse around on a flat surface. Inside the mouse, rollers and sensors send signals to the computer, telling it the distance, direction, and speed of the ball's motions (see Figure 2A.13). The computer uses this data to position the mouse pointer on the screen.

Another popular type of mouse, the optical mouse, is nonmechanical. This type of mouse emits a beam of light from its underside; it uses the light's reflection to judge the distance, direction, and speed of its travel (see Figure 2A.14).

The mouse offers two main benefits. First, the mouse lets you position the cursor anywhere on the screen quickly without using the cursor-movement keys. You simply move the pointer to the on-screen position you want and press the mouse button; the cursor appears at that location.

Second, instead of forcing you to type or issue commands from the keyboard, the mouse and mouse-based operating systems let you choose commands from easy-to-use menus and dialog boxes (see Figure 2A.15). The result is a much more intuitive way to use computers. Instead of remembering obscure command names, users can figure out rather easily where commands and options are located.

FIGURE 2A.11

An example of a pointer as it might appear on a computer screen.

Norton ONLINE

For more information on mice and mouse manufacturers, visit **http://www.mhhe.com/petemorton**

simnet™

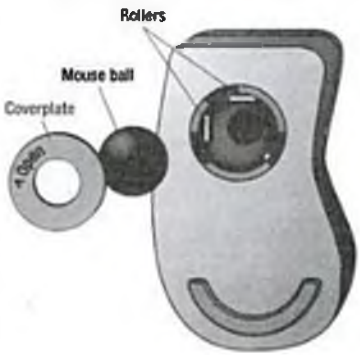


FIGURE 2A.12

The parts of a mechanical mouse, seen from the bottom.

Norton ONLINE

For more information on optical mice, visit **http://www.mhhe.com/petemorton**

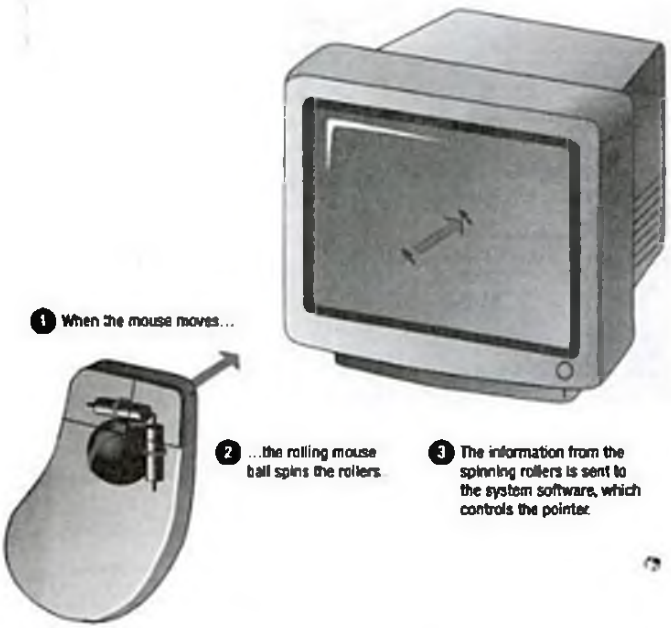


FIGURE 2A.13

How the mouse controls the pointer.

Urheberrechtlich geschütztes Material

FIGURE 2A.14

The underside of an optical mouse.



If you use a drawing program, you can use the mouse to create graphics such as lines, curves, and freehand shapes on the screen. The mouse has helped establish the computer as a versatile tool for graphic designers, starting what has since become a revolution in the graphic design field.

Using the Mouse

You use a mouse to move the pointer to a location on the screen, a process called *pointing*. Everything you do with a mouse is accomplished by combining pointing with these techniques:

- Clicking
- Double-clicking
- Dragging
- Right-clicking

Pointing means pushing the mouse across your desk. On the screen, the pointer moves in relation to the mouse (see Figure 2A.16). Push the mouse forward, and the pointer moves up. Push the mouse to the left, and the pointer moves to the left. To point to an object or location on the screen, you simply use the mouse to place the pointer on top of the object or location.

The mice that come with IBM-compatible computers usually have two buttons, but techniques such as clicking, double-clicking, and dragging are usually carried out with the left mouse button (see Figure 2A.17). In multibutton mice, one button must be designated

Norton ONLINE

For more information on mouse techniques, visit **http://www.mhhe.com/peternorton**

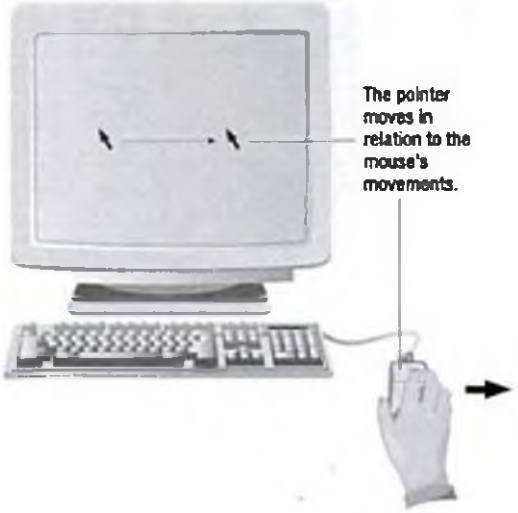
FIGURE 2A.15

Using the mouse to choose a command from a menu.



FIGURE 2A.16

Using the mouse to control the on-screen pointer.



Urheberrechtlich geschütztes Material

as the "primary" button, referred to as the mouse button. Some mice can have three or more buttons. The buttons' uses are determined by the computer's operating system, application software, and mouse-control software.

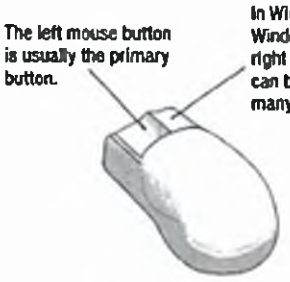


FIGURE 2A.17

Standard button configuration on a two-button mouse.

To click an item with the mouse, you move the pointer to the item on the screen. When the pointer touches the object, quickly press and release the primary mouse button once (see Figure 2A.18). Clicking—or *single-clicking*, as it is also called—is the most important mouse action. To select any object on the screen, such as a menu, command, or button, you click it.



FIGURE 2A.18

Clicking a mouse.

Double-clicking an item means pointing to the item with the mouse pointer and then pressing and releasing the mouse button twice in rapid succession (see Figure 2A.19). Double-clicking is primarily used with desktop objects such as icons. For example, you can double-click a program's icon to launch the program.



FIGURE 2A.19

Double-clicking a mouse.

Dragging an item means positioning the mouse pointer over the item, pressing the primary mouse button, and holding it down as you move the mouse. As you move the pointer, the item is "dragged" along with it across the screen (see Figure 2A.20). You can then drop the item in a new position on the screen. This technique is also called drag-and-drop editing, or just drag and drop. Dragging is a very handy tool. In a word-processing program, for example, you can drag text from one location to another in a document. In a file-management program, you can drag a document's icon and drop it onto a printer's icon to print the document.



FIGURE 2A.20

Dragging with a mouse.

Windows and many Windows programs support right-clicking, which means pointing to an item on the screen, then pressing and releasing the right mouse button (see Figure 2A.21). Right-clicking usually opens a shortcut menu that contains commands and options that pertain to the item to which you are pointing.



FIGURE 2A.21

Right-clicking a mouse.

A wheel mouse has a small wheel nestled among its buttons (see Figure 2A.22). You can use the wheel for various purposes, one of which is scrolling through long documents. Not all applications and operating systems support the use of the wheel.

Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on the care and usage of mice, visit http://www.mhhe.com/petemorton



FIGURE 2A.22

A wheel mouse.

Mouse Button Configurations

The mouse usually sits to the right of the keyboard (for right-handed people), and the user maneuvers the mouse with the right hand, pressing the left button with the right forefinger. For this reason, the left mouse button is sometimes called the primary mouse button.

If you are left-handed, you can configure the right mouse button as the primary button (as shown in Figure 2A.23). This configuration lets you place the mouse to the left of the keyboard, control the mouse with your left hand, and use your left forefinger for most mouse actions.

Newer mice enable you to configure buttons to perform different tasks than clicking. You might configure a button to delete selected text, for example, or to open a program that lets you search for files. Such settings may limit the usefulness of the mouse but can be helpful if you need to perform a certain task many times.

simnet™



FIGURE 2A.23

Most operating systems provide tools for configuring mouse buttons.

Variants of the Mouse

Although the mouse is a handy tool, some people do not like using a mouse or have difficulty maneuvering one. For others, a mouse requires too much desktop space—a real problem when you are not working at a desk!

For these reasons and others, hardware makers have developed devices that duplicate the mouse's functionality but interact with the user in different ways. The primary goals of these "mouse variants" are to provide ease of use while taking up less space than a mouse. They all remain stationary and can even be built into the keyboard.



Norton ONLINE

For more information on trackballs, visit http://www.mhhe.com/petemorton

Trackballs

A trackball is a pointing device that works like an upside-down mouse. You rest your index finger or thumb on an exposed ball, then place your other fingers on the buttons. To move the pointer around the screen, you roll the ball with your index finger or thumb. Because you do not move the whole device, a trackball requires less space than a mouse. Trackballs gained popularity with the advent of laprop computers, which typically are used on laps or on small work surfaces that have no room for a mouse.

Trackballs come in different models, as shown in Figure 2A.24. Some trackballs are large and heavy with a ball about the same size as a cue ball. Others are much smaller. Most trackballs feature two buttons, although three-button models

Urheberrechtlich geschütztes Material

SELF-CHECK ::

Circle the correct answer for each question.

1. The most common keyboard layout has about this many keys.
   a. 10 b. 100 c. 110
2. Which special keyboard key has a picture of the Windows logo on it?
   a. START key b. SHORTCUT key c. ALTERNATE key
3. Most full-size PCs feature one of these as the pointing device.
   a. Keyboard b. Mouse c. Scanner

are also available. Trackball units also are available in right- and left-handed models.



FIGURE 2A.24

Trackballs come in many shapes and sizes.

Trackpads

The trackpad (also called a touchpad) is a stationary pointing device that many people find less tiring to use than a mouse or trackball. The movement of a finger across a small touch-sensitive surface is translated into pointer movement on the computer screen. The touch-sensitive surface may be only 1.5 or 2 inches square, so the finger never has to move far. The trackpad's size also makes it suitable for a notebook computer. Some notebook models feature a built-in trackpad rather than a mouse or trackball (see Figure 2A.25).

Like mice, trackpads usually are separate from the keyboard in desktop computers and are attached to the computer through a cord. Some special keyboards feature built-in trackpads. This feature keeps the pad handy and frees a port that would otherwise be used by the trackpad.

Trackpads include two or three buttons that perform the same functions as mouse buttons. Some trackpads are also "strike sensitive," meaning you can tap the pad with your fingertip instead of using its buttons.

Norton ONLINE

For more information on trackpads and integrated pointing devices, visit **http://www.mhhe.com/petermorton**

Pointers in the Keyboard

Many portable computers now feature a small joystick positioned near the middle of the keyboard, typically between the G and H keys. The joystick is controlled with either forefinger, and it controls the movement of the pointer on screen. Because users do not have to take their hands off the keyboard to use this device, they can save a great deal of time and effort. Two buttons that perform the same function as mouse buttons are just beneath the spacebar and are pressed with the thumb.

Several generic terms have emerged for this device; many manufacturers refer to it as an integrated



FIGURE 2A.25

Some notebook computers and desktop keyboards feature a built-in trackpad.

Urheberrechtlich geschütztes Material

Productivity Tip

Saving Time With Keyboard Shortcuts

In the 1980s, as programmers began packing more features into PC software, they also developed ways for users to issue an ever-increasing number of commands. Software packages came with long lists of commands, all of which had to be entered at the keyboard. (This was before the mouse came into common use.) As a result, the computer keyboard rapidly became a valuable tool.

Programmers began devising keyboard shortcuts that allow users to issue commands quickly by typing a short combination of keystrokes. Keyboard shortcuts involve using a modifier key (such as ALT or CTRL) along with one or more alphanumeric or function keys. To print a document in many applications, for example, the user can press CTRL+P.

Function keys also became important. The F1 key, for example, became the universal way to access online help. IBM-compatible computer keyboards originally had 10 function keys; eventually the number of function keys was expanded to 12.

Another common type of keyboard shortcut involves pressing the ALT key to access a program's menu system. When running any Windows program, you can press ALT to activate the menu bar, and then press a highlighted letter in a menu's name to open that menu.

Still, a keyboard can hold only so many keys, and the lists of keyboard shortcuts became unmanageable. A single program could use dozens of "hotkeys," as these shortcuts were called. If you used several programs, you had to learn different shortcuts for each program. Finally, the Common User Access (CUA) standard led to the standardization of many commonly used hotkeys across different programs and environments. With this standard for commonly used hotkeys, users have fewer hotkeys to remember.

Despite such standards, pointing devices (such as the mouse) came along none too soon for hotkey-weary computer users. Microsoft Windows and the Macintosh operating system gained popularity because of their easy-to-use, mouse-oriented graphical interfaces. By operating the mouse, users could make selections visually from menus and dialog boxes. Emphasis rapidly began shifting away from the keyboard to the screen; today, many users do not know the purpose of their function keys!



FIGURE 2A.26

IBM's ThinkPad computers feature the TrackPoint pointing device, and similar devices are found in many other portable PCs.

pointing device, while others call it a 3-D point stick. On the IBM ThinkPad line of notebook computers, the pointing device is called the TrackPoint (see Figure 2A.26).

Ergonomics and Input Devices

Any office worker will tell you that working at a desk all day can be extremely uncomfortable (see Figure 2A.27). Sitting all day and using a computer can be even worse. Not only does the user's body ache from being in a chair too long, but hand and wrist injuries can result from using a keyboard and mouse for long periods. Eyes can become strained from staring at a monitor for hours. Such injuries can be extreme, threatening the user's general health and ability to work.

Much is being done to make computers easier, safer, and more comfortable to use. Ergonomics, which is the study of the physical relationship between people and their tools—such as computers—addresses these issues. Now more than ever before, people recognize the importance of having ergonomically correct computer furniture and using proper posture and techniques while working with computers. (The term *ergonomically correct* means that a tool or a workplace is designed to work properly with the human body, and thus reduces the risk of strain and injuries.)

Urheberrechtlich geschütztes Material

Pointing, however, can slow you down. As menus and dialog boxes become increasingly crowded, commands can be hard to find and their locations can be as difficult to remember as keyboard shortcuts. Many computer users overcome these problems by using a combination of keyboard shortcuts and a pointing device. You use one hand to issue many basic shortcuts (such as CTRL+P and CTRL+S) or to launch macros. A macro is a series of commands that a program memorizes for you. Macros enable you to issue an entire set of commands in just a few keystrokes. Using these techniques minimizes keystrokes and leaves a hand free to use a pointing device.

The following table lists some of the shortcut keys available in Microsoft Word.

Press	To
CTRL+B	Toggle bold character formatting on or off for the selected or inserted text; make letters bold or unbold
CTRL+I	Toggle italic character formatting on or off for the selected or inserted text; make letters italic
CTRL+U	Toggle underline character formatting on or off for the selected or inserted text; underline letters
CTRL+SHIFT+<	Decrease font size for the selected or inserted text
CTRL+SHIFT+>	Increase font size for the selected or inserted text
CTRL+Q	Remove paragraph formatting for the selected paragraph or paragraphs
CTRL+SPACEBAR	Remove character formatting for the selected text
CTRL+C	Copy the selected text or object
CTRL+X	Cut the selected text or object
CTRL+V	Paste text or an object
CTRL+Z	Undo the last action
CTRL+Y	Redo the last action

Repetitive Stress Injuries

The field of ergonomics did not receive much attention until a certain class of injuries began appearing among clerical workers who spend most of their time entering data on computer keyboards. These ailments are called repetitive stress injuries (RSIs) or *repetitive strain injuries* and result from continuously using the body in ways it was not designed to work. One type of RSI that is especially well documented among computer users is carpal tunnel syndrome, a wrist or hand injury caused by using a keyboard for long periods of time.

Norton ONLINE

For more information on ergonomics and avoiding computer-related injuries, visit **http://www.mhhe.com/peternorton**

simnet™



FIGURE 2A.27

Experience shows that office work can pose specific health risks.

Urheberrechtlich geschütztes Material

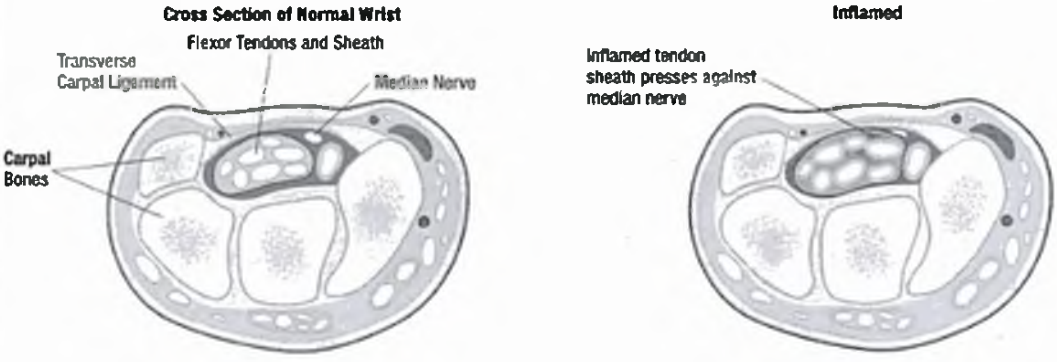


FIGURE 2A.28

Carpal tunnel syndrome affects the nerves running through the carpal tunnel of the wrist.

The carpal tunnel is a passageway in the wrist through which nerves pass (see Figure 2A.28). In carpal tunnel syndrome, tendons in the tunnel become inflamed because the victim has held his or her wrists stiffly for long periods, as people tend to do at a keyboard. When the tendons become inflamed, they press against the nerves, causing tingling, numbness, pain, or the inability to use the hands. Carpal tunnel syndrome is the best-known repetitive stress injury. It can become so debilitating that victims can miss weeks or months of work. In extreme cases, surgery is required.

Avoiding Keyboard-Related Injuries

If you use a computer frequently, you can avoid RSIs by adopting a few good work habits, and by making sure that your hardware and workspace are set up in an ergonomically friendly way.

At Issue

Computer Voting—Is It a Good Thing?

The dispute over electronic voting is as heated as a debate between presidential candidates. The risks versus the benefits are discussed, investigated, and argued. But what are the facts that lie beneath the fuss?

The key function of an electronic voting system is to obtain voter preferences and report them—reliably and accurately. Some assert that electronic systems are safer than other methods of voting because they implement security checks and audit trails, and are tougher to tamper with than paper ballots.

One of the most widely used electronic voting systems, Diebold Election Systems (http://www.diebold.com/dieboldes/accuvote_ts.htm), boasts some 33,000 voting stations in locations across the United States. Diebold's AccuVote-TS system is a voter-activated interactive touch-screen system using an intelligent Voter Card as the voter interface. The interface allows voters to view and cast their votes by touching target areas on an electronically generated ballot pad.

Each unit provides a direct-entry computerized voting station that automatically records and stores ballot information and results. While classified as a direct record entry (DRE) device, the AccuVote-TS system has additional capabilities. The tabulator is a multifunctional interface that counts and tabulates the ballots at precincts on election day and communicates with the host computer at Election Central for accurate and timely jurisdictionwide results.

However, electronic voting systems have generated concern because their work is not readily accessible for inspection; what goes on behind the screen is a mystery to the general public and therefore causes uneasiness. With computer voting, voter records are intangibly stored on a hard drive, with voting results recorded in electronic memory.

Indeed, a July 2003 analysis of the Diebold touch screen by computer researchers from Johns Hopkins and Rice universities (found at http://www.newscientist.com) showed that the software was riddled with errors and open to fraud. However, even with the possibility of fraud, electronic

Urheberrechtlich geschütztes Material

When setting up your computing workspace, make it a priority to choose a comfortable, ergonomically designed chair (see Figure 2A.29). Your office chair should

- Allow you to adjust its height.
- Provide good lower-back support.
- Have adjustable armrests.

Your desk also should be well-suited to computer use, like the one shown in Figure 2A.30. The desk should hold your keyboard and mouse at the proper height, so that your hands are at the same height as your elbows (or a few inches lower) when you hold them over the keyboard.

Here are some other tips that can help you avoid RSIs while working with your keyboard and mouse:

- **Use an Ergonomic Keyboard.** Traditional, flat keyboards are not well-suited to the shape of human hands. An ergonomic keyboard allows you to hold your hands in a more natural position (with wrists straight, rather than angled outward) while typing (see Figure 2A.31).
- **Use a Padded Wrist Support.** If you type a lot, a wrist support can be helpful by allowing you to rest your hands comfortably when you are not actually typing. Remember, however, that



FIGURE 2A.29

An ergonomically designed computer chair and desk.



FIGURE 2A.30

A properly designed computer desk features a built-in shelf or tray to hold the keyboard and mouse.



systems may still be safer than prior methods of voting because they implement redundant security checks and audits and may be more difficult to tamper with because of the size and nature of their tabulating components.

Another argument in favor of paper ballots, or at least paper receipts, is that in order to verify an election, all you need to do is gather up the ballots and tabulate them a second (or third, as the case may be) time. However, auditing paper ballot systems is not always as easy as it sounds. Ballots, particularly punch-cards, sometimes provide ambiguous results, as seen in a recent presidential election. They are easily forged and they must be physically handled and transported, which provides the opportunity for substitution or loss.

Whether computerized or traditional, no election system is infallible, and in truth, perhaps it doesn't need to be. As some have said, every safe has the capability to be cracked. The same is true for voting systems. The issue is not whether they are 100 percent secure, but whether they present adequate safeguards to give us faith in the integrity of our elections.

Urheberrechtlich geschütztes Material

you should never rest your wrists on anything—even a comfortable wrist support—while you type. Use the support only when your fingers are not moving over the keyboard.

- **Keep Your Wrists Straight.** When typing, your hands should be in a straight line with your forearms, when viewed either from above or from the side (see Figure 2A.32). Keeping the wrists bent in either direction can cause muscle fatigue.
- **Sit Up Straight.** Avoid slouching as you type, and keep your feet flat on the floor in front of you. Avoid crossing your legs in front of you or under your chair for long periods.
- **Learn to Type.** You will use the keyboard more efficiently and naturally if you know how to type. If you "hunt and peck," you are more likely to slouch and keep your head down while looking at the keyboard. This technique not only slows you down, but it leads to fatigue and stiffness.
- **Take Frequent Breaks.** Get up and move around for a few minutes each hour, and stretch occasionally throughout the day.

FIGURE 2A.31

An example of an ergonomic keyboard.



FIGURE 2A.32

When typing, your hands should be in line with your forearms at all times and when viewed from any angle.



Urheberrechtlich geschütztes Material

Summary ::

- A standard computer keyboard has about 100 keys.
- Most keyboards follow a similar layout, with their keys arranged in five groups. Those groups include the alphanumeric keys, numeric keypad, function keys, modifier keys, and cursor-movement keys.
- When you press a key, the keyboard controller places a code in the keyboard buffer to indicate which key was pressed. The keyboard sends the computer a signal, which tells the CPU to accept the keystroke.
- The mouse is a pointing device that lets you control the position of a graphical pointer on the screen without using the keyboard.
- Using the mouse involves five techniques: pointing, clicking, double-clicking, dragging, and right-clicking.
- A trackball is like a mouse turned upside-down. It provides the functionality of a mouse but takes less space on the desktop.
- A trackpad is a touch-sensitive pad that provides the same functionality as a mouse. To use a trackpad, you glide your finger across its surface.
- Many notebook computers provide a joystick-like pointing device built into the keyboard. You control the pointer by moving the joystick. On IBM systems, this device is called a TrackPoint. Generically, it is called an integrated pointing device.
- Continuous use of a keyboard and pointing device can lead to repetitive stress injuries.
- The field of ergonomics studies the way people use tools. This study leads to better product designs and techniques that help people avoid injuries at work.
- Ergonomically designed keyboards are available to help users prevent repetitive stress injuries to the wrists and hands.

Key Terms ::

alphanumeric key, 60
buffer, 54
carpal tunnel syndrome, 61
click, 57
cursor, 52
cursor-movement key, 52
double-clicking, 57
drag and drop, 57
drag-and-drop editing, 57
dragging, 57
ergonomics, 60
function key, 51
insertion point, 52
integrated pointing device, 59
keyboard buffer, 54
keyboard controller, 53
keyboarding, 50
mechanical mouse, 55
modifier key, 50
numeric keypad, 51
optical mouse, 55
pointer, 54
pointing, 56
pointing device, 54
repeat rate, 54
repetitive stress injury (RSI), 61
right-clicking, 57
trackpad, 59
TrackPoint, 60
wheel mouse, 57

Urheberrechtlich geschütztes Material

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. In computer use, the skill of typing is often referred to as _____ .
2. IBM-compatible PCs have 10 or 12 _____ keys.
3. In many programs, an on-screen symbol called a(n) _____ or a(n) _____ shows you where you are in a document.
4. A(n) _____ is a temporary storage area that holds data until the CPU is ready for it.
5. In addition to pointing, the four primary mouse techniques are _____ , _____ , _____ , and _____ .
6. You use a mouse (or one of its variants) to position a(n) _____ on the screen.
7. In many Windows applications, you can open a shortcut menu by _____ the mouse.
8. Many laptop computers feature a small joystick between the G and H keys, which is called a(n) _____ or a(n) _____ .
9. _____ is the study of the way people work with tools.
10. _____ is a common type of repetitive stress injury among computer users.

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. Some people claim that when computers can interpret handwriting and speech with 100 percent accuracy, this will become unnecessary.
   a. mice b. typing c. pointing device d. special-purpose keys
2. These keys make up the part of the keyboard that looks like a typewriter's keys.
   a. special-purpose keys b. function keys c. typing keys d. alphanumeric keys
3. The common keyboard arrangement is called the _____ layout.
   a. QWERTY b. QEWTYR c. QYWERT d. QWERYT
4. Which of the following is *not* a modifier key?
   a. SHIFT b. CTRL c. ALT d. BACKSPACE
5. In most programs, you can press this key to get help.
   a. ESC b. F1 c. ALT d. F10
6. When you press a key, this device notifies the system software.
   a. keyboard b. keyboard buffer c. keyboard controller d. keyboard CPU
7. In many Windows applications, you can use this key as an alternative to the right mouse button.
   a. ESC b. F1 c. SPACEBAR d. SHORTCUT

Urheberrechtlich geschütztes Material

8. This type of mouse uses reflected light to measure its movements.
   a. optical b. laser c. mechanical d. wheel
9. In a multi-button mouse, one button must be designated as the _____ button.
   a. first b. left c. primary d. user
10. You can _____ a program's icon to launch the program.
    a. point to b. double-click c. right-click d. drag

Review Questions ::

In your own words, briefly answer the following questions.

1. Most standard keyboards include five major groups of keys. List them.
2. Why are most standard keyboards called "QWERTY" keyboards?
3. What does the CTRL key do?
4. What is the purpose of the START key, which appears on many IBM-compatible keyboards?
5. What happens when you press a key on the computer's keyboard?
6. What is the purpose of the mouse pointer?
7. How does a mechanical mouse work?
8. Describe two benefits of using a mouse.
9. What does the term *dragging* mean and how do you do it?
10. Describe the cause and effect of carpal tunnel syndrome.

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Test your typing skills in Notepad. Click the START button, point to All Programs, click Accessories, and then click Notepad to open the Notepad text-editing program. Notepad opens in a window. Have a classmate time you as you type a paragraph of text. The paragraph should be at least five lines long and should make sense. (For example, you could type a paragraph of text from any page in this book.) Do not stop to correct mistakes; keep typing until you are finished typing the selection.
2. Inspect your system's mouse settings. (Do not change any settings without your instructor's permission.) Use the following steps:
   a. Click the START button to open the Start menu; then click Control Panel. The Control Panel window opens.
   b. Double-click the Mouse icon to open the Mouse Properties dialog box. Click the tabs in this dialog box and inspect your settings.
   c. Experiment with the Pointer Speed and Show Pointer Trails tools. How do they affect your mouse's performance. When you are finished, click Cancel.

Urheberrechtlich geschütztes Material

Inputting Data in Other Ways

OBJECTIVES ::

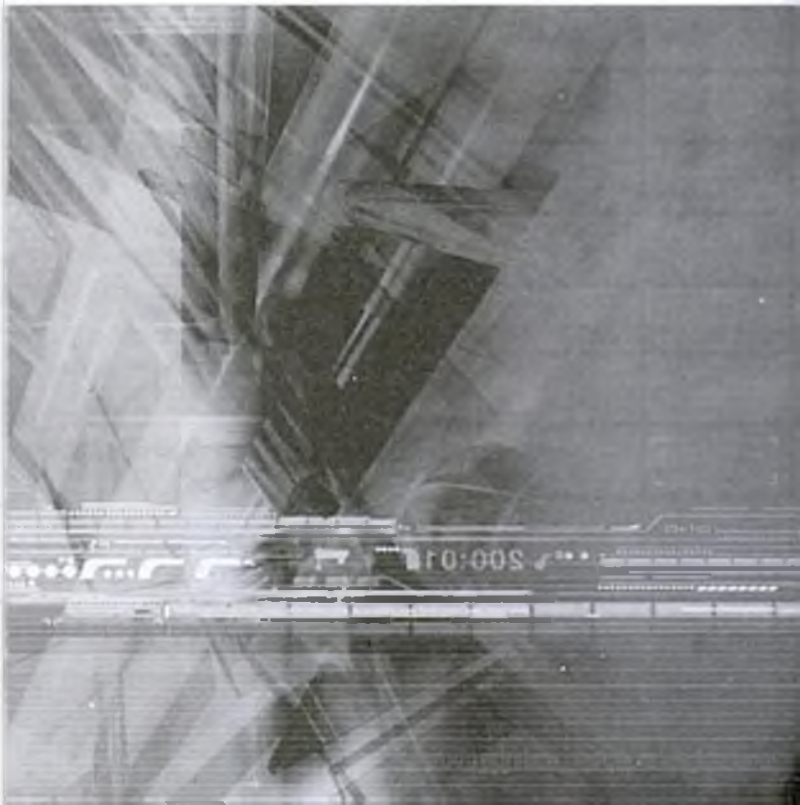
- List two reasons why some people prefer alternative methods of input over a standard keyboard or mouse.
- List three categories of alternative input devices.
- List two types of optical input devices and describe their uses.
- Describe the uses for speech-recognition systems.
- Identify two types of video input devices and their uses.

Overview: Options for Every Need and Preference

Although the keyboard and the mouse are the input devices that people use most often, there are many other ways to input data into a computer. Sometimes the tool is simply a matter of choice. Some users just prefer the feel of a trackball over a mouse. In many cases, however, an ordinary input device may not be the best choice. In a dusty factory or warehouse, for example, a standard keyboard or mouse can be damaged if it becomes clogged with dirt. Grocery checkout lines would slow down dramatically if cashiers had to manually input product codes and prices. In these environments, specialized input devices tolerate extreme conditions and reduce the risk of input errors.

Alternative input devices are important parts of some special-purpose computers. Tapping a handheld computer's screen with a pen is a much faster way to input commands than typing on a miniature keyboard. On the other hand, a specialized device can give new purpose to a standard system. If you want to play action-packed games on your home PC, for example, you will have more fun if you use a joystick or game controller than a standard keyboard or mouse.

This lesson examines several categories of alternative input devices and discusses the special uses of each. You may be surprised at how often you see these devices, and you may decide that an alternative device will be your primary means of interacting with your computer.



Devices for the Hand

Most input devices are designed to be used by hand. Even specialized devices like touch screens enable the user to interact with the system by using his or her fingertips. Unlike keyboards and mice, many of these input devices are highly intuitive and easy to use without special skills or training.

Pens

Pen-based systems—including many tablet PCs, personal digital assistants, and other types of handheld computers—use a pen for data input (see Figure 2B.1). This device is sometimes called a stylus. You hold the pen in your hand and write on a special pad or directly on the screen. You also can use the pen as a pointing device, like a mouse, to select commands by tapping the screen.

You might think that pen-based systems would be a handy way to enter text into the computer for word processing. In reality, developers have had a great deal of trouble perfecting the technology so that it deciphers people's handwriting with 100 percent reliability. Because handwriting recognition is so complex, pen-based computers are not used generally to enter large amounts of text, although they are used frequently for taking notes, creating short messages, and writing annotations on electronic documents (see Figure 2B.2). PDAs and tablet PCs are popular for these kinds of tasks, which do not require keyboarding.



FIGURE 2B.1

To interact with a pen-based computer, you can use the pen to point, tap, drag, draw, and even write on the device's screen.

Pen-based computers are commonly used for data collection, where the touch of a pen might place a check in a box to indicate a part that must be ordered or a service that has been requested. Another common use is for inputting signatures or messages that are stored and transmitted as a graphic image, such as a fax. When delivery-service drivers make deliveries, they often have recipients sign their names on such a computer-based pad (see Figure 2B.3). As handwriting-recognition technology becomes increasingly reliable, pen-based systems will undoubtedly become more common.



FIGURE 2B.2

Tablet PCs allow the user to input data (such as notes, appointments, or phone numbers) by writing directly on the screen with the unit's pen.



FIGURE 2B.3

When you receive a package via UPS, you may be asked to sign your name on a pen-based computer system.

Norton ONLINE

For more information on pen-based computing systems, visit **http://www.mhhe.com/petemorton**

Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on touch screens, visit **http://www.mhhe.com/petermorton**

simnet™



FIGURE 2B.4

This student is using a touch-screen system to get information at a public information kiosk.

Touch Screens

Touch screens accept input by allowing the user to place a fingertip directly on the computer screen, usually to make a selection from a menu of choices. Most touch-screen computers use sensors on the screen's surface to detect the touch of a finger, but other touch screen technologies are in use, as well.

Touch screens work well in environments where dirt or weather would render keyboards and pointing devices useless, and where a simple, intuitive interface is important. They are well-suited for simple applications, such as automated teller machines or public information kiosks (see Figure 2B.4). Touch screens have become common in fast-food restaurants, department stores, drugstores, and supermarkets, where they are used for all kinds of purposes, from creating personalized greeting cards to selling lottery tickets.



Norton ONLINE

For more information on gaming devices, visit **http://www.mhhe.com/petermorton**

FIGURE 2B.5

With their fast processors and high-quality graphics, PCs are great for playing games.

Game Controllers

You may not think of a game controller as an input device, but it is. Personal computers are widely used as gaming platforms, challenging dedicated video game units like the Sony PlayStation and others (see Figure 2B.5). Because PCs offer higher graphics resolution than standard televisions, many gamers believe a well-equipped PC provides a better game-playing experience. If your computer is connected to the Internet, you can play games with people around the world.

A game controller can be considered an input device because a computer game is a program, much like a word processor. A game accepts input from the user, processes data, and produces output in the form of graphics and sound. As computer games become more detailed and elaborate, more specialized game controllers are being developed to take advantage of their features.



Game controllers generally fall into two broad categories: game pads and joysticks (see Figure 2B.6). Joysticks have been around for a long time and can be used with applications other than games. (Some joystick users actually prefer using a joystick rather than a mouse with some business applications.) Joysticks enable the user to "fly" or "drive" through a game, directing a vehicle or character. They are popular in racing and flying games. A variant of the joystick is the racing game controller, which includes an actual steering wheel; some racing game controllers even include foot pedals and gearshifts.

If you have ever used a video gaming system, you are familiar with game pads.

Urheberrechtlich geschütztes Material

A game pad is a small, flat device that usually provides two sets of controls—one for each hand. These devices are extremely flexible and are used to control many kinds of games. If you do not have a joystick, you can use a game pad to control most racing and flying games. (Many computer games still provide support for a mouse or keyboard, so a dedicated game controller is not always required.)



FIGURE 2B.6

Several kinds of game control devices are available, some of which are quite sophisticated. Some controllers even provide tactile feedback, such as vibrations or pulses, to help players "feel" the action in the game.

Optical Input Devices

For a long time, futurists and computer scientists have had the goal of enabling computers to "see." Computers may never see in the same way that humans do, but optical technologies allow computers to use light as a source of input. These tools fall into the category of optical input devices.

Norton ONLINE

For more information on bar codes and bar code readers, visit **http://www.mhhe.com/pelternorton**

Bar Code Readers

Bar code readers are one of the most widely used input devices. The most common type of bar code reader is the flatbed model, which is commonly found in supermarkets and department stores (see Figure 2B.7). Workers for delivery services, such as FedEx, also use handheld bar code readers in the field to identify packages (see Figure 2B.8).

These devices read bar codes, which are patterns of printed bars that appear on product packages. The bar codes identify the product. The bar code reader emits a beam of light—frequently a laser beam—that is reflected by the bar code image. A light-sensitive detector identifies the bar code image by recognizing special bars at both ends of the image. These special bars are different, so the reader can tell whether the bar code has been read right-side up or upside down.

After the detector has identified the bar code, it converts the individual bar patterns into numeric digits—code the computer can understand (see Figure 2B.9). The reader then feeds the data into the computer, as though the number had been typed on a keyboard.



FIGURE 2B.7

To enter prices and product information into a cash register, a cashier passes groceries over a flatbed bar code reader. The reader projects a web of laser beams onto the package's bar code and measures the pattern of the reflected light.



FIGURE 2B.8

Courier services, like FedEx, use handheld bar code readers to track packages all the way to their destination.

Urheberrechtlich geschütztes Material



FIGURE 2B.9

Manufacturers use bar codes to identify millions of unique products.

Image Scanners and Optical Character Recognition (OCR)

The bar code reader is a special type of image scanner. Image scanners (also called *scanners*) convert any printed image into electronic form by shining light onto the image and sensing the intensity of the light's reflection at every point. Figure 2B.10 illustrates the scanning process.

Color scanners use filters to separate the components of color into the primary additive colors (red, green, and blue) at each point. Red, green, and blue are known as primary additive colors because they can be combined to create any other color. Processes that describe color in this manner are said to use RGB color.

The image scanner is useful because it translates printed images into an electronic format that can be stored in a computer's memory. Then you can use software to organize or manipulate the electronic image. For example, if you scan a photo, you can use a graphics program such as Adobe Photoshop to increase the contrast or adjust the colors. If you have scanned a text document, you might want to use optical character recognition (OCR) software to translate the image into text that you can edit. When a scanner first creates an image from a page, the image is stored in the computer's memory as a bitmap. A bitmap is a grid of dots, each dot represented by one or more bits. The job of OCR software is to translate that array of dots into text that the computer can interpret as letters and numbers.

To translate bitmaps into text, the OCR software looks at each character and tries to match the character with its own assumptions about how the letters should look. Because it is difficult to make a computer recognize an unlimited number of typefaces and fonts, OCR software is extremely complex and not always 100 percent reliable. Figure 2B.11 shows a few of the many ways the letter *g* can appear on a printed page.

Despite the complexity of the task, OCR software has become quite advanced. Today, many programs can decipher a page of text received by a fax machine. In fact, computers with fax modems can use OCR software to convert faxes directly into text that can be edited with a word processor.

Scanners come in a range of sizes from handheld models to flatbed scanners that sit on a desktop (see Figure 2B.12). Handheld scanners are more portable but

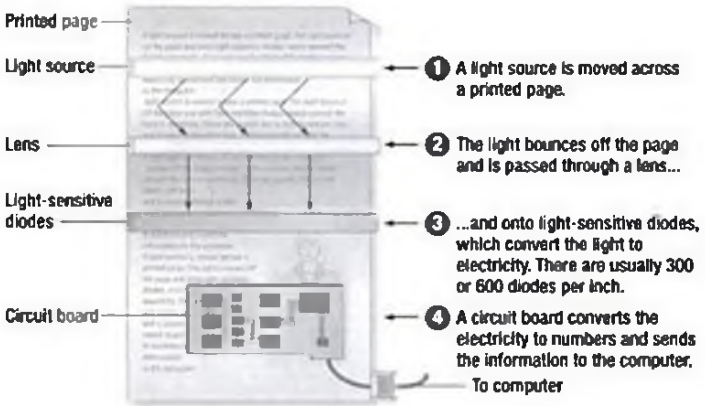
Norton ONLINE

For more information on image scanners and OCR software, visit **http://www.mhhe.com/petermorton**

simnet™

FIGURE 2B.10

How an image is scanned.



Urheberrechtlich geschütztes Material

typically require multiple passes to scan a single page because they are not as wide as letter-size paper. Flatbed scanners offer higher-quality reproduction than do handheld scanners and can scan a page in a single pass. (Multiple scans are sometimes required for color images, however.) To use a flatbed scanner, you place the printed image on a piece of glass similar to the way you place a page on a photocopier. In some medium-sized scanners, you feed the sheet to be scanned through the scanner, similar to the way you feed a page through a fax machine.



FIGURE 2B.11

A few of the ways that a lowercase *g* can appear in print.



FIGURE 2B.12

Large-format flatbed scanners produce high-resolution, digitized versions of documents. Graphic artists prefer this type of scanner because it yields the highest-quality scans of photographs and other images.

SELF-CHECK ::

Circle the correct answer for each question.

1. These are often used for taking notes, but not for entering large amounts of text.
   a. touch screens b. pen-based computers c. optical scanners
2. The racing game controller is a variation of this.
   a. joystick b. mouse c. scanner
3. A bar code reader emits this.
   a. sound b. light c. commands

Urheberrechtlich geschütztes Material

Norton Notebook

Speech Recognition



The youngest daughter of an associate recently entered graduate studies at MIT. She's already received a BS in Engineering and an MA in Mathematics. So what has drawn her to Cambridge? "The speech-recognition railroad," she says. When I asked her how long she plans to stay on that train—"All the way to retirement!"

That answer speaks about more than just her smart sense of humor and the lucrative prospects of an MIT doctorate. It also reveals the nearly glacial pace of movement toward achieving that "holy grail" of human interface. Science has explored this idea—talk to machines and they do what we tell them—for nearly a century, and simulations of success have been in the public eye for almost as long. A popular sight at the 1939–1940 New York World's Fair was Westinghouse's "Elektro," a 10-foot-tall "robot" (the word was coined just 18 years prior) that could walk, dance, speak, and smoke a cigarette, all in apparent obedience to spoken commands. Of course, Elektro had a lot of human help, and there wasn't much progress in the world of speech recognition during the subsequent 50 years. Meanwhile Gene Roddenberry's *Star Trek* and George Lucas's *Star Wars* made commonplace the fantasy of machines that could, at the least, understand anything spoken by anyone and, at best, carry on conversations that expressed their own personalities. But, in the words of some forgotten sage, our own real future isn't what it used to be.

It's not for want of trying. Serious research has been done on the subject of voice recognition and control since the earliest days of computing. It turns out that what is such an innate skill for us humans is far from easy for computers. And this was something of a surprise, because of how we humans hierarchically rate our own five senses. When we have thought about those senses in the past—sight, hearing, taste, smell, and touch—we've tended to order them with our precious and delicate binocular, full-color sight at the pinnacle. The eye and our entire vision mechanism are so complex—as I'm writing this, it remains one of very few organs of the body that we cannot transplant with impressive success. This complexity led many to assume that we would have computers listening to our voices long before they could see us. Wrong, again.

Computers can recognize individual human faces, machine parts, and components with accuracy and a precision far greater than our organic vision. Computers do this by using very sophisticated software to compare live video images with massive databases of, say, faces and facial features. Just like people, then, a computer needs to be taught what you look like before it can recognize you. Once the software records certain characteristics of your face, it can still recognize you even if you change your hair, grow a beard, even pretend to be of the opposite sex.

Voice recognition isn't nearly as successful. Part of the problem resides in the nature of sound. There are recognizable edges to your face, a line to the angle of your nose, and so forth, but there are no obvious "lines" to separate the sound waves of your voice from the background noise of, say, a loud party. As human beings, we rely tremendously on the context of a conversation to help understand what is

Audiovisual Input Devices

Today, many new PCs are equipped with complete multimedia capabilities. New computers have features that enable them to record audio and video input and play it back.

Microphones

Now that sound capabilities are standard in computers, microphones are becoming increasingly important as input devices to record speech. Spoken input is used often in multimedia, especially when the presentation can benefit from narration. Most PCs now have phone-dialing capabilities. If you have a microphone and speakers (or a headset microphone with an earphone), you can use your PC to make telephone calls.

Microphones also make the PC useful for audio and videoconferencing over the Internet. For this type of sound input, you need a microphone and a sound card. A sound card is a special device inside the computer, which translates analog



Norton ONLINE

For more information on microphones, sound cards, and speech recognition, visit http://www.mhhe.com/petermorton

simnet™

Urheberrechtlich geschütztes Material



said to us in a noisy environment. Computers can be programmed to work with context, but they have to be able to distinguish our voices *first*. So, while facial recognition systems can pick out an individual walking along a busy street, speech recognition requires a carefully controlled environment from the start.Good voice recognition systems can be trained to recognize and associate certain sounds with human words. Training usually involves spending several hours reading passages of text into a microphone while the computer "listens" and learns how the speaker pronounces certain sounds. Once the computer recognizes these phonemes, it can combine them together—usually in conjunction with a dictionary—to make whole words from the sounds.

But what happens when those sounds don't sound like those sounds? When I say, "Print a letter," it sounds like me—not like you, or like someone with a different regional accent. In fact, when I say, "Print a letter," with a bad sinus infection, even *I* no longer sound like myself. How is a computer to know that "pibbta lebrah" means anything at all? Given today's technology, it can't. Each voice recognition system needs to be trained to recognize the voice of each user, and if a user's voice changes significantly—or if the noise environment of the speaker changes—the computer must be retrained. Most of the best trained systems provide better than 99 percent accuracy, which sounds excellent, until you consider that means that the computer makes as many as one recognition mistake for every 100 sounds—not words, *sounds*—it hears. (A few "no-training" systems are beginning to appear, but these have had limited applications, such as speaking numbers to choose from a telephone menu of options.)

Thousands of human hours have gone into the research and development of computer speech recognition to bring us to where we are today. Has it been worth it? Absolutely! Speech recognition holds untold promise for millions of people with different abilities, some of which have limited their freedom of creativity with modern technology. As personal computers continue to benefit from advances in processor power, it will be increasingly possible to make ever-more complex analyses of sound. This, in turn, will push recognition capabilities closer and closer to a level of perfection that has remained so elusive. It's also possible, even likely, that a new group of thinkers will conceive of an entirely new way to look at the problem. It may be *you* who finally unlocks speech recognition for generations to come.

NORTON NOTEBOOK

audio signals (that is, sound waves) from the microphone into digital codes the computer can store and process. This process is called digitizing. Sound cards also can translate digital sounds back into analog signals that can then be sent to the speakers.



FIGURE 2B.13

Your PC may enable you to record spoken messages with a microphone and sound card.

Using simple audio recording software that is built into your computer's operating system, you can use a microphone to record your voice and create files on disk (see Figure 2B.13). You can embed these files in documents, use them in Web pages, or e-mail them to other people.

There is also a demand for translating spoken words into text, much as there is a demand for translating handwriting into text. Translating voice to text is a capability known as speech recognition (or voice recognition). With it, you can dictate to the computer instead of typing, and you can control the computer with simple commands, such as Open or Cancel.

Urheberrechtlich geschütztes Material

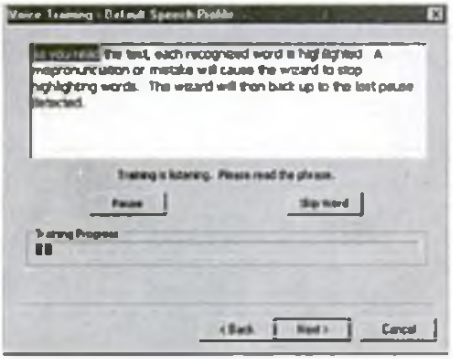


FIGURE 2B.14

This dialog box helps the user "train" speech-recognition software to achieve higher accuracy in dictation.

Speech-recognition software takes the smallest individual sounds in a language, called *phonemes*, and translates them into text or commands. Although the English language uses only about 40 phonemes, reliable translation is difficult. For example, some words in English have the same sound but have different meanings (*two* versus *too*, for example). The challenge for speech-recognition software is to deduce a sound's meaning correctly from its context and to distinguish meaningful sounds from background noise.

Speech-recognition software has been used in commercial applications for years, but traditionally it has been extremely costly, as well as difficult to develop and use. Low-cost commercial versions of speech-recognition software are now available, and they promise to be a real benefit to users who cannot type or have difficulty using a keyboard.

Newer-generation speech-recognition programs are much more reliable than the packages that were available a few years ago. Some packages can recognize accurately 80 to 90 percent of spoken words by using large stored vocabularies, or words they can recognize. The user may need to "train" the software to recognize speech patterns or the pronunciation of some words, but this procedure is relatively simple (see Figure 2B.14). Another enhancement to speech-recognition programs is their ability to recognize continuous speech. Older systems required the user to pause between words, which improved accuracy but greatly slowed the data-entry process.

Speech-recognition programs usually require the use of a noise-canceling microphone (a microphone that filters out background noise). Most commercial packages come with a microphone (see Figure 2B.15).



FIGURE 2B.15

Microphones are becoming increasingly popular input devices.

Other Types of Audio Input

Computers can accept many kinds of audio input. If your computer has a sound card with the appropriate plugs, you may be able to input music from a compact disc, a tape player, a radio, or even a record player.

If the audio source outputs sounds in the form of analog waves (as is the case when you speak into a microphone), the computer's sound card must convert the analog signals into digital code so the computer can store and use it. This is not necessary when recording audio from a compact disc or a digital video disc, but conversion is required for analog sources such as phonograph records and cassette tapes.

If your sound card has a built-in Musical Instrument Digital Interface (MIDI) port, or if you have a dedicated MIDI adapter, you can connect many kinds of electronic musical instruments to your computer. MIDI-based instruments can communicate with and control one another, and any PC can be used to control MIDI instruments and to record their output (see Figure 2B.16). MIDI is extremely popular among musicians of all stripes, who use it to write, record, and edit music, and even to control instruments and effects during performances.



FIGURE 2B.16

Keyboards, drum machines, sequencers, and other types of electronic instruments can be connected together—and to a computer—by using MIDI technology.

Urheberrechtlich geschütztes Material

Video Input

With the growth of multimedia and the Internet, computer users are adding video input capabilities to their systems in great numbers. Applications such as videoconferencing enable people to use full-motion video images, which are captured by a PC video camera, and transmit them to a limited number of recipients on a network or to the world on the Internet. Videos are commonly used in presentations and on Web pages where the viewer can start, stop, and control various aspects of the playback.

The video cameras used with computers digitize images by breaking them into individual pixels. (A pixel is one or more dots that express a portion of an image.) Each pixel's color and other characteristics are stored as digital code. This code is then compressed (video images can be very large) so that it can be stored on disk or transmitted over a network.

A popular and inexpensive type of PC video camera—called a Webcam—can sit on top of a PC monitor or be placed on a stand, so the user can "capture" images of himself or herself while working at the computer (see Figure 2B.17). This arrangement is handy for videoconferencing, where multiple users see and talk to one another in real time over a network or Internet connection (see Figure 2B.18).



FIGURE 2B.17

Using a PC video camera or Webcam system, you can conduct online videoconferences and include full-motion video in your documents or e-mail messages.

Using a video capture card, the user also can connect other video devices, such as VCRs and camcorders, to the PC. This enables the user to transfer images from the video equipment to the PC, and vice versa. Affordable video capture cards enable home users to edit their videotapes like professionals.



FIGURE 2B.18

PC video cameras enable you to conduct video phone calls. Many PCs feature built-in software that transforms a conventional telephone call into a two-way video phone call.

Digital Cameras

Digital cameras work much like PC video cameras, except that digital cameras are portable, handheld devices that capture still images (see Figure 2B.19). Whereas normal film cameras capture images on a specially coated film, digital cameras capture images electronically. The digital camera digitizes the image, compresses it, and stores it on a special memory card. The user can then copy the information to a PC, where the image can be edited, copied, printed, embedded in a document, or transmitted to another user.

Most digital cameras can store dozens of high-resolution images at a time, and most cameras accept additional memory that increases their capacity even further. Moving digital images from a digital camera to a computer is a simple process that uses standard cables, disks, or even infrared networking capabilities. A wide range of digital cameras are available, from inexpensive home-use models (with prices starting at just over $100) to professional versions costing several thousand dollars.

Norton ONLINE

For more information on different types of video input, visit **http://www.mhhe.com/petemorton**

Norton ONLINE

For more information on digital cameras, visit **http://www.mhhe.com/petemorton**

simnet™

Urheberrechtlich geschütztes Material

Computers In Your Career

Hardware Technician

Ask Andy Yother what the best part of his job is and his answer comes quickly: "I get to play with million-dollar toys," says this lead hardware and support engineer at Norcross, Ga.–based Canvas Systems, a reseller of certified, pre-owned IT equipment. Those toys span a wide range of technology systems and manufacturers, making Yother's job both challenging and fulfilling at the same time.

"I handle any piece of equipment that a manufacturer like Sun Microsystems or IBM would make," says Yother. "It's neat to know that during any given week I'm going to build, configure, test, and prepare for sale a wider variety of equipment than most folks will see in their entire careers."

Yother, who is currently completing his Bachelor's degree in business administration at Shorter College, has racked up career experience working for PC makers and circuit board manufacturers. He started in an entry-level position at Canvas Systems, handling low-level testing and identification of systems. Today he oversees a team of six auditors and five engineers who build bare-metal assembly orders to customer specifications, starting with the system board and working up.

"Our customers contact us, tell us what they need, and we start with the bare bones and work up from there," says Yother, whose typical workday starts at 8 AM and ends at 7 PM or later, depending on the time of year and level of demand. "We configure the machines, test them, and prepare them for customer use."

Keeping up with changing technology is no easy task for Yother, who must know how to break down and rebuild both older systems and the newest, state-of-the-art systems available on the market. To keep up, he reads trade and technology magazines, visits manufacturers' Web sites, and subscribes to online mailing lists. "It's about trying to find the best sources of accurate information, and digesting it all," says Yother. "Some days, my brain just aches from information overload."

Yother sees hardware technicians' roles increasing in the future. "We wouldn't have an IT field without the circuits, memory, and processors to back it up," says Yother, who advises all aspiring technicians to learn the computer inside and out, and truly understand how it processes information and accomplishes tasks.



FIGURE 2B.19

Although most digital cameras look like traditional film cameras, they work in a very different way.

Digital cameras have become standard equipment for designers of all kinds. In the field of Web page design, for example, digital cameras enable designers to shoot a subject and quickly load the images onto their computers. This process saves the step of acquiring existing photographs or developing and printing film-based photos—which must be scanned into the computer. Designers can update a Web site's illustrations quickly and regularly using digital cameras.

Graphic designers can edit and enhance digital photographs in innumerable ways, using photo-editing software (see Figure 2B.20). For example, a landscape designer can use a digital camera to take a picture of a house, and then use landscape design software to modify the image to show how the house might appear with different landscaping.

Urheberrechtlich geschütztes Material



Whether they're working for a company like Canvas Systems or within a firm's IT department, hardware maintenance technicians are responsible for the following kinds of tasks:

- Installing and configuring new computer hardware.
- Installing peripherals.
- Upgrading computers (installing updated cards, memory, drives, etc.).
- Dealing with network-related hardware issues (installing network interface cards, working with cabling, installing hubs or routers, etc.).
- Troubleshooting and repairing hardware of all types.

Many companies rely on their hardware maintenance technicians for input when planning for new system development, expansion, or acquisitions. Their input is important because technicians are in daily contact with end users and develop a good understanding of their needs. A significant advantage of the hardware technician's job is that it is a great springboard to other, more advanced careers in technology. Entry-level technicians typically earn $20,000 to $25,000, with pay scales increasing quickly with experience to levels of $50,000 a year or more.

COMPUTERS IN YOUR CAREER



FIGURE 2B.20

Using photo editing software, a photographer can edit a digital photograph in many different ways.

Urheberrechtlich geschütztes Material

Summary ::

- With a pen-based system, you use a pen (also called a stylus) to write on a special pad or directly on the screen.
- Pen-based computers are handy for writing notes or selecting options from menus, but they are not well-suited for inputting long text documents.
- Touch-screen systems accept input directly through the monitor. Touch-screen systems are useful for selecting options from menus, but they are not useful for inputting text or other types of data in large quantities.
- A game controller is a special input device that accepts the user's input for playing a game. The two primary types of game controllers are joysticks and game pads.
- Bar code readers, such as those used in grocery stores, can read bar codes, translate them into numbers, and input the numbers into a computer system.
- Image scanners convert printed images into digitized formats that can be stored and manipulated in computers.
- An image scanner equipped with OCR software can translate a page of text into a string of character codes in the computer's memory.
- Microphones can accept auditory input. Using speech-recognition software, you can use your microphone as an input device for dictating text, navigating programs, and choosing commands.
- To use a microphone or other audio devices for input, you must install a sound card on your computer.
- A sound card takes analog sound signals and digitizes them. A sound card also can convert digital sound signals to analog form.
- PC video cameras and digital cameras can digitize full-motion and still images, which can be stored and edited on the PC or transmitted over a LAN or the Internet.

Urheberrechtlich geschütztes Material

Key Terms ::

bar code, 71
bar code reader, 71
digital camera, 77
digitizing, 75
game controller, 70
game pad, 71
image scanner, 72
joystick, 70
optical character recognition (OCR) software, 72
PC video camera, 77
pen, 69
sound card, 74
speech recognition, 75
stylus, 69
video capture card, 77
voice recognition, 75
Webcam, 77

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. The pen used with a computer—such as a tablet PC—is also called a(n) _____.
2. You might not think of a(n) _____ as a true input device, but it is.
3. You can find _____ being used as input devices in supermarkets and department stores everywhere.
4. A bar code reader is a special type of _____.
5. In a computer, a(n) _____ translates analog audio signals into digital codes the computer can use.
6. The process of translating voice into text or commands the computer can understand is called _____.
7. Using a special _____ camera, you can participate in online videoconferences.
8. A(n) _____ is a popular and inexpensive type of PC video camera.
9. Using a(n) _____, you can connect video devices such as a VCR or camcorder to your PC.
10. A(n) _____ stores still images on a special memory card, rather than on film.

Urheberrechtlich geschütztes Material

Multiple Choice

Circle the word or phrase that best completes each statement.

1. With a pen-based system, you can use the pen as a(n) _____ , to select commands.
   a. keyboard b. pointing device c. antenna d. microphone
2. Pen-based computers are commonly used for this type of work.
   a. writing lots of text b. taking pictures c. data collection d. recording sounds
3. _____ are well-suited for use as input devices at automated teller machines or public information kiosks.
   a. Touch screens b. Pens c. Microphones d. Monitors
4. A game controller can be considered an input device because a computer game is one of these.
   a. a joystick b. a part of a computer c. a fun pastime d. a program
5. Game pads usually have two sets of these, one for each hand.
   a. controls b. joysticks c. games d. microphones
6. This type of technology lets computers use light as a source of input.
   a. optative b. optical c. optimal d. optional
7. A(n) _____ is used to identify a product and provide information about it, such as its price.
   a. price check b. bar code c. numeric digit d. light-sensitive detector
8. Which type of software can translate scanned text into text that you can edit?
   a. OCS b. ORC c. OCR d. ORS
9. The process of converting analog sounds into code a computer can use is called _____ .
   a. sound recognition b. optical character recognition c. scanning d. digitizing
10. This type of connection lets a computer communicate with, control, and record electronic musical instruments.
    a. DIMI b. MIDI c. DIIM d. MDII

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. In what ways can you use the pen in a pen-based computing system?
2. How do most touch-screen systems work?
3. List one reason why many people believe a PC provides a better game-playing experience than dedicated video game units do.
4. Explain how a bar code reader reads a bar code and what it does with the information from a bar code.
5. What does an image scanner do?
6. How does OCR software translate scanned text into text that you can edit?
7. List three things you can do with the files you create by recording your voice on your computer.
8. What two capabilities does speech-recognition software give you?
9. List four audio sources you can use to record music on your computer.
10. What can you do with a video capture card?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. If your computer has a microphone and sound card, complete the following steps to record a message and play it back:
   a. Click the START button to open the Start menu; then click All Programs | Accessories | Entertainment | Sound Recorder.
   b. When the Sound Recorder program opens, click the RECORD button and speak into your computer's microphone; then click the STOP button.
   c. Click PLAY to hear your message.
   d. Close the program by clicking the CLOSE button (with an X on it) in the upper-right corner of the window. If Windows prompts you to save the file, click No.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Check your keyboard's repeat rate. You can control the length of time your keyboard "waits" as you hold down an alphanumeric key before it starts repeating the character. You also can set the repeat speed. In this exercise, check the repeat settings but do not change any settings without your instructor's permission.
   a. Click the START button on the Windows taskbar to open the Start menu.
   b. Click Control Panel. Double-click the Keyboard icon in the Control Panel window.
   c. Click the tabs at the top of the Keyboard Properties dialog box and inspect the current settings.
   d. Click the Speed tab. Drag the Repeat delay and Repeat rate indicators all the way to the right, then to the left, and in different combinations. Test the repeat rate at each setting by clicking in the test box and then holding down an alphanumeric key.
   e. Drag the Cursor blink rate indicator to the right and left. How fast do you want your cursor to blink?
   f. Click Cancel to close the dialog box without making changes.
2. Mouse practice. Take the following steps:
   a. Click the START button on the Windows taskbar to open the Start menu.
   b. Point to All Programs, click Accessories, and then click WordPad. The WordPad program will open in its own window. (WordPad is a "lightweight" word-processing application.) Notice the blinking insertion point in the window.
   c. Type: **Now is the time for all good men to come to the aid of their country.**
   d. Using your mouse, click in different parts of the sentence. The insertion point moves wherever you click.
   e. Double-click the word *good*. The word becomes selected: the letters change from black to white, and the background behind the word changes color.
   f. Right-click the selected word. A shortcut menu appears.
   g. Choose the Cut option. The highlighted word disappears from your screen.
   h. Click in front of the word *country* to place the insertion point; right-click again. When the shortcut menu appears, choose Paste. The word *good* reappears.
   i. Double-click the word *good* again to select it. Now click on the selected word and drag it to the left while holding down the mouse button. (A little mark appears on the mouse pointer, indicating that you are dragging something.) When the mouse pointer arrives in front of the word *men*, release the mouse button. The word *good* is returned to its original place.
   j. Continue practicing your mouse techniques. When you are finished, close the WordPad program by clicking the CLOSE button (the button marked with an X) in the upper-right corner of the window. The program will ask if you want to save the changes to your document; choose No.
3. Pick your favorite pointing device. Visit these commercial Web sites for information on various types of pointing devices.

Urheberrechtlich geschütztes Material

- **AVB Products.** http://www.avbusa.com
- **Cirque.** http://www.cirque.com
- **Hunter Digital.** http://www.footmouse.com
- **Logitech.** http://www.logitech.com
- **Razer.** http://www.razerzone.com
- **Pegasus Technologies.** http://www.pegatech.com

When you are finished, decide which device would work best for you. Be prepared to tell your classmates about the device and explain why you selected it.

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Despite the rapid advancements being made with handwriting-recognition software, do you think that the keyboard will continue to be the preferred input device for generating text? Which alternative—speech recognition or handwriting recognition—do you think has a better chance of ultimately replacing the keyboard as the primary means of input?
2. Suppose that you are responsible for computerizing a gourmet restaurant's order-entry system. What type of input devices do you think would work best for waiters to input orders to the kitchen?

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- The availability and use of screen-reading technologies for computer users who are sight impaired.
- The kind of information stored in a product's bar code.
- The DVORAK keyboard (an alternative to the standard QWERTY keyboard).

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

A computer's input devices make it useful to people. With this thought in mind, discuss the following questions in class.

1. Currently, commercially available PCs are configured for use by persons who do not suffer from physical impairments or disabilities that would prohibit using a computer. If a person with a physical impairment wants to use a computer, he or she may need to purchase special equipment or software. Do you think this is fair? Should every PC be accessible to everyone, whether they have physical impairments or not? If you believe this should be the case, how would you make computers accessible to everyone?
2. You have applied for a job as a reporter for a newspaper. Your journalistic skills are excellent. You are not a touch typist, however, and your typing speed is very slow. For this reason, the managing editor is reluctant to hire you at the position's advertised salary. How would you react to this situation? Is the editor right? Should keyboarding skills be a requirement for such a job? Would you be willing to learn to type or accept the job at a lower salary? Be prepared to defend your position.

Urheberrechtlich geschütztes Material



CHAPTER 3

Seeing, Hearing, and Printing Data

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **3A:**
Video and Sound

- Monitors
- Ergonomics and Monitors
- Data Projectors
- Sound Systems

Lesson **3B:**
Printing

- Commonly Used Printers
- High-Quality Printers



Video and Sound

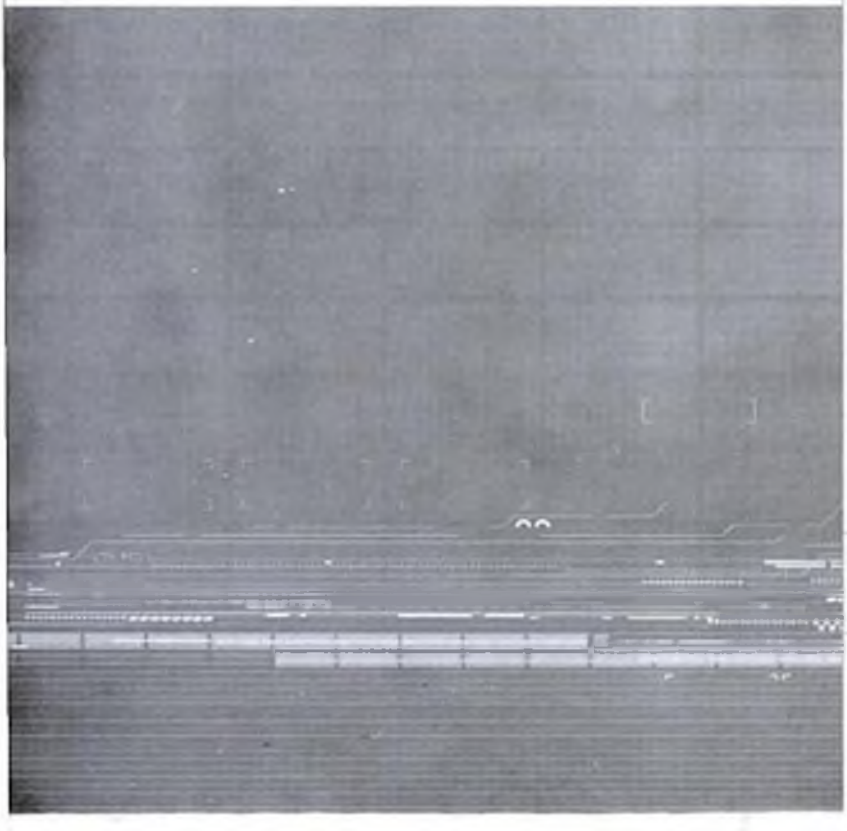
Overview: Reaching Our Senses with Sight and Sound

In the beginning, computing was anything but a feast for the senses. The earliest computers were little more than gigantic calculators controlled by large panels of switches, dials, and buttons. Today, nearly every computer features some kind of visual display, but display screens were uncommon until the 1960s.

Now, computers can communicate information to you in several ways, but the most exciting types of output are those that appeal to the senses. It is one thing to read text on a printed page, but it is very different to see a document take shape before your eyes. It can be very exciting to watch moving, three-dimensional images on a large, colorful screen while listening to sounds in stereo.

Modern display and sound systems make the computing experience a more inviting one. Because of these sophisticated output technologies, computers are easier to use, data is easier to manage, and information is easier to access. These technologies enable us to play games and watch movies, experience multimedia events, and use the PC as a communications tool.

This lesson introduces you to monitors and sound systems. You will learn about the different types of monitors commonly used with computers and how they work. You also will learn some important criteria for judging a monitor's performance. This lesson also shows you how computers can output sounds.



OBJECTIVES ::

- List the two most commonly used types of computer monitors.
- Explain how a CRT monitor displays images.
- Identify two types of flat-panel monitors and explain their differences.
- List four characteristics you should consider when comparing monitors.
- Describe how data projectors are used.
- Explain how a computer outputs sound.

Urheberrechtlich geschütztes Material



FIGURE 3A.1

The most common types of monitors used with personal computers



FIGURE 3A.2

Monochrome monitors are usually used for text-only displays.



FIGURE 3A.3

Grayscale displays are often used in lower-cost models of handheld computers because they are cheaper than color displays.

Monitors

The keyboard is the most commonly used input device and the monitor is the most commonly used output device on most personal computer systems. As you use your computer—whether you are typing a letter, copying files, or surfing the Internet—hardly a moment goes by when you are not looking at your monitor. In fact, people often form an opinion about a computer just by looking at the monitor. They want to see whether the image is crisp and clear and how well graphics are displayed on the monitor.

Two important hardware devices determine the quality of the image you see on any monitor: the monitor itself and the video controller. In the following sections, you will learn about both of these devices in detail and find out how they work together to display text and graphics.

In general, two types of monitors are used with PCs (see Figure 3A.1). The first is the typical monitor that comes with most desktop computers; it looks a lot like a television screen and works in much the same way. This type of monitor uses a large vacuum tube, called a cathode ray tube (CRT). The second type, known as a flat-panel display, was used primarily with portable computers in the past. Today, flat-panel monitors are a popular feature with desktop computers.

All monitors can be categorized by the way they display colors:

- Monochrome monitors display only one color (such as green, amber, or white) against a contrasting background, which is usually black. These monitors are used for text-only displays where the user does not need to see color graphics (see Figure 3A.2).
- Grayscale monitors display varying intensities of gray (from a very light gray to black) against a white or off-white background and are essentially a type of monochrome monitor. Grayscale flat-panel displays are used in low-end portable systems—especially handheld computers—to keep costs down (see Figure 3A.3).

Urheberrechtlich geschütztes Material



FIGURE 3A.4

Color monitors are almost always included with new computers. This screen is set to display more than 16 million colors, making it a good choice for multimedia content and browsing the World Wide Web.

Norton ONLINE

For more information on computer monitors, visit **http://www.mhhe.com/pelnorton**

» Color monitors can display between 16 colors and 16 million colors (see Figure 3A.4). Today, most new monitors display in color. Many color monitors can be set to work in monochrome or grayscale mode.

CRT Monitors

Figure 3A.5 shows how a typical CRT monitor works. Near the back of a monitor's housing is an electron gun. The gun shoots a beam of electrons through a magnetic coil (sometimes called a yoke), which aims the beam at the front of the monitor. The back of the monitor's screen is coated with phosphors, chemicals that glow when they are struck by the electron beam. The screen's phosphor coating is organized into a grid of dots. The smallest number of phosphor dots that the gun can focus on is called a pixel, a contraction of the term *pic*ture *el*ement. Each pixel has a unique address, which the computer uses to locate the pixel and control its appearance. Some electron guns can focus on pixels as small as a single phosphor dot.

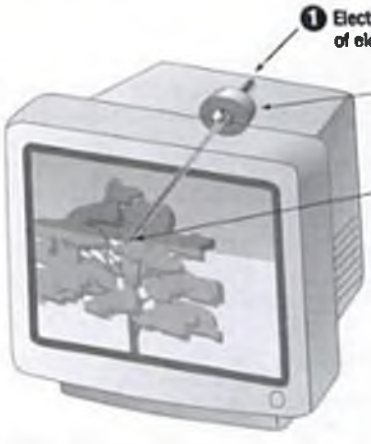


FIGURE 3A.5

How a CRT monitor creates an image.

Actually, the electron gun does not just focus on a spot and shoot electrons at it. It systematically aims at every pixel on the screen, starting at the top left corner and scanning to the right edge. Then it drops down a tiny distance and scans another line, as shown in Figure 3A.6.

Like human eyes reading the letters on a page, the electron beam follows each line of pixels across the screen until it reaches the bottom of the screen. Then it starts over. As the electron gun scans, the circuitry driving the monitor adjusts the intensity of each beam. In a monochrome monitor, the beam's intensity determines whether a pixel is on (white) or off (black). In the case of a grayscale monitor, the beam's intensity determines how brightly each pixel glows.

Urheberrechtlich geschütztes Mat

FIGURE 3A.6

The scanning pattern of the CRT's electron gun.

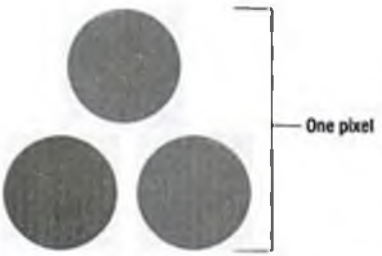


Norton ONLINE

For more information on CRT monitors, visit http://www.mhhe.com/petemorton

FIGURE 3A.7

In color monitors, each pixel is made of three dots—red, green, and blue—arranged in a triangle.



A color monitor works like a monochrome one, except that there are three electron beams instead of one. The three guns represent the primary additive colors (red, green, and blue), although the beams they emit are colorless. In a color monitor, each pixel includes three phosphors—red, green, and blue—arranged in a triangle (see Figure 3A.7). When the beams of each of these guns are combined and focused on a pixel, the phosphors light up. The monitor can display different colors by combining various intensities of the three beams.

A CRT monitor contains a shadow mask, which is a fine mesh made of metal, fitted to the shape and size of the screen. The holes in the shadow mask's mesh are used to align the electron beams, to ensure that they strike precisely the correct phosphor dot. In most shadow masks, these holes are arranged in triangles.

CRT monitors have long been the standard for use with desktop computers because they provide a bright, clear picture at a relatively low cost. There are two major disadvantages, however, associated with CRT monitors:

- Because CRT monitors are big, they take up desktop space and can be difficult to move. A standard CRT monitor may be more than 16 inches deep and weigh about 30 pounds. (A new breed of "thin" CRTs is significantly thinner and lighter than old-fashioned CRT monitors, but they are still relatively deep and heavy.) By contrast, flat-panel monitors are gaining popularity because they are only a few inches deep and usually weigh less than 10 pounds (see Figure 3A.8).
- CRT monitors require a lot of power to run; therefore, they are not practical for use with notebook computers. Instead, notebook computers use flat-panel monitors that are less than one-half-inch thick and can run on battery power that is built into the computer.

Flat-Panel Monitors

Although flat-panel monitors have been used primarily on portable computers, a new generation of large, high-resolution, flat-panel displays is gaining popularity among users of desktop systems. These new monitors provide the same viewable area as CRT monitors, but they take up less desk space and run cooler than traditional CRT monitors.

Urheberrechtlich geschütztes Material



FIGURE 3A.8

Comparing the size of a standard CRT monitor and a flat-panel monitor.

There are several types of flat-panel monitors, but the most common is the liquid crystal display (LCD) monitor (see Figure 3A.9). The LCD monitor creates images with a special kind of liquid crystal that is normally transparent but becomes opaque when charged with electricity.

One disadvantage of LCD monitors is that their images can be difficult to see in bright light. For this reason, laptop computer users often look for shady places to sit when working outdoors or near windows. A bigger disadvantage of LCD monitors, however, is their limited viewing angle—that is, the angle from which the display's image can be viewed clearly (see Figure 3A.10). With most CRT monitors, you can see the image clearly even when standing at an angle to the screen. In LCD monitors, however, the viewing angle shrinks; as you increase your angle to the screen, the image becomes fuzzy quickly. In many older flat-panel systems, the user must face the screen nearly straight on to see the



Norton ONLINE

For more information on flat-panel monitors, visit **http://www.mhhe.com/petemorton**.

FIGURE 3A.9

Today, most portable computers and handheld computing devices feature a color LCD monitor. Even very small devices can deliver crisp, sharply detailed images by using the latest advances in LCD technology.

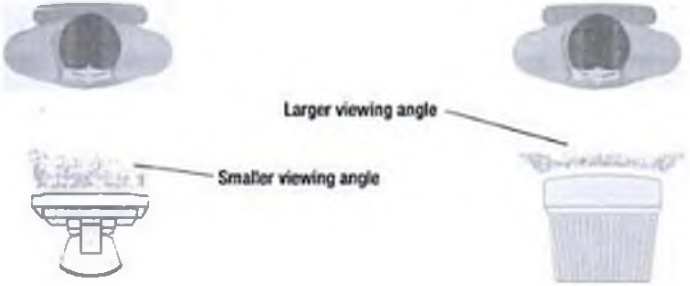


FIGURE 3A.10

Flat-panel displays typically have a smaller viewing angle than CRT monitors.

Urheberrechtlich geschütztes Material

image clearly. Technological improvements have extended the viewing angles of flat-panel monitors.

There are two main categories of liquid crystal displays:

» The passive matrix LCD relies on transistors for each row and each column of pixels, thus creating a grid that defines the location of each pixel. The color displayed by a pixel is determined by the electricity coming from the transistors at the end of the row and the top of the column. Although passive matrix monitors are inexpensive to manufacture, they have a narrow viewing angle. Another disadvantage is that they don't "refresh" the pixels very quickly. (Refresh rate is described in more detail later in this lesson.) If you move the pointer too quickly, it seems to disappear, an effect known as submarining. Animated graphics can appear blurry on a passive matrix monitor.

  Most passive matrix screens now use dual-scan LCD technology, which scans the pixels twice as often. Submarining and blurry graphics are less troublesome than they were before the dual-scan technique was developed.

» The active matrix LCD technology assigns a transistor to each pixel, and each pixel is turned on and off individually. This enhancement allows the pixels to be refreshed much more rapidly, so submarining is not a problem. Active matrix screens have a wider viewing angle than passive matrix screens. Active matrix displays use thin-film transistor (TFT) technology, which employs as many as four transistors per pixel. Today, most notebook computers feature TFT displays (see Figure 3A.11).

Norton ONLINE

For more information on monitor manufacturers, visit http://www.mhhe.com/petermorton

Other Types of Monitors

While CRT and flat-panel monitors are the most frequently used types of displays in PC systems, there are other kinds of monitors. These displays use specialized technologies and have specific uses:

» Paper-white displays are sometimes used by document designers such as desktop publishing specialists, newspaper or magazine compositors, and other persons who create high-quality printed documents. A paper-white display produces a very high contrast between the monitor's white background and displayed text or graphics, which usually appear in black. An LCD version of the paper-white display is called a page-white display. Page-white displays utilize a special technology, called supertwist, to create higher contrasts.

» Electroluminescent displays (ELDs) are similar to LCD monitors but use a phosphorescent film held between two sheets of glass. A grid of wires sends current through the film to create an image.

» Plasma displays are created by sandwiching a special gas (such as neon or xenon) between two sheets of glass. When the gas is electrified via a grid of small electrodes, it glows. By controlling the amount of voltage applied at various points on the grid, each point acts as a pixel to display an image.



FIGURE 3A.11

As the cost of high-quality TFT displays has come down, they have become the most commonly used type of display on notebook computers.

Urheberrechtlich geschütztes Material

Comparing Monitors

If you need to buy a monitor, go comparison shopping before making a purchase (see Figure 3A.12). Look for a monitor that displays graphics nicely and is easy on your eyes, allowing you to work longer and more comfortably. A poor monitor can reduce your productivity and may even contribute to eyestrain.

When shopping for a monitor, first look at a screen full of text and examine the crispness of the letters, especially near the corners of the screen. In standard CRT monitors, the surface of the screen is curved, causing some distortion around the edges and especially in the corners (see Figure 3A.13). In some low-cost monitors, this distortion can be bothersome. Thin CRT displays have flat screens so, like flat-panel LCD monitors, they eliminate this problem.

Next, display a picture with which you are familiar and see whether the colors look accurate. If possible, spend some time surfing the World Wide Web to display different types of pages.

Even if the monitor looks good (or if you are buying it through the mail), you need to check several specifications. The following are the most important:

- Size
- Resolution
- Refresh rate
- Dot pitch

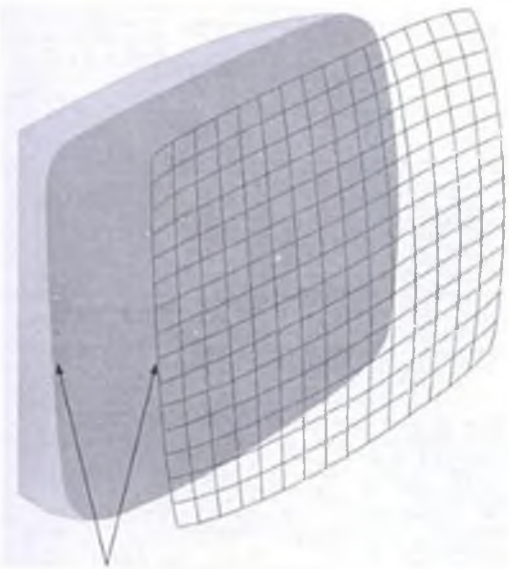


FIGURE 3A.12

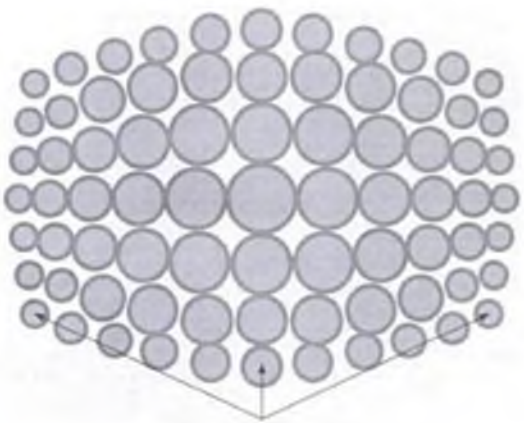
It's a good idea to compare monitors before buying one, to find one that is right for you.

FIGURE 3A.13

In a standard CRT monitor, the screen's surface is curved. This can cause some distortion of images.



In a standard CRT monitor, the screen is curved.



The curvature can cause displayed images to be distorted as they fall across the curve. This can affect text and graphics, and may be most noticeable at the corners of the screen.

Urheberrechtlich geschütztes Material

Size

A monitor's size affects how well you can see images. With a larger monitor, you can make the objects on the screen appear bigger, or you can fit more of them on the screen (see Figure 3A.14). Monitors are measured diagonally, in inches, across the front of the screen. A 17-inch monitor measures 17 inches from the lower left to the upper right corner. However, a CRT monitor's actual viewing area—that is, the portion of the monitor that actually displays images—is smaller than the monitor's overall size. The viewing area of a flat-panel display will be somewhat larger than the viewing area of a comparably sized CRT monitor. As a rule of thumb, buy the largest monitor you can afford.

Resolution

The term resolution refers to the sharpness or clarity of an image. A monitor's resolution is determined by the number of pixels on the screen, expressed as a matrix. The more pixels a monitor can display, the higher its resolution and the clearer its images appear. For example, a resolution of 640 × 480 means that there are 640 pixels horizontally across the screen and 480 pixels vertically down the screen. Because the actual resolution is determined by the video controller—not by the monitor itself—most monitors can operate at several different resolutions. Figure 3A.15 shows five commonly used resolution settings: (a) 640 × 480,

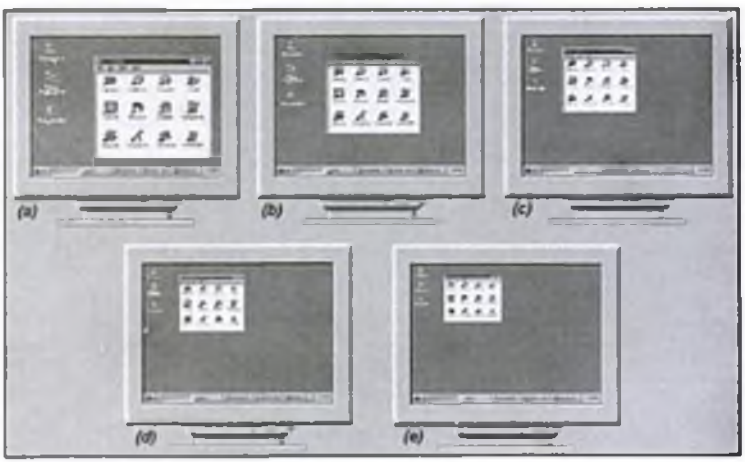
FIGURE 3A.14

The larger your monitor, the more easily you can see text and graphics.



FIGURE 3A.15

Most monitors can operate at different resolutions, as shown here.



Urheberrechtlich geschütztes Material

(b) 800 × 600, (c) 1024 × 768, (d) 1152 × 864, and (e) 1280 × 1024. Note that, as the resolution increases, the image on the screen gets smaller.

There are various standards for monitor resolution. The Video Graphics Array (VGA) standard is 640 × 480 pixels. The Super VGA (SVGA) standard expanded the resolutions to 800 × 600 and 1024 × 768. Today, nearly any color monitor can be set to even higher resolutions. Higher settings are not always better, however, because they can cause objects on the screen to appear too small, resulting in eyestrain and squinting. Compare the two screens shown in Figure 3A.16. Both were taken from the same 17-inch monitor. The first image is displayed at 640 × 480 resolution; the second image shows the same screen at 1280 × 1024.

Refresh Rate

A monitor's refresh rate is the number of times per second that the electron guns scan every pixel on the screen (see Figure 3A.17). Refresh rate is important because phosphor dots fade quickly after the electron gun charges them with electrons. If the screen is not refreshed often enough, it appears to flicker, and flicker is one of the main causes of eyestrain. Refresh rate is measured in Hertz (Hz), or in cycles

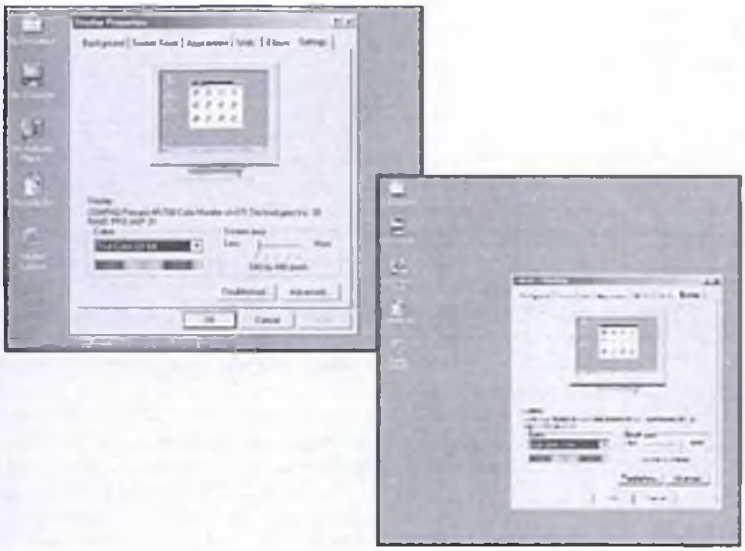


FIGURE 3A.16

VGA and Super VGA

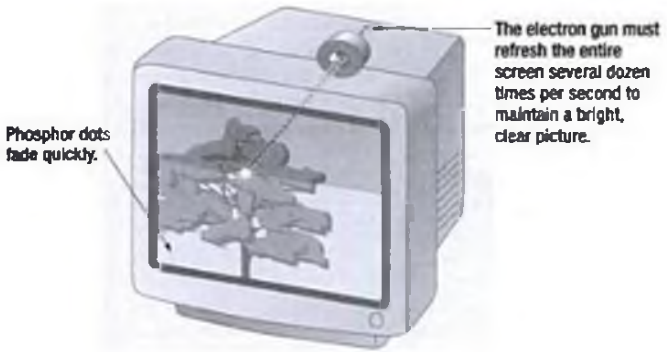


FIGURE 3A.17

This illustration shows how a monitor refreshes its pixels.

Urheberrechtlich geschütztes Material

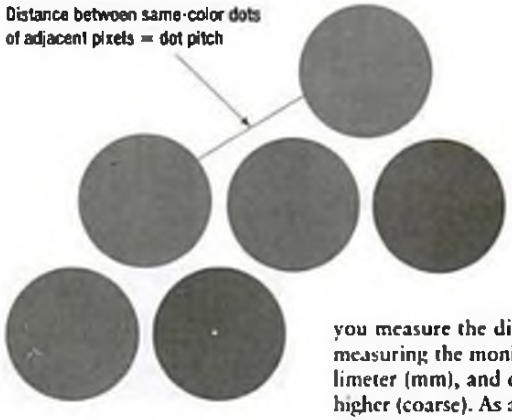


FIGURE 3A.18

Measuring dot pitch in a color monitor.

per second. This means that if a monitor's refresh rate is 100 Hz, it refreshes its pixels 100 times every second.

When purchasing a monitor, look for one with a refresh rate of 72 Hz or higher. The high refresh rate can help you avoid eyestrain. Note that some monitors have different refresh rates for different resolutions. Make sure the refresh rate is adequate for the resolution you will be using.

Dot Pitch

The last critical specification of a color monitor is the dot pitch, the distance between the like-colored phosphor dots of adjacent pixels (see Figure 3A.18). In other words, if you measure the distance between the red dots of two adjacent pixels, you are measuring the monitor's dot pitch. Dot pitch is measured as a fraction of a millimeter (mm), and dot pitches can range from .15 mm (very fine) to .40 mm or higher (coarse). As a general rule, the smaller the dot pitch, the finer and more detailed images will appear on the monitor.

Most experts agree that, when shopping for a color monitor, you should look for a dot pitch no greater than 0.28 millimeter (.28 mm). That number generally applies to 15-inch monitors. If you want a larger monitor, look for an even finer dot pitch, such as .22 mm or less.

Video Cards

The quality of the images that a monitor can display is defined as much by the video card (also called the *video controller* or the *video adapter*) as by the monitor itself. As shown in Figure 3A.19, the video controller is an intermediary device between the CPU and the monitor. It contains the video-dedicated memory and other circuitry necessary to send information to the monitor for display on the screen. In most computers, the video card is a separate device that is plugged into the motherboard. In many newer computers, the video circuitry is built directly into the motherboard, eliminating the need for a separate card.

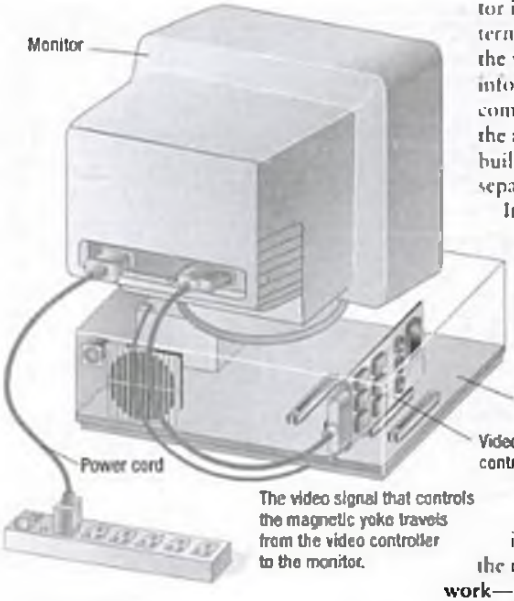


FIGURE 3A.19

The video controller connects the CPU, via the data bus on the motherboard, to the monitor.

In the early days of personal computing, PC screens displayed only text characters and usually only in one color. These displays took little processing power because there were only 256 possible characters and 2,000 text positions on the screen. Rendering each screen required only 4,000 bytes of data. Today, however, computers are required to display high-quality color graphics as well as full-motion animations and video. These displays require the CPU to send information to the video controller about every pixel on the screen. At a minimum resolution of 640 × 480, there are 307,200 pixels to control. If you run your monitor at 256 colors, each pixel requires one byte of information. Thus, the computer must send 307,200 bytes to the monitor for each screen. The screen changes constantly as you work—the screen is updated many times each second, whether anything on the screen actually changes or not.

If the user wants more colors or a higher resolution, the amount of data can be much higher. For example, for "high color" (24 bits, or 3 bytes, per pixel will render millions of colors) at a resolution of 1024 × 768, the computer must send 2,359,296 bytes to the monitor for each screen.

Urheberrechtlich geschütztes Material

The result of these processing demands is that video controllers have increased dramatically in power and importance. Today's video controllers feature their own built-in microprocessors (see Figure 3A.20), which frees the CPU from the burden of making the millions of calculations required for displaying graphics. The speed of the video controller's chip determines the speed at which the monitor can be refreshed.

Video controllers also feature their own built-in video RAM, or VRAM (which is separate from the RAM that is connected to the CPU). VRAM is dual-ported, meaning that it can send a screen full of data to the monitor and at the same time receive the next screen full of data from the CPU. Today's most sophisticated video controllers, which are fine-tuned for multimedia, video, and 3-D graphics, may have as much as 256 MB or more of video RAM.



FIGURE 3A.20

Today's video controllers feature sophisticated circuitry to meet the demands of animation, 3-D graphics, and full-motion video.

Ergonomics and Monitors

As you saw in Chapter 2, a number of health-related issues have been associated with computer use. Just as too much keyboarding or improper typing technique can lead to hand or wrist injuries, too much time at a monitor can endanger your eyesight. Protecting your eyesight means choosing the right kind of monitor and using it correctly.

Eyestrain

Eyestrain is one of the most frequently reported health problems associated with computers, but is also one of the most easily avoided. Eyestrain is basically fatigue of the eyes, caused by focusing on the same point for too long. When you look at the same object (such as a monitor) for too long, the eye's muscles become strained.

Think of how your arms would feel if you held them straight out for several minutes. Your shoulders and upper arms would soon begin to ache and feel weak; eventually you would have to rest your arms, or at least change their position. The same kind of thing occurs in eyestrain.

Experts say that eyestrain does not pose any long-term risks to eyesight, but it can lead to headaches. It also can reduce your productivity by making it harder to concentrate on your work.

Luckily, you can take several steps to reduce eyestrain when using a computer:

- Choose a monitor that holds a steady image without flickering. The dot pitch should be no greater than .28 mm and the refresh rate should be at least 72 Hz.
- Position your monitor so it is 2–2½ feet away from your eyes, so that the screen's center is a little below your eye level. Then tilt the screen's face upward about 10 degrees, as shown in Figure 3A.21. This angle will enable you to view the monitor comfortably without bending your neck. If you have vision problems that require corrective lenses, however, ask your optometrist about the best way to position your monitor.
- Place your monitor where no light reflects off the screen. If you cannot avoid reflections,



FIGURE 3A.21

By positioning your monitor as shown here, you can avoid eyestrain and neck fatigue.

Norton ONLINE

For more information on video controllers, visit **http://www.mhhe.com/petermorton**

simnet™

Norton ONLINE

For more information on monitors and your vision, visit **http://www.mhhe.com/petermorton**

Urheberrechtlich geschütztes Material

Norton Notebook

Flat Video Is Anything But



You may find it hard to believe, but it wasn't too long ago that a full 50 percent of my usable desk space was monopolized by my PC's monitor. And it wasn't just me. Since the first days of the PC, computer users have turned to video displays to see their work. Unfortunately, video displays are large, and big ones are *huge*. A video display with a 21-inch diagonal view was commonly in a case that was about two feet square! You lose desk real estate pretty quickly with hardware like that, but video monitors had one undeniable advantage: They were the only game in town. If you needed to use a PC and see what you were doing—always helpful—there was no alternative but to place what amounted to an overpriced television set smack in the middle of your workspace. (In fact, early models of Apple brand personal computers actually *did* use television sets as their displays.) Early relocatable PCs weighed in at about 25 pounds, so the success of portable computing relied entirely on the success of making components lighter and smaller. Video displays were quickly replaced with a variety of panel-type screens. Batteries weigh more than most anything else, but small batteries were drained powerless in as little as 30 minutes by early flat panels. Flat panel screens are also delicate to manufacture, and yields—the number of usable products a factory makes (as opposed to the total number of a product that it *tries* to make that aren't useable for whatever reason)—were originally very low. This kept costs very high, which suppressed demand, which discouraged investment in cheaper methods, and on and on.

It was around this time that the first freestanding flat panel displays for desktop PCs were marketed. For a variety of reasons—they were generally larger than notebook flat panel displays, and so were more expensive and difficult to manufacture, and they required a different type of video interface than was standard on every desktop PC at the time—desktop flat panels were priced well out of the reach of the average user. It was not at all uncommon for a desktop flat panel to retail for twice what the entire desktop PC cost. They were, however, sharp and colorful and produced clear, vibrant images. Desktop flat panels definitely possessed the marketing "Wow!" factor (and they gave you your desk back). Demand increased and production technology improved. Slowly, prices began to fall.

Now, roughly half way through the first decade of the twenty-first century, flat panels are everywhere. They remain a bit more expensive than comparably-sized CRT video monitors, but that gap continues to shrink, and the so-called average PC system usually now includes a flat panel instead of a CRT. As flat-panel displays for television and home theatre increase in popularity, technology will continue to improve and prices will continue to drop. Already, what was once a $2,000 desktop flat panel now costs less than one-third of that.

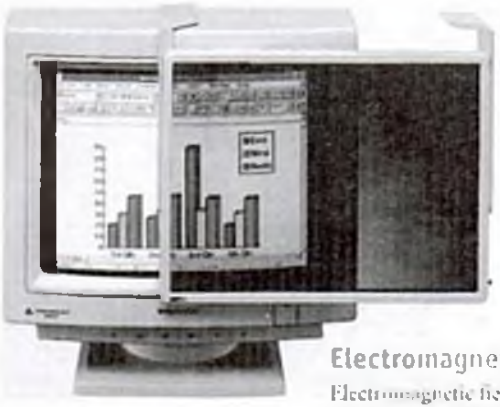


FIGURE 3A.22

An antiglare screen cuts down the reflections on a monitor's surface.

use an antiglare screen to reduce the reflections on the screen (see Figure 3A.22).

- Keep your screen clean.
- Avoid looking at the monitor for more than 30 minutes without taking a break. When taking a break from the monitor, focus on objects at several different distances. It is a good idea to simply close your eyes for a few minutes, to give them some rest.
- Do not let your eyes become dry. If dryness is a problem, ask your optometrist for advice.

Electromagnetic Fields

Electromagnetic fields (EMFs) are created during the generation, transmission, and use of low-frequency electrical power. These fields exist near power lines, electrical appliances, and any piece of equipment that has an electric motor. A debate has continued for years whether EMFs can be linked to cancer. Conclusions vary depending on the study and criteria used, but many people remain convinced that EMFs pose a health threat of some kind.

Urheberrechtlich geschütztes Material



But flat panels are in no danger of becoming boring technology. Already, people are transitioning from CRT-based home televisions to flat-panel screens. A number of technologies are sparring for preeminence, and it's likely that several types of flat panel will continue to co-exist to meet the tastes and price-points of the world market. One of the newest developments in the flat-panel world might even herald the most significant change in home entertainment since the introduction of color television. Sharp Corporation recently introduced the world's first notebook computer with a true 3D display. (By "true 3D" I mean a display that shows images in three dimensions *without* special glasses.) An innovative way of producing the flat panel itself (a matter of *parallax*, if you're curious) makes it possible for Sharp to send a slightly different image to a user's left eye than to his or her right eye. When the brain combines the images, it's tricked into perceiving depth. What this technology could mean for medical diagnostics, for pharmaceutical and genetic research, and for education is staggering. What it could mean for entertainment—think "3D TV"—is astounding. For years, researchers have tried to develop practical three-dimensional television, most of which was based on dubious holographic processes or required cumbersome wired goggles or glasses. Displaying 3D content on this new screen simply requires the user press a button labeled "3D."

Already, at least one producer of the very successful IMAX3D movies has released their films on DVD. A number of major game manufacturers, including the ubiquitous Electronic Arts, also have agreed to develop 3D games for this new way of seeing. Sharp itself has created a 3D slide creator/viewer that allows any user to create 3D images of family, friends, and places with an existing digital camera.

Of course, there is no guarantee that any particular innovation or technology will be the one that gets adopted universally and changes major aspects of our lives. There's also no publicly available evidence at the time of this writing that this system will work on the "living room" scale, as a three-dimensional entertainment system for whole families. But Sharp has the distinction of having the first three-dimensional video system that is practical, convenient, and affordable. We may all need to come up with a replacement name for "flat panels." That old name just may not seem appropriate for long.

NORTON NOTEBOOK

EMFs have an electrical component and a magnetic component. Of the two, the magnetic fields raise the health concern because they can penetrate many kinds of materials. These fields, however, lose strength rapidly with distance. To reduce your exposure to EMFs, take the following steps:

- Take frequent breaks away from the computer.
- Sit at arm's length away from the system unit, monitor, and other equipment.
- If possible, use a flat-panel display, which does not radiate EMFs.

SELF-CHECK ::

Circle the correct answer for each question.

1. A monitor is an example of this kind of device.
   a. processing b. input c. output
2. The back of a CRT monitor's screen is coated with these.
   a. phosphors b. electrons c. elements
3. In a plasma display, gas is electrified by a grid of these.
   a. electronics b. electrodes c. electrons

Urheberrechtlich geschütztes Material

Data Projectors



FIGURE 3A.23

Data projectors make it easy to deliver a presentation directly from a computer, so it can be viewed by a group of people.

Portable computers have all but replaced old-fashioned slide projectors and overhead projectors as the source of presentations. Instead of using 35-millimeter photographic slides or 8.5- by 11-inch overhead transparencies, more and more people are using software to create colorful slide shows and animated presentations. These images can be shown directly from the computer's disk and displayed on the PC's screen or projected on a wall or large screen.

To get these presentations onto the "big screen," data projectors are becoming increasingly common. (Data projectors also are called *digital light projectors* and *video projectors*.) A data projector plugs into one of the computer's ports and then projects the video output onto an external surface (see Figure 3A.23). These small devices weigh only a few pounds and can display over 16 million colors at high resolution. Many projectors can work in either still-video (slide) mode or full-video (animation) mode, and can display output from a VCR or DVD drive as well as from a computer disk.

Most projectors use LCD technology to create images. (For this reason, these devices are sometimes called *LCD projectors*.) Like traditional light projectors, LCD projectors require the room to be darkened. They display blurry images in less-than-optimal lighting conditions.

Newer models use digital light processing (DLP) technology to project brighter, crisper images. DLP devices use a special microchip called a digital micromirror device, which actually uses mirrors to control the image display. Unlike LCD-based projectors, DLP units can display clear images in normal lighting conditions.

Norton ONLINE

For more information on computer data projectors, visit http://www.mhhe.com/petemorton

Sound Systems



FIGURE 3A.24

Speakers are common features on today's multimedia PCs. Top-of-the-line PC audio systems include premium sound cards and tweeters, midrange speakers, and subwoofers for sound quality that rivals home stereo systems.

Microphones are now important input devices, and speakers and their associated technologies are key output systems (see Figure 3A.24). Today, nearly any new multimedia-capable PC includes a complete sound system, with a microphone, speakers, a sound card, and a CD-ROM or DVD drive. Sound systems are especially useful to people who use their computer to create or use multimedia products, watch videos or listen to music, or participate in online activities such as videoconferences or distance learning.

The speakers attached to these systems are similar to those you connect to a stereo. The only difference is that they are usually smaller and may contain their own amplifiers. Otherwise, they do the same thing any speaker does: They transfer a constantly changing electric current to a magnet, which pushes the speaker cone back and forth. The moving speaker cone creates pressure vibrations in the air—in other words, sound (see Figure 3A.25).

Sound Cards

The most complicated part of a computer's sound system is the sound card. A computer's sound card is a circuit board that converts sound from analog to digital form, and vice versa, for recording or playback. A sound card actually has both input and output functions (see Figure 3A.26). If you want to use your computer's microphone to record your voice, for instance, you connect the microphone to the sound card's input jack. Other audio input devices connect to the sound card as well, such as the computer's CD-ROM or DVD drive. You may be able to attach other kinds of audio devices to your sound card, such as tape players, record players, and others.

Urheberrechtlich geschütztes Material

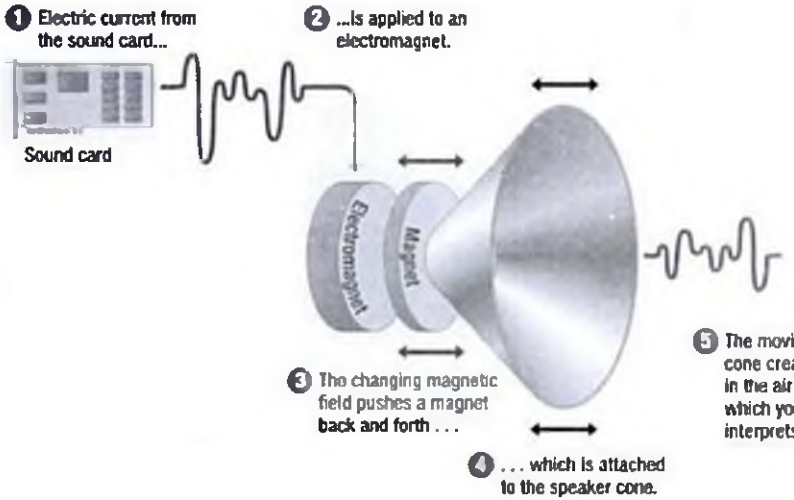


FIGURE 3A.25

How a computer uses a speaker to create sound

Norton ONLINE

For more information on computer sound systems, visit http://www.mhhe.com/peternorton

As you learned in Chapter 2, the sound card accepts sound input (from a microphone or other device) in the form of analog sound waves. You can think of analog signals as fluctuations in the intensity of an electrical current. The sound card measures those signals and converts them into a digital format, which the computer can use.

To play back audio, the sound card reverses the process. That is, it translates digital sounds into the electric current that is sent to the speakers, which are connected to the card's output jacks.

With the appropriate software, you can do much more than simply record and play back digitized sound (see Figure 3A.27). Sound editing programs provide a miniature sound studio, allowing you to view the

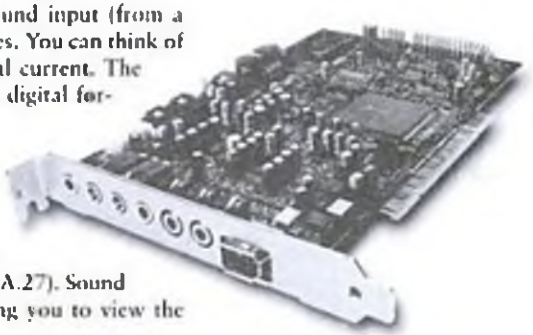


FIGURE 3A.26

High-end sound cards support all sorts of devices, and allow you to record, play, and edit all kinds of audio.

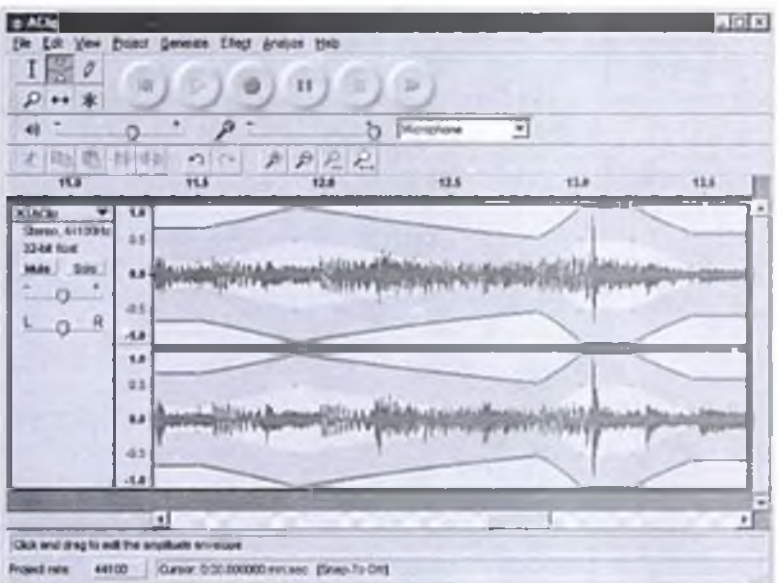


FIGURE 3A.27

Editing an audio file with Audacity, a free, open source audio editing program.

Urheberrechtlich geschütztes Material

At Issue

Call of the Wild: Bioacoustic Research

Using high-tech hardware and software to "bug" the Earth's wild places from the African savannah to the ocean floor, scientists are gaining a better understanding of the secret lives of animals. Bioacoustics Research gives scientists and researchers new insight into animal biodiversity by recording animal vocalization. This valuable statistical information yields a wealth of data about the health and behavior of indigenous animal populations.

Those listening to the calls of the wild hear sounds ranging from clicks and rumbles to squawks and whines, as they try to interpret and analyze the sounds the creatures they study make. These Bioacoustics Researchers use sound to understand everything from the spawning habits of fish to the migratory path of herons to the social behaviors of humpback whales.

The Bioacoustics Research Program (BRP) at Cornell University is one of the world's leading Bioacoustics programs. The computer software, techniques, and equipment developed at BRP for recording and analyzing sounds are used by scientists both at Cornell and around the world to study animal communication.

One of the key tools used by the Cornell team is an ARU—an autonomous acoustic recording device—which consists of a microphone (or hydrophone), amplifier, frequency filter, programmable computer, and specially developed software that schedules, records, and stores the acoustic data. The crucial features of the ARU are its small size, low power consumption, and large storage capacity (an ARU can collect up to 60 gigabytes of digital recordings).

One exciting application of the technology is the ongoing study of whale communication. BRP has several projects underway recording ocean sounds in locations ranging from Southern California to the North Atlantic to the southern ocean. Subjects include the study of Blue, Finback, Bowhead, Minke, Humpback, and the highly endangered North Atlantic Right whale.

For the collection of whale sounds, researchers use a special ARU device, called a "pop-up," for undersea deployment. The pop-up is carried out to sea by ship or small boat and released, sinking to the ocean floor, where it hovers like a balloon tied to a brick. It contains a computer microprocessor, enough hard disks for up to six months of data

sound wave and edit it. In the editing, you can cut bits of sound, copy them, and amplify the parts you want to hear more loudly; cut out static; and create many exotic audio effects.

Headphones and Headsets

Many computer users prefer listening to audio through headphones or a headset, rather than using speakers. These devices are helpful when using portable computers, which do not have very high-quality speakers, or when playing audio might disturb other people.



FIGURE 3A.28

Listening to audio through headphones.

Headphones include a pair of speakers, which are attached to an adjustable strap that can be custom-fitted to the wearer's head (see Figure 3A.28). Today, even inexpensive headphones (such as those that come with portable CD players) have reasonably high-quality speakers, are lightweight, and are comfortable to wear. Nearly any set of standard headphones can be plugged into the output jack of a computer's sound card, as long as they have a "mini" stereo plug. For headphones equipped with larger plugs, adapters are available.

Urheberrechtlich geschütztes Material



storage, acoustic communications circuitry, and batteries, all sealed in a single 17-inch glass sphere. An external hydrophone is connected to the internal electronics through a waterproof connector. At the conclusion of a mission, the sphere separates itself from its anchor and "pops up" to the surface where it is recovered. Scientists then extract the data and process it to quantify ocean noises, detect endangered species, and describe the densities and distributions of different whale species.

Back on land, the computer workstation used by Cornell is powered by RAVEN, a software application for the digital acquisition, visualization, measurement, manipulation, and analysis of sound. RAVEN was developed by BRP with support from the National Science Foundation to provide a low-cost, user-friendly research and teaching environment tailored to the needs of biologists working with acoustic signals.

Together, this combination of technologies have given scientists some of "the best profiles of any endangered species yet," according to BRP.

A headset includes one or two speakers and a microphone, all mounted to an adjustable headstrap. The headset's microphone plugs into the sound card's microphone input, and the speakers connect to the sound card's speaker jack. Headsets replace both remote microphones and speakers and are useful for speech-recognition applications, or when using the computer to make phone calls or participate in videoconferences.

Urheberrechtlich geschütztes Material

Summary

- Computer monitors are roughly divided into two categories: CRT and flat-panel displays.
- Monitors also can be categorized by the number of colors they display. Monitors are usually monochrome, grayscale, or color.
- A CRT monitor uses an electron gun that systematically aims a beam of electrons at every pixel on the screen.
- Most LCD displays are either active matrix or passive matrix.
- When purchasing a monitor, you should consider its size, resolution, refresh rate, and dot pitch.
- The video controller is an interface between the monitor and the CPU. The video controller determines many aspects of a monitor's performance; for example, the video controller lets you select a resolution or set the number of colors to display.
- The video controller contains its own on-board processor and memory, called video RAM.
- A digital light projector is a portable light projector that connects to a PC. This type of projector is rapidly replacing traditional slide projectors and overhead projectors as a means for displaying presentations.
- Many digital light projectors provide the same resolutions and color levels as high-quality monitors, but they project the image on a large screen.
- The newest projectors use digital light processing to project bright, crisp images. A DLP projector uses a special microchip that contains tiny mirrors to produce images.
- Multimedia PCs generally come with sound systems, which include a sound card and speakers.
- The sound card translates digital signals into analog signals that drive the speakers.
- Many people prefer to listen to audio output through headphones or a headset, instead of using speakers.

Key Terms

active matrix LCD, 92
antiglare screen, 98
cathode ray tube (CRT), 88
color monitor, 89
data projector, 100
digital light processing (DLP), 100
dot pitch, 96
dual-scan LCD, 92
electroluminescent display (ELD), 92
electromagnetic field (EMF), 98
eyestrain, 97
flat-panel display, 88
grayscale monitor, 88
headphones, 102
headset, 103
Hertz (Hz), 95
liquid crystal display (LCD), 91
monochrome monitor, 88
page-white display, 92
paper-white display, 92
passive matrix LCD, 92
pixel, 89
plasma display, 92
refresh rate, 95
resolution, 94
shadow mask, 90
sound card, 100
submarining, 92
Super VGA (SVGA), 95
thin-film transistor (TFT), 92
video card, 96
Video Graphics Array (VGA), 95
video RAM (VRAM), 97
viewing angle, 91
viewing area, 94

Urheberrechtlich geschütztes Material

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. Standard computer monitors work by using a large vacuum tube, which is called a(n) _____ .
2. In a CRT monitor, the electron gun can focus on _____ as small as a single phosphor dot.
3. In a CRT monitor, the holes in the _____ align the electron beams so they precisely strike the phosphor dots.
4. The most common type of flat-panel monitor is the _____ monitor.
5. One disadvantage of _____ LCD monitors is that they don't refresh very quickly.
6. In active matrix displays that use _____ technology, each pixel has multiple transistors.
7. The portion of a monitor that actually displays images is called the _____ .
8. VGA and SVGA are standards for monitor _____ .
9. In most computers, a device called the _____ sends information to the monitor for display on the screen.
10. A(n) _____ lets you display data on a big screen, directly from the computer's disk.

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. Which type of monitor is most commonly used with portable computers?
   a. cathode ray tube b. monochrome c. flat-panel display d. data projector
2. This type of monitor can display only one color, such as white, against a black background.
   a. grayscale b. monochrome c. color d. SVGA
3. In a CRT monitor, this component helps the electron gun aim its beam at the screen's phosphor dots.
   a. magnetic coil b. magnetic field c. magnetic switch d. magnetic tube
4. An LCD monitor uses crystals that become opaque when _____ is applied.
   a. pressure b. force c. phosphor d. electricity
5. Most passive matrix LCD monitors now use _____ technology.
   a. thin-film b. active matrix c. dual-scan d. flat-panel
6. Document designers sometimes use a special type of monitor called a _____ display.
   a. CRT b. paper-white c. TFT d. electroluminescent
7. Resolution is determined by the computer's _____ .
   a. monitor b. video controller c. CPU d. system unit
8. A monitor's _____ is measured in Hertz (Hz).
   a. refresh rate b. speed c. resolution d. viewable area
9. The Video Graphics Array (VGA) resolution standard is _____ pixels.
   a. 640 × 480 b. 800 × 600 c. 1024 × 768 d. 1280 × 1024
10. When you choose a monitor, look for one with a dot pitch that is no greater than _____ .
    a. .18 mm b. .28 mm c. .38 mm d. .08 mm

Urheberrechtlich geschütztes Material

Review Questions

In your own words, briefly answer the following questions.

1. There are two basic types of monitors used with PCs. List them.
2. How does a color CRT monitor produce images on the screen?
3. What are two disadvantages of CRT monitors, compared to flat-panel displays?
4. What are two disadvantages of LCD monitors, compared to CRT monitors?
5. How does a plasma display monitor work?
6. List the four factors you should consider when comparing monitors.
7. As it relates to monitors, what does the term "resolution" refer to?
8. What is dot pitch?
9. How should you position your monitor, if you want to avoid eyestrain?
10. How does digital light processing (DLP) technology work?

Lesson Labs

Complete the following exercises as directed by your instructor.

1. Examine your computer's monitor. First, look at the monitor attached to your computer. What brand and model is it? What other information can you get from the monitor by looking at its exterior? (Remember to look at the back.) Next, measure the monitor. What is the diagonal measurement of the monitor's front side? What is the viewing area, measured diagonally? Visit the manufacturer's Web site and see if you can find any additional information about your specific monitor.
2. If your PC has speakers attached to it, you can easily check or change the speaker volume. Move the mouse pointer to the Windows taskbar. Look for a small icon that looks like a speaker. If you see such an icon, click it. (If not, ask your instructor for assistance.) A small volume control will appear on the screen. You can use the mouse to drag the volume control up or down to change the volume setting, or select the Mute checkbox to silence the sound system. Click anywhere outside the volume control to close it.

Urheberrechtlich geschütztes Material

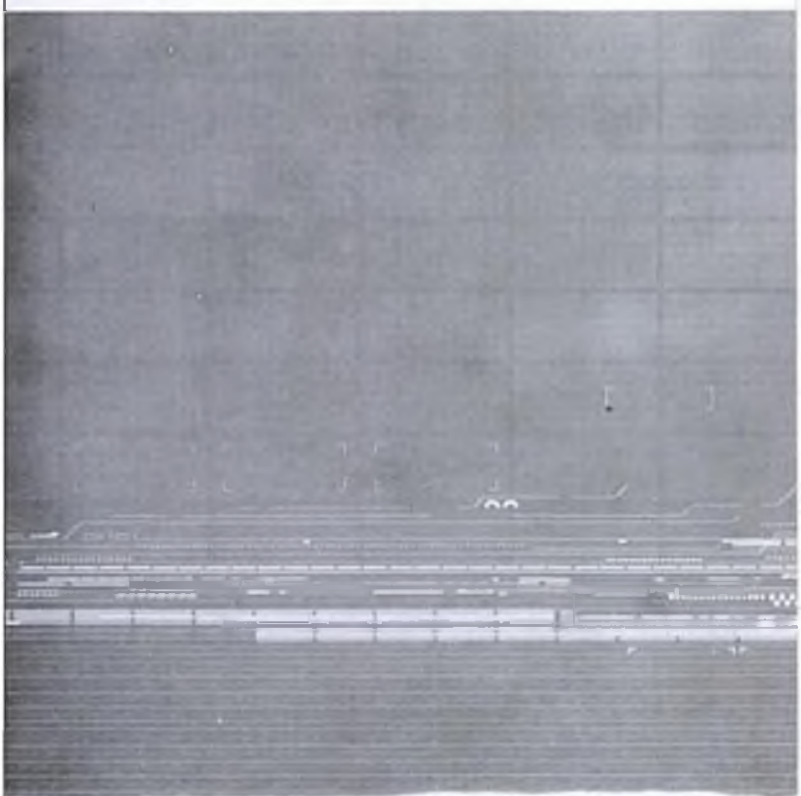
Printing

Overview: Putting Digital Content in Your Hands

Most computer users can't imagine working without a printer. Monitors and sound systems let you see and hear your work, but printers give you something you can touch, carry, and share with others. Printed documents are essential in most workplaces, where people must share reports, budgets, memos, and other types of information.

Over the past decade, the variety of available printing devices has exploded; however, three types of printers have become the most popular: dot matrix, ink jet, and laser. Within those three groups, consumers have hundreds of options, ranging widely in price and features. Several other types of special printing devices are available for users with special needs, such as large-format printouts or images with extremely accurate color and high resolution.

This lesson introduces you to the basics of hard-copy output devices. You will learn about the most common types of printers and see how each creates an image on paper. You will learn the criteria for evaluating different printers and examine some of the specialized printing devices designed for professional use.



OBJECTIVES ::

- List the three most commonly used types of printers.
- List the four criteria you should consider when evaluating printers.
- Describe how a dot matrix printer creates an image on a page.
- Explain how an ink jet printer creates an image on a page.
- Explain how a laser printer creates an image on a page.
- List four types of high-quality printing devices commonly used in business.

Urheberrechtlich geschütztes Material

Commonly Used Printers

Besides the monitor, the other important output device is the printer. Generally, printers fall into two categories: impact and nonimpact. An impact printer creates an image by using pins or hammers to press an inked ribbon against the paper. A simple example of an impact printer is a typewriter, which uses small hammers to strike the ribbon. Each hammer is embossed with the shape of a letter, number, or symbol; that shape is transferred through the inked ribbon onto the paper, creating a printed character.

Although it is seldom done today, many modern electric typewriters can be connected to a PC and used as a letter-quality printer (see Figure 3B.1). As a printer, however, even a good typewriter is slow and limited in the kinds of documents it can produce. The most common type of impact printer is the dot matrix printer (see Figure 3B.2). Other types of impact printers are line printers and band printers.

Nonimpact printers use other means to create an image. Ink jet printers, for example, use tiny nozzles to spray droplets of ink onto the page. Laser printers work like photocopiers, using heat to bond microscopic particles of dry toner to specific parts of the page (see Figure 3B.3).

In the early years of computing, dot matrix printers were the most commonly used printing devices. They are not as prevalent now, although dot matrix printers are still popular in business and academic settings because they are relatively fast and inexpensive to operate, and they do a good job of printing text and simple graphics. Ink jet printers now offer much higher quality for about the same price, and they have become more popular than dot matrix printers in homes and small businesses. Laser printers are also popular in homes and businesses, but they are more expensive to buy and operate than either ink jet or dot matrix devices.



FIGURE 3B.1

Although they are much slower than normal printers, many electronic typewriters can be connected to a PC and used to print documents such as letters or memos. This arrangement works well when the user does not need many different fonts or printing options or to print a high volume of documents.

Dot Matrix Printers

Dot matrix printers are commonly used in workplaces where physical impact with the paper is important, such as when the user is printing to carbon-copy or pressure-sensitive forms. These printers can produce sheets of plain text very quickly. They also are used to print very wide sheets, as data processing departments often use when generating large reports with wide columns of information.



FIGURE 3B.2

Many people think dot matrix printers are obsolete, but these printers are still widely sold and used. They are inexpensive compared to other kinds of printers and while they are not well suited to printing graphics, good dot matrix printers can produce high-quality text documents. Like other types of impact printers, dot matrix printers can be used with carbon copy and other kinds of cop/ forms.

A dot matrix printer creates an image by using a mechanism called a print head, which contains a cluster (or *matrix*)

Urheberrechtlich geschütztes Material

of short pins arranged in one or more columns. On receiving instructions from the PC, the printer can push any of the pins out in any combination. By pushing out pins in various combinations, the print head can create alphanumeric characters (see Figures 3B.4 and 3B.5).

When pushed out from the cluster, the protruding pins' ends strike a ribbon, which is held in place between the print head and the paper. When the pins strike the ribbon, they press ink from the ribbon onto the paper.

The more pins that a print head contains, the higher the printer's resolution. The lowest-resolution dot matrix printers have only nine pins; the highest-resolution printers have 24 pins.

The speed of dot matrix printers is measured in characters per second (cps). The slowest dot matrix printers create 50 to 70 characters per second; the fastest print more than 500 cps.

Although dot matrix printers are not commonly used in homes, they are still widely used in business, as are other types of impact printers:

» **Line Printers.** A line printer is a special type of impact printer. It works like a dot matrix printer but uses a special wide print head that can print an entire line of text at one time (see Figure 3B.6). Line printers do not offer high resolution but are incredibly fast; the fastest can print 3,000 lines of text per minute.

» **Band Printers** A band printer features a rotating band embossed with alphanumeric characters. To print a character, the machine rotates the band to the desired character, then a small hammer taps the band, pressing the character against a ribbon. Although this sounds like a slow process, band printers are very fast and very robust. Depending on the character set used, a good-quality band printer can generate 2,000 lines of text per minute.



FIGURE 3B.3

Laser printers produce the highest-quality text output, as well as graphics. Laser printers are commonly found in business settings where many people need to print documents. Sophisticated high-volume laser printers are often connected to networks and handle printing tasks for large workgroups.



FIGURE 3B.4

A dot matrix printer forms a character by creating a series of dots.

Norton ONLINE

For more information on dot matrix printers, visit **http://www.mhhe.com/petermorton**

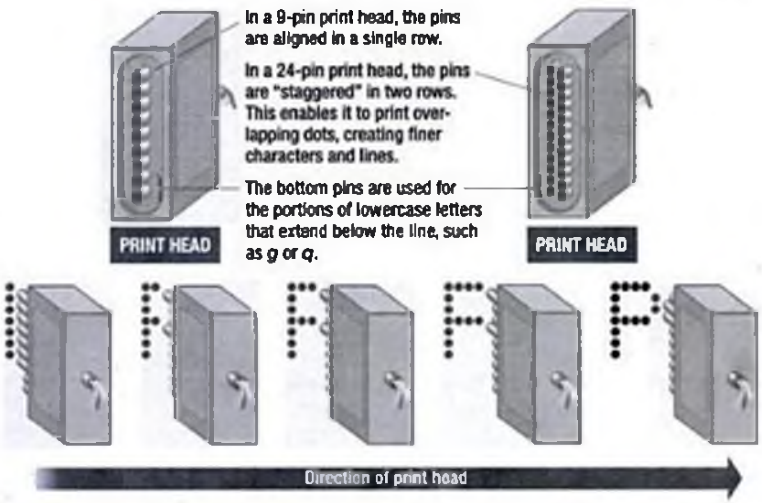


FIGURE 3B.5

How a dot matrix printer creates an image.

Urheberrechtlich geschütztes Material

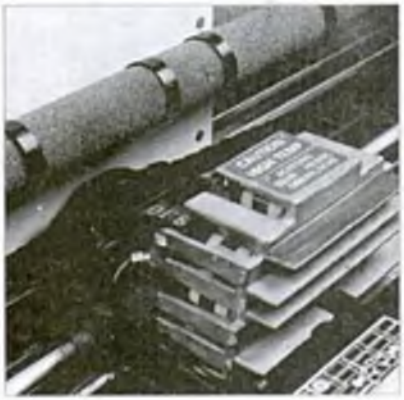


FIGURE 3B.6

Line printers use a special wide print head to print an entire line of text at one time.

Ink Jet Printers

Ink jet printers create an image directly on the paper by spraying ink through tiny nozzles (see Figure 3B.7). The popularity of ink jet printers jumped around 1990 when the speed and quality improved and prices plummeted. Today, good ink jet printers are available for less than $100. These models typically attain print resolutions of at least 300 dots per inch. These same models can print from two to four pages per minute (only slightly slower than the slowest laser printers).

Compared to laser printers, the operating cost of an ink jet printer is relatively low. Expensive maintenance is rare, and the only part that needs routine replacement is the ink cartridge, which ranges in price from $20 to $35. Many ink jet printers use one cartridge for color printing and a separate black-only cartridge for black-and-white printing. This feature saves money by reserving colored ink only for color printing.

Color ink jet printers have four ink nozzles: cyan (blue), magenta (red), yellow, and black. For this reason, they are sometimes referred to as CMYK printers, or as using the CMYK color process. These four colors are used in almost all color printing because it is possible to combine them to create any color. Notice that the colors are different from the primary additive colors (red, green, and blue) used in monitors. Printed color is the result of light bouncing off the paper, not color transmitted directly from a light source. Consequently, cyan, magenta, yellow, and black are sometimes called subtractive colors and color printing is sometimes called four-color printing. When used with special printing paper, many ink jet printers can produce photo-quality images. For this reason, they are often used to print pictures taken with a digital camera.

Norton **ONLINE**

For more information on ink jet printers, visit http://www.mhhe.com/petermorton

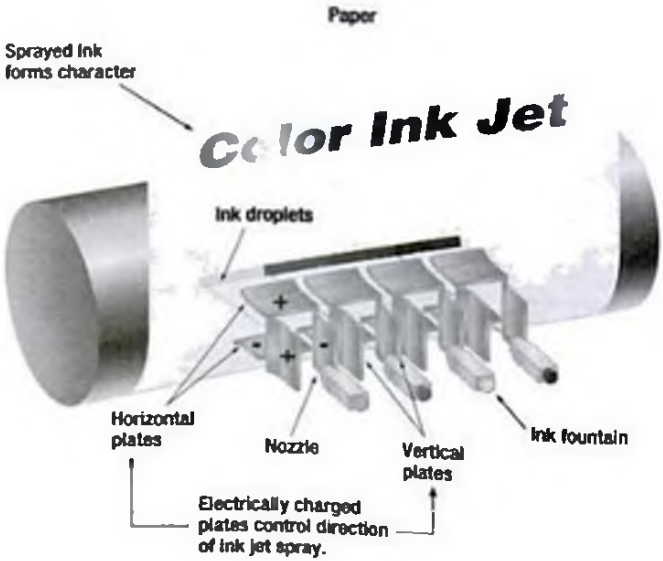


FIGURE 3B.7

How an ink jet printer creates an image.

Urheberrechtlich geschütztes Material

Laser Printers

Laser printers are more expensive than ink jet printers, their print quality is higher, and most are faster. As their name implies, a laser is at the heart of these printers. A CPU and memory are built into the printer to interpret the data that it receives from the computer and to control the laser. The result is a complicated piece of equipment that uses technology similar to that in photocopiers. Figure 3B.8 shows how a laser printer works. The quality and speed of laser printers make them ideal for office environments, where several users can easily share the same printer via a network.

Just as the electron gun in a monitor can target any pixel, the laser in a laser printer can aim at any point on a drum, creating an electrical charge. Toner, which is composed of tiny particles of ink, sticks to the drum in the places the laser has charged. Then, with pressure and heat, the toner is transferred off the drum onto the paper. The amount of memory that laser printers contain determines the speed at which documents are printed.

A color laser printer works like a single-color model, except that the process is repeated four times and a different toner color is used for each pass. The four colors used are the same as in the color ink jet printers: cyan, magenta, yellow, and black.

Single-color (black) laser printers typically can produce between 4 and 16 pages of text a minute. If you are printing graphics, the output can be a great deal slower. The most common laser printers have resolutions of 300 or 600 dpi, both horizontally and vertically, but some high-end models have resolutions of 1,200 or 1,800 dpi. The printing industry stipulates a resolution of at least 1,200 dpi for top-quality professional printing. It is difficult to detect the difference between text printed at 600 dpi and at 1,200 dpi; the higher resolution is most noticeable in graphics reproduction such as photographs and artwork.

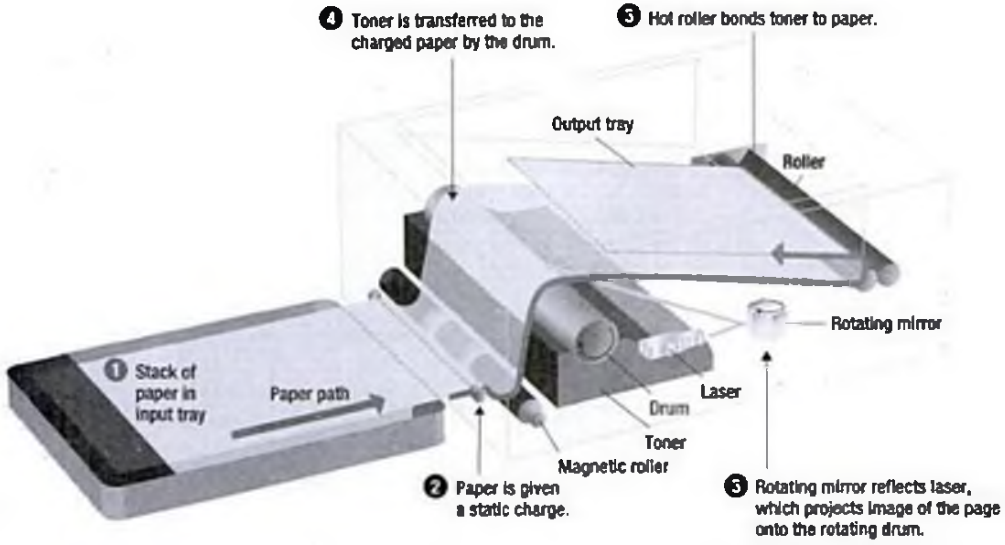
Laser printers start at about $150, and the price increases dramatically along with speed and resolution. Color laser printers are considerably more expensive than single-color printers. In addition, laser printers require new toner cartridges after a few thousand pages, and toner cartridges can cost anywhere from $40 to $200.

Norton ONLINE

For more information on laser printers, visit http://www.mhhe.com/petermorton.

FIGURE 3B.8

How a laser printer creates a printed page.



Urheberrechtlich geschütztes Material



FIGURE 3B.9

All-in-one office machines, like this one, include a printer, copier, scanner, and fax.

All-in-One Peripherals

Several printer makers now use ink jet or laser printers as the basis for all-in-one peripherals (see Figure 3B.9). These devices combine printing capabilities with scanning, photocopying, and faxing capabilities. Small, lightweight, and easy to use, all-in-one devices are popular in home offices and small businesses, among users who cannot afford to buy several professional-quality devices for these tasks.

All-in-one peripherals are available in black-and-white and color models, at prices as low as $200. Laser-based models are significantly more expensive than ink jet models, especially when color printing is required.

Comparing Printers

When you are ready to buy a printer, you must consider how you plan to use it. Do you need to print only text, or are graphics capabilities also important? Do you need to print in color? Will you need to print a wide variety of fonts in many sizes? How quickly do you want your documents to be printed?

When evaluating printers, four additional criteria are important:

- **Image Quality.** Image quality, also known as print resolution, is usually measured in dots per inch (dpi). The more dots per inch a printer can produce, the higher its image quality. For example, most medium-quality ink jet and laser printers can print 300 or 600 dots per inch, which is fine for most daily business applications. If a printer's resolution is 600 dpi, this means it can print 600 columns of dots and 600 rows of dots in each square inch of the page, a total of 360,000 dots (600 × 600 = 360,000) per inch, as shown in Figure 4B.10. Professional-quality printers, used for creating colorful presentations, posters, or renderings, offer resolutions of 1,800 dpi or even higher.
- **Speed.** Printer speed is measured in the number of pages per minute (ppm) the device can print. (As you learned earlier, however, the speed of dot matrix printers is measured in characters per second.) Most printers have different ppm ratings for text and graphics because graphics generally take longer to print. As print speed goes up, so does cost. Most consumer-level laser printers offer print speeds of 6 or 8 ppm, but high-volume professional laser printers can exceed 50 ppm.
- **Initial Cost.** The cost of new printers has fallen dramatically in recent years, while their capabilities and speed have improved just as dramatically. It is possible to buy a good-quality ink jet printer for personal use for less than $100; low-end laser printers can be found for less than $200. Professional-quality, high-output systems can range in price from $1,000 to tens of thousands of dollars. Color printers always cost more than black-and-white printers, and this is especially true of laser printers.

Norton ONLINE

For more information on all-in-one peripherals, visit http://www.mhhe.com/petemorton

FIGURE 3B.10

The image quality of laser and ink jet printers is measured in dots per inch.



Urheberrechtlich geschütztes Material

» **Cost of Operation.** The cost of ink or toner and maintenance varies with the type of printer (see Figure 3B.11). Many different types of printer paper are available, too, and the choice can affect the cost of operation. Low-quality recycled paper, for example, is fine for printing draft-quality documents and costs less than a penny per sheet. Glossy, thick, photo-quality stock, used for printing photographs, can cost several dollars per sheet depending on size.

SELF-CHECK ::

Circle the correct answer for each question.

1. When discussing printers, image quality is also known as this.
   a. output b. resolution c. ppm
2. In a dot matrix printer, this component contains a cluster (or matrix) of pins.
   a. print head b. cartridge c. drum
3. A laser printer's speed is measured in _____ .
   a. cps b. ppm c. dpi

High-Quality Printers

Although most offices and homes use ink jet or laser printers, other types of printers are used for special purposes. These printers are often used by publishers and small print shops to create high-quality output, especially color output. The last type discussed in this section, the plotter, is designed specifically for printing large-format construction and engineering documents.



FIGURE 3B.11

For all their speed and convenience, high-volume printers can be costly to maintain. Toner cartridges for high-quality laser printers can cost well over $100 apiece.

Photo Printers

With digital cameras and scanners becoming increasingly popular, users want to be able to print the images they create or scan. While the average color ink jet or laser printer can handle this job satisfactorily, many people are investing in special photo printers (see Figure 3B.12). Many photo printers use ink jet technology, but a few use dye-sublimation technology. The best photo printers can create images that look nearly as good as a photograph printed using traditional methods.

Photo printers work slowly; some can take two to four minutes to create a printout. Several models create prints no larger than a standard 4 × 6-inch snapshot, although newer photo printers can produce 8 × 10-inch or even 11 × 14-inch prints. Many larger-format photo printers can print multiple images on a single sheet of paper (see Figure 3B.13).



FIGURE 3B.12

Photo printers make it easy to print images taken with a digital camera.



FIGURE 3B.13

Many photo printers can output prints in a variety of sizes.

Urheberrechtlich geschütztes Material

Productivity Tip

The Care and Feeding of Printers

Whether you own a $50 dot matrix printer or a $5,000 color laser printer, you want to get the most from your investment. Although today's printers are much more durable than those of a decade ago, they still work better and last longer if they are properly maintained. Luckily, most consumer-grade printers are easy to take care of. Here are some tips that will help you get years of service from your printer, no matter what kind of device it is.

Getting Basic Information

When maintaining your printer, the best place to start is the owner's manual. Check it for specific instructions on setting up, cleaning, clearing out paper jams, replacing components, and other maintenance-related tasks. You may be able to find these instructions on the manufacturer's Web site.

Always unplug your printer and let it cool down completely before doing any maintenance or cleaning. All printers—especially units that are used a lot—get hot inside, possibly hot enough to burn you. To avoid shock, disconnect the printer's cables from your computer or network. Also, be sure to remove the paper from the printer before working on it.

Positioning a Printer

Make sure your printer has room to breathe. This means setting up so there is space around it, to allow air to flow through the printer. This keeps down dust and avoids overheating. Avoid crowding objects (such as stacks of books or boxes) around the printer, or you may block air flow. Never stack anything on top of a printer; the weight can cause malfunctions.

Cleaning a Printer

Printers usually don't require heavy cleaning, but paper dust and airborne particles can collect inside a printer, adding to heat build-up and leading to mechanical problems. You can clean the outside surfaces of most printers with a dry or damp cloth, but don't use solvents or spray cleaners, which may be harmful to some printer parts.

To clean the inside of the printer, open it up and remove all paper. Remove the toner cartridge, ink cartridges, or ribbon as your owner's manual directs. Use a lint-free cloth or swabs to gently remove built-up dust and dirt. Do not use a wet cloth, and never spray any kind of liquid cleaner into your printer unless the manufacturer recommends doing so.

If the printer has a great deal of dust built up inside, you can use a vacuum cleaner with a narrow nozzle to pull out the dust. If dust appears to be stuck or is embedded in tiny spaces, use a can of compressed air to blast it loose, then vacuum it out.



FIGURE 3B.14

Many photo printers accept the memory card from a digital camera, freeing you from connecting the printer to the camera or to a computer.

Because ink jet photo printers spray so much ink on the paper, it can take several minutes for a printout to dry, so smearing can be a problem. Still, these printers give digital photography enthusiasts a way to print and display their photos in hard-copy form. Photo printers range in price from $200 to more than $500, and the cost per print ranges from a few cents to a dollar (several times more expensive than traditional film processing).

One advantage of the newest photo printers is that they do not need a computer. These photo printers feature slots for memory cards used by many digital cameras (see Figure 3B.14). Instead of connecting the printer to a computer, the user can simply remove the memory card from the camera and plug it into the printer. Some photo printers can connect directly to a camera by a cable or even by an infrared connection.

Thermal-Wax Printers

Thermal-wax printers are used primarily for presentation graphics and handouts. They create bold colors and have a low per-page cost for printouts with heavy

Urheberrechtlich geschütztes Material

Dealing with Paper Jams

For years, paper jams have been the scourge of computer users. They strike at the worst times, and can take a long time to clear out. The best way to solve this problem is to prevent it:

- Make sure your paper is compatible with your printer. Some ink jet printers, for example, do not work well with thick, glossy paper. Check your manual to see what weights and sizes of paper will work best with your printer.
- Set the printer on an even, level surface. Tilting can encourage paper jams.
- Don't overfill the paper tray. Paper must be flat and able to slide freely through the mechanism. If the tray is crammed with paper, the sheets may be buckled or stuffed in too tightly to move.

If you experience a paper jam, see your owner's manual for instructions on clearing it. If paper jams are a common problem, contact the manufacturer for help.



Compressed air is inexpensive and easy to use and can help keep your printer in top shape.

Maintaining Your Drivers

Printers use special programs, called drivers, which enable them to communicate and exchange data with your PC and programs. If you use Windows 98, Me, NT, 2000, or XP, then there's a good chance that your printer's driver is built into the operating system. If not, you can install your printer's driver from the disk that comes with the printer.

Printer makers sometimes release updated versions of their printers' drivers, and it's a good idea to make sure that you are using the most current driver. To check for updated drivers, visit the manufacturer's Web site. If you use Microsoft's Windows Update service, your updated drivers may be available there. For more information on Windows Update, visit http://windowsupdate.microsoft.com.

color requirements, such as posters or book covers. The process creates vivid colors because the inks do not bleed into each other or soak the specially coated paper. Thermal-wax printers operate with a ribbon coated with panels of colored wax that melts and adheres to plain paper as colored dots when passed over a focused heat source.

Dye-Sublimation Printers

Desktop publishers and graphic artists get realistic quality and color for photo images using dye-sublimation (dye-sub) printers (see Figure 3B.15). In dye-sublimation technology, a ribbon containing panels of color is moved across a focused heat source capable of subtle temperature variations. The heated dyes evaporate from the ribbon and diffuse on specially coated paper or another



FIGURE 3B.15

Dye-sublimation printers come in a wide range of sizes and are used to print all kinds of high-resolution color documents, such as photographs, presentation graphics, posters, and t-shirts.

Urheberrechtlich geschütztes Material

Computers In Your Career

Computer Training Specialist

Not everyone is proficient with computers, and not everyone wants to be. It's Karen Koenig's job to make sure that the students she's working with leave her classroom not only more knowledgeable about computers, but also more confident in their ability to use them in daily life.

"Once in a while I'll get a student who is afraid to touch the computer, for fear that he or she may delete files or mess something up," says Koenig, a computer training specialist in the Professional and Community Education area of Bowling Green State University's Continuing & Extended Education program located in Bowling Green, Ohio. "It's very rewarding when that same person walks out of my classroom feeling much more comfortable using technology."

A graduate of Bowling Green State University, Koenig earned her degree in business education and is a certified Microsoft Office User Specialist (MOUS). She began her career teaching a sole computer class, and later became a full-time instructor. Koenig spends her time teaching both day and evening classes of university faculty/staff and other adult students on how to use computers and specific applications like Microsoft Excel and Microsoft Word. Along the way, she's mastered applications such as HTML for Web site building and university-specific programs, such as a calendar-scheduling application used by faculty and staff.

Koenig sees future opportunities for computer trainers as good, based on how integrated computers are in our everyday lives. "It's amazing just how many people know nothing about computers, even though they've been around for so long," says Koenig, who is continually updating her own skills to meet her students' needs.

A successful trainer needs a strong background in general computer hardware and software. This means that a trainer should have a solid understanding of how a computer system functions and a mastery of current operating systems and common application software.

material, where they form areas of different colors. The variations in color are related to the intensity of the heat applied. Dye-sub printers create extremely sharp images, but they are slow and costly. The special paper they require can make the per-page cost as high as $3 to $4.

Plotters

A plotter is a special kind of output device. It is like a printer because it produces images on paper, but the plotter is typically used to print large-format images, such as construction drawings created by an architect.

Early plotters were bulky, mechanical devices that used robotic arms, which literally drew the image on a piece of paper. Table plotters (or flatbed plotters) use two robotic arms, each of which holds a set of colored ink pens, felt pens, or pencils. The two arms work in concert, operating at right angles as they draw on a stationary piece of paper. In addition to being complex and large (some are almost as big as a billiard table), table plotters are notoriously slow; a large, complicated drawing can take several hours to print.



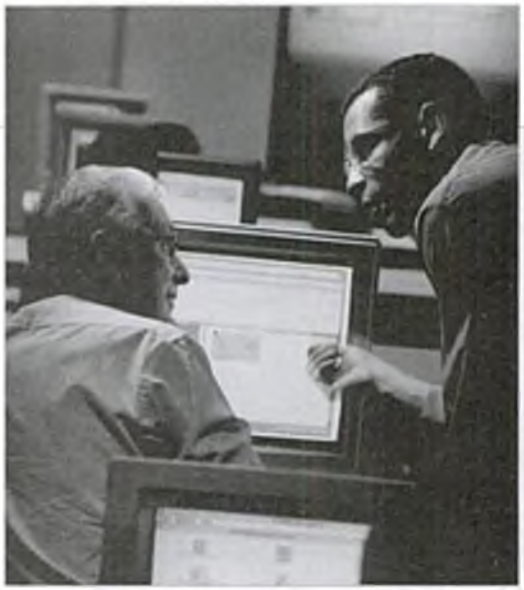
FIGURE 3B.16

A roller plotter uses a robotic arm to draw with colored pens on oversized paper. Here, an architectural drawing is being printed.

Urheberrechtlich geschütztes Material

Often, trainers must get additional instruction or certification if they want to teach others to use certain programs. Companies such as Microsoft and Oracle, for example, offer trainer-certification programs that ensure employers that a trainer has mastered certain products and is qualified to teach others how to use them.

The pay scale for computer training specialists covers a wide range. Freelance trainers, for instance, may charge an hourly rate (ranging from $25 to $50, or higher), which goes up with the complexity of the programs being taught. The annual salary for full-time trainers can start out in the $18,000 to $30,000 range, but can go up with experience and expertise. Top-level trainers (who teach other trainers and develop training courses or materials) can earn $50,000 per year or more.



A variation on the table plotter is the roller plotter (also known as the drum plotter), which uses only one drawing arm but moves the paper instead of holding it flat and stationary (see Figure 3B.16). The drawing arm moves side to side as the paper is rolled back and forth through the roller. Working together, the arm and roller can draw perfect circles and other geometric shapes, as well as lines of different weights and colors.

In recent years, mechanical plotters have been displaced by thermal, electrostatic, and ink jet plotters, as well as large-format dye-sub printers. These devices, which also produce large-size drawings, are faster and cheaper to use than their mechanical counterparts. They also can produce full-color renderings as well as geometric line drawings, making them more useful than standard mechanical plotters (see Figure 3B.17).



FIGURE 3B.17

Like desktop ink jet printers, an ink jet plotter uses a spray system to create either simple line drawings or detailed artistic renderings.

Urheberrechtlich geschütztes Material

Summary ::

- Printers fall into two general categories: impact and nonimpact.
- Impact printers create an image on paper by using a device to strike an inked ribbon, pressing ink from the ribbon onto the paper. Nonimpact printers use various methods to place ink on the page.
- When evaluating printers for purchase, you should consider four criteria: image quality, speed, initial cost, and cost of operation.
- A dot matrix printer is an impact printer. It uses a print head that contains a cluster of pins. The printer can push the pins out in rapid sequence to form patterns. The pins are used to press an inked ribbon against paper, creating an image.
- The speed of dot matrix printers is measured in characters per second. The fastest ones can print 500 characters each second.
- An ink jet printer is an example of a nonimpact printer. It creates an image by spraying tiny droplets of ink onto the paper.
- Ink jet printers are inexpensive for both color and black printing, have low operating costs, and offer quality and speed comparable to low-end laser printers.
- Laser printers are nonimpact printers. They use heat and pressure to bond tiny particles of toner (a dry ink) to paper.
- Laser printers produce higher-quality print and are fast and convenient to use, but they are also more expensive than ink jet printers. Laser printers are available in both color and black and white, and the highest-end laser printers provide resolutions of 1,200 dpi and greater.
- Thermal-wax and dye-sublimation printers are used primarily by print shops and publishers to create high-quality color images.
- Photo printers are specialized printers used to print color photographs taken with digital cameras.
- Plotters create large-format images, usually for architectural or engineering purposes, using mechanical drawing arms, ink jet technology, or thermal printing technology.

Urheberrechtlich geschütztes Material

Key Terms ::

all-in-one peripheral, 112
band printer, 109
characters per second (cps), 109
dot matrix printer, 108
dots per inch (dpi), 112
dye-sublimation (dye-sub) printer, 115
impact printer, 108
ink jet printer, 110
laser printer, 111
line printer, 109
nonimpact printer, 108
pages per minute (ppm), 112
photo printer, 113
plotter, 116
print head, 108
thermal-wax printer, 114
toner, 111

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. A(n) _____ printer creates an image by using pins or hammers to press an inked ribbon against the paper.
2. A dot matrix printer creates an image by using a mechanism called a(n) _____ .
3. The speed of dot matrix printers is measured in _____ _____ .
4. A laser printer is an example of a(n) _____ printer.
5. A(n) _____ printer creates an image by spraying ink through tiny nozzles.
6. A laser printer uses tiny particles of ink, called _____ , to create an image.
7. A device that combines printing, scanning, faxing, and copying capabilities is called a(n) _____ .
8. An ink jet printer's image quality is measured in _____ .
9. A laser printer's speed is measured in _____ .
10. A(n) _____ printer creates vivid colors because the inks do not bleed into each other or soak the specially coated paper.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. Which of the following is the most common type of impact printer?
   a. typewriter b. dot matrix printer c. line printer d. band printer
2. A laser printer works like this device.
   a. scanner b. dot matrix printer c. photocopier d. fax machine
3. A dot matrix printer's print head contains a cluster of _____ .
   a. pins b. dots c. hammers d. characters
4. Which type of impact printer prints an entire line of text at one time?
   a. hammer printer b. ink jet printer c. band printer d. line printer
5. In ink jet printers, only this part needs routine replacement.
   a. ink jet b. ink well c. ink cartridge d. ink blot
6. Cyan, magenta, yellow, and black are sometimes called _____ colors.
   a. multiplicative b. divisive c. additive d. subtractive
7. The term *dots per inch (dpi)* refers to a printer's _____ .
   a. resolution b. speed c. output d. colors
8. Which printer's speed is *not* measured in pages per minute?
   a. ink jet b. dot matrix c. laser d. plotter
9. Most photo printers use this technology.
   a. plotter b. laser c. thermal-wax d. ink jet
10. To print out large-format copies of construction drawings, an architect might use this device.
    a. photo printer b. plotter c. line printer d. laser printer

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What is the difference between an impact printer and a nonimpact printer?
2. How does a dot matrix printer create an image on paper?
3. How does a band printer work?
4. What kind of resolution and speed can you expect from a low-cost ink jet printer?
5. What four colors are used in color ink jet and laser printers?
6. How does a laser printer create an image on paper?
7. What four factors should you consider when evaluating printers?
8. If a printer is said to have a resolution of 600 dpi, what does this mean?
9. Describe a specific advantage of some new photo printers.
10. How does a dye-sublimation printer create an image on paper?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Find out what type of printer is connected to your computer. Open your PC's Printers window as directed by your instructor. If a printer is connected to your system, it will appear in this window. Right-click the printer's icon to open a shortcut menu. Then choose Properties to open the Properties dialog box for the printer. Write down the data in the dialog box. Do not make any changes in the dialog box, but leave it open for the next exercise.
2. With your printer's Properties dialog box open, click the General tab. Near the bottom of the tab, click the button labeled Print Test Page. A new dialog box appears, asking you to confirm that your printer produced a test page. If your printer produced a test page, click Yes (or Ok). If not, click No (or Troubleshoot) and ask your instructor for assistance. When you are finished, click Cancel to close the dialog box. Close all open windows.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Change your display's color settings. By experimenting with your PC's color settings, you can determine the settings that work best for you. For example, if you do not plan to browse the World Wide Web or use multimedia products, you probably do not need to use the system's highest color settings; if you do, you need to make sure your monitor's settings are up to the task or you will not get the most from your computing experience. Before you take the following steps, close any running programs and make sure there is no disk in your system's floppy disk drive.
   a. Click the Start button to open the Start menu. Next, click Control Panel. The Control Panel window opens.
   b. Double-click the Display icon. The Display Properties dialog box opens.
   c. Click the Settings tab. Note the setting in the Color quality box and write it down.
   d. Click the Color quality drop-down list arrow and choose the lowest color setting. Then click Apply. Follow any instructions that appear on your screen. (Your computer may restart.)
   e. Open a program or two and look at the screen. How does it look? Note your impressions.
   f. Repeat steps A through E, this time choosing the highest color setting. Again, note your impressions.
   g. Repeat steps A through E, and select the system's original color setting.
2. What is your resolution? Like the color setting, your system's screen resolution can affect the quality of your computing experience. If your resolution is set too high, text and icons may be too small to view comfortably and you may strain your eyes. If the resolution is too low, you will spend extra time navigating to parts of your applications that do not fit on the screen. Try different settings to find what works best for you.
   a. Click the Start button to open the Start menu. Next, click Control Panel. The Control Panel window opens.
   b. Double-click the Display icon. The Display Properties dialog box opens.
   c. Click the Settings tab. Note the current setting in the Screen resolution box and write it down.
   d. Click the Screen resolution slider control and drag it to the lowest setting. Then click Apply. Follow any instructions that appear on your screen. (Your computer may restart.)
   e. Open a program or two and look at the screen. How does it look? Note your impressions.
   f. Repeat steps A through E, this time choosing the highest setting. Again, note your impressions.
   g. Repeat steps A through E, and select the system's original resolution setting.
3. Pick your dream printer. Visit these Web sites for information on various types of printers:

   Canon. http://www.usa.canon.com/consumer

   Epson. http://www.epson.com

Urheberrechtlich geschütztes Material

Hewlett-Packard. http://www.hp.com
Lexmark. http://www.lexmark.com
NEC Technologies. http://www.nectech.com
Okidata. http://www.okidata.com
Tektronix. http://www.tek.com

When you are finished, decide which device would work best for you. Be prepared to tell your classmates about the device and to explain why you selected it.

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. When you think about the two most frequently used output devices for computers (monitors and printers), why will color technology for printers become more commonplace, more affordable, and more necessary to many users?
2. Think about your career plans. What type of output devices will be essential to your work?

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics.

- Trends in monitor sizes, features, and prices.
- The most popular type of printer among home users.
- An in-depth discussion of dye-sublimation technology and its uses.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

We may think we cannot use a computer unless it has a full array of output devices, but is this true? With this thought in mind, discuss the following questions in class.

1. The number of unneeded printouts is growing every year. This practice wastes paper, electricity, storage space, and natural resources. It also contributes to pollution and landfill use. If you could do one thing to reduce the practice of unnecessary printing, what would it be? Would you restrict paper use in offices? Would you ration paper? Would you take printers away from certain types of workers? Would you forbid the printing of certain types of documents (such as e-mail messages)? Are such radical actions needed? If you do not agree, what types of actions would you support?
2. Because PCs provide an ever-increasing variety of multimedia options, people are spending more and more time at their computers. Much of this time is spent playing games, downloading music from the Internet, Web surfing, and so on. In fact, recent studies indicate that many computer users are addicted to the Internet or to game playing. Do these facts bother you? Why or why not? Do you worry that you spend too much time at your computer? What would you do to help a friend or coworker if you thought he or she was devoting too much time to the computer?

Urheberrechtlich geschütztes Materi



CHAPTER 4

Processing Data

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson 4A:
Transforming Data into Information

- How Computers Represent Data
- How Computers Process Data
- Factors Affecting Processing Speed

Lesson 4B:
Modern CPUs

- A Look Inside the Processor
- Microcomputer Processors
- RISC Processors
- Parallel Processing
- Extending the Processor's Power to Other Devices



LESSON // 4A

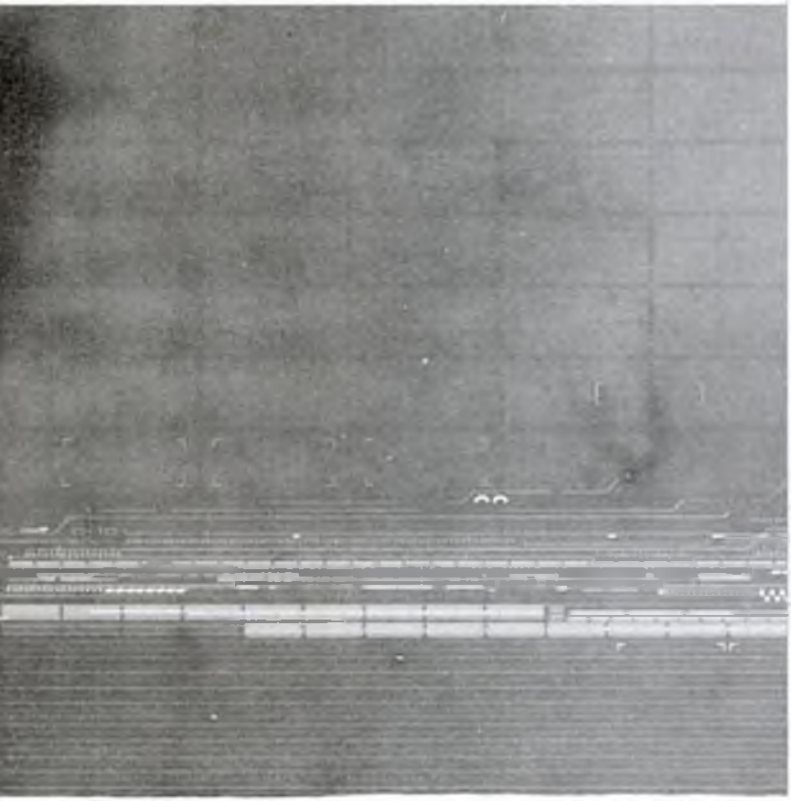
Transforming Data into Information

Overview: The Difference between Data and Information

It often seems as though computers must understand us because we understand the information they produce. However, computers cannot understand anything. Computers recognize two distinct physical states produced by electricity, magnetic polarity, or reflected light. Essentially, they understand whether a switch is on or off. In fact, the CPU, which acts like the "brain" of the computer, consists of several million tiny electronic switches, called transistors. A computer appears to understand information only because it operates at such phenomenal speeds, grouping its individual on/off switches into patterns that become meaningful to us.

In the world of computing, *data* is the term used to describe the information represented by groups of on/off switches. Although the words *data* and *information* often are used interchangeably, there is an important distinction between the two words. In the strictest sense, data consist of the raw numbers that computers organize to produce information.

You can think of data as facts out of context, like the individual letters on this page. Taken individually, most of them do not have much, if any, meaning. Grouped together, however, the data convey specific meanings. Just as a theater's marquee can combine thousands of lights to spell the name of the current show, a computer can group meaningless data into useful information, such as spreadsheets, charts, and reports.



OBJECTIVES ::

- Explain why computers use the binary number system.
- List the two main parts of the CPU and explain how they work together.
- List the steps that make up a machine cycle.
- Explain the difference between RAM and ROM.
- List three hardware factors that affect processing speed.

Urheberrechtlich geschütztes Material

How Computers Represent Data

simnet™

From a very early age, we are introduced to the concept of numbers and counting. Toddlers learn early that they can carry two cookies, one in each hand. Kindergartners start counting by twos and fives. Invariably, we use the decimal number system. Our number system is based on 10, most likely because we have 10 fingers. A number system is simply a manner of counting. Many different number systems exist. Consider a clock. Clocks have 24 hours, each composed of 60 minutes. Each minute is composed of 60 seconds. When we time a race, we count in seconds and minutes.

Computers, like clocks, have their own numbering system, the binary number system.

Number Systems

To a computer, everything is a number. Numbers are numbers; letters and punctuation marks are numbers; sounds and pictures are numbers. Even the computer's own instructions are numbers. When you see letters of the alphabet on a computer screen, you are seeing just one of the computer's ways of representing numbers. For example, consider the following sentence:

Here are some words.

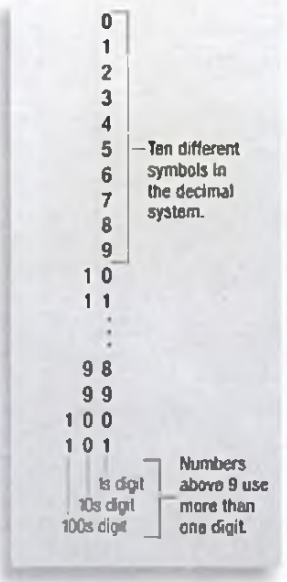
This sentence may look like a string of alphabetic characters to you, but to a computer it looks like the string of ones and zeros shown in Figure 4A.1.

FIGURE 4A.1

These 1s and 0s represent a sentence. The decimal system uses 10 symbols and multiple digits for the numbers 9 and higher.

H	0100 1000
e	0110 0101
r	0111 0010
e	0110 0101
	0010 0000
a	0110 0001
r	0111 0010
e	0110 0101
	0010 0000
s	0111 0011
o	0110 1111
m	0110 1101
e	0110 0101
	0010 0000
w	0111 0111
o	0110 1111
r	0111 0010
d	0110 0100
s	0111 0011
.	0010 1110

Computer data looks especially strange because people normally use base 10 to represent numbers. The decimal number system (*deci* means "10" in Latin) is called "base 10" because 10 symbols are available: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. When you need to represent a number greater than 9, you use two symbols together, as in 9 + 1 = 10. Each symbol in a number is called a "digit," so 10 is a two-digit number. To build all the two-digit numbers (10–99) in the decimal number system, you use up all the possible pairings of the system's 10 symbols. After all 90 of the two-digit numbers are built, then you begin using three-digit numbers (100–999), and so on. This pattern can continue indefinitely, using only the 10 symbols you started with.



As the numbers start to become longer, the concept of place becomes important. Consider the number 1,325. Four places are represented in this number: the thousands, hundreds, tens, and ones. Thus, there is a 1 in the thousands place, a 3 in the hundreds place, a 2 in the tens place, and a 5 in the ones place. Figure 4A.2 illustrates the value of place.

FIGURE 4A.2

The decimal value 1,325 broken down into thousands, hundreds, tens, and ones places.

1325

= 1 * 1000 + 3 * 100 + 2 * 10 + 5 * 1

In a computer, however, all data is represented by the state of the computer's electronic switches. A switch has only two possible states—on and off—so it can represent only two numeric values. To a computer, when a switch is

Urheberrechtlich geschütztes Material

off, it represents a 0; when a switch is on, it represents a 1 (see Figure 4A.3). Because there are only two values, computers are said to function in base 2, which is also known as the binary number system (*bi* means "2" in Latin).



FIGURE 4A.3

Places in the decimal number system. In a computer, data are represented by the state of electronic switches. If a switch is on, it represents a 1. If a switch is off, it represents a 0.

When a computer needs to represent a quantity greater than one, it does the same thing you do when you need to represent a quantity greater than nine: it uses two (or more) digits. With only two digits to work with, there are many fewer two-digit pairings than in the decimal system. Binary has only two two-digit pairings. Once these two pairings are exhausted, four three-digit pairings are built. To familiarize yourself with the binary system, look at Table 4A.1.

In examining Table 4A.1 several trends become apparent. The first trend: notice that all odd numbers in decimal have a 1 as the last binary digit. A second trend: the pattern repeats. Consider the first four digits: 0, 1, 10, 11. The three-digit numbers repeat the pattern in order with a 1 (and filler zeros) placed at the beginning. The same is true of the eight four-digit numbers. They simply repeat the previous eight patterns in order, placing a 1 (and filler zeros) at the beginning. This pattern repeats indefinitely.

Norton ONLINE

For more information on number systems, visit http://www.mhhe.com/petermorton

Bits and Bytes

When referring to computerized data, the value represented by each switch's state—whether the switch is turned on or off—is called a bit (a combination of *bi*nary digit). A bit is the smallest possible unit of data a computer can recognize or use. To represent anything meaningful (in other words, to convey information), the computer uses bits in groups.

A group of eight bits is called a byte (see Figure 4A.4). Half of a byte is called a nibble. With one byte, the computer can represent one of 256 different symbols or characters because the eight 1s and 0s in a byte can be combined in 256 different ways.

The value 256 is more than the number of symbols; it is the number of patterns of 0 and 1 that can be created using eight bits. This number can be obtained using a calculation: There are two possible states for a switch, on and off. In a byte there are eight switches. To calculate the number of patterns, raise 2 to the number of bits: $2^8 = 256$. Table 4A.2 shows the first 9 powers of 2.

The byte is an extremely important unit because there are enough different eight-bit combinations to represent all the characters on the keyboard, including all the letters (uppercase and lowercase), numbers, punctuation marks, and other symbols. If you look back at Figure 4A.1, you will notice that each of the characters (or letters) in the sentence *Here are some words.* is represented by one byte (eight bits) of data.

TABLE 4A.1

Counting in Base 10 and Base 2

Base 10	Base 2
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16	10000

Text Codes

Early programmers realized that they needed a standard text code that was agreeable to all of them. In such a system, numbers would represent the letters of the alphabet, punctuation marks, and other symbols. This standard code system would enable any programmer or program to use the same combinations of numbers to represent the same individual pieces of data. The four most popular text code systems invented are the following:

» **EBCDIC.** EBCDIC (pronounced EB-si-dic) stands for Extended Binary Coded Decimal Interchange Code. EBCDIC is an eight-bit code that defines 256 symbols. It is still used in IBM mainframe and midrange systems, but it is rarely encountered in personal computers.

Urheberrechtlich geschütztes Material



FIGURE 4A.4

One byte is composed of eight bits. A nibble is four bits.

TABLE 4A.2

Powers of 2

Power of 2	Value
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256

simnet™

Norton ONLINE

For more information on text codes, visit http://www.mhhe.com/peternorton

» **ASCII.** ASCII (pronounced AS-key) stands for the American Standard Code for Information Interchange. Today, the ASCII character set is by far the most commonly used in computers of all types. Table 4A.3 shows the 128 ASCII codes. ASCII is an eight-bit code that specifies characters for values from 0 to 127.

» **Extended ASCII.** Extended ASCII is an eight-bit code that specifies the characters for values from 128 to 255. The first 40 symbols represent pronunciation and special punctuation. The remaining symbols are graphic symbols.

» **Unicode.** The Unicode Worldwide Character Standard provides up to four bytes—32 bits—to represent each letter, number, or symbol. With four bytes, enough Unicode codes can be created to represent more than 4 billion different characters or symbols. This total is enough for every unique character and symbol in the world, including the vast Chinese, Korean, and Japanese character sets and those found in known classical and historical texts. In addition to world letters, special mathematical and scientific symbols are represented in Unicode. One major advantage that Unicode has over other text code systems is its compatibility with ASCII codes. The first 256 codes in Unicode are identical to the 256 codes used by the ASCII and Extended ASCII systems.

How Computers Process Data

Two components handle processing in a computer: the central processing unit, or CPU, and the memory. Both are located on the computer's motherboard (see Figure 4A.5).

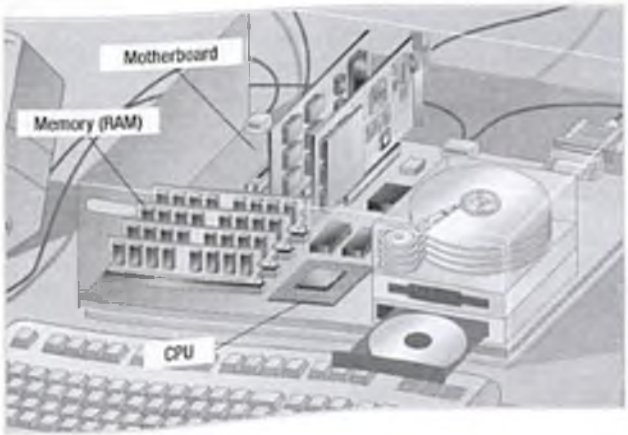


FIGURE 4A.5

Processing devices.

Urheberrechtlich geschütztes Material

TABLE 4A.3

ASCII Codes

ASCII Code	Decimal Equivalent	Character	ASCII Code	Decimal Equivalent	Character	ASCII Code	Decimal Equivalent	Character
0000 0000	0	Null prompt	0010 1011	43	+	0101 0110	86	V
0000 0001	1	Start of heading	0010 1100	44	,	0101 0111	87	W
0000 0010	2	Start of text	0010 1101	45	-	0101 1000	88	X
0000 0011	3	End of text	0010 1110	46	.	0101 1001	89	Y
0000 0100	4	End of transmit	0010 1111	47	/	0101 1010	90	Z
0000 0101	5	Enquiry	0011 0000	48	0	0101 1011	91	[
0000 0110	6	Acknowledge	0011 0001	49	1	0101 1100	92	\
0000 0111	7	Audible bell	0011 0010	50	2	0101 1101	93	]
0000 1000	8	Backspace	0011 0011	51	3	0101 1110	94	^
0000 1001	9	Horizontal tab	0011 0100	52	4	0101 1111	95	_
0000 1010	10	Line feed	0011 0101	53	5	0110 0000	96	`
0000 1011	11	Vertical tab	0011 0110	54	6	0110 0001	97	a
0000 1100	12	Form feed	0011 0111	55	7	0110 0010	98	b
0000 1101	13	Carriage return	0011 1000	56	8	0110 0011	99	c
0000 1110	14	Shift out	0011 1001	57	9	0110 0100	100	d
0000 1111	15	Shift in	0011 1010	58	:	0110 0101	101	e
0001 0000	16	Data link escape	0011 1011	59	;	0110 0110	102	f
0001 0001	17	Device control 1	0011 1100	60	<	0110 0111	103	g
0001 0010	18	Device control 2	0011 1101	61	=	0110 1000	104	h
0001 0011	19	Device control 3	0011 1110	62	>	0110 1001	105	i
0001 0100	20	Device control 4	0011 1111	63	?	0110 1010	106	j
0001 0101	21	Neg. acknowledge	0100 0000	64	@	0110 1011	107	k
0001 0110	22	Synchronous idle	0100 0001	65	A	0110 1100	108	l
0001 0111	23	End trans. block	0100 0010	66	B	0110 1101	109	m
0001 1000	24	Cancel	0100 0011	67	C	0110 1110	110	n
0001 1001	25	End of medium	0100 0100	68	D	0110 1111	111	o
0001 1010	26	Substitution	0100 0101	69	E	0111 0000	112	p
0001 1011	27	Escape	0100 0110	70	F	0111 0001	113	q
0001 1100	28	File separator	0100 0111	71	G	0111 0010	114	r
0001 1101	29	Group separator	0100 1000	72	H	0111 0011	115	s
0001 1110	30	Record separator	0100 1001	73	I	0111 0100	116	t
0001 1111	31	Unit separator	0100 1010	74	J	0111 0101	117	u
0010 0000	32	Blank space	0100 1011	75	K	0111 0110	118	v
0010 0001	33	!	0100 1100	76	L	0111 0111	119	w
0010 0010	34	"	0100 1101	77	M	0111 1000	120	x
0010 0011	35	#	0100 1110	78	N	0111 1001	121	y
0010 0100	36	$	0100 1111	79	O	0111 1010	122	z
0010 0101	37	%	0101 0000	80	P	0111 1011	123	{
0010 0110	38	&	0101 0001	81	Q	0111 1100	124	|
0010 0111	39	'	0101 0010	82	R	0111 1101	125	}
0010 1000	40	(	0101 0011	83	S	0111 1110	126	~
0010 1001	41	)	0101 0100	84	T	0111 1111	127	Delete or rubout
0010 1010	42	*	0101 0101	85	U			

Urheberrechtlich geschütztes Material

The CPU

The CPU is the "brain" of the computer, the place where data is manipulated. In large computer systems, such as supercomputers and mainframes, processing tasks may be handled by multiple processing chips. (Some powerful computer systems use hundreds or even thousands of separate processing units.) In the average microcomputer, the entire CPU is a single unit, called a microprocessor. Regardless of its construction, every CPU has at least two basic parts: the control unit and the arithmetic logic unit.

The Control Unit

All the computer's resources are managed from the control unit. Think of the control unit as a traffic signal directing the flow of data through the CPU, as well as to and from other devices. The control unit is the logical hub of the computer.

The CPU's instructions for carrying out commands are built into the control unit. The instructions, or instruction set, list all the operations that the CPU can perform. Each instruction in the instruction set is expressed in microcode—a series of basic directions that tell the CPU how to execute more complex operations.

The Arithmetic Logic Unit

Because all computer data is stored as numbers, much of the processing that takes place involves comparing numbers or carrying out mathematical operations. In addition to establishing ordered sequences and changing those sequences, the computer can perform two types of operations: arithmetic operations and logical operations. Arithmetic operations include addition, subtraction, multiplication, and division. Logical operations include comparisons, such as determining whether one number is equal to, greater than, or less than another number. Also, every logical operation has an opposite. For example, in addition to "equal to" there is "not equal to." Table 4A.4 shows the symbols for all the arithmetic and logical operations.

Many instructions carried out by the control unit involve simply moving data from one place to another—from memory to storage, from memory to the printer, and so forth. When the control unit encounters an instruction that involves arithmetic or logic, however, it passes that instruction to the second component of the CPU, the arithmetic logic unit, or ALU. The ALU actually performs the arithmetic and logical operations described earlier.

The ALU includes a group of registers—high-speed memory locations built directly into the CPU that are used to hold the data currently being processed. You can think of the register as a scratchpad. The ALU will use the register to hold the data currently being used for a calculation. For example, the control unit might load two numbers from memory into the registers in the ALU. Then it might tell the ALU to divide the two numbers (an arithmetic operation) or to see whether the numbers are equal (a logical operation). The answer to this calculation will be stored in another register before being sent out of the CPU.

TABLE 4A.4

Operations Performed by the Arithmetic Logic Unit

Arithmetic Operations		Logical Operations	
+	add	=, ≠	equal to, not equal to
−	subtract	>, ≯	greater than, not greater than
×	multiply	<, ≮	less than, not less than
÷	divide	≥, ≱	greater than or equal to, not greater than or equal to
^	raise by a power	≤, ≰	less than or equal to, not less than or equal to

Machine Cycles

Each time the CPU executes an instruction, it takes a series of steps. The completed series of steps is called a machine cycle. A machine cycle itself can be broken down into two smaller

Urheberrechtlich geschütztes Material

cycles: the instruction cycle and the execution cycle. At the beginning of the machine cycle (that is, during the instruction cycle), the CPU takes two steps:

1. **Fetching.** Before the CPU can execute an instruction, the control unit must retrieve (or fetch) a command or data from the computer's memory.
2. **Decoding.** Before a command can be executed, the control unit must break down (or decode) the command into instructions that correspond to those in the CPU's instruction set. Figure 4A.6 shows how the CPU plays a sound.

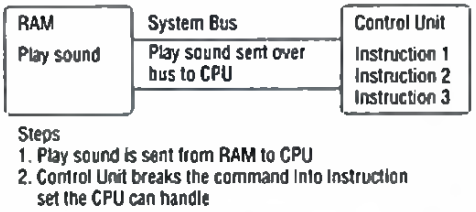


FIGURE 4A.6

Fetching and decoding an instruction to play a sound.

At this point, the CPU is ready to begin the execution cycle:

1. **Executing.** When the command is executed, the CPU carries out the instructions in order by converting them into microcode.
2. **Storing.** The CPU may be required to store the results of an instruction in memory (but this condition is not always required). Figure 4A.7 shows the result of the sound being played.

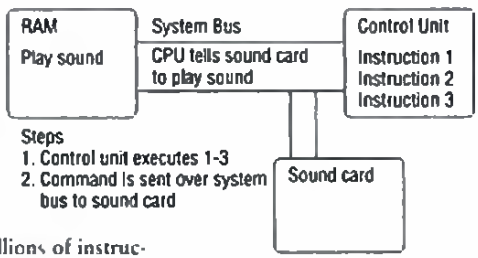


FIGURE 4A.7

The execution cycle plays the sound.

Although the process is complex, the computer can accomplish it at an incredible speed, translating millions of instructions every second. In fact, CPU performance is often measured in millions of instructions per second (MIPS). Newer CPUs can be measured in billions of instructions per second (BIPS).

Even though most microprocessors execute instructions rapidly, newer ones can perform even faster by using a process called pipelining (or pipeline processing). In pipelining, the control unit begins a new machine cycle—that is, it begins executing a new instruction—before the current cycle is completed. Executions are performed in stages: When the first instruction completes the "fetching" stage, it moves to the "decode" stage and a new instruction is fetched. It is helpful to think of a pipeline as an assembly line. Each instruction is broken up into several parts. Once the first part of an instruction is done, it is passed to the second part. Since the first step in the line is now idle, the pipeline then feeds a new step one. Using this technique, newer microprocessors can execute up to 20 instructions simultaneously.

Modern operating systems support the running of many programs, or multitasking. The CPU may be asked to perform tasks for more than one program. To make this work, the OS and the CPU create threads. A thread is one instruction from a program. The CPU will execute one thread from a program at one time. Since the CPU can perform each thread quickly, the user thinks that each program is being run at the same time. Newer processors support hyperthreading. Hyperthreading allows multiple threads to be executed at one time.

Norton ONLINE

For more information on machine cycles, visit http://www.mhhe.com/petemorton.

Memory

The CPU contains the basic instructions needed to operate the computer, but it cannot store entire programs or large sets of data permanently. The CPU needs to have millions (or even trillions, in some computers) of bytes of space where it can quickly read or write programs and data while they are being used. This area is called memory, and it consists of chips either on the motherboard or on a small circuit board attached to the motherboard. This electronic memory allows the CPU to store and retrieve data quickly.

There are two types of built-in memory: permanent and nonpermanent (see Figure 4A.8). Some memory chips retain the data they hold, even when the computer is turned off. This type of permanent memory is called nonvolatile. Other

Urheberrechtlich geschütztes Material



FIGURE 4A.8

The CPU is attached to two kinds of memory: RAM, which is volatile, and ROM, which is nonvolatile.

chips—in fact, most of the memory in a microcomputer—lose their contents when the computer's power is shut off. This type of nonpermanent memory is called volatile.

Nonvolatile Memory

Nonvolatile chips hold data even when the computer is unplugged. In fact, putting data permanently into this kind of memory is called "burning in the data," and it is usually done at the factory. During normal use, the data in these chips is only read and used—not changed—so the memory is called read-only memory (ROM). Specifically, chips that cannot be changed are called programmable read only memory (PROM). PROM chips are often found on hard drives and printers. They contain the instructions that power the devices. These instructions, once set, never need to be changed.

When a computer is turned on, it must know how to start. ROM contains a set of start-up instructions called the basic input output system (BIOS) for a computer. In addition to booting the machine, BIOS contains another set of routines, which ensure that the system is functioning properly and all expected hardware devices are present. This routine is called the power on self test (POST).



FIGURE 4A.9

A 512MB CompactFlash card for a digital camera.

Flash Memory

Flash memory is a special type of nonvolatile memory. It is often used in portable digital devices for storage. Digital cameras, portable MP3 players, USB "keychain" storage devices, and game consoles all use flash memory. The flash memory works by having actual switches store the binary values that make up the data. Thus, on a camera with a flash card, the picture is stored on the card by turning millions of tiny switches on and off. Barring catastrophic damage to the card, the picture is stored indefinitely. Figure 4A.9 shows a typical flash memory card.

Volatile Memory

Volatile memory requires power to store data. The volatile memory in a computer is called random access memory (RAM). When people talk about computer memory in connection with microcomputers, they usually mean the RAM. RAM's job is to hold programs and data while they are in use. Physically, RAM consists of chips on a small circuit board (see Figure 4A.10). Single in-line memory modules (SIMMs) and dual in-line memory module (DIMM) chips are found in desktop computers, while the smaller, small outline DIMM (SO-DIMM) chips are found in laptop computers.

RAM is designed to be instantly accessible by the CPU or programs. The "random" in RAM implies that any portion of RAM can be accessed at any time. This helps make RAM very fast. Without the random abilities of RAM, the computer would be very slow.

Norton ONLINE

For more information on memory, visit http://www.mhhe.com/peternorton

Urheberrechtlich geschütztes Material



FIGURE 4A.10

Memory chips.

A computer does not have to search its entire memory each time it needs to find data because the CPU uses a memory address to store and retrieve each piece of data (see Figure 4A.11). A memory address is a number that indicates a location on the memory chips, just as a post office box number indicates a slot into which mail is placed. Memory addresses start at zero and go up to one less than the number of bytes of memory in the computer.

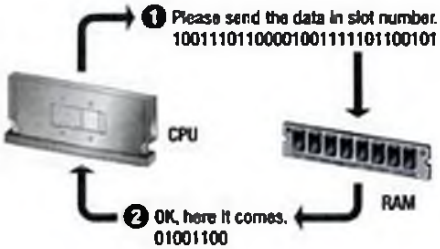


FIGURE 4A.11

To request a byte of data, the CPU sends a memory address to RAM.

RAM is not used just in conjunction with the computer's CPU. RAM can be found in various places in a computer system. For example, most newer video and sound cards have their own built-in RAM (see Figure 4A.12), as do many types of printers.

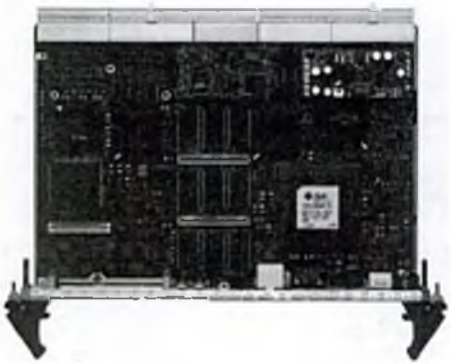


FIGURE 4A.12

Memory chips can be found in many parts of a computer system, such as this video card.

Factors Affecting Processing Speed

A CPU's design determines its basic speed, but other factors can make chips already designed for speed work even faster. You already have been introduced to some of these, such as the CPU's registers and memory. In this section, you will see how other factors—such as the cache memory, the clock speed, and the data bus—affect a computer's speed. Figure 4A.13 shows how these components might be arranged on the computer's motherboard.

Registers

The registers in the first PCs could hold two bytes—16 bits—each. Most CPUs sold today, for both PCs and Macintosh computers, have 32-bit registers. Many newer PCs, as well as minicomputers and high-end workstations, have 64-bit registers.

Norton ONLINE

For more information on processing speeds, visit http://www.mhhe.com/petemorton

Urheberrechtlich geschütztes Material

At Issue

Cyborgs Among Us: Wearable Technology

Cyborg: the melding of man and machine, organism and circuitry. Though no Robocop, metaphoric cyborgs are more than the stuff of media sci-fi. They are reality for the thousands who utilize a new generation of wearable computing device making intimate human–machine interaction now possible.

The term *wearable computer* refers to a wireless computer system worn on the user's body, either in a backpack, on a belt, or sewn into a piece of clothing such as a jacket or vest. Some are small enough to fit in the user's shirt pocket or have monitors worn as eyeglasses.

Wearable computers are designed specifically for mobile and mostly hands-free operations, often incorporating head-mounted displays and vocal recognition software. Most variations of wearable PCs are always on and always accessible. In this way, this new computing framework differs from that of other existing wireless technologies, such as laptop computers and personal digital assistants.

It is this "always ready" feature that is the true hallmark of wearables. Unlike other personal computers or handheld devices, a wearable computer is subsumed into the personal space of the user, becoming almost a part of him or her. This leads to a new form of synergy between human and computer, brought about by long-term adaptation through constancy of the user–computer interface. Over time, the user adapts to the computer to the point he or she no longer feels as if it is a separate entity. Often users report feeling uncomfortable—even "naked"—without their devices.

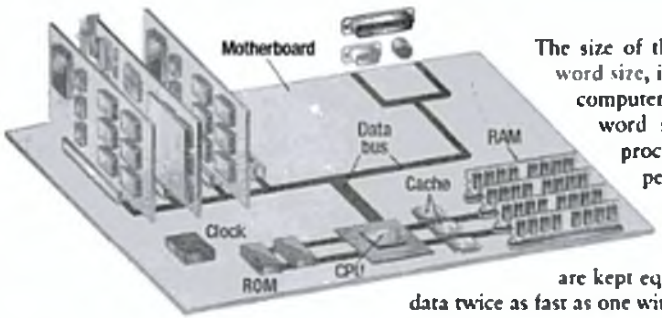


FIGURE 4A.13

Devices affecting processing speed.

The size of the registers, which is sometimes called the word size, indicates the amount of data with which the computer can work at any given time. The bigger the word size, the more quickly the computer can process a set of data. Occasionally, you will hear people refer to "32-bit processors" or "64-bit processors" or even "64-bit computers." This terminology refers to the size of the registers in the processor. If all other factors are kept equal, a CPU with 32-bit registers can process data twice as fast as one with 16-bit registers.

Memory and Computing Power

The amount of RAM in a computer can have a profound effect on the computer's power. More RAM means the computer can use bigger, more powerful programs, and those programs can access bigger data files.

More RAM also can make the computer run faster. The computer does not necessarily have to load an entire program into memory to run it. However, the greater the amount of the program that fits into memory, the faster the program runs. To run Windows, for example, the computer usually does not need to load all its files into memory to run properly; it loads only the most essential parts into memory.

When the computer needs access to other parts of an operating system or a

SELF-CHECK ::

Complete each statement by filling in the blank(s).

1. A computer's CPU consists of millions of tiny switches called _____ .
   a. bits b. transistors c. registers
2. Base 2 is another name for the _____ .
   a. binary number system b. hexadecimal number system c. decimal number system
3. _____ can represent more than 4 billion different characters or symbols.
   a. ASCII b. Extended ASCII c. Unicode

Urheberrechtlich geschütztes Material

Also unlike other portable devices, wearable PCs are full-featured computers, with all of the functionality of a traditional desktop or mainframe computer.

One company leading the way in the wearables space is Hitachi. The Hitachi wearable PC unit is small and lightweight enough to be carried in a pocket. It includes a head-mounted display that gives users the illusion that there is a 13-inch color screen in front of them. Users operate the machine via a tiny handheld optical mouse.

The Hitachi wearable PC runs on Microsoft's Windows CE operating system and contains a Hitachi 128 MHz RISC processor and 32 MB of RAM. It also comes with a Flash card and a USB slot. According to the firm, the unit measures 140 × 90 × 26 mm, and the whole device weighs a slight 500 g.



Though still on the cutting edge, many experts believe that wearables will someday soon supersede technologies such as mobile phones and PDAs, holding out the promise that wearable computers will improve the quality of day-to-day life for their Cyborg users.

program on the disk, it can unload, or swap out, nonessential parts from RAM to the hard disk. Then the computer can load, or swap in, the program code or data it needs. While this is an effective method for managing a limited amount of memory, the computer's system performance is slower because the CPU, memory, and disk are continuously occupied with the swapping process. Swapping unused contents of RAM to the hard disk is known as virtual memory. As shown in Figure 4A.14, if your PC has 128 MB of RAM (or more), you will notice a dramatic difference in how fast Windows runs because the CPU will need to swap program instructions between RAM and the hard disk much less often.

If you purchase a new computer system, it will probably come with at least 256 MB of RAM. Microsoft suggests 256 MB as the minimum recommended configuration for Windows XP. If you plan to play graphic-intensive games or develop complex graphics, you will need more RAM. The cost of upgrading the memory of a computer is very low, so upgrading RAM is the simplest and most cost-effective way to get more speed from

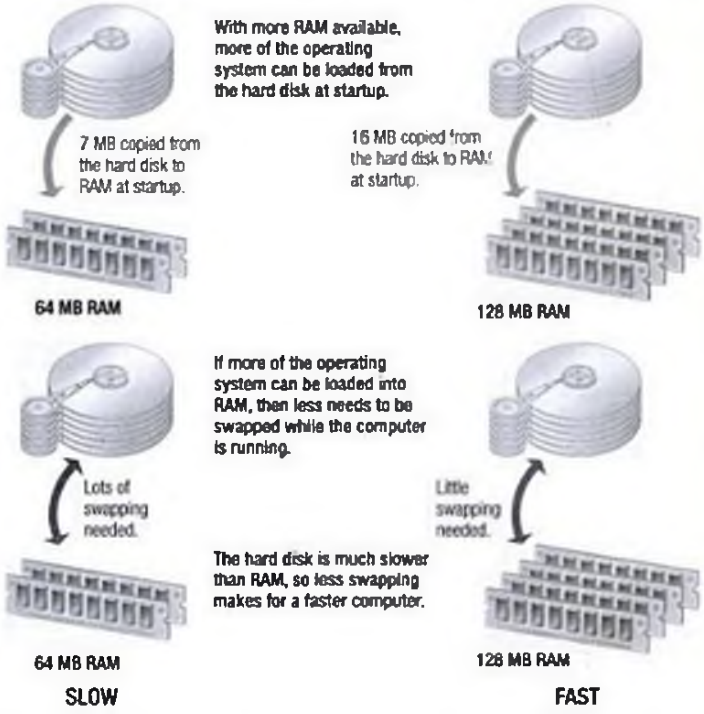


FIGURE 4A.14

How RAM affects speed.

Urheberrechtlich geschütztes Material

your computer. See the Productivity Tip, "Do You Need More RAM?" later in this chapter.

The Computer's Internal Clock

Every microcomputer has a system clock, but the clock's primary purpose is not to keep the time of day. Like most modern wristwatches, the clock is driven by a quartz crystal. When electricity is applied, the molecules in the crystal vibrate millions of times per second, a rate that never changes. The speed of the vibrations is determined by the thickness of the crystal. The computer uses the vibrations of the quartz in the system clock to time its processing operations.

Over the years, system clocks have become steadily faster. For example, the first PC operated at 4.77 megahertz. Hertz (Hz) is a measure of cycles per second. Megahertz (MHz) means "millions of cycles per second." Gigahertz (GHz) means "billions of cycles per second."

The computer's operating speed is tied to the speed of the system clock. For example, if a computer's clock speed is 800 MHz, it "ticks" 800 million times per second. A clock cycle is a single tick, or the time it takes to turn a transistor off and back on again. A processor can execute an instruction in a given number of clock cycles. As the system's clock speed increases, so does the number of instructions it can carry out each second.

Clock speeds greater than 1 GHz are now common, and processor speeds are increasing rapidly. At the time this book was written, processor speeds had eclipsed 3 GHz.

The Bus

A bus is a path between the components of a computer. There are two main buses in a computer: the internal (or system) bus and the external (or expansion) bus. The system bus resides on the motherboard and connects the CPU to other devices that reside on the motherboard. An expansion bus connects external devices, such as the keyboard, mouse, modem, printer, and so on, to the CPU. Cables from disk drives and other internal devices are plugged into the bus. The system bus has two parts: the data bus and the address bus (see Figure 4A.15).

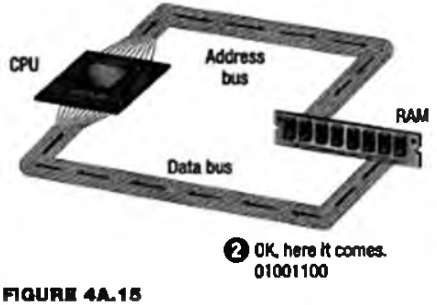


FIGURE 4A.15

The system bus includes an address bus and a data bus. The address bus leads from the CPU to RAM. The data bus connects the CPU to memory, and to all the storage, input/output, and communications devices that are attached to the motherboard.

The Data Bus

The data bus is an electrical path that connects the CPU, memory, and the other hardware devices on the motherboard. Actually, the bus is a group of parallel wires. The number of wires in the bus affects the speed at which data can travel between hardware components, just as the number of lanes on a highway affects how long it takes people to reach their destinations. Because each wire can transfer one bit of data at a time, an eight-wire bus can move eight bits at a time, which is a full byte (see Figure 4A.16). A 16-bit bus can transfer two bytes, and a 32-bit bus can transfer four bytes at a time. Newer model computers have a 64-bit data bus called the FrontSide Bus that transfers eight bytes at a time.

Like the processor, the bus's speed is measured in megahertz (MHz) because it has its own clock speed. As you would imagine, the faster a bus's clock speed, the faster it can transfer data between parts of the computer. The majority of today's PCs have a bus speed of either 100 MHz or 133 MHz, but speeds of 800 MHz and higher are becoming more common.

The bus speed is directly tied into the CPU speed. All processors use a multiplier to make the CPU run faster. Here is how it works. Consider a system bus that runs at 400 MHz supporting a 1.6 GHz processor. The fastest the CPU can talk to

Urheberrechtlich geschütztes Material

external devices is 400 MHz. However, internally the processor runs at 1.6 GHz, or four times the bus speed. The multiplier in this system is four. Since the processor is so much faster than the bus, the processor spends most of the time idle.

The Address Bus

The address bus is a set of wires similar to the data bus (see Figure 4A.17). The address bus connects only the CPU and RAM and carries only memory addresses. (Remember, each byte in RAM is associated with a number, which is its memory address.)

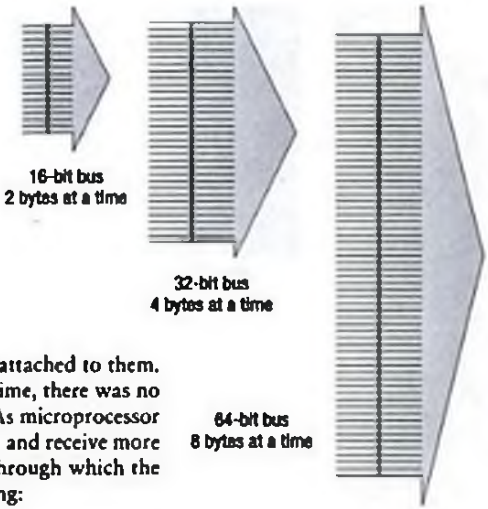


FIGURE 4A.16

With a wider bus, the computer can move more data in the same amount of time, or the same amount of data in less time.

Bus Standards

PC buses are designed to match the capabilities of the devices attached to them. When CPUs could send and receive only one byte of data at a time, there was no point in connecting them to a bus that could move more data. As microprocessor technology improved, however, chips were built that could send and receive more data at once, and improved bus designs created wider paths through which the data could flow. Common bus technologies include the following:

- The Industry Standard Architecture (ISA) bus is a 16-bit data bus. It became the de facto industry standard on its release in the mid-1980s and is still used in many computers to attach slower devices (such as modems and input devices) to the CPU.
- The Local bus was developed to attach faster devices to the CPU. A local bus is an internal system bus that runs between components on the motherboard. Most system buses use some type of local bus technology today and are coupled with one or more kinds of expansion bus.
- The Peripheral Component Interconnect (PCI) bus is a type of local bus designed by Intel to make it easier to integrate new data types, such as audio, video, and graphics.
- The Accelerated Graphics Port (AGP) bus incorporates a special architecture that allows the video card to access the system's RAM directly, greatly increasing the speed of graphics performance. The AGP standard has led to the development of many types of accelerated video cards that support 3-D and full-motion video. While AGP improves graphics performance, it cannot be used with all PCs. The system must use a chip set that supports the AGP standard. Most new computers feature AGP graphics capabilities in addition to a PCI system bus and an expansion bus.
- The Universal Serial Bus (USB) is a relatively new bus found on all modern machines. Unlike the PCI and AGP, USB is a hot swappable bus. This means that a user can connect then disconnect a USB device without affecting the machine. USB supports up to 127 devices connected in either a daisy chain or hub layout. In a daisy chain, each device is connected to the device before and after it in the line. The last device terminates the chain. Apple keyboards and mouse use USB daisy chain. The hub allows multiple devices to plug into one unit. Figure 4A.18 shows a Macintosh USB keyboard and mouse.

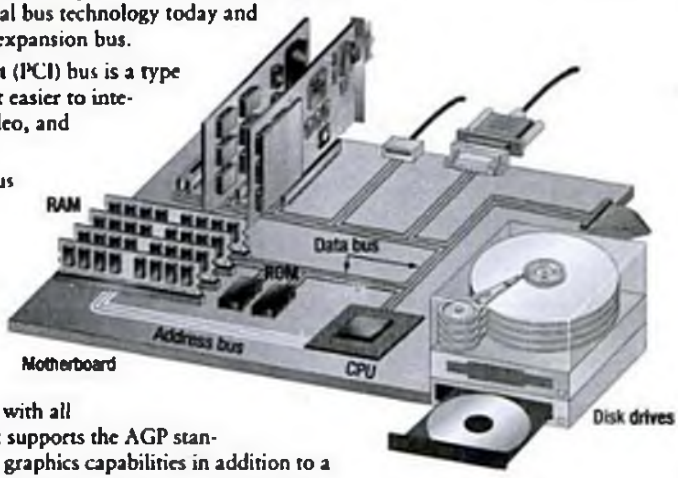


FIGURE 4A.17

Requests for data are sent from the CPU to RAM along the address bus. The request consists of a memory address. The data returns to the CPU via the data bus.

Urheberrechtlich geschütztes Material



FIGURE 4A.18

Macintosh USB keyboard and mouse.

- IEEE 1394 (FireWire) ports were once found only on Macintosh computers, but they are now increasingly common in IBM-compatible PCs. FireWire is used to connect video devices such as cameras and video cameras. Many digital TV connections also use FireWire.
- The PC Card bus is used exclusively on laptop computers. Like USB, PC Card is hot swappable. A PC Card is about the size of a stack of four credit cards. Common uses for PC Card include WiFi cards, network cards, and external modems. For secure notebooks, thumb scanners and other biometric security systems can be purchased. The most current form of PC Card is called CardBus and is mainly an external extension of an internal PCI bus. Figure 4A.19 shows a network interface card in the form of a PC Card.



FIGURE 4A.19

A PC Card device.

Traditionally, the performance of computer buses was measured by the number of bits they could transfer at one time. Hence, the newest 64-bit buses are typically considered the fastest available. However, buses are now also being measured according to their data transfer rates—the amount of data they can transfer in a second—often measured in megahertz (MHz) or gigahertz (GHz). Hertz measures the number of times an electrical wave passes a fixed point on the bus. Higher numbers mean that more data can be transferred. Table 4A.5 lists the performance specifications of common buses.

Cache Memory

Moving data between RAM and the CPU's registers is one of the most time-consuming operations a CPU must perform, simply because RAM is much slower than the CPU. A partial solution to this problem is to include a cache memory in the CPU. Cache (pronounced *cash*) memory is similar to RAM except that it is extremely fast compared to normal memory and it is used in a different way.

Figure 4A.20 shows how cache memory works with the CPU and RAM. When a program is running and the CPU needs to read a piece of data or program instructions from RAM, the CPU checks first to see whether the data is in cache memory. If the data is not there, the CPU reads the data from RAM into its registers, but it also loads a copy of the data into cache memory. The next time the CPU needs the data, it finds it in the cache memory and saves the time needed to load the data from RAM.

TABLE 4A.5

Performance Specifications of Common Buses

Bus Type	Width (bits)	Transfer Speed	Hot Swappable
AGP 8	32	2.1 GHz	No
FireWire	32	400 MHz	Yes
ISA	16	8.33 MHz	No
PC Card	32	33 MHz	Yes
PCI	32	33 MHz	No
USB 2.0	32	480 MHz	Yes

Urheberrechtlich geschütztes Material

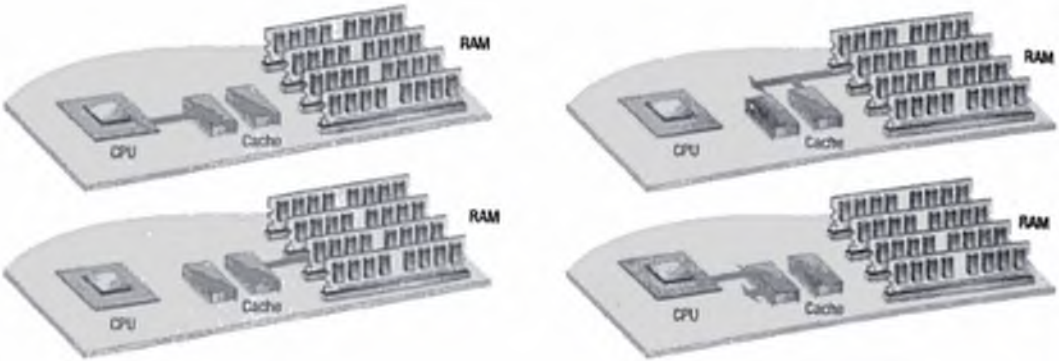


FIGURE 4A.20

The cache speeds processing by storing frequently used data or instructions in its high-speed memory. External (Level-2) cache is shown here, but most computers also have memory circuitry built directly into the CPU.

Cache is present in several places in a computer. Most hard drives and network cards have cache present to speed up data access. Without cache, your computer would be a much slower device.

Since the late 1980s, most PC CPUs have had cache memory built into them. This CPU-resident cache is often called Level-1 (L1) cache. Today, many CPUs have as much as 256 KB built in.

To add even more speed to modern CPUs, an additional cache is added to CPUs. This cache is called Level-2 (L2) cache. This cache used to be found on the motherboard. However, Intel and AMD found that placing the L2 cache on the CPU greatly increased CPU response. Many PCs being sold today have 512 KB or 1024 KB of motherboard cache memory; higher-end systems can have as much as 2 MB of L2 cache.

In addition to the cache memory built into the CPU, cache is also added to the motherboard. This motherboard-resident cache is now called Level-3 (L3) cache. L3 cache is found on very-high-end computers. It is not necessary for a computer to have L3 cache.

The three caches work like a assistant to a mechanic. First, the mechanic prepares a box containing all the tools he may need for the current job. Most likely, this is only a portion of his entire tool set. The mechanic slides under the car and uses a wrench to try to remove a nut. L2, seeing the mechanic use the wrench, figures that he will need either oil to loosen the nut or pliers to remove a bolt. L2 tries to predict what the mechanic will need and grabs these items from the box. Eventually, the mechanic finishes with the wrench and asks for the pliers. L1 holds on to the wrench in case the mechanic needs it again. L2 holds on to tools that might be needed soon. Eventually the mechanic will need the wrench again. L1 then hands the wrench to the mechanic who finishes the job. The process is made faster because the mechanic does not need to stop and root through the toolbox for each necessary tool.

L1, L2, and L3 all speed up the CPU, although in different ways. L1 cache holds instructions that have recently run. L2 cache holds potential upcoming instructions. L3 holds many of the possible instructions. In all cases, the cache memory is faster for the CPU to access, resulting in a quicker program execution.

Norton **ONLINE**

For more information on bus technologies, visit **http://www.mhhe.com/petemorton**

Urheberrechtlich geschütztes Material

Productivity Tip

Do You Need More RAM?

You've probably heard it a hundred times. RAM upgrades are cheap, easy, and fast—a great way to improve your PC's performance. But is it really as simple and inexpensive as the experts keep saying?

Well, yes and no. A lot of factors determine how costly or difficult a RAM upgrade can be, and other factors determine whether it will even do you any good. But make no mistake about it: if your computer is running slower than you like, adding RAM may give it some pep. If your PC is relatively new (say, no more than three years old), you may want to consider installing more RAM before trading up to a new system. The performance boost could make you want to keep that old PC a while longer.

If your PC is more than a couple of years old, and if you are becoming increasingly unhappy with its performance, then perhaps it is time to think about a memory upgrade. If that sounds like an overly simplistic approach to making the decision, ask yourself the following questions:

- Does your PC have less than 128 MB of RAM?
- Do you typically run more than one application at a time?
- Are you using a newer version of Windows, such as Windows Me, 2000, or XP?
- Does the system noticeably slow down during a long computing session, especially if you launch and close multiple programs or use the Internet?
- Do you need to reboot frequently?
- Do you ever see "Insufficient memory" messages when you try to run a program or load a file?
- Does your hard disk light seem to flicker most of the time?

If you can answer "yes" to more than one of those questions, a RAM upgrade may be a good idea.

The decision to upgrade does not require a degree in computer science and you do not need to do much math. You should base your decision to upgrade on your satisfaction with the computer's performance. You should compare the cost and probable benefits of a RAM upgrade with the expense of a more thorough upgrade (such as replacing a processor, motherboard, and hard disk) or simply buying a new system.

Urheberrechtlich geschütztes Material



A RAM upgrade may be the fastest, cheapest, and easiest way to improve your PC's performance.

Deciding to upgrade RAM offers two big advantages. First, it is less expensive than just about any other kind of upgrade you can do. Second, even if the upgrade does not improve your computer's performance a lot, it probably will not hurt anything, either.

You should not expect a RAM upgrade to speed up your system the way a new processor would. In fact, experts say that there is no reason to put more than 512 MB of RAM in most personal computers. Depending on the types of applications that are run, additional memory may not even be used because Windows allocates a certain amount of memory for itself and for each running application.

On the other hand, if your PC is short on RAM, it will not be able to run current software products very efficiently. For example, the practical minimum for a PC running a newer version of Windows 98 or Me is now considered to be 64 MB, and for running Windows 2000 or XP, the minimum is 128 MB. These requirements will give the PC enough memory to load essential operating system components and a couple of applications. Beyond that, however, the system has to rely on the hard disk as a source of "virtual memory," requiring the hard disk and RAM to spend time swapping data back and forth as it is needed. This process greatly reduces performance.

Realistically, the only way to answer this question is to do the upgrade. Chances are good that you will notice at least some improvement in your system's behavior.

Urheberrechtlich geschütztes Material

Summary ::

- Computer data is reduced to binary numbers because computer processing is performed by transistors that have only two possible states: on and off.
- The binary number system works the same way as the decimal system, except that it has only two available symbols (0 and 1) rather than ten (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9).
- A single unit of data is called a bit; eight bits make up one byte.
- In the most common text-code set, ASCII, each character consists of one byte of data. In the Unicode text-code set, each character consists of up to four bytes of data.
- A microcomputer's processing takes place in the central processing unit, the two main parts of which are the control unit and the arithmetic logic unit (ALU).
- Within the CPU, program instructions are retrieved and translated with the help of an internal instruction set and the accompanying microcode.
- The CPU follows a set of steps for each instruction it carries out. This set of steps is called the machine cycle. By using a technique called pipelining, many CPUs can process more than one instruction at a time.
- The actual manipulation of data takes place in the ALU, which is connected to the registers that hold data and program instructions while they are being processed.
- Random access memory (RAM) is volatile (or temporary). Programs and data can be written to and erased from RAM as needed.
- Read only memory (ROM) is nonvolatile (or permanent). It holds instructions that run the computer when the power is first turned on.
- The CPU accesses each location in memory by using a unique number, called the memory address.
- The size of the registers, also called word size, determines the amount of data with which the computer can work at one time.
- The amount of RAM can affect speed because the CPU can keep more of the active program and data in memory, which is faster than storage on disk.
- The computer's system clock sets the pace for the CPU by using a vibrating quartz crystal. The faster the clock, the more instructions the CPU can process per second.
- The system bus has two parts—the data bus and the address bus—both of which are located on the motherboard.
- The width of the data bus determines how many bits can be transmitted at a time between the CPU and other devices.
- Peripheral devices can be connected to the CPU by way of an expansion bus.
- Cache memory is a type of high-speed memory that contains the most recent data and instructions that have been loaded by the CPU. The amount of cache memory has a tremendous impact on the computer's speed.

Key Terms ::

Accelerated Graphics Port (AGP) bus, 137
address bus, 137
American Standard Code for Information Interchange (ASCII), 128
arithmetic logic unit (ALU), 130
arithmetic operation, 130
basic input output system (BIOS), 132
billions of instructions per second (BIPS), 131
binary number system, 127
bit, 127
bus, 136
cache memory, 138
clock cycle, 136
clock speed, 136
control unit, 130
data bus, 136
data transfer rate, 138
decimal number system, 126

Urheberrechtlich geschütztes Material

decode, 131
dual in-line memory module (DIMM), 132
execute, 131
execution cycle, 131
Extended ASCII, 128
Extended Binary Coded Decimal Interchange Code (EBCDIC), 127
fetch, 131
flash memory, 132
FrontSide Bus, 136
gigahertz (GHz), 136
hertz (Hz), 136
hyperthreading, 131
IEEE 1394 (FireWire), 138
Industry Standard Architecture (ISA) bus, 137
instruction cycle, 131
instruction set, 130
Level-1 (L1) cache, 139
Level-2 (L2) cache, 139
Level-3 (L3) cache, 139
local bus, 137
logical operation, 130
machine cycle, 130
megahertz (MHz), 136
memory address, 133
microcode, 130
millions of instructions per second (MIPS), 131
multitasking, 131
nonvolatile, 131
PC Card, 138
Peripheral Component Interconnect (PCI) bus, 137
pipelining, 131
power on self test (POST), 132
programmable read only memory (PROM), 132
register, 130
read only memory (ROM), 132
single in-line memory module (SIMM), 132
small outline DIMM (SO-DIMM), 132
store, 131
swap in, 135
swap out, 135
system clock, 136
text code, 127
thread, 131
transistor, 125
Unicode Worldwide Character Standard, 128
Universal Serial Bus (USB), 137
virtual memory, 135
volatile, 132
word size, 134

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. People use the _____ number system, but computers use the _____ number system.
2. The term _____ is a combination of the words *binary digit*.
3. The most widely used text code system among personal computers is _____ .
4. A processor's built-in instructions are stored as _____ .
5. _____ are high-speed memory locations built directly into the CPU that hold data while they are being processed.
6. The _____ is run when the system turns on and verifies that the hardware is working.
7. Digital cameras use _____ to store pictures on removable cards.
8. The computer uses _____ when it runs out of RAM, swapping program instructions or data out to the hard drive.
9. A _____ is a portion of a computer program that is being run by a CPU.
10. The _____ contains the list of all commands a CPU understands.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. The _____ standard promises to provide enough characters to cover all the world's languages.
   a. ASCII b. Unicode c. RAM d. EBCDIC
2. _____ may be built directly into a CPU or placed on the motherboard.
   a. RAM b. Parallel c. Cache memory d. Flash
3. The CPU uses a _____ to store and retrieve each piece of data in memory.
   a. control unit b. cache c. memory address d. POST
4. The computer can move data and instructions between storage and memory, as needed, in a process called _____.
   a. swapping b. volatility c. pipelining d. exchanging
5. The bus's speed is directly tied to the speed of the computer's _____.
   a. RAM b. CPU c. ROM d. DIMM
6. A laptop will most likely use _____ memory chips.
   a. DIMM b. SO-DIMM c. SIPP d. SIMM
7. Memory that loses its data when power is turned off is considered _____ memory.
   a. volatile b. static c. dynamic d. refreshed
8. The acronym _____ means billions of operations per second.
   a. GB b. MHz c. KHz d. GHz
9. A CPU that is following a series of steps to complete an instruction is using _____ technology.
   a. threading b. pipelining c. cache d. multitasking
10. This cache holds the most recently used data or instructions.
    a. L1 b. L2 c. L3 d. L4

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What is the difference between data and information?
2. How many characters or symbols can be represented by one eight-bit byte?
3. What is meant by "word size"?
4. What is the difference between arithmetic operations and logical operations?
5. What is a data bus?
6. Describe how virtual memory works.
7. What is the difference between an L1 and an L2 cache?
8. Describe the role of a computer's system clock.
9. Why is a CPU often idle?
10. Why is it important to have a standard text code?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Using the list of ASCII characters in Table 5A.3, compose a sentence using ASCII text codes. Make sure the sentence includes at least six words and make it a complete sentence. Swap your ASCII sentence with a classmate, then translate his or her sentence into alphabetical characters. Time yourself. How long did it take you to translate the sentence? What does this tell you about the speed of a computer's processor?
2. Compare ASCII and EBCDIC. Create a table that lists the ASCII values and their corresponding EBCDIC values. Determine a mathematical formula to translate from one to another.

Urheberrechtlich geschütztes Material

LESSON // 4B

Modern CPUs

OBJECTIVES ::

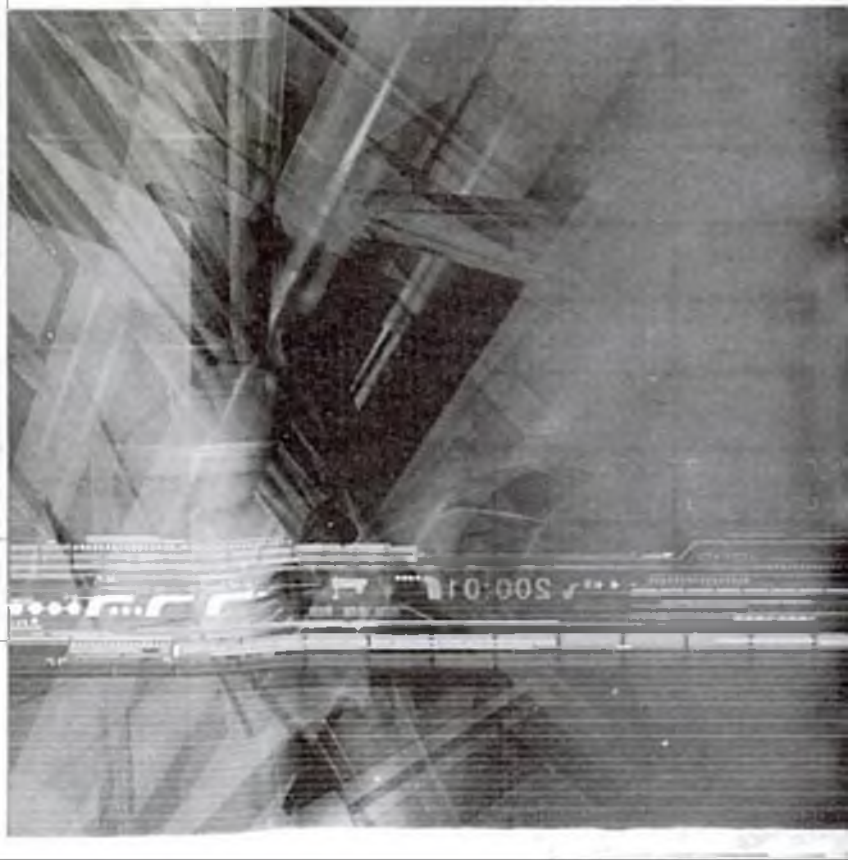
- Name the best-known families of CPUs.
- Differentiate the processors used in Macintosh and IBM-compatible PCs.
- Define the terms CISC and RISC.
- Identify one advantage of using multiple processors in a computer.
- Identify four connections used to attach devices to a PC.

Overview: The Race for the Desktop

How fast is fast enough? How powerful does a computer need to be? We may never know the ultimate answer to these questions because when it comes to computer performance, the bar continues to be raised.

Software developers and users constantly make greater demands of computers, requiring them to perform an ever-higher number of tasks. Processor developers respond with chips of ever-increasing speed and power. Chipmakers such as Intel, IBM, Freescale, Advanced Micro Devices (AMD), and others keep proving that there seems to be no end to the potential power of the personal computer.

This lesson looks at the processors most commonly found in personal computers and describes some of their most important features and distinguishing characteristics. You will learn how these CPUs are typically differentiated from one another and see how their performance is measured. You also will learn some of the ways you can extend the power of your PC's processor to other components by using its expansion capabilities.



A Look Inside the Processor

You have already seen how a PC processes and moves data. For most people, the great mystery of the PC is what takes place inside its circuitry. How can this box of chips, wires, and other parts—most of which don't even move—do its work?

A processor's performance—even its capability to function—is dictated by its internal design, or architecture. A chip's architecture determines where its parts are located and connected, how it connects with other parts of the computer, and much more. It also determines the path that electricity (in the form of moving electrons) takes as it moves through the processor, turning its transistors on and off. There are many different chip architectures in use today, and each family of PC processors is based on its own unique architecture.

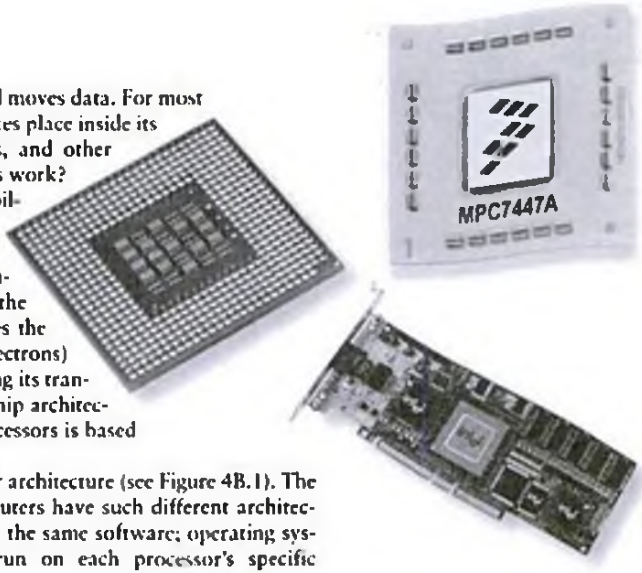


FIGURE 4B.1

Different processors have different architectures. In some cases, architectures are so different that processors cannot run the same software. For this reason, software must be written especially for Windows PCs, Macintosh computers, and workstations.

In fact, processors are differentiated by their architecture (see Figure 4B.1). The processors of IBM PCs and Macintosh computers have such different architectures, for example, that they cannot even run the same software; operating systems and programs must be written to run on each processor's specific architecture, to meet its requirements.

A processor's architecture determines how many transistors it has, and therefore the processor's power (see Figure 4B.2). Simply stated, the more transistors in a processor, the more powerful it is. The earliest microprocessors had a few thousand transistors. The processors in today's PCs contain tens of millions. In the most powerful workstation and server computers, a processor may contain hundreds of millions of transistors. When a computer is configured to use multiple processors, it can ultimately contain billions of transistors.

A processor includes many other features that affect its performance. For example, a processor's performance is affected by the number of bits of data it can process at any one time. Currently, nearly all standard PC processors move data in 32-bit chunks; they are called "32-bit processors." In 2003 American Micro Devices (AMD) released a new generation of desktop PC processor that can handle 64 bits of data. (High-end workstations and many minicomputer systems have used 64-bit processors for about a decade.)

Microcomputer Processors

For two decades after the birth of the personal computer, the biggest player in the PC CPU market was Intel Corporation. This dominance began to change in 1998 when several leading computer makers began offering lower-priced systems using chips made by AMD and other chip manufacturers. Initially, these microprocessors offered less performance at a lower price. That situation has changed, however, as AMD made rapid advances in its products' capabilities. Today, Intel and AMD chips compete head to head, not only in performance, but also in price.

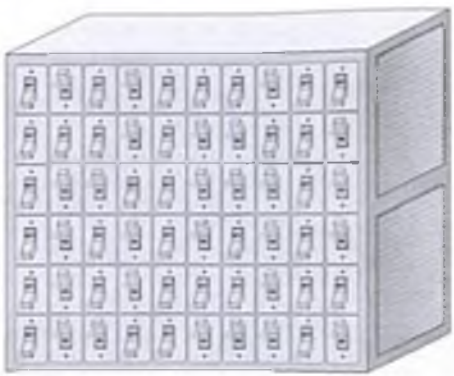


FIGURE 4B.2

Transistors are a key ingredient in any processor. The more transistors available, the more powerful the processor.

Intel and AMD are not the only manufacturers on the block. Motorola, now known as Freescale, manufactured the processors for all Macintosh computers up to and including the G4. They still make chips for communication devices. The newer Macintosh G5 boasts a chip made by IBM. Many other companies make specialized processors for workstations, minicomputers, handheld devices, automobile electronics, and kitchen appliances.

Urheberrechtlich geschütztes Material

simnet™

Norton ONLINE

For more information on Intel's line of processors, visit http://www.mhhe.com/petemorton

As you read the following sections, remember that performance specifications and features can change rapidly. Chip manufacturers make constant improvements to their products; as a result, the most popular PC processors now operate at speeds higher than 3 GHz, and they continue to be faster every month. By continuously refining chip designs and manufacturing processes, chip makers are always finding ways to add more transistors to chips.

Intel Processors

Intel is historically the leading provider of chips for PCs. In 1971, Intel invented the microprocessor—the so-called computer on a chip—with the 4004 model (see Figure 4B.3). This invention led to the first microcomputers that began appearing in 1975. Even so, Intel's success in this market was not guaranteed until 1981 when IBM released the first IBM PC, which was based on an Intel microprocessor.

FIGURE 4B.3

Intel's first microprocessor, the 4004.



A list of current Intel chips (see Figure 4B.4), along with their clock speeds and numbers of transistors, is shown in Table 4B.1.

FIGURE 4B.4

The Pentium 4, Celeron, Xeon, and Itanium 2 processors.



Advanced Micro Devices (AMD) Processors

In 1998, Advanced Micro Devices (AMD) emerged as a primary competitor to Intel's dominance in the IBM-compatible PC market. Until that time, AMD processors were typically found in lower-performance, low-priced home and small business computers selling for less than $1,000. With the release of the K6 and Athlon processor series, AMD proved that it could compete feature for feature with many of Intel's best-selling products. AMD even began a new race for the fastest PC processor.

A list of current AMD chips (see Figure 4B.5), along with their clock speeds and numbers of transistors, is shown in Table 4B.2.

Norton ONLINE

For more information on AMD's line of processors, visit http://www.mhhe.com/petemorton

TABLE 4B.1

Current Intel Processors

Model	Primary Use	Clock Speed	Number of Transistors
Itanium 2	Server	1.3 GHz and up	410 million
Pentium 4	PC	1.4 GHz and up	42–55 million
Pentium III Xeon	Server/Workstation	700 MHz and up	42–55 million
Pentium III	PC	650 MHz and up	28–44 million
Celeron	Budget PC	500 MHz and up	28–44 million

Urheberrechtlich geschütztes Material

TABLE 4B.2

AMD Processors Used In Today's Personal Computers

Model	Clock Speed	Number of Transistors
Athlon FX 64	2.2 GHz and up	105.9 Million
Athlon XP	2.2 GHz and up	54.3 Million
Opteron for servers	1.4 GHz and up	106 Million
Athlon	1.0 GHz and up	37 million
Duron	600 MHz and up	25 million





FIGURE 4B.5

The Athlon and Duron processors.

Freescale Processors

Freescale Semiconductor, Inc., a subsidiary of Motorola, Inc., has a 50-year history in microelectronics. As mentioned earlier, many Apple computers use Freescale processors. Freescale processors were also an early favorite among companies that built larger, UNIX-based computers.

Through the years, Freescale offered two processor architectures that were used in Macintosh computers. The first is known as the 680*x*0 family. A new type of processor, which was developed by Freescale, Apple, and IBM, has replaced this family of processors. This new processor architecture, called the PowerPC architecture, is the basis for all new computers made by Apple. Freescale's MPC74*xx* processors can be found in Apple's G4 computers. PowerPC processors from Freescale are also ideal for Linux operating system implementations, which are growing in popularity among desktop users.





FIGURE 4B.6

MC680x0 die photograph and MPC7447A PowerPC processor from Freescale Semiconductor

IBM Processors

In addition to working with Apple and Freescale on the PowerPC line, IBM makes high-performance mainframe and workstation CPUs. In 2003, IBM partnered with Apple and released the G5 (see Figure 4B.7), advertised as the "fastest desktop processor ever." While most new chips can make this claim, the G5 delivered. The G5 delivered true workstation power at the cost of a standard desktop. As a demonstration, Pixar studios were provided with several G5-equipped computers. The Disney/Pixar movie *Finding Nemo* was created entirely on the G5 desktop computers. Previous releases from Pixar, including *Toy Story*, required high-end workstations.





FIGURE 4B.7

The IBM/Apple G5 processor.

Urheberrechtlich geschütztes Material

Norton Notebook

What *Is* a Computer Chip?



Throughout this book (and in any other information you read about computers), you see references to chips. Processors reside on chips, as do memory and other types of computer circuitry. But what does this mean? What is a computer chip?

To understand how chips work, you have to think small . . . very, very small. That's because the transistors, circuits, and connections that exist on a computer chip are so tiny that their dimensions are sometimes measured in terms of atoms rather than millimeters or inches.

Most computer chips are created on very thin wafers, which are made of nearly pure silicon. (Silicon is a mineral that is purified and refined for use in chips. It is used in many other products, too.) Some chips may be made from other materials, such as various types of plastic, but the chips commonly found in personal computers are silicon-based.

The Making of a Chip

Transistors and circuits exist as tiny channels on the surface of a chip, which means they must be carved out of the silicon. To do this, chip manufacturers use a process called photolithography to physically etch out the tiny grooves and notches that make up the chip's circuits. In the first step of this process, the silicon wafer's surface is covered with a gooey substance called photoresist, which is sensitive to certain types of light.

Next, a glass pattern (called a mask) is placed over the wafer. This pattern is marked with the precise lines where each transistor and circuit will lie on the chip's surface. The manufacturer then shines ultraviolet light through the pattern; the pattern's dark lines "mask" the silicon wafer from the light, protecting it. The exposed photoresist reacts to the light that touches it, softening the silicon beneath it. The exposed silicon is washed away, leaving a pattern of fine tracings on its surface.

The manufacturer then coats the wafer's surface with ions. This coating changes the way the silicon conducts electricity, making it more efficient at moving electrons through its circuits. (Moving electrons represent the binary 1s and 0s that make up data for the computer.) Because electrons are so small, the chip's circuitry can be very fine.

In the next step of the process, atoms of metal (such as aluminum or copper) are placed in the etched channels on

Comparing Processors

Most non–computer people only use the clock speed to compare two processors. This is a good comparison, but it is akin to comparing cars only by their top speed. There are many features of a car that are as important as rated speed. When comparing processors, many factors come into play. Larger cache and faster system bus speeds usually indicate more powerful processors. Table 4B.3 contrasts three powerful desktop processors.

TABLE 4B.3

CPUs' Performance Specifications

Specification	AMD Athlon 64 FX	Intel Pentium IV	PowerMac G5
Number of registers	16	16	80
Word size	64 bits	32 bits	64 bits
FrontSide or system bus speed	1.6 GHz	800 MHz	1 GHz
L1 cache	128 KB	na	na
L2 cache	1024 KB	512	512

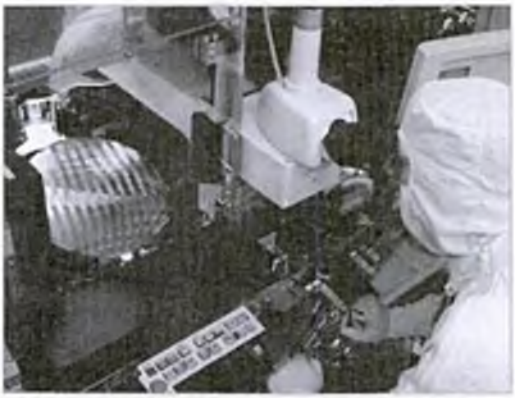
Urheberrechtlich geschütztes Material

the wafer's surface. These connections will conduct electrons as they move through the chip.

So Many Transistors, So Little Space

Today's manufacturing processes are so precise that they can squeeze millions of transistors onto a single chip not much larger than a person's thumbnail. One way to achieve this is by etching the chip's surface in separate layers, literally stacking sets of circuits on top of one another.

Another way is to place those circuits closer and closer together. Currently, chipmakers can place transistors so close that they are separated by less than a micron. (A micron is one-millionth of a meter.) Production technologies are constantly being refined. Today's popular PC processors contain tens of millions of transistors; in a few years, there may be as many as one billion transistors on a single processor chip.



:: Chip designs are constantly evolving, making processors ever faster and more powerful.

RISC Processors

The processors in IBM-compatible PCs are complex instruction set computing (CISC) processors. The instruction sets for these CPUs are large, typically containing 200 to 300 instructions.

Another theory in microprocessor design holds that if the instruction set for the CPU is kept small and simple, each instruction will execute in much less time, allowing the processor to complete more instructions during a given period. CPUs designed according to this theory are called reduced instruction set computing (RISC) processors. RISC instruction sets are considerably smaller than those used by CISC processors. The RISC design, which is used in the PowerPC processor but was first implemented in the mid-1980s, results in a faster and less expensive processor.

SELF-CHECK ::

Complete each statement by filling in the blanks.

1. The Itanium 2 processor has _____ transistors.
   a. 45 million b. 105.9 million c. 410 million
2. The Athlon and Duron processors are made by _____.
   a. Intel b. AMD c. Freescale
3. A joint effort of IBM, Freescale, and Apple produced the _____ processor.
   a. G4 b. G5 c. G6

Parallel Processing

Another school of thought on producing faster computers is to build them with more than one processor. This type of system is said to be a multiprocessing (MP)

Urheberrechtlich geschütztes Material

system. The result is a system that can handle a much greater flow of data, complete more tasks in a shorter time, and deal with the demands of many input and output devices. A special form of MP that uses an even number of processors is symmetric multiprocessing (SMP). SMP's advantage is the number of processors is limited to a power of two. The limitation on the number of processors makes the systems easier to design.

Parallel processing is not a new idea in the minicomputer, mainframe, and supercomputer arenas. Manufacturers have developed computers with hundreds or even thousands of microprocessors— systems known as massively parallel processing (MPP) computers.

At the other end of the spectrum, multiple-processor versions of PCs are available today and are commonly used as network servers, Internet host computers, and stand-alone workstations. In fact, recent generations of standard PC microprocessors incorporate a measure of parallel processing by using pipelining techniques to execute more than one instruction at a time.



Norton ONLINE

For more information on parallel processing technologies, visit **http://www.mhhe.com/pelernorton**

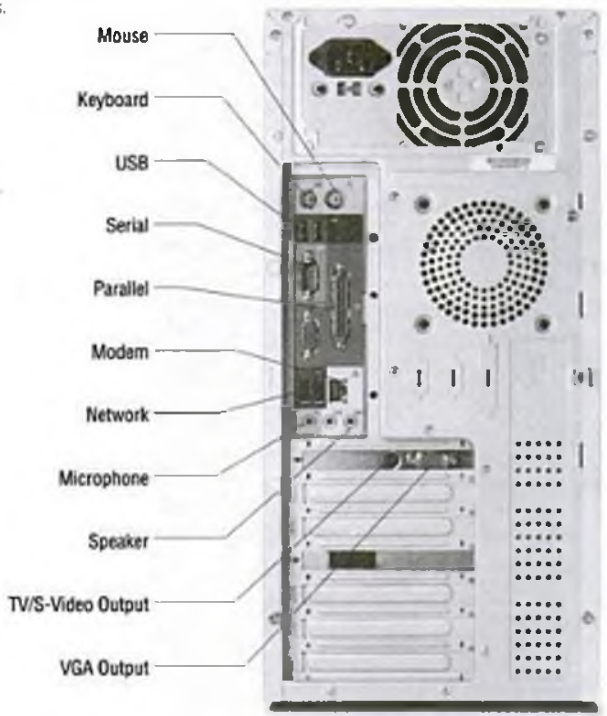
simnet™

Extending the Processor's Power to Other Devices

You have already learned that all the components of a computer tie into the computer's CPU by way of the bus. When you need to add a new piece of hardware to your computer, you need to know how to connect it to the bus. In some cases, you can plug the device into an existing socket, or port, on the back of the computer. Most computers have several types of ports, each with different capabilities and uses. Older computers feature only three or four distinct types of ports, but new systems provide a wide array of specialized ports. When a port is not available, you need to install a circuit board that includes the port you need.

FIGURE 4B.8

Standard computer ports on modern computers.



Standard Computer Ports

All modern computers come with the same basic set of ports. These allow you to connect common devices to your computer. Without these ports, your computer would not boot properly and if it did, you would be unable to interact with the software on the system.

Figure 4B.8 shows the back of a new computer. It contains several color-coded ports. At first glance, it can be overwhelming. However remember that most plugs only fit where they belong and a mistake is never catastrophic. The most commonly used ports are

- **Mouse and Keyboard Ports.** Accepts the keyboard and mouse plugs. The mouse is always the top port. If you make a mistake and plug the mouse into the keyboard port, the computer will not boot properly.
- **Two USB ports.** These accept any number of devices including cameras and joysticks.

Urheberrechtlich geschütztes Material

» **Serial Port.** Serial ports are connected to external modems.

» **Parallel Port.** Most common uses are to connect older printers to the computer.

» **Audio Ports.** There are typically three audio ports on modern computers. The green speaker port is for your headphones or desktop speakers. The pink microphone port is for a small microphone. The yellow speaker out is designed for serious audiophiles to connect their computer to a home stereo system. Intense gamers or PC movie viewers may employ this option.

» **Network Port.** This port allows your computer to plug into a network or use a high-speed Internet connection. You will learn more about networking in Chapter 7, "Networks."

» **Modem Port.** It connects your computer to a phone line. The most common use for a modem is Internet access. You learned more about the Internet in Chapter 8, "Presenting the Internet."

» **Monitor Port.** Most monitors connect to the three-row port on the right side of the image. This can be found either by the serial port or with the expansion cards. Other monitor options may include connections to a TV.

Serial and Parallel Ports

A PC's internal components communicate through the data bus, which consists of parallel wires. Similarly, a parallel interface is a connection of eight or more wires through which data bits can flow simultaneously. Most computer buses transfer 32 bits simultaneously. However, the standard parallel interface for external devices such as printers usually transfers eight bits (one byte) at a time over eight separate wires.

With a serial interface, data bits are transmitted one at a time through a single wire (however, the interface includes additional wires for the bits that control the flow of data). Inside the computer, a chip called a universal asynchronous receiver-transmitter (UART) converts parallel data from the bus into serial data that flows through a serial cable. Figure 4B.9 shows how data flows through a nine-pin serial interface.

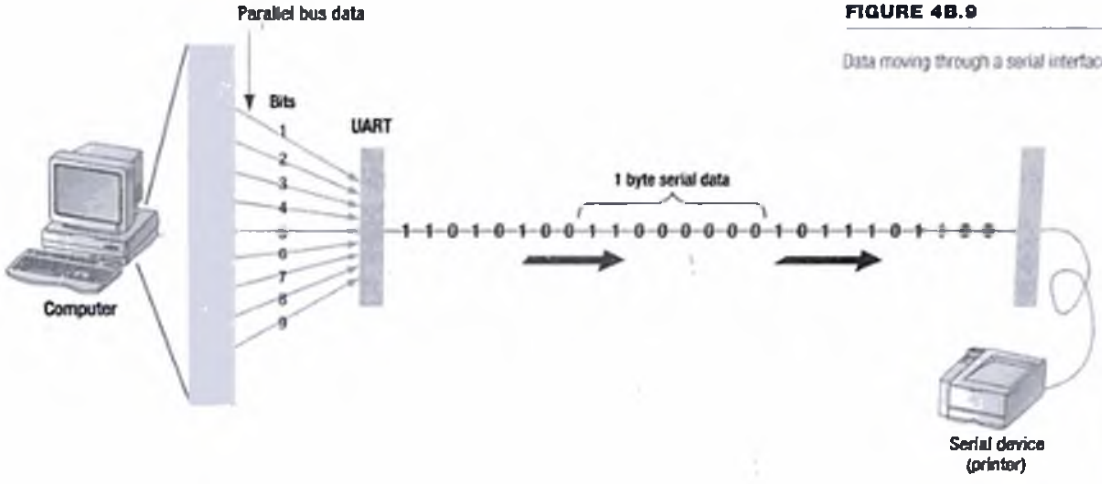


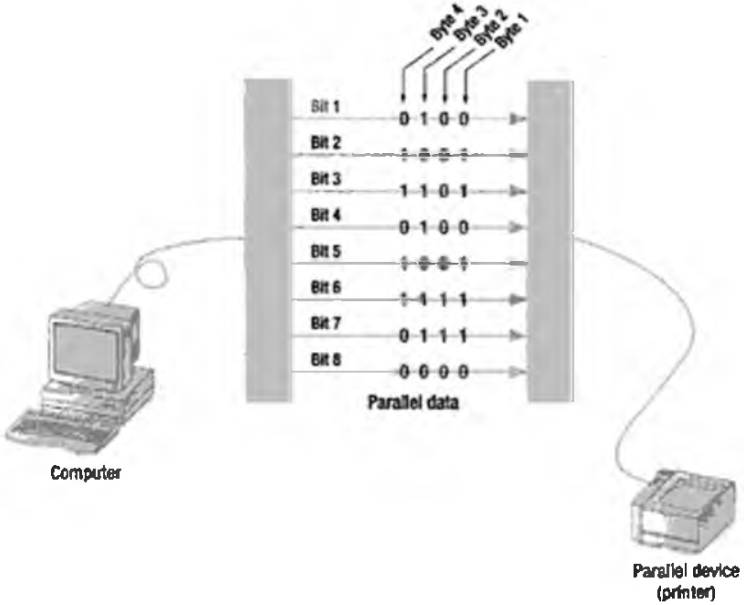
FIGURE 4B.9

Data moving through a serial interface.

Urheberrechtlich geschütztes Material

FIGURE 4B.10

Data moving through a parallel interface



As you would expect, a parallel interface can handle a higher volume of data than a serial interface because more than one bit can be transmitted through a parallel interface simultaneously. Figure 4B.10 shows how data moves through a parallel interface.

Specialized Expansion Ports

In addition to the standard collection of expansion ports, many PCs include specialized ports. These ports allow the connection of special devices, which extend the computer's bus in unique ways.

SCSI

The Small Computer System Interface (SCSI, pronounced *scuzzy*) takes a different approach from standard parallel or serial ports. Instead of forcing the user to plug multiple cards into the computer's expansion slots, a single SCSI adapter extends the bus outside the computer by way of a cable. Thus, SCSI is like an extension cord for the data bus. Like plugging one extension cord into another to lengthen a circuit, you can plug one SCSI device into another to form a chain, as shown in Figure 4B.11. When devices are connected together this way and plugged into a single port, they are called a "daisy chain." Many devices use the SCSI interface. Fast, high-end hard disk drives often have SCSI interfaces, as do scanners, tape drives, and optical storage devices such as CD-ROM drives.

USB

The Universal Serial Bus (USB) has become the most popular external connection for PCs—both IBM-compatible and Macintosh systems. USB has several features that have led to its popularity. First, USB is a hot swappable bus. This means that users can switch USB devices without rebooting the PC. A second feature is its ease of use. Simply plugging the device in makes it ready to run. Finally, USB supports

Unterrichtlich geschütztes Material

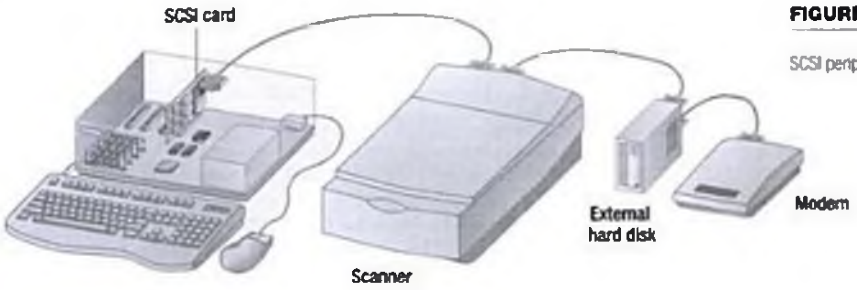


FIGURE 4B.11

SCSI peripherals daisy-chained together.

127 daisy-chained devices. Today, most new computers feature at least four USB ports, with two often in the front of the PC.

IEEE 1394 (FireWire)

Like the USB standard, the IEEE 1394 (FireWire) standard extends the computer's bus to many peripheral devices through a single port. Because IEEE 1394–compliant technology is so expensive, however, it is not expected to become the dominant bus technology, although it may gain wide acceptance as a standard for plugging video and other high-data-throughput devices to the system bus.

Musical Instrument Digital Interface (MIDI)

The Musical Instrument Digital Interface (MIDI) has been in use since the early 1980s, when a group of musical instrument manufacturers developed the technology to enable electronic musical instruments to communicate. Since then, MIDI has been adapted to the personal computer. Many sound cards are MIDI-compliant and feature a special MIDI port. Using a MIDI port, you can plug a wide variety of musical instruments and other MIDI-controlled devices into the computer. MIDI systems are widely used in recording and performing music to control settings for electronic synthesizers, drum machines, light systems, amplification, and more.

Norton ONLINE

For more information on SCSI, USB, FireWire, and MIDI technologies, visit http://www.mhhe.com/petemorton

Expansion Slots and Boards

PCs are designed so that users can adapt, or configure, the machines to their own particular needs. PC motherboards have two or more empty expansion slots, which are extensions of the computer's bus that provide a way to add new components to the computer. The slots accept expansion boards, also called cards, adapters, or sometimes just boards. Figure 4B.12 shows a PC expansion board being installed. The board is being attached to the motherboard—the main system board to which the CPU, memory, and other components are attached.



FIGURE 4B.12

An expansion board being inserted into an expansion slot.

Adapters that serve input and output purposes provide a port to which devices can be attached and act as translators between the bus and the device itself. Some adapters also do a significant amount of data processing. For example, a video controller

Urheberrechtlich geschütztes Material

Computers In Your Career

Computer Sales Professional

Computer-based phone systems were so revolutionary back in 1996 that few companies were interested in them. That reluctance made Mike Plumer's job as salesperson for AltiGen Communications, a Fremont, California, manufacturer of server-based phone systems, pretty challenging. "We were asking companies to buy something that they didn't even know existed," recalls Plumer, the firm's senior director of sales.

Plumer worked through the early challenges by finding other sales reps with a good mix of technical and business knowledge to join him, and by "knocking on a lot of companies' doors" to find those that were willing to purchase AltiGen's innovative products.

As with any new technology, AltiGen's products didn't stay unique for long as other companies began producing server-based systems. A public relations major who graduated from Iowa State University, Plumer continues to handle sales for the company while also overseeing its 14-person worldwide sales force. His day typically starts with a commute to work—time he uses to plan out the day ahead. Upon arriving at the office, he makes calls to his field sales reps and managers for a "status check."

In addition to selling and overseeing AltiGen's sales force, Plumer also handles myriad other tasks. When telecommunications companies are visiting for on-site sales training, for example, he may conduct a one-hour presentation on Voice over IP and networking. Such diversions keep the job interesting, says Plumer, who enjoys selling systems that range in price from $20,000 to $150,000.

"These sales require interaction not only with a company's tech personnel, but also with top decision makers," says Plumer. "You must be able to relate to people at the decision-making level while also displaying the technical aptitude needed to help them make those decisions." He sees future sales opportunities in the IT field as "very good," based on the fact that all high-tech companies rely on productive salespeople to push their products out to the masses.

Computer sales professionals like Plumer sell a wide variety of products and services. Here are just a few:

» **PC Hardware Sales.** This field includes personal computers—desktops, portables, network servers, network computers, and handheld computers.

is a card that provides a port on the back of the PC into which you can plug the monitor. It also contains and manages the video memory and does the processing required to display images on the monitor. Similar devices include sound cards, internal modems or fax/modems, and network interface cards.

PC Cards

Another type of expansion card is the PC Card (initially called a Personal Computer Memory Card International Association, or PCMCIA, card). It is a small device about the size of a credit card (see Figure 4B.13). This device was designed initially for use in notebook computers and other computers that are too small to accept a standard expansion card. A PC Card fits into a slot on the back or side of the notebook computer. PC Card adapters are also available for desktop computers, enabling them to accept PC Cards. Even some types of digital cameras accept PC Cards that store digital photographs. PC Cards are used for a wide variety of purposes and can house modems, network cards, memory, and even fully functioning hard disk drives.

FIGURE 4B.13

Small PC Card devices provide memory, storage, communications, and other capabilities



Urheberrechtlich geschütztes Material

- **Enterprise Hardware Sales.** The term *enterprise* usually means "big company," and big companies often have specialized, high-level computing needs.
- **Specialty Hardware Sales.** Nearly every kind of organization has some type of specialized hardware need, such as high-output color printers, storage subsystems, backup systems, and other peripherals.
- **Telecommunications Sales.** Telecommunications and computer technologies go hand in hand, and today's businesses are hungry for both.
- **Software Sales.** This industry extends beyond sales of operating systems and word processors; enterprise software includes massive database systems, network management software, data-mining tools, and other powerful and expensive packages.



Sales professionals are compensated in different ways, including straight salary, commissions, bonuses, profit sharing, stock options, and other rewards. According to the Bureau of Labor Statistics, *Occupational Outlook Handbook, 2004–05 Edition*, the median annual earnings of sales representatives in the computer and data processing services field were $55,740. In addition to their earnings, sales representatives are usually reimbursed for expenses such as transportation costs, meals, hotels, and entertaining customers.

There are three categories of PC Card technologies: Type I, Type II, and Type III. The different types are typically defined by purpose. For example, Type I cards usually contain memory, Type II cards are used for network adapters, and Type III cards usually house tiny hard drives. Type I PC Cards are the thinnest available and have the fewest uses. Type III cards are the thickest and enable developers to fit disk storage devices into the card-size shell. Some PC Card adapters can hold multiple cards, greatly expanding the capabilities of the small computer.

Plug and Play

With the introduction of Windows 95, Intel-based PCs began supporting the Plug and Play standard, making it easier to install hardware via an existing port or expansion slot. Using hardware that complies with Windows' Plug and Play standard, the operating system can detect a new component automatically, check for existing driver programs that will run the new device, and load necessary files. In some cases, Windows will prompt you to install the needed files from a disk. Depending on how the new device is connected, this process may require restarting the system for the new hardware's settings to take effect. Still, this process is much simpler than the one required prior to Plug and Play technology, which usually forced the user to manually resolve conflicts between the new hardware and other components.

Norton ONLINE

For more information on Plug and Play, visit http://www.mhhe.com/petermorton

Urheberrechtlich geschütztes Material

Summary ::

- A processor's architecture, or internal design, dictates its function and performance.
- A key to a processor's performance is the number of transistors it contains. Chip designers constantly look for new ways to place more transistors on microprocessor chips. Today's PC processors contain tens of millions of processors.
- Intel manufactured the processors used in the first IBM personal computers. Today, Intel's most popular PC processors are the Pentium 4, Pentium III Xeon, Pentium III, and Celeron. A newer Intel processor, the Itanium, is a 64-bit processor used in high-performance workstations and network servers.
- Advanced Micro Devices (AMD), which initially made lower-performance processors for low-cost PCs, now manufactures high-performance processors that compete directly with Intel. AMD's most popular PC processors are the Athlon and Duron.
- Freescale manufactured processors used in Apple's older Macintosh computers; its most popular processors are in the PowerPC family. Freescale also makes processors for other types of computing devices, such as minicomputers and workstations.
- IBM manufactures processors used in a variety of environments. IBM processors can be found in many models of mainframes. More recently IBM teamed with Freescale and Apple to develop the G5 processor.
- Most of the processors used in personal computers are based on complex instruction set computing (CISC) technology. PowerPC processors, and processors used in many other types of computers, are based on reduced instruction set computing (RISC) technology. Because they contain a smaller instruction set, RISC processors can run faster than CISC processors.
- A parallel processing system harnesses the power of multiple processors in a single system, enabling them to share processing tasks. In a massively parallel processor (MPP) system, many processors are used. Some MPP systems use thousands of processors at one time.
- External devices, such as those used for input and output, are connected to the system by ports on the back or front of the computer.
- Most computers come with a serial port and a parallel port. A serial port transmits one bit of data at a time; a parallel port transmits one byte (eight bits) of data at a time.
- If the computer does not have the right type of port for an external device (or if all the existing ports are in use), an expansion board can be installed into one of the PC's empty expansion slots.
- Bus technologies such as Small Computer System Interface (SCSI), Universal Serial Bus (USB), and IEEE 1394 (FireWire) enable the user to connect many devices through a single port.

Urheberrechtlich geschütztes Material

Key Terms ::

adapter, 155
Advanced Micro Devices (AMD), 148
architecture, 147
board, 150
card, 155
complex instruction set computing (CISC), 151
configure, 155
expansion board, 155
expansion slot, 155
Freescale, 149
IBM, 149
Intel, 148
massively parallel processing (MPP), 152
multiprocessing (MP), 151
Musical Instrument Digital Interface (MIDI), 155
parallel interface, 153
Plug and Play, 157
reduced instruction set computing (RISC), 151
serial interface, 153
Small Computer System Interface (SCSI), 154
symmetric multiprocessing (SMP), 152
universal asynchronous receiver-transmitter (UART), 153

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. A processor's internal design is called its _____ .
2. _____ and _____ are the leading manufacturers of processors for IBM-compatible personal computers.
3. When you _____ a PC, you are adapting it to best meet your needs.
4. With a(n) _____ interface, data bits are transmitted one at a time through a single wire.
5. The _____ enables electronic instruments and computers to communicate with one another.
6. The _____ allows devices to be connected in a daisy chain.
7. _____ ports can transmit eight bytes at a time.
8. In _____ processors, the instruction sets are large, typically containing 200–300 instructions.
9. An expansion _____ is plugged into a computer to provide additional connectivity or functionality.
10. A system that employs an even number of processors is said to use _____ .

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A computer system that uses a smaller instruction set is said to use _____ technology.
   a. parallel processing b. RISC c. cache d. Zip
2. FireWire is another name for the _____ interface.
   a. parallel b. IEEE 1394 c. MIDI d. USB
3. The _____ processor is used in Apple's Macintosh computers.
   a. Celeron b. Athlon c. ThinkPad d. PowerPC
4. The more _____ a processor has, the more powerful it is.
   a. microns b. transistors c. connections d. neurons
5. The instruction set for a _____ processor usually contains 200 to 300 instructions.
   a. CISC b. SMP c. RISC d. IBM
6. You can connect an electronic instrument to your computer via the _____ port.
   a. PS2 b. USB c. HDX d. MIDI
7. Older printers are likely to be connected through the _____ interface.
   a. COM b. parallel c. modem d. network
8. Your phone line is connected to the _____ on your computer.
   a. PS2 b. USB c. modem d. network
9. The green audio port is used to connect your _____ .
   a. microphone b. speaker c. stereo d. guitar
10. Which of the following cannot be the number of processors in an SMP system?
    a. 4 b. 6 c. 8 d. 16

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. Describe the purpose of expansion slots in a PC.
2. What is the primary difference between a RISC processor and a CISC processor?
3. Why is a processor's architecture important?
4. What are the advantages of parallel processing?
5. What is the purpose of the UART?
6. Name the five processors currently available from Intel Corporation.
7. Name the five processors currently available from AMD.
8. The AMD Athlon 64 FX, the Intel Pentium 4, and the PowerMac G5 are the most powerful processors currently in use in PCs. What are the word sizes of these three processors?
9. Why can it be said that recent-generation PCs incorporate a measure of parallel processing, even though they have only one processor?
10. What is a "daisy chain"?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. To view information about your computer's components, follow these steps:
   a. Open the Control Panel window. (The steps for opening the Control Panel vary, depending on the version of Windows you use. If you need help, ask your instructor.) In the Control Panel window, double-click the System icon.
   b. In the System Properties dialog box, select the Hardware tab and then open the Device Manager window to view the list of categories of devices attached to your system. If a category is preceded by a plus sign (+), click this symbol to display all the devices in that category.
   c. To read about a device, right-click its name, and then click Properties. A dialog box will appear displaying information about the selected device. *Warning*: Do not make any changes.
   d. Review the properties for your system's disk drives, ports, and system devices.
   e. Close any open windows or dialog boxes; then close the Control Panel window.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Plug it in. With your instructor observing, turn your computer and monitor off and unplug them from their power source. Then take these steps:
   a. Move to the back of the computer and inspect all the cables plugged into it. Which devices are connected to the PC and by which cables? Which port is connected to each device? Make a chart of these connections.
   b. Unplug each connection. After all students have unplugged their devices for their computers, switch places with someone and reconnect all the devices to the computer. Does the other student's system have the same connections as yours? If not, can you reconnect all its devices correctly?
   c. Return to your PC. Use your chart to see whether your system has been reconnected correctly. If not, correct any connecting errors. When you are sure all devices are plugged into the right ports, reconnect the PC and monitor to the power source. Turn the PC on and make sure everything is working correctly.
2. Watch those files grow. The concept of bits and bytes may seem unimportant until you begin creating files on your computer. Then you can begin to understand how much memory and storage space your files take up (in bytes, of course). Create a file in Notepad, save it to disk, and take the following steps to add to the file to see how it grows:
   a. Launch Notepad. The steps to launch the program vary, depending on which version of Windows you use. If you need help, ask your instructor for directions.
   b. Type two or three short paragraphs of text. When you are done, click the File menu, and then click the Save As command.
   c. In the Save As dialog box, choose a drive and folder in which to save the new file, and give the file a short name you can remember easily, such as SIZE-TEST.TXT.
   d. With Notepad running, launch Windows Explorer. If you need help, ask your instructor for directions.
   e. Navigate to the drive and folder where you saved your Notepad file. When you find the file, look for its size in the Size column and write down the size. Close the Exploring window.
   f. Return to the Notepad window and add two or three more paragraphs of text. Then click the File menu and click the Save command to resave the file under the same name.
   g. Reopen Windows Explorer and look at the file's size again. Has it changed? By how much?
3. Learn more about Unicode. The Unicode text code system will become universally accepted in the next few years. All operating systems, application programs, data, and hardware architectures have started to conform to it. For this reason, learn as much as you can about Unicode and how it may affect your computing in the future. Visit the Unicode Consortium Web site: http://www.unicode.org.

Urheberrechtlich geschütztes Material

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Do you think the international interchange of data provided by the Unicode character set is a worthwhile goal for computing technology? Do you see any other benefits to Unicode's widespread implementation?
2. Why is the CPU commonly referred to as the computer's "brain"? Do you think it is a good idea to use this term to describe the CPU? Why?

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- The history of the Pentium family of processors.
- The uses of parallel processing computer systems in business.
- The USB and FireWire bus standards, and their possible impact on computers of the future.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

Computers are becoming more powerful all the time. Many people see this capability as a source of limitless benefits, but others view it as a threat. With this thought in mind, discuss the following questions in class.

1. As technology improves, processing becomes faster. It can be argued that computer technology has made Americans less patient than they were a decade ago. Do you agree? If so, do you see it as a benefit of our technological progress or a drawback? Should we restrain our urge to increase the pace of life? Be prepared to explain your position.
2. Computers are not only getting faster, but they also are becoming exponentially more powerful all the time. For example, many think that in the next decade artificial intelligence will be developed to the point that computers can begin reasoning—weighing facts, solving problems, perhaps even making decisions. Will people relinquish even a tiny bit of control to computers? If so, what kinds of decisions will we allow them to make for us? What risks do we run by enabling computers to become "smart" enough to solve problems or ultimately to think?

Urheberrechtlich geschütztes Material



CHAPTER 5

Storing Data

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **5A:**
Types of Storage Devices

- Categorizing Storage Devices
- Magnetic Storage Devices
- Optical Storage Devices
- Solid-State Storage Devices

Lesson **5B:**
Measuring and Improving Drive Performance

- Average Access Time
- Data Transfer Rate
- Optimizing Disk Performance
- Drive Interface Standards



Types of Storage Devices

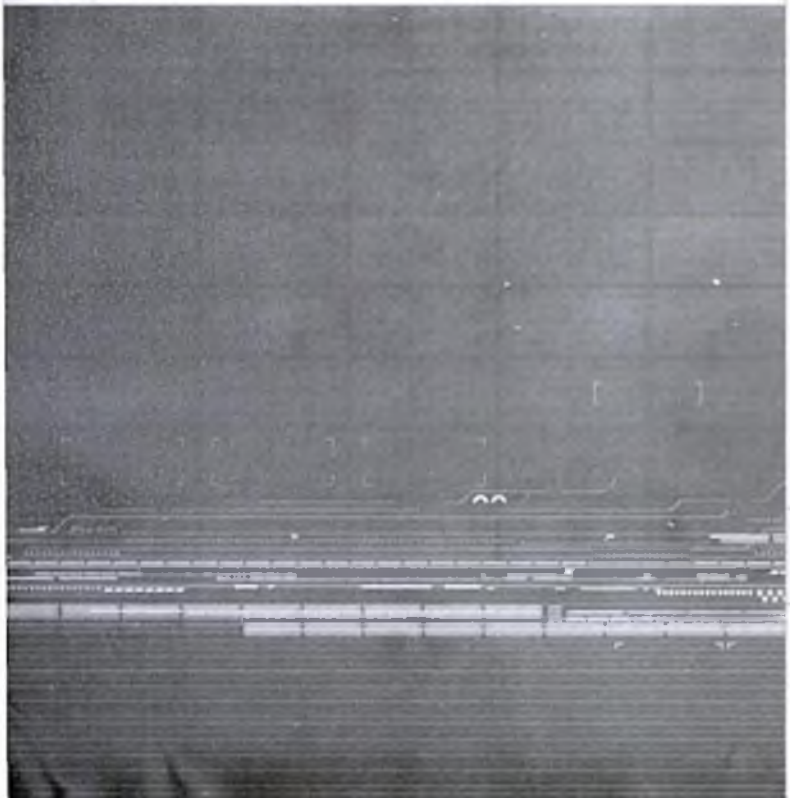
Overview: An Ever-Growing Need

The earliest personal computers provided very little space for storing data. Some PCs did not feature disk drives at all. Instead, they stored programs and data on standard audio cassette tapes. Some PCs featured one or two floppy disk drives, but no hard disks. When the earliest PC hard disks came on the scene, they stored only 10 MB of data. Still, compared to a floppy disk (which then had a capacity of only 512 KB), 10 MB seemed like an infinite amount of space.

By contrast, even today's lowest-cost PCs feature hard disks with capacities of 40 GB, 80 GB, or more. You can easily find a hard drive that holds 180 GB of data for less than $200. Just as important, these large drives can transfer data at amazing speeds, and many are external—meaning they can connect to any computer via a USB or FireWire port.

In addition to floppy disks and hard drives, today's computer user can choose from a wide range of storage devices, from "key ring" devices that store hundreds of megabytes to digital video discs, which make it easy to transfer several gigabytes of data.

This lesson examines the primary types of storage found in today's personal computers. You'll learn how each type of storage device stores and manages data.



OBJECTIVES ::

- List four types of magnetic storage media commonly used with PCs.
- Explain how data is stored on the surface of a magnetic disk.
- List seven types of optical storage devices that can be used with PCs.
- Explain how data is stored on the surface of an optical disc.
- Name three types of solid-state storage devices.

Urheberrechtlich geschütztes Material

Categorizing Storage Devices

The purpose of a storage device is to hold data—even when the computer is turned off—so the data can be used whenever it is needed. Storage involves two processes:

- Writing, or recording, the data so it can be found later for use.
- Reading the stored data, then transferring it into the computer's memory.

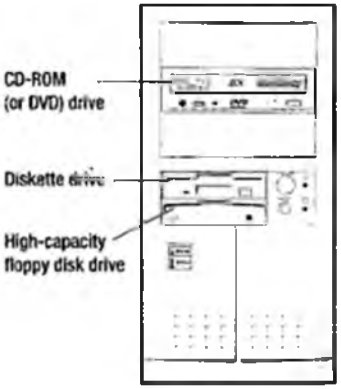


FIGURE 5A.1

Common storage devices found in today's PCs

The physical materials on which data is stored are called storage media. The hardware components that write data to, and read data from, storage media are called storage devices (see Figure 5A.1). For example, a diskette is a storage medium (*medium* is the singular form of the word *media*); a diskette drive is a storage device.

The two main categories of storage technology used today are magnetic storage and optical storage. Although most storage devices and media employ one technology or the other, some use both. A third category of storage—solid-state storage—is increasingly being used in computer systems, but is more commonly found in devices such as digital cameras and media players.

Nearly every new PC comes with a diskette drive and a built-in hard disk, as shown in Figure 5A.1. Some PC makers now sell computers without built-in diskette drives, although they can be added to the system. Most new PCs also have a CD-ROM or DVD-ROM drive. For a little more expense, many consumers replace the optical drive with one that will let them record data onto an optical disc. A built-in drive for removable high-capacity floppy disks is another common feature in new PCs.

Norton ONLINE

For more information on types of storage devices used in personal computers, visit **http://www.mhhe.com/petemorton**

simnet™

Magnetic Storage Devices

Because they all use the same medium (the material on which the data is stored), diskette drives, hard disk drives, high-capacity floppy disk drives, and tape drives use similar techniques for writing and reading data. The surfaces of diskettes, hard disks, high-capacity floppy disks, and magnetic tape are coated with a magnetically sensitive material, such as iron oxide, that reacts to a magnetic field (see Figure 5A.2).

Diskettes contain a single thin disk, usually made of plastic. This disk is flexible, which is why diskettes are often called floppy disks. A diskette stores data on both sides of its disk (numbered as side 0 and side 1), and each side has its own read/write head. High-capacity floppy disks contain a single disk, too, but their formatting enables them to store much more data than a normal floppy disk, as you will see later. Hard disks usually contain multiple disks, which are called platters because they are made of a rigid material such as aluminum.

Norton ONLINE

For more information on magnetic storage devices and their operation, visit **http://www.mhhe.com/petemorton**

simnet™

How Data Is Stored on a Disk

You may remember from science projects that one magnet can be used to make another. For example, you can make a magnet by taking an iron bar and stroking it in one direction with a magnet. The iron bar becomes a magnet itself, because

Urheberrechtlich geschütztes Material

its iron molecules align themselves in one direction. Thus, the iron bar becomes polarized; that is, its ends have opposite magnetic polarity.

You also can create a magnet by using electrical current to polarize a piece of iron, as shown in Figure 5A.3. The process results in an electromagnet; you can control the polarity and strength of an electromagnet by changing the direction and strength of the current.

Magnetic storage devices use a similar principle to store data. Just as a transistor can represent binary data as "on" or "off," the orientation of a magnetic field can be used to represent data. A magnet has one important advantage over a transistor: that is, it can represent "on" and "off" without a continual source of electricity.

The surfaces of magnetic disks and tapes are coated with millions of tiny iron particles so that data can be stored on them. Each of these particles can act as a magnet, taking on a magnetic field when subjected to an electromagnet. The read/write heads of a magnetic disk or tape drive contain electromagnets that generate magnetic fields in the iron on the storage medium as the head passes over the disk or tape. As shown in Figure 5A.4, the read/write heads record strings of 1s and 0s by alternating the direction of the current in the electromagnets.

To read data from a magnetic surface, the process is reversed. The read/write head passes over the disk or tape while no current is flowing through the electromagnet. The head possesses no charge, but the storage medium is covered with magnetic fields, which represent bits of data. The storage medium charges the magnet in the head, which causes a small current to flow through the head in one direction or the other, depending on the field's polarity. The disk or tape drive

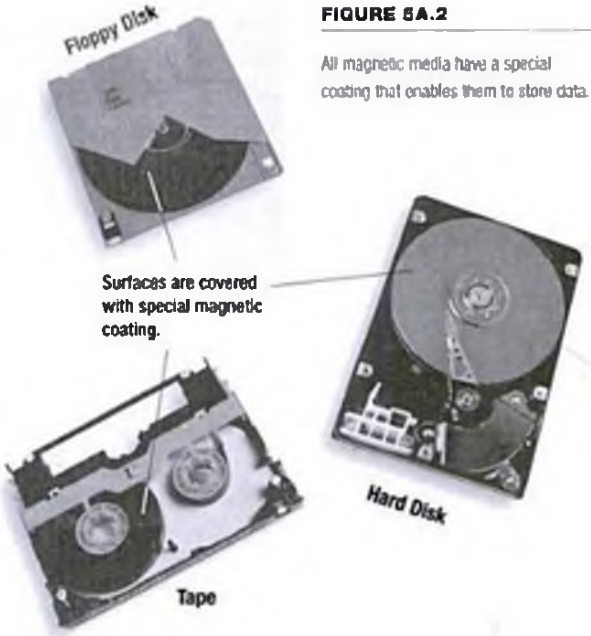


FIGURE 5A.2

All magnetic media have a special coating that enables them to store data.

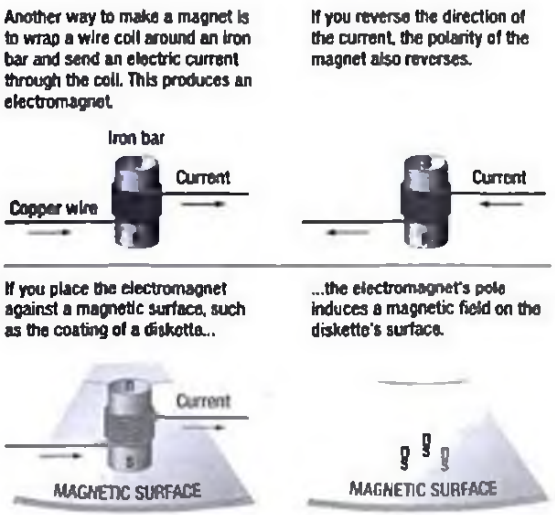


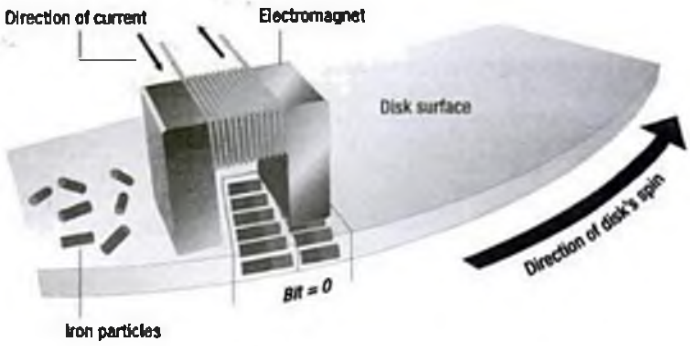
FIGURE 5A.3

How an electromagnet creates a field on a magnetic surface.

Urheberrechtlich geschütztes Material

FIGURE 5A.4

A read/write head recording data on the surface of a magnetic disk.



senses the direction of the flow as the storage medium passes by the head, and the data is sent from the read/write head into memory.



Norton ONLINE

For more information on formatting disks, visit **http://www.mhhe.com/petemorton**

How Data is Organized on a Magnetic Disk

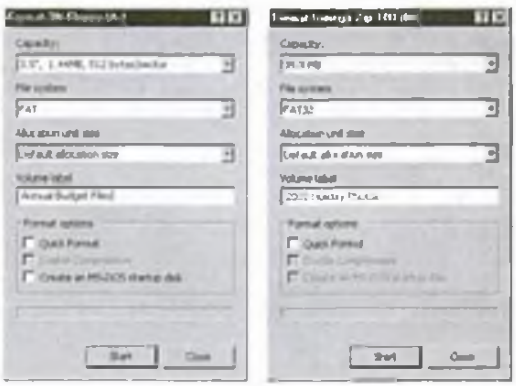
Before the computer can use a magnetic disk to store data, the disk's surface must be magnetically mapped so that the computer can go directly to a specific point on it without searching through data. (Because a magnetic disk drive's heads can go directly to any point on the disk's surface to read or write data, magnetic storage devices are also categorized as random access storage devices.) The process of mapping a disk is called formatting or initializing.

When you purchase new diskettes or high-capacity floppy disks, they should already be formatted and ready to use with your computer. In a new computer, the built-in hard disk is almost always already formatted and has software installed on it. If you buy a new hard disk by itself, however, you may need to format it yourself, but this is not difficult to do.

You may find it helpful to reformat diskettes from time to time, because the process ensures that all existing data is deleted from the disk. During the formatting process, you can determine whether the disk's surface has faulty spots, and you can copy important system files to the disk. You can format a floppy disk by using operating system commands (see Figure 5A.5).

FIGURE 5A.5

Formatting a diskette and a Zip disk (a high-capacity floppy disk).



Tracks and Sectors

When you format a magnetic disk, the disk drive creates a set of concentric rings, called tracks, on each side of the disk. The number of tracks required depends on the type of disk. Most diskettes have 80 tracks on each side of the disk. A hard disk may have several hundred tracks on each side of each platter. Each track is a separate circle, like the circles on a bull's-eye target. The tracks are numbered from the outermost circle to the innermost, starting with 0, as shown in Figure 5A.6.

In the next stage of formatting, the tracks are divided into smaller parts. Imagine slicing a disk the way you slice a pie. As shown in Figure 5A.7, each slice would cut across all the disk's tracks, resulting in short segments called sectors. Sectors are where data is physically stored on the disk. In all diskettes and most hard disks, a sector can store up to 512 bytes (0.5 KB). All the sectors on a disk

Urheberrechtlich geschütztes Material



FIGURE 5A.6

Tracks are concentric circles on a disk's surface.

are numbered in one long sequence, so that the computer can access each small area on the disk by using a unique number.

A sector is the smallest unit with which any magnetic disk drive can work; the drive can read or write only whole sectors at a time. If the computer needs to change just one byte out of 512, it must rewrite the entire sector.

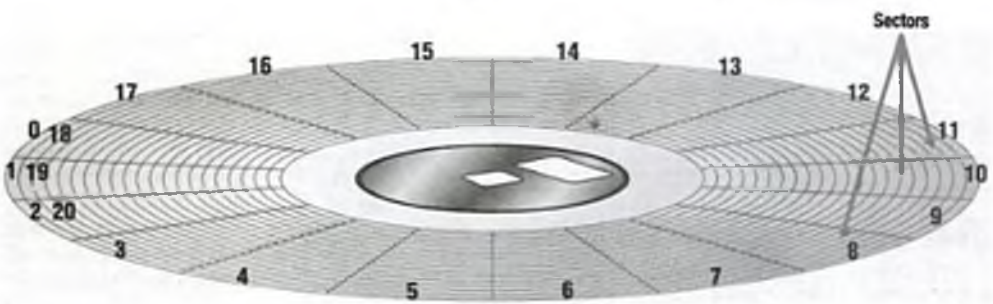
If a diskette has 80 tracks on each side, and each track contains 18 sectors, then the disk has 1,440 sectors (80 × 18) per side, for a total of 2,880 sectors. This configuration is true regardless of the length of the track. The disk's outermost track is longer than the innermost track, but each track is still divided into the same number of sectors. Regardless of physical size, all of a diskette's sectors hold the same number of bytes; that is, the shortest, innermost sectors hold the same amount of data as the longest, outermost sectors.

Of course, a disk's allocation of sectors per track is somewhat wasteful, because the longer outer tracks could theoretically store more data than the shorter inner tracks. For this reason, most hard disks allocate more sectors to the longer tracks on the disk's surface. As you move toward the hard disk's center, each subsequent track has fewer sectors. This arrangement takes advantage of the hard disk's potential capacity and enables a typical hard disk to store data more efficiently than a floppy disk. Because many hard disks allocate sectors in this manner, their sectors-per-track specification is often given as an average. Such hard disks are described as having "an average of *x* sectors per track."

As you will learn in Chapter 6, "Using Operating Systems," the computer's operating system (sometimes with help from utility programs) is responsible for managing all disk operations in a computer. It is up to the operating system to determine the precise locations where files are stored on the surface of a disk.

FIGURE 5A.7

Sectors on a disk, each with a unique number.



Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on file systems, visit http://www.mhhe.com/petermorton.

How the Operating System Finds Data on a Disk

A computer's operating system can locate data on a disk because each track and each sector are labeled, and the location of all data is kept in a special log on the disk. The labeling of tracks and sectors is called logical formatting.

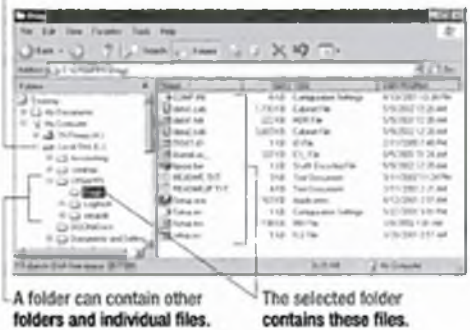
Different operating systems can format disks in different ways. Each formatting method configures the disk's surface in a different manner, resulting in a different file system—a logical method for managing the storage of data on a disk's surface. A commonly used logical format performed by Windows is called the FAT file system because it relies on a standardized file allocation table (FAT) to keep track of file locations on the disk.

When a diskette is formatted with the FAT file system, four areas are created on the disk.

- The boot sector contains a program that runs when you first start the computer. This program determines whether the disk has the basic components that are necessary to run the operating system successfully. If the program determines that the required files are present and the disk has a valid format, it transfers control to one of the operating system programs that continues the process of starting up. This process is called booting, because the boot program makes the computer "pull itself up by its own bootstraps." The boot sector also contains information that describes other disk characteristics, such as the number of bytes per sector and the number of sectors per track—information that the operating system needs to access data on the disk.
- The file allocation table (FAT) is a log that records the location of each file and the status of each sector. When you write a file to a disk, the operating system checks the FAT to find an open area, stores the file, and then logs the file's identity and its location in the FAT. When a program needs to locate data on the disk, the operating system checks the FAT to see where that data is stored. During formatting, two copies of the FAT are created; both copies are always maintained to keep their information current.
- The root folder is the "master folder" on any disk. A folder (also called a directory) is a tool for organizing files on a disk. Folders can contain files or other folders, so it is possible to set up a hierarchical system of folders on your computer, just as you can have folders within other folders in a file cabinet. The topmost folder is known as the *root*, but may also be called the *root folder* or *root directory*. This is the folder that holds all the information about all the other folders on the disk. When you use the operating system to view the contents of a folder, the operating system lists specific information about each file in the folder, such as the file's name, its size, the time and date that it was created or last modified, and so on. Figure 5A.8 shows a typical folder listing on a Windows XP system.

FIGURE 5A.8

A folder listing in Windows XP.



- The data area is the part of the disk that remains free after the boot sector, the FAT, and the root folder have been created. This is where data and program files are actually stored on the disk.

During logical formatting, the operating system also groups sectors together, into storage units called clusters. A cluster, therefore, is simply a group of sectors that the OS sees as a single unit. A cluster is the smallest space an OS will allocate to a single file, and a cluster may store an entire file or just part of a file. Cluster sizes vary, depending on the size and type of the disk, but they can range from four sectors for diskettes to 64 sectors for some hard disks. Cluster usage is tracked in the file allocation table.

Urheberrechtlich geschütztes Material

In the example shown earlier, you saw the results of formatting a floppy disk on a computer using the FAT file system. Different operating systems use different file systems:

- **File Allocation Table (FAT).** This file system, which is also known as FAT16, was used in MS-DOS and was the basis for the early Windows operating systems. In fact, all versions of Windows support FAT, although it is no longer the preferred file system; newer file systems offer better security and greater flexibility in managing files.
- **FAT32.** Introduced in Windows 95, FAT32 is an extended edition of the original FAT file system, providing better performance than FAT. It continues to be supported in Windows 2000 and Windows XP.
- **New Technology File System (NTFS).** Introduced with Windows NT and the basis for later operating systems, NTFS was a leap forward from FAT, offering better security and overall performance. NTFS also allowed Windows computers to use long file names (file names longer than eight characters) for the first time.
- **NTFS 5.** This updated version of NTFS is used in Windows 2000 and XP.
- **High-Performance File System (HPFS).** This was designed for use with IBM's OS/2.

Other operating systems (such as UNIX), and even some network operating systems (such as Novell NetWare), use their own file systems. Although each file system has different features and capabilities, they all perform the same basic tasks and enable a computer's disks and operating system to store and manage data efficiently.

Norton ONLINE

For more information on floppy disks, visit http://www.mhhe.com/peternorton

Diskettes (Floppy Disks)

Figure 5A.9 shows a diskette and a diskette drive. The drive includes a motor that rotates the disk on a spindle and read/write heads that can move to any spot on the disk's surface as the disk spins. The heads can skip from one spot to another on the disk's surface to find any piece of data without having to scan through all of the data in between.

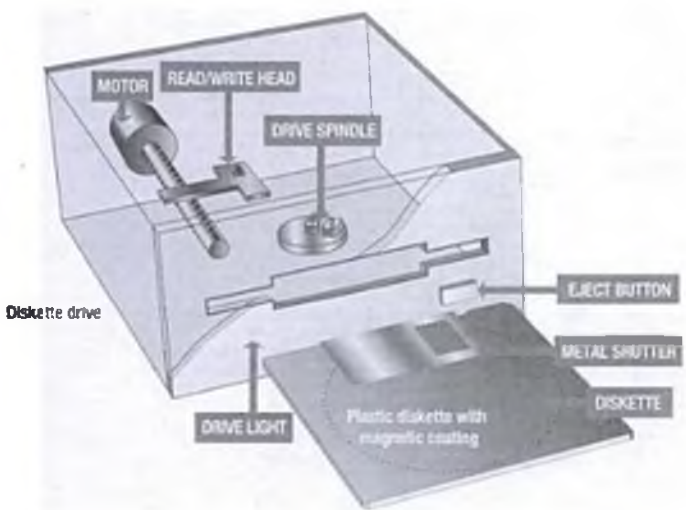


FIGURE 5A.9

Parts of a diskette and a diskette drive.

Urheberrechtlich geschütztes Material

Diskettes spin at about 300 revolutions per minute. Therefore, the longest it can take to position a point on the diskette under the read/write heads is the amount of time required for one revolution—about 0.2 second. The farthest the heads have to move is from the center of the diskette to the outside edge (or vice versa). The heads can move from the center to the outside edge in even less time—about 0.17 second. Because both operations (rotating the diskette and moving the heads from the center to the outside edge) take place simultaneously, the maximum time to position the heads over a given location on the diskette—known as the maximum access time—remains the greater of the two times, or 0.2 second (see Figure 5A.10).

The maximum access time for diskettes can be longer, however, because diskettes do not spin when they are not being used. It can take about 0.5 second to rotate the disk from a dead stop.

A 3.5-inch diskette, as shown in Figure 5A.11, is encased in a hard plastic shell with a sliding shutter. When the disk is inserted into the drive, the shutter is slid back to expose the disk's surface to the read/write head.

A disk's density is a measure of its capacity—the amount of data it can store. To determine a disk's density, you can multiply its total number of sectors by the number of bytes each sector can hold. For a standard floppy disk, the equation looks like this:

```
    2,880 sectors
  × 512 bytes per sector
-------------------------
1,474,560 total bytes
```

FIGURE 5A.10

How maximum access time is determined for a diskette drive.

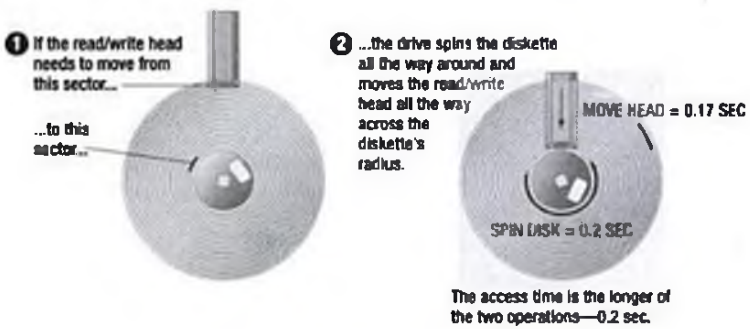
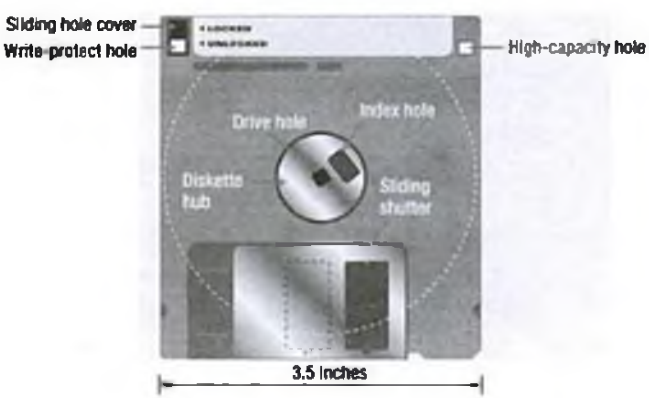


FIGURE 5A.11

A 3.5-inch diskette.



Urheberrechtlich geschütztes Material

Hard Disks

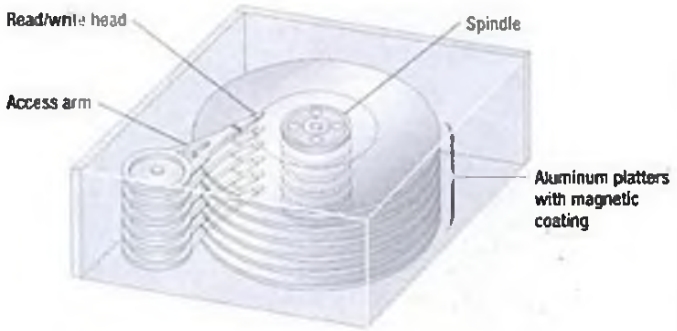


FIGURE 5A.12

Parts of a hard disk.

A hard disk includes one or more platters mounted on a central spindle, like a stack of rigid diskettes. Each platter is covered with a magnetic coating, and the entire unit is encased in a sealed chamber. Unlike diskettes, where the disk and drive are separate, the hard disk and drive are a single unit. It includes the hard disk, the motor that spins the platters, and a set of read/write heads (see Figure 5A.12). Because you cannot remove the disk from its drive (unless it is a removable hard disk), the terms *hard disk* and *hard drive* are used interchangeably.

The smallest hard disks available today can store several hundred megabytes; the largest store 200 GB or even more. Most entry-level consumer PCs now come with hard disks of at least 40 GB, but minimum capacities are continually increasing.

The hard disks found in most PCs spin at a speed of 3,600, 7,200, or 10,000 revolutions per minute (rpm). Very-high-performance disks found in workstations and servers can spin as fast as 15,000 rpm. (Compare these figures to a diskette's spin rate of 300 rpm). The speed at which the disk spins is a major factor in its overall performance. The hard disk's high rotational speed allows more data to be recorded on the disk's surface. This is because a faster-spinning disk can use smaller magnetic charges to make current flow through the read/write head. The drive's heads also can use a lower-intensity current to record data on the disk.

Hard disks pack data more closely together than floppy disks can, but they also hold more data because they include multiple platters. To the computer system, this configuration means that the disk has more than two sides: sides 0, 1, 2, 3, 4, and so on. Larger-capacity hard disks may use 12 or more platters.

Like diskettes, hard disks generally store 512 bytes of data in a sector, but hard disks can have more sectors per track—54, 63, or even more sectors per track are not uncommon.

Norton ONLINE

For more information on hard disks, visit **http://www.mhhe.com/pcnorton**

Removable High-Capacity Magnetic Disks

Norton ONLINE

For more information on removable high-capacity magnetic disks, visit **http://www.mhhe.com/pcnorton**

simnet™

Removable high-capacity disks and drives combine the speed and capacity of a hard disk with the portability of a diskette. A wide variety of devices fall into this category, and each device works with its own unique storage medium. There are basically two types of removable high-capacity magnetic disks:

- **High-Capacity Floppy Disks.** Many computer makers now offer built-in high-capacity floppy disk drives in addition to a standard diskette drive. You can easily add a high-capacity floppy disk drive to a system that doesn't already have one. These drives use disks that are about the same size as a 3.5-inch diskette but have a much greater capacity than a standard diskette. The most commonly used high-capacity floppy disk system is the Zip drive and disks, made by Iomega Corp. (see Figure 5A.13). Zip disks come in capacities ranging from 100 MB to 750 MB.
- **Hot-Swappable Hard Disks.** At the high end in terms of price and performance are hot-swappable hard disks, also called removable hard disks. These disks are sometimes used on high-end



FIGURE 5A.13

The Iomega Zip system.

Urheberrechtlich geschütztes Material

Productivity Tip

Backing Up Your Data

Backing up your data simply means making a copy of it, separate from the original version on your computer's hard disk. You can back up the entire disk, programs and all, or you can back up your data files. If your original data is lost, you can restore the backup copy, then resume your work with no more than a minor inconvenience. Here are some tips to help you start a regular backup routine.

Choose Your Medium

The most popular backup medium is the floppy disk, but you may need dozens of them to back up all your data files. A tape drive, removable hard disk, CD-RW, or DVD-RW drive may be a perfect choice if the medium provides enough storage space to back up your entire disk. When choosing your backup medium, the first rule is to make sure it can store everything you need. It also should enable you to restore backed-up data and programs with little effort. You can find medium-capacity tape drives and Zip drives for as little as $100 to $300. Prices increase with speed and capacity. Large-capacity disk cartridges, such as Iomega's Peerless system, start at around $350 for the drive; 10 GB Peerless disks cost about $150; and the 20 GB version costs about $200.

Remote backup services are a growing trend. For a fee, such a service can connect to your computer remotely (via an Internet or dial-up connection) and back up your data to their servers. You can restore data remotely from such a system.

Make Sure You Have the Right Software

For backing up your entire hard disk to a high-capacity device, use the file-transfer software that came with the device. Your operating system also may have a built-in backup utility that works with several devices. The critical issue when choosing backup software is that it should enable you to organize your backups, perform partial backups, and restore selected files when needed.

Set a Schedule and Stick to It

Your first backup should be a full backup—everything on your hard disk—and it should be repeated once a week. Beyond that, you can do a series of partial backups—either

workstations or servers that require large amounts of storage. They allow the user to remove (swap out) a hard disk and insert (swap in) another while the computer is still running (hot). Hot-swappable hard disks are like removable versions of normal hard disks. The removable box includes the disk, drive, and read/write heads in a sealed container.

Norton ONLINE

For more information on tapes and tape drives, visit http://www.mhbe.com/petemorton

Tape Drives

Tape drives read and write data to the surface of a tape the same way an audiocassette recorder does. The difference is that a computer tape drive writes digital data rather than analog data—discrete 1s and 0s rather than finely graduated signals created by sounds in an audio recorder.



FIGURE 5A.14

New generation tape drives feature data capacities of 200 GB and higher, and can transfer several megabytes of data per second.

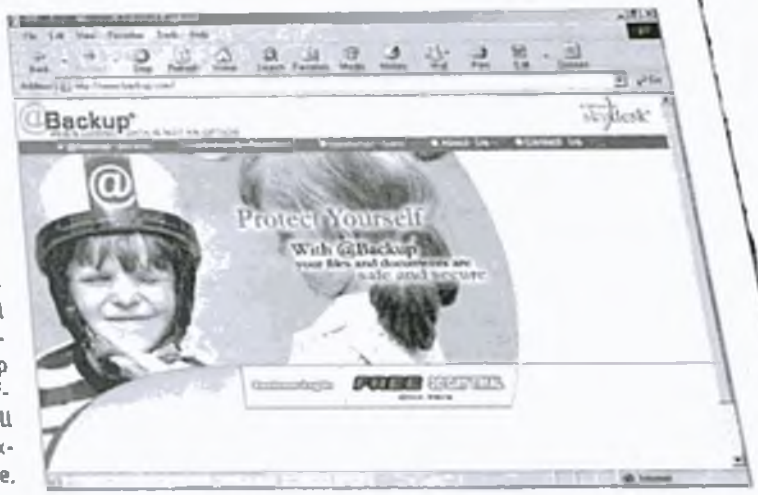
Tape storage is best used for data that you do not use often, such as backup copies of your hard disk's contents. Businesses use tape drives for this purpose because they are inexpensive, reliable, and have capacities as high as 200 GB and greater (see Figure 5A.14).

Urheberrechtlich geschütztes Material

incremental (files that have changed since the last partial backup) or differential (files that have changed since the last full backup).

Keep Your Backups Safe

Be sure to keep your disks or tapes in a safe place. Experts suggest keeping them somewhere away from the computer. If your computer is damaged or stolen, your backups will not suffer the same fate. Some organizations routinely ship their media to a distant location, such as a home office or a commercial warehouse, or store them in weather- and fireproof vaults. Home users may want to keep their backups in a fireproof box. Companies often keep three or more full sets of backups, all at different sites. Such prudence may seem extreme, but where crucial records are at stake, backups of files are vital to the welfare of a business.



Tapes, however, are slow when it comes to accessing data. Because a tape is a long strip of magnetic material, the tape drive has to write data to it serially—one byte after another. To find a piece of data on a tape, the drive must scan through all the data in sequence until it finds the right item. For this reason, tape drives are often called sequential access devices. They locate data much more slowly than a random access storage device such as a hard disk.

SELF-CHECK ::

Circle the correct answer for each question.

1. A diskette is an example of a storage _____ .
   a. mediator b. media c. medium
2. Unlike a transistor, a magnetic disk can store data without a continual source of _____ .
   a. electricity b. RPMs c. polarity
3. Different operating systems use different _____ systems.
   a. power b. file c. disk

Optical Storage Devices

The most popular alternatives to magnetic storage systems are optical systems, including CD-ROM, DVD-ROM, and their variants. These devices fall into the category of optical storage because they store data on a reflective surface so it can be read by a beam of laser light. A laser uses a concentrated, narrow beam of light, focused and directed with lenses, prisms, and mirrors.

Norton ONLINE

For more information on optical storage technologies, visit http://www.mhhe.com/peternorton

Norton ONLINE

For more information on CD-ROM, visit **http://www.mhhe.com/peternorton**

simnet™

CD-ROM

The familiar audio compact disc is a popular medium for storing music. In the computer world, however, the medium is called *compact disc–read-only memory* (*CD-ROM*). CD-ROM uses the same technology used to produce music CDs. If your computer has a CD-ROM drive, a sound card, and speakers, you can play audio CDs on your PC (see Figure 5A.15).

A CD-ROM drive reads digital data (whether computer data or audio) from a spinning disc by focusing a laser on the disc's surface. Some areas of the disc reflect the laser light into a sensor, and other areas scatter the light. A spot that reflects the laser beam into the sensor is interpreted as a 1, and the absence of a reflection is interpreted as a 0.



FIGURE 5A.15

Real Networks, Inc., makes a variety of programs that let you record and play music on your PC. Here, the RealOne Player is being used to play music on an audio CD.

Data is laid out on a CD-ROM disc in a long, continuous spiral. Data is stored in the form of lands, which are flat areas on the metal surface, and pits, which are depressions or hollows. As Figure 5A.16 shows, a land reflects the laser light into the sensor (indicating a data bit of 1) and a pit scatters the light (indicating a data bit of 0). A standard compact disc can store 650 MB of data or about 70 minutes of audio. A newer generation of compact discs, however, can hold 700 MB of data or 80 minutes of audio.

Compared to hard disk drives, CD-ROM drives are slow. One reason has to do with the changing rotational speed of the disk. Like a track on a magnetic disk, the track of an optical disk is split into sectors. However, the sectors are laid out differently than they are on magnetic disks (see Figure 5A.17).

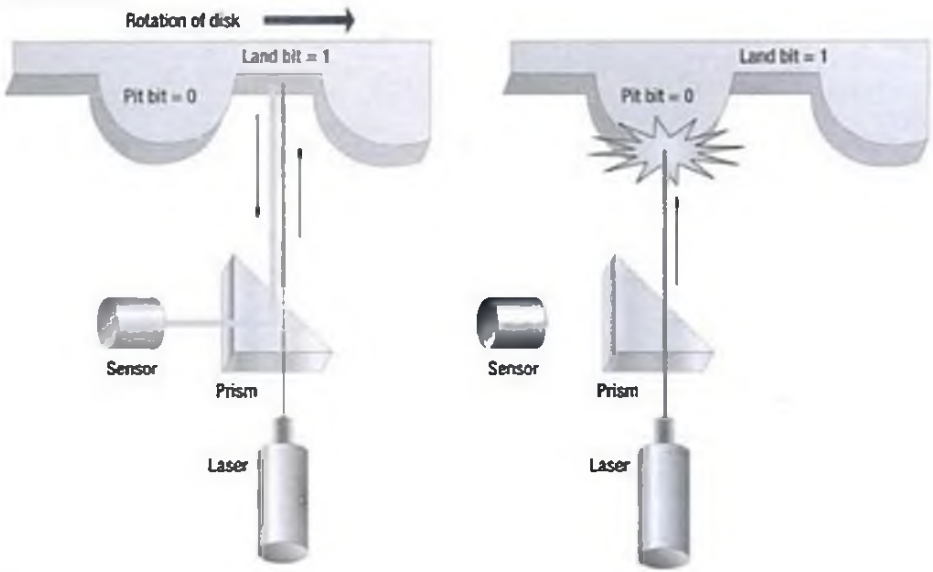


FIGURE 5A.16

How a CD-ROM drive reads data from the surface of a compact disc.

Urheberrechtlich geschütztes Material

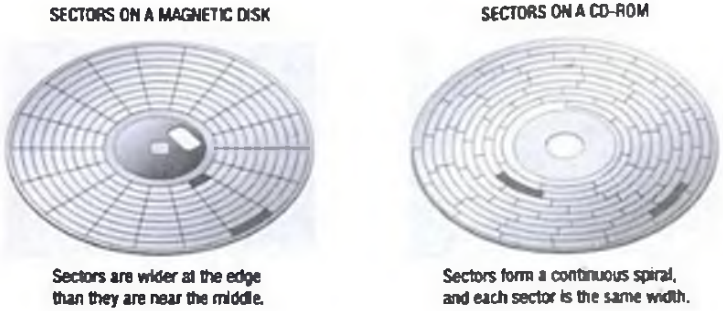


FIGURE 5A.17

The arrangement of sectors on a compact disc and a magnetic disk.

The sectors near the middle of the CD wrap farther around the disk than those near the edge. For the drive to read each sector in the same amount of time, it must spin the disc faster when reading sectors near the middle and slower when reading sectors near the edge. Changing the speed of rotation takes time—enough to seriously impair the overall performance of the CD-ROM drive.

The first CD-ROM drives could read data at 150 KBps (kilobytes per second) and were known as *single-speed* drives. Today, a CD-ROM drive's speed is expressed as a multiple of the original drive's speed—2x, 4x, 8x, and so on. A 2x drive reads data at a rate of 300 KBps (2 × 150). At the time this book was published, the fastest available CD-ROM drive was listed at a speed of 75x; it could read data at a rate of 11,250 KBps (or slightly more than 11 MBps).

Norton ONLINE

For more information on DVD-ROM, visit http://www.mhhe.com/peternorton

simnet™

DVD-ROM

Many of today's new PCs feature a built-in digital video disc– read-only memory (DVD-ROM) drive rather than a standard CD-ROM drive. DVD-ROM is a high-density medium capable of storing a full-length movie on a single disk the size of a CD. DVD-ROM achieves such high storage capacities by using both sides of the disc and special data-compression technologies and by using extremely small tracks for storing data. (Standard compact discs store data on only one side of the disc.)



FIGURE 5A.18

If your PC features a DVD drive, you can watch movies on your computer.

The latest generation of DVD-ROM disc actually uses layers of data tracks, effectively doubling their capacity. The device's laser beam can read data from the first layer and then look through it to read data from the second layer.

DVDs look like CDs (see Figure 5A.18). DVD-ROM drives can play ordinary CD-ROM discs (see Figure 5A.19). A slightly different player, the DVD movie player, connects to your

Urheberrechtlich geschütztes Material

FIGURE 5A.19

DVD-ROM movie players can read video, audio, and data from DVDs and CDs. In PC systems, built-in DVD-ROM drives look just like standard CD-ROM drives.



television and plays movies like a VCR. The DVD movie player also will play audio CDs as well as many types of data CDs, such as home-recorded audio discs, video CDs, and others.

Since each side of a standard DVD-ROM disc can hold 4.7 GB, these discs can contain as much as 9.4 GB of data. Dual-layer DVD-ROM discs can hold 17 GB of data.

Recordable Optical Technologies

The latest innovations in consumer-grade optical technologies allow home users to create their own DVDs, filled with audio and video, music, or computer data. Here are some popular "writable" CD and DVD technologies:

- **CD-Recordable.** A CD-Recordable (CD-R) drive allows you to create your own data or audio discs that can be read by most CD-ROM drives. Most CD-R discs can be played in audio CD players, too. After information has been written to part of the special recordable disc (called a CD-R disk), that information cannot be changed. With most CD-R drives, you can continue to record information to other parts of the disc until it is full.
- **CD-ReWritable (CD-RW).** Using a CD-ReWritable (CD-RW) drive, you can write data onto special rewritable compact discs (called CD-RW discs), then overwrite it with new data. In other words, you can change the contents of a CD-RW disc in the same manner as a floppy disk. CD-RW discs have the same capacity as standard compact discs, and most can be overwritten up to 100 times. CD-RW discs, however, will not play on every CD-ROM drive, and most CD-RW discs cannot store audio data.
- **PhotoCD.** Kodak developed the PhotoCD system to store digitized photographs on a recordable compact disc. Many film developing stores have PhotoCD drives that can record your photos on a CD. You can then put the PhotoCD in your computer's CD-ROM drive (assuming that it supports PhotoCD, and most do) and view the images on your computer as shown in Figure 5A.20. You also can paste them into other documents. With a PhotoCD, you can continue to add images until the disc is full. After an image has been written to the disc, however, it cannot be erased or changed.
- **DVD-Recordable (DVD-R).** After PC makers began adding DVD-ROM drives to computers, it did not take long for user demand to build for a recordable DVD system. The first to emerge is called DVD-Recordable (DVD-R).



Norton ONLINE

For more information on recordable optical storage, visit **http://www.mhhe.com/petermorton**

Urheberrechtlich geschütztes Material

Like CD-R, a DVD-R system lets you record data onto a special recordable digital video disc, using a special drive. Once you record data onto a DVD-R disc, you cannot change it.

» **DVD-RAM.** The newest optical technology to reach consumers, sophisticated DVD-RAM drives let you record, erase, and re-record data on a special disc. Using video editing software, you can record your own digitized videos onto a DVD-RAM disc, then play them back in any DVD player. DVD-RAM drives can read DVDs, DVD-R discs, CD-R discs, CD-RW discs, and standard CDs.



FIGURE 5A.20

After your pictures have been processed and stored on a PhotoCD, you can see them on your computer screen and copy them into documents.

Solid-State Storage Devices

Solid-state storage devices are unique among today's storage devices because they do not use disks or tapes and have no moving parts. Solid-state storage is neither magnetic nor optical. Instead, it relies on integrated circuits to hold data. Some solid-state storage devices are nonvolatile, meaning they can retain their data even when the system's power is turned off. Others are volatile, meaning they require a constant supply of electricity or they will lose their data. The device's volatility depends on the type of memory circuits it uses.

Byte for byte, standard magnetic or optical storage is less expensive and more reliable than solid-state storage. However, solid-state storage devices have a big advantage over standard storage devices: speed. Memory devices can move data in much less time than any mechanical storage device. This is because solid-state devices have no moving parts and because they already store data electronically (the way it is used by the CPU). Unlike standard devices, solid-state devices do not need to move a head or sensor to find data or to convert it from magnetic or optical form into electronic form.

Norton ONLINE

For more information on solid-state storage devices, visit **http://www.mhhe.com/peternorton**

Flash Memory

As you learned in Chapter 4, flash memory is a special type of memory chip that combines the best features of RAM and ROM. Like RAM, flash memory lets a user or program access data randomly. Also like RAM, flash memory lets you overwrite any or all of its contents at any time. Like ROM, flash memory is nonvolatile, so data is retained even when power is off.

Flash memory has many uses. For example, it is commonly used in digital cameras and multimedia players such as MP3 players. A new type of storage device for PCs, called the flash memory drive, is about the size of a car key (see Figure 5A.21). In fact, many users carry a flash memory drive on their keychain. These tiny devices usually connect to a computer's USB or FireWire port and can store 256 MB or more of data.



Norton ONLINE

For more information on flash memory and flash memory devices, visit **http://www.mhhe.com/peternorton**

FIGURE 5A.21

Flash memory drives are small and easy to use but hold a lot of data.

Urheberrechtlich geschütztes Material

Norton Notebook

Looking Back, Moving Forward



If there is any quality of a new technology that limits its adoption into the growing world of the PC, it's backwards compatibility. As the name suggests, backwards compatibility means that the technologies of tomorrow work with the technologies of today. (Similarly, forward compatibility means that today's technologies will work with the technologies of tomorrow.) Backwards compatibility (BC) is the point at which technological innovation meets economics. More simply: people will buy new stuff when they don't have to throw out all of their old stuff to use the new. Sometimes, even partial BC isn't enough. VCRs that supported the advanced SVHS video format could play traditional VHS tapes, but the higher-quality SVHS tapes they recorded couldn't be played on VHS VCRs. This meant consumers couldn't share SVHS home videos with grandparents and cousins unless the whole family bought SVHS machines. It never happened.

Having learned this and many similar lessons, the consortia that defined the various formats for recordable compact discs kept BC at the forefront of their work. The result? An audio CD-R burned in the world's fastest drive will still chug out tunes on Sony's original Discman from 1984. The importance of backwards compatibility was briefly lost, however, when many of the same companies worked together to develop the recordable DVD. In fairness, the issue wasn't just that manufacturers *chose* against BC. The technology didn't yet exist to make affordable, recordable DVDs that would work in the established base of DVD-ROM drives and home players. But, as late as 2003, many manufacturers continued to assume that purchasers of still-expensive DVD recorders wouldn't care if they could share home videos with grandparents and cousins. Sound familiar?

With no fewer than five major contenders for the "recordable DVD format crown," the matter seemed unlikely to resolve itself quickly. Then, home player makers realized they could provide compatibility with four of the five formats at no additional cost. Indeed, the price of home units has plummeted. This is supply and demand: Make your product usable by the most people, and you'll sell so many that you can lower the price. DVD recorder manufacturers have followed suit. Virtually all new DVD recorders can write discs in any of the four formats.

This might have been the end of the race were it not for two factors. First, recordable DVD discs are not just for video. They're used for PC backups, moving files, and so on. So they're subject to the same requirements of any other PC storage media. Briefly, these are ever-greater capacity, greater speed, lower cost, and BC. The second factor is that commercially released video DVDs have a higher storage capacity than first-generation recordables. Consumers couldn't easily back up the DVD movies they bought, and smaller video production houses couldn't produce DVDs with the same broad features consumers expect in commercial products.

Why do commercial discs have higher capacity? They implement two layers of recording material. The laser reads



Norton ONLINE

For more information on smart cards visit
http://www.mhhe.com/petemorton

Smart Cards

Although it looks like an ordinary credit card, a smart card is a device with extraordinary potential (see Figure 5A.22). Smart cards contain a small chip that stores data. Using a special device, called a smart card reader, the user can read data from the card, add new data, or revise existing data.

Some smart cards, called intelligent smart cards, also contain their own tiny microprocessor, and they function like a computer. Although they have not yet come into widespread use, smart cards are finding many purposes—both current and future. For example, large hotels now issue guests a smart card instead of a key; the card not only allows guests to access their room, but it also allows them to charge other services and expenses to the card as well.

Someday, smart cards may be used to store digital cash that can be used to make purchases in stores or online (as long as the user has a reader connected to the PC). Smart cards could store a person's entire medical history, or they could be used as a source of secure ID.

Urheberrechtlich geschütztes Material

the second, fully reflective layer by shining right through the first, semireflective/semitransparent layer. Dual-layer DVDs are economical—one disc costs less than two—and are convenient for users (no discs to turn over). Naturally, home players have supported dual layers for years.

Because the dual-layer idea already existed, it gave the DVD consortia a target for high-capacity recordable DVDs: backwards compatibility. This proved difficult. Commercially released DVD discs are made by completely different means than are recordables. The former are actually *pressed*, whereas most of the latter rely on phase changes in a crystalline layer. These simulate a pressed DVD's pits and lands. So any BC dual-layer system had to function like existing recordable discs *and* like commercial discs. The developers of the generally superior DVD+RW format were first to succeed, with the first drives available in 2004. Their achievement was both a technical and a political success; the motion-picture industry has attempted to stop the development of DVD technology because of fears that widespread copying of DVD movies will destroy their business model.

There comes a time in any technological chain, however, where backwards compatibility has too many drawbacks to make it cost-effective or even reasonable. This happened when the market embraced DVDs over CDs, so we could have full-length, high-quality digital movies on a single disc. Blu-Ray laser drives will likely be a similar successful break from BC. Announced in late 2003, Blu-Ray optical drives use a blue laser instead of the traditional red DVD laser or infrared CD laser. Blue lasers produce light at shorter wavelength than the others, so pits and lands can pack more densely. Blu-Ray provides 23 GB of storage on a 120 mm disc. That translates into 13 hours of standard video (conveniently, just over two hours of the forthcoming HDTV video). Planned improvements will take the capacity up to 100 GB, positioning these drives to replace the VCR and disk-based personal video recorders. Since a different laser type is required, Blu-Ray discs won't be playable in existing DVD players. However, DVDs and CDs of all current types should play in Blu-Ray drives with no trouble.



A Blu-Ray disc recorder



FIGURE 5A.22

Smart cards may someday replace credit cards and drivers' licenses, or may be used as a form of portable storage for computer data.

Urheberrechtlich geschütztes Material

Norton ONLINE

For more information on solid-state disks, visit http://www.mhhe.com/petemorton



FIGURE 5A.23

Solid-state disk systems, like this one, can store vast amounts of data.

Solid-State Disks

A solid-state disk (SSD) is not a disk at all (see Figure 5A.23). Rather, this device uses very fast memory chips, such as synchronous dynamic RAM (SDRAM), to store data. SDRAM is much faster than standard RAM. Large-scale SSD systems can store a terabyte or more of data. An SSD may be a free-standing unit that connects to a server computer or a card that plugs into one of the server's expansion slots.

SSDs are gaining popularity among large organizations, which need instant access to constantly changing data. As mentioned already, solid-state storage devices allow much faster access to data, even while that data is being viewed and updated by other users. For this reason, SSDs are used primarily for enterprise-level network storage, to make data available to a large number of users at one time.

The biggest drawback of RAM-based SSDs (aside from their high cost) is volatility. RAM circuits need constant power to store data, or data will be lost. For this reason, many SSD systems feature built-in battery backups and a set of hard disks that "mirror" the memory. If power fails or a circuit goes bad, the system can still use backup data stored on its hard disks.

Urheberrechtlich geschütztes Material

Summary ::

- Common storage devices can be categorized as magnetic, optical, or solid-state.
- The most common magnetic storage media are diskettes, hard disks, high-capacity floppy disks, and magnetic tape.
- The primary types of optical storage are compact disc-read-only memory (CD-ROM), digital video disc-read-only memory (DVD-ROM), CD-Recordable (CD-R), CD-ReWritable (CD-RW), DVD-Recordable (DVD-R), DVD-RAM, and PhotoCD.
- Magnetic storage devices work by polarizing tiny pieces of iron on the magnetic medium. Read/write heads contain electromagnets that create magnetic charges on the medium.
- Before a magnetic disk can be used, it must be formatted—a process that maps the disk's surface and creates tracks and sectors where data can be stored.
- Hard disks can store more data than diskettes because they contain more disks, rotate the disks at a higher speed, and can divide tracks into greater numbers of sectors.
- Removable hard disks combine high capacity with the convenience of diskettes.
- High-capacity floppy disks are a popular add-on for personal computers. They offer capacities up to 750 MB and the same portability as standard floppy disks.
- Magnetic tape systems offer slow data access; because of their large capacities and low cost, they are a popular backup medium.
- CD-ROM uses the same technology as a music CD does: a laser reads lands and pits on the surface of the disc.
- Standard CD-ROM discs can store up to 650 MB, although newer discs can hold 700 MB. Once data is written to the disc, it cannot be changed.
- DVD-ROM technology is a variation on the standard CD-ROM. DVDs offer capacities up to 17 GB.
- Other popular variations on the CD-ROM are CD-Recordable, CD-ReWritable, and PhotoCD. Popular variations of DVD-ROM are DVD-Recordable and DVD-RAM.
- Solid-state storage devices store data on memory circuits rather than disks or tapes. They store data electronically, not in a magnetic or optical form.
- Solid-state storage devices can use either volatile or nonvolatile memory. Examples of such devices include flash memory, smart cards, and solid-state disks.

Urheberrechtlich geschütztes Material

Key Terms ::

boot sector, 170
booting, 170
cluster, 170
data area, 170
density, 172
directory, 170
DVD-RAM, 179
DVD-Recordable (DVD-R), 178
file allocation table (FAT), 170
file system, 170
flash memory drive, 179
folder, 170
formatting, 168
high-capacity floppy disk, 173
hot-swappable hard disk, 173
initializing, 168
intelligent smard card, 180
land, 176
logical formatting, 170
magnetic storage, 166
optical storage, 166
PhotoCD, 178
pit, 176
polarize, 167
random access storage device, 168
root folder, 170
sector, 168
sequential access device, 175
smart card, 180
solid-state disk (SSD), 182
solid-state storage, 166
storage device, 166
storage media, 166
Synchronous Dynamic RAM (SDRAM), 182
track, 168

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. Floppy disks and compact discs are examples of _____ .
2. Because a hard disk can go directly to any piece of data stored on its surface, it is called a(n) _____ storage device.
3. When formatting a magnetic disk, the disk drive creates a set of concentric rings, called _____ , on its surface.
4. A(n) _____ is a group of sectors, which the operating system treats as a single storage unit.
5. A(n) _____ is a logical method for managing the storage of data on a disk's surface.
6. A magnetic disk's _____ is a measure of its storage capacity.
7. On the surface of an optical disc, data is stored as a series of _____ and _____ .
8. By using a(n) _____ drive, you can write data onto a special digital video disc, then erase or overwrite the data.
9. A(n) _____ hard disk can be removed and replaced while the computer is still running.
10. The _____ is the part of a magnetic disk that actually stores data and program files.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A(n) _____ is an example of a magnetic storage device.
   a. flash memory drive b. CD-ROM drive c. hard disk drive d. optical drive
2. Diskettes spin at about _____ revolutions per minute.
   a. 3 b. 30 c. 300 d. 3,000
3. The _____ of a hard disk contains a small program that runs when you start the computer.
   a. boot sector b. file allocation table c. file system d. file cluster
4. In a magnetic disk drive, the read/write heads generate _____ in the iron particles on the storage medium.
   a. polarized magnets b. electromagnetic pulses c. magnetic waves d. magnetic fields
5. The process of mapping a magnetic disk's surface is called _____ .
   a. polarizing b. charging c. formatting d. accessing
6. A magnetic disk's tracks are divided into smaller parts, called _____ .
   a. clusters b. sectors c. bytes d. slices
7. A(n) _____ is a tool for organizing the files on a disk.
   a. disk b. folder c. cluster d. record
8. A CD-ROM drive reads data from a spinning disc by focusing a(n) _____ on the disc's surface.
   a. laser b. read/write head c. magnetic field d. track
9. Each side of a standard DVD-ROM disc can hold up to _____ of data.
   a. 4.7 GB b. 9.4 GB c. 17 GB d. 140 GB
10. Intelligent smart cards contain their own _____ .
    a. read/write head b. microprocessor c. laser d. flash memory drive

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. List four types of magnetic storage media commonly used with PCs.
2. List seven types of optical storage devices that can be used with PCs.
3. Name three types of solid-state storage devices.
4. Why is a hard disk called a random access storage device?
5. Describe how a magnetic disk drive's read/write head can pass data to and from the surface of a disk.
6. What is the purpose of formatting a magnetic disk?
7. What is the storage capacity of a standard floppy disk?
8. Although magnetic tape can store a large quantity of data, it has one drawback when compared to other storage media, such as hard disks. Describe that drawback.
9. Describe the function of lands and pits on the surface of a compact disc.
10. How does a solid-state disk store data?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Format a blank floppy disk:
   a. Make sure the disk's write-protect tab is closed. Place the disk in the diskette drive.
   b. Launch Windows Explorer. (The steps to launch Windows Explorer depend on the version of Windows you use. Ask your instructor for specific directions.)
   c. Right-click the floppy disk icon in the left pane. Click Format on the shortcut menu.
   d. In the Format dialog box, choose a capacity for the disk. Click the Quick (Erase) option. Make sure the Display Summary When Finished option is checked. Click Start.
   e. Click Close twice. Remove the disk from the drive. Leave the Exploring window open.
2. Explore the contents of your hard disk. In the Exploring window's left pane, click the system's hard disk icon labeled (C:). Look at the status bar at the bottom of the window. How many "objects" (folders) are stored on the hard disk? How much free space is available? Click several folders and review their contents in the right pane. When finished, close the Exploring window.

Urheberrechtlich geschütztes Material

Measuring and Improving Drive Performance

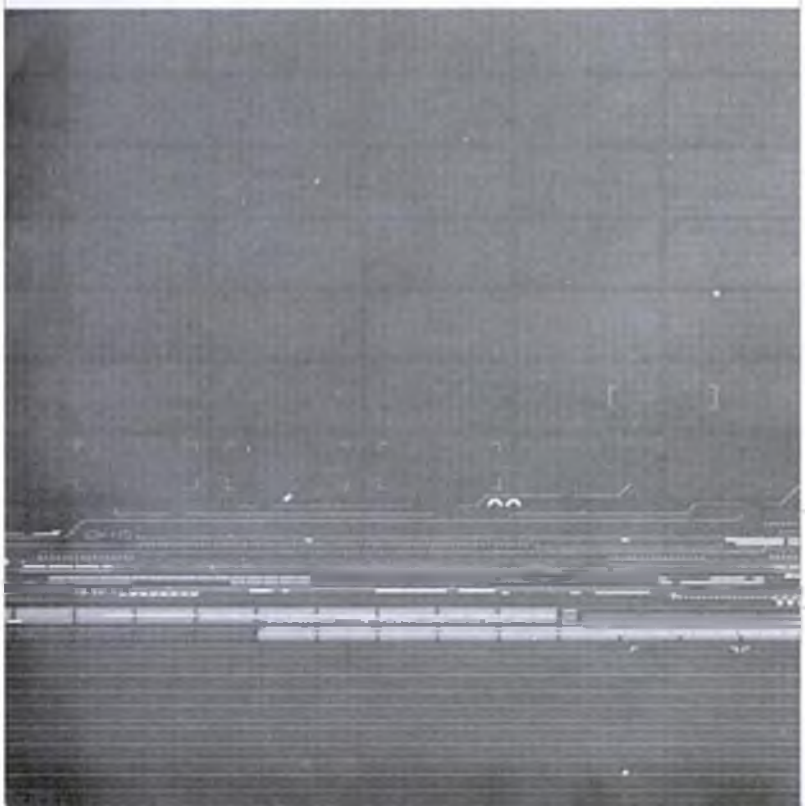
Overview: The Need for Speed

An important factor in measuring overall system performance is the speed at which the computer's disk drives operate. Measures of drive performance generally are applied to the computer's hard disk but also can be applied to other types of drives.

When evaluating the performance of common storage devices, you need to be aware of two common measures: the average access time and the data transfer rate. For random-access devices (all the storage devices discussed, with the exception of magnetic tapes and solid-state devices), you generally want a low access time and a high data transfer rate.

Because tape drives are always slower than other types of storage devices, convenience and capacity are their best measures of performance. Solid-state devices typically access and transfer data much more rapidly than other types of storage devices so, again, convenience and capacity are usually your greatest concern when evaluating them.

These performance factors can be important when you are buying a new computer or upgrading your current system. You want to make sure that your drives operate at a speed that complements your processor's capabilities. You also want to make sure that the drive uses an interface that is compatible with any other devices you may add to the computer.



OBJECTIVES ::

- Define the term *average access time* and describe how it is measured.
- Explain why file compression is a factor in drive performance.
- Define the term *data transfer rate* and describe how it is measured.
- Explain two steps you can take to optimize the performance of your computer's hard disk.
- Identify four drive interface standards commonly used in PCs.

Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on determining a disk drive's average access time, visit http://www.mhhe.com/pcmorton

Average Access Time

For a storage device, average access time (or seek time) is the amount of time the device takes to move its read or read/write heads to any spot on the medium. It is important that the measurement be an average because access times can vary greatly, depending on how far the heads need to move. To measure the access time of a drive effectively, you must test many reads of randomly chosen sectors—a method that approximates the actual read instructions a disk drive would receive under normal circumstances.

Average access time is an important measure of performance for storage devices and memory. Even though memory chips have no moving read/write head, it is still critical to know how fast a memory system can locate a piece of data on a chip. For storage devices, access times are measured in milliseconds (ms), or one-thousandths of a second. For memory devices, access times are measured in nanoseconds (ns), or one-billionths of a second.

In a disk drive, access time depends on a combination of two factors: the speed at which a disk spins (revolutions per minute, or rpm) and the time it takes to move the heads from one track to another. The maximum access time for diskettes, as you learned in the previous lesson, is 0.2 second, or 200 milliseconds. The average access time is about one half the maximum, or 100 milliseconds.



FIGURE 5B.1

Like many storage device manufacturers, Seagate Technology, Inc., provides product specifications on its Web site.

Average access times for hard drives can vary, but most good drives work at rates of 6 to 12 milliseconds, many times faster than diskette drives. Some very-high-performance hard disks have access times as fast as four or five milliseconds.

At 80 to 800 ms, access times for CD-ROM drives tend to be quite slow by hard disk standards, but tape drives offer the longest average access times of any storage device. Depending on the type of drive and format used, tape drives can take from a few seconds to a few minutes to find a specific piece of data on the tape's surface.

The easiest way to determine the average access time for a device is to check the manufacturer's specifications. You should be able to find the specifications for a device in its packaging or documentation, or you may be able to get them from the manufacturer's Web site (see Figure 5B.1). Popular computer-related magazines—such as *PC Magazine*, *Computer Shopper*, and others—regularly test new drives to measure various performance factors.

Data Transfer Rate

The other important statistic for measuring drive performance is the speed at which it can transfer data—that is, the amount of time it takes for one device to send data to another device. Speeds are expressed as a rate, or as some amount of data per unit of time. When measuring any device's data transfer rate (also called throughput), time is measured in seconds, but units of data may be measured in bytes, KB, MB, or GB. Figure 5B.2 illustrates data transfer rate.

As is the case with access times, data transfer rates can vary greatly from one device to another. Speeds for hard disks are generally high, from about 15 MBps for low-end home systems to 80 MBps and higher for the faster drives designed for high-performance workstations and servers. When buying a hard disk, the data transfer rate is at least as important a factor as the access time.



Norton ONLINE

For more information on determining a storage device's data transfer rate, visit http://www.mhhe.com/pcmorton

Urheberrechtlich geschütztes Material

CD-ROMs and diskettes are the slowest storage devices. CD-ROMs range from 300 KBps for a double-speed player to 900 KBps for a 6x drive, to even higher speeds, with the data transfer rate corresponding to the drive's speed. Diskette drives average about 45 KBps. Removable hard disks range from about 1.25 MBps up into the hard disk range.

Some drive manufacturers and dealers advertise their drives' data transfer rates in units of megabytes per second (MBps); others express them in megabits per second (Mbps). When shopping, note if the rate specified is "MBps" or "Mbps."

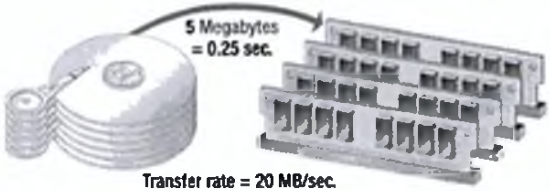


FIGURE 5B.2

Data transfer rate is the time required to move a specific amount of data (for example, 20 MB) from one device to another, such as from the hard disk to memory.

Optimizing Disk Performance

Over time, a PC's performance can slow down. This is especially true with older systems, but even newer PCs can suffer from occasional performance downturns. The computer may act sluggish in general or slow down when performing specific tasks such as loading or saving documents.

When a PC slows down in this manner, some hard-disk maintenance may fix the problem. Any PC that gets used a lot should get routine disk maintenance, or disk optimization. Using your operating system's built-in tools or other utilities, you can keep your computer's hard disk (or any other magnetic disk) running the best it can.

Norton ONLINE

For more information on disk optimization tools and methods, visit **http://www.mhhe.com/peternorton**

Cleaning Up Unneeded Files

If your system has been in use for a while (even just a few months), hundreds of unneeded files may be cluttering up your hard disk. Windows accumulates all sorts of files during normal operations. Some of these files are meant to be stored only temporarily, but Windows does not always clean them out. If you ever shut down your computer improperly, Windows does not have a chance to delete these files, and they will stay put until you clear them out yourself. These files can really slow down your system because the hard disk has to deal with the unneeded files when looking for data or looking for space to store new files.

These files, called temporary (temp) files, are used by Windows to store various versions of documents in progress, files being sent to the printer, automatic backup files, and more. Windows usually stores these files with the filename extension .tmp in various locations on your disk. A hard disk also can get cluttered up by temporary Internet files, which are saved by your Web browser.

Newer versions of Windows feature a built-in utility called Disk Cleanup (see Figure 5B.3). Disk Cleanup and other disk-cleaning utilities can quickly find temporary files and remove them from your disk. The process takes only a few minutes and can free hundreds of megabytes of wasted space on an average hard disk.



FIGURE 5B.3

This is the Disk Cleanup utility in Windows XP. It lets you choose the kinds of files you want to delete, then locates and removes them from the disk.

Urheberrechtlich geschütztes Material



FIGURE 5B.4

The Add or Remove Programs utility in Windows XP. This window lets you select a program on your hard disk and remove it. The utility tells you how much disk space you will recover by removing a program.

Most computer users should clean the temporary files off their hard disks at least once a week.

If your hard disk contains programs that you do not plan to use, you can remove them—a process called uninstalling. To remove a program, start by checking its group in the Programs menu. If you see an Uninstall option, click it, and the program will uninstall itself. If you use a recent version of Windows, you also can use its Add or Remove Programs utility (see Figure 5B.4). There are a number of commercial software products that can uninstall programs from your system, too. Removing unneeded programs can improve your computer's performance.

Scanning a Disk for Errors

Another way to optimize disk performance is to scan the disk for errors, fix the errors, and possibly recover data that has been lost or corrupted because of a disk error. A disk error can be a bad spot on the disk's physical surface, or it can be a piece of data that cannot be accounted for in the FAT. Scanning a disk can be a time-consuming process, but if the disk has errors, scanning may be able to fix problems and improve performance.

Several (but not all) versions of Windows have a built-in disk-scanning utility (see Figure 5B.5), but you also can buy very sophisticated disk scanners.

Defragmenting a Disk

On the surface of a magnetic disk, fragmentation occurs when a file is stored in noncontiguous sectors on the disk's surface. In other words, pieces of files become scattered around on the disk. As you create, modify, copy, and delete files (and install and uninstall programs) over time, many files can become fragmented. Although your operating system keeps track of each fragment, a greatly fragmented disk can slow system performance because it can take longer to find and load all the pieces of files as they are needed by an application.

Windows features a built-in defragmentation utility, called Disk Defragmenter (see Figure 5B.6). You can use this utility—or one of several commercial utilities—to ensure that your files are stored as efficiently as possible on the disk. If your disk has never been defragmented before, you may notice a significant performance improvement after running this type of utility. (It is usually recommended that you run a disk-scanning utility before defragmenting the disk.)

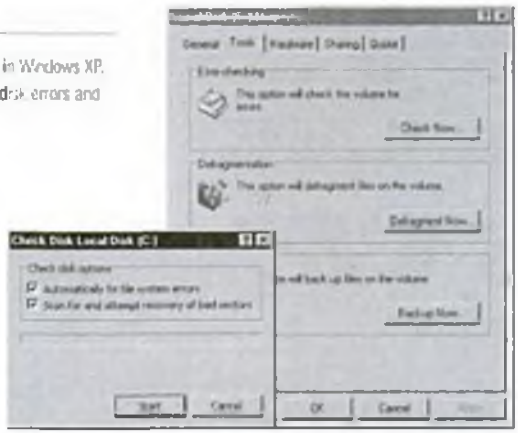


Norton ONLINE

For more information on data compression, visit **http://www.mhhe.com/petemorton**

FIGURE 5B.5

The disk scanning utility in Windows XP. This tool attempts to fix disk errors and recover lost data.



File Compression

Even with the large storage devices available, many users still find themselves pushing the limits of their computer's storage capacity. One solution to this storage problem, besides upgrading to larger devices, is to compress data. File compression, or data compression, is the technology for shrinking the size of a file so it takes up less space on the disk. This frees up space for more data and programs to reside on the disk.

Compressing files will not necessarily improve a disk's performance; that is,

Urheberrechtlich geschütztes Material

compressing files will not reduce a disk's access time. However, file compression can enable you to store more data on a disk, effectively increasing the disk's capacity.

Entire hard disks, floppy disks, or individual files can be compressed by as much as a 3:1 ratio (so that 300 MB of data fill only 100 MB of space, for instance). File compression is performed by software that squeezes data into smaller chunks by removing information that is not vital to the file or data.

Some favorite compression programs for PCs include PKZIP and WinZip. StuffIT is a favorite compression utility among Macintosh enthusiasts.

Most file-compression utilities are useful for compressing one or more files to reduce their storage requirements. When you use a utility like WinZip, the program actually shrinks the selected files and then saves them together inside a new file, with its own name. The resulting file is called an archive file because it stores the compressed files inside it. Archive files are commonly used for exactly that purpose—archiving unneeded data files.

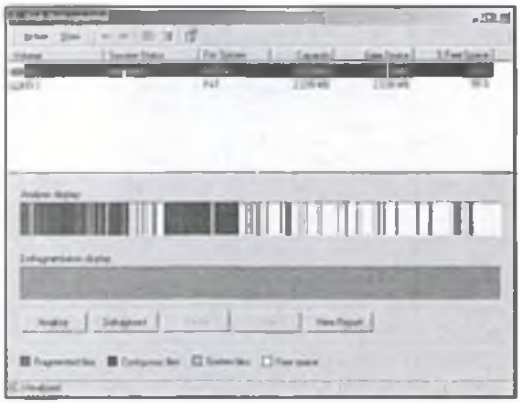


FIGURE 5B.6

The Disk Defragmenter utility in Windows XP.

Figure 5B.7 shows an example of a file-compression utility at work. Depending on the circumstances (the compression software used, the data file's native program, and other factors), the user may need to extract the compressed files manually (that is, return them to their uncompressed state) before using them. Most file compression utilities enable the user to create self-extracting archive files—files that can extract themselves automatically.

Utilities such as WinZip, PKZIP, and StuffIT generally are not used to compress the contents of an entire hard disk. Because such files must be expanded manually, a lot of effort would be required to compress a disk's contents, select and expand files when you want to use them, and then recompress them. For this reason, programs such as DriveSpace are helpful. (DriveSpace is built into some versions of Windows, and you can purchase commercial utilities that perform full-disk compression. Windows XP includes its own utility for compressing disks.)

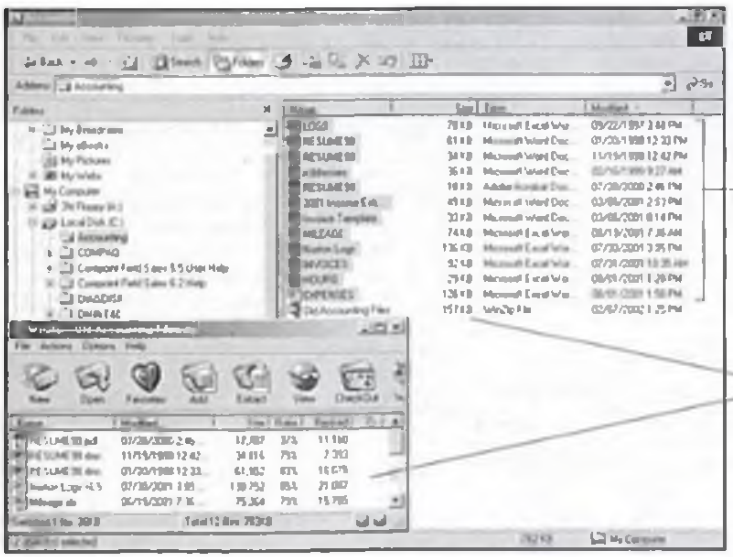


FIGURE 5B.7

The WinZip file compression utility at work.

Urheberrechtlich geschütztes Material

At Issue

Digital Student Portfolios

The days of three-ring binders and spiral notebooks may be numbered. At a rising number of schools across the country, students record and share their school work not on paper but digitally.

Digital student portfolios are a selective collection of student work, chosen to present a personal learning history, posted to the World Wide Web or school intranet. Electronic portfolios can be an effective avenue for students to record personal learning, growth, and change. They can present documentation of students' abilities, provide information about what students have accomplished, as well as create a platform for students to share their work with parents, peers, and the public.

Work included in a student's portfolio may be about literature and writing, science, math, the arts, or any other subject area in the curriculum. Electronic portfolios can include varied media such as text, graphics, video, and sound, going far beyond what paper portfolios can produce and generating the capability for a wider audience.

Beyond the personal purpose of portfolios, portfolios bring together curriculum, instruction, and assessment. Creating a digital portfolio program within a school can have broader applications and can encourage schools to think about their systems and visions, and what the school wants students to be able to say about themselves.

The Coalition of Essential Schools (CES), a national affiliation of schools with a common set of beliefs about the purpose and practice of schooling, has implemented a student digital portfolio program as a school-wide innovation.

This program was activated with the understanding that the every school in the network would be involved in the preparation, planning, and implementation of a digital portfolio system. While this has been a more time-consuming and intricate process for CES than anticipated, it has allowed for more support for the program and more understanding about the schools' systems and their curriculum.

While CES uses custom-designed digital portfolio software, schools interested in working with digital portfolios can choose from a number of software products. These fall into two broad categories: software specifically designed for work with portfolios and general hypermedia software tools.

Drive-Interface Standards



Norton ONLINE

For more information on drive interface standards, visit **http://www.mhhe.com/peternorton**

Another important factor in determining how quickly a drive can read and write data is the type of controller that the drive uses. Just as a video monitor requires a controller to act as an interface between the CPU and the display screen, storage devices also need a controller to act as an intermediary between the drive and the CPU. A disk controller connects the disk drive to the computer's bus, acting as an interface between the two and enabling the drive to exchange data with other devices.

Currently, most personal computers use one of two drive-interface standards for built-in disk drives: EIDE or SCSI. A lot of confusion surrounds these two drive-interface standards because competing developers have introduced many variations of and names for these technologies. If you buy a PC today, it will almost certainly feature one of these two drive interfaces. If you plan to purchase a drive for an existing PC, be sure that the new drive is compatible with the computer's drive interface.

Two other types of interface—Universal Serial Bus (USB) and IEEE 1394 (also known as FireWire)—make it possible to attach additional disk drives and other devices to a computer. These interfaces

SELF-CHECK ::

Circle the correct answer for each question.

1. File compression works by removing _____ from a file.
   a. old data b. unsaved data c. unneeded data
2. What does the term *Mbps* stand for _____?
   a. megabits per second b. megabits per sector c. megabits per storage
3. What kind of storage device can be affected by fragmentation? _____
   a. optical b. magnetic c. solid-state

Urheberrechtlich geschütztes Material



Both of these types of tools are exclusively engineered for assembling information about student work. The features vary, and schools should consider what end result is desired from a portfolio system and how each tool might help before making purchasing decisions. Electronic Portfolio by Learning Quest, Electronic Portfolio by Scholastic, and Persona Plus are examples of commercially available portfolio software.

A number of schools are opting to use hypermedia presentation tools to build portfolios from scratch. Digital Chisel (Pierian Spring Software), Director (Macromedia), and HyperStudio (Roger Wagner Publishing) are just a few examples of hypermedia software that can be utilized for digital portfolios. In addition, some schools create digital portfolios using Web-based tools.

One such school is Celebration School, a partnership between the Walt Disney Company, Stetson University, and the Osceola, Florida, school district. Using a network-based technology environment and Web-centric software, student data and information are not only platform independent, but also location independent—accessible at home and in the classroom, and across the 700-PC Celebration campus.

Says Scott Muri, Instructional Technology Specialist for the school, "As we look at the future direction of school, we're becoming increasingly Web-centric in order to effectively bridge the gap between school and home."

"Thanks to Web-based technology, in answering the parent's question 'What did you learn in school today?' the student can now say, 'Well, let me show you!'"

Source: http://www.essentialschools.org

are not specifically drive-interface standards, because they are open and flexible enough to accommodate many kinds of devices.

Enhanced Integrated Drive Electronics (EIDE)

Enhanced integrated drive electronics (EIDE) is an improved version of an older drive-interface standard, called integrated drive electronics (IDE). While the IDE standard still exists and is the basis for several drive interfaces, the standard is known by many different names, and *EIDE* is widely regarded as the catchall term for drive interfaces based on this standard.

As a result, most new computer systems use the EIDE drive-interface standard, or one like it. The latest version of EIDE supports data transfer rates of 66 MBps. The EIDE standard's variants go by names such as Fast IDE, ATA, Fast ATA, ATA-2, ATA-3, ATA-4, Ultra ATA, and ATA66. Each offers somewhat different features and performance. For example, some EIDE disk controllers can host as many as four separate hard disks, providing access to more than 500 GB of data on a single system.

Small Computer System Interface (SCSI)

The history of the small computer system interface (SCSI) goes back to the 1970s. SCSI was originally developed as a way to connect third-party peripheral devices to mainframe computers—specifically, IBM mainframe computers. SCSI went through many transformations before the American National Standards Institute (ANSI) established a definition for the interface in 1986. Since then, the definition of SCSI has continued to evolve into SCSI-2, Wide SCSI, Fast SCSI, Fast Wide

Urheberrechtlich geschütztes Material

Computers In Your Career

Careers in Outsourcing

There's no one looking over Barbara Odom's shoulder as she works on IT projects, and that's exactly how she likes it. As an independent technical writer based in Altamonte Springs, Florida, Odom has been running her own show, creating software documentation for high-tech companies since 1997. Her clients are concentrated in the financial arena and range from companies that develop financial software to companies that run ATM networks.

"Most of my clients tend to be small, entrepreneurial startups that don't have their own IT departments," says Odom, who charges those clients either $50 an hour or a flat fee to create how-to procedural guides that end users refer to when they need help installing, running, or troubleshooting their technology applications. Armed with a bachelor's degree in English from the State University of New York, Odom's job experience started in the 1980s when she served as a software support professional, conducted training classes, and wrote training materials.

Odom's work spans both online help systems and hard-copy manuals. Some projects require her to dial into a company's mainframe to access proprietary software for which she creates user manuals and documentation. Once completed, she edits the text and tweaks it to make sure it targets the proper audience, then submits the work and moves on to the next project.

When she's not writing, Odom is managing her company's technology needs, marketing herself to potential customers, upgrading hardware and software systems, and updating her own high-tech knowledge base. While Odom enjoys the independence that being an outsourcer provides, she's sometimes left out of the loop at the customer level and largely on her own when creating and completing projects.

"I don't get a lot of handholding or training," she says. "That in itself can be enjoyable, however, since it means I really have to sit down and figure out how the application works and how to convey that to the user."

As Odom has discovered, not every company can afford to staff a full-time IT department, but outsourcing isn't limited to small entrepreneurial types. Reston, Virginia–based market research firm Input reports that state and local

SCSI, Ultra SCSI, SCSI-3 (also known as Ultra-Wide SCSI), Ultra 2 SCSI, and Wide Ultra 2 SCSI.

SCSI allows even higher data transfer rates than are possible with EIDE. The Wide Ultra 2 SCSI interface, for example, supports a data transfer rate of 80 MBps. Because of its speed, flexibility, and high throughput rates, the SCSI drive interface standard is usually found in higher-end business systems, servers, and workstations (see Figure 5B.8).



FIGURE 5B.8

SCSI drive interfaces are often found in high-performance desktop computers, workstations, and network servers.

USB and FireWire

As you learned in Chapter 4, "Processing Data," many newer computers feature Universal Serial Bus (USB) and IEEE 1394 (FireWire) interfaces. All sorts of peripherals can be attached to a computer through a USB or FireWire port, including storage devices (see Figure 5B.9).

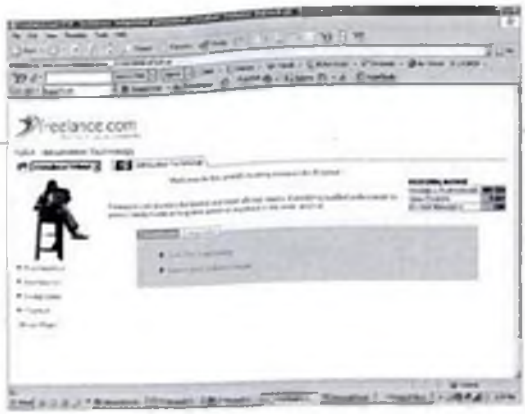
Urheberrechtlich geschütztes Material

governments also have jumped on the outsourcing bandwagon and will outsource $23 billion worth of information technology work by 2008.

Millions of skilled workers now work exclusively on an outsourced basis and make themselves available to any company that needs their skills for a given amount of time for fees that range from $25 to $100 an hour. Here are some of the most commonly outsourced positions for people with computer skills:

» **Programmers.** Software projects often get behind schedule or overwhelm a company's development staff. In either case, the company can fill the gaps by hiring a freelance programmer.

» **Network Administrators.** Nearly every American company has a computer network, but the vast majority of small- and medium-sized businesses cannot afford to keep a network administrator on staff. Instead, the business may outsource the work.



» **Hardware Technicians.** Successful freelance technicians have training (and certification, if possible) on many types of computer hardware, including desktop PCs, network servers, networking hardware, printers, and more.

Although USB and FireWire are not considered to be drive interfaces per se (they support many types of devices), they support high data transfer rates and provide connections that allow the host computer to control an external storage device just as if it were an internal one.

Like SCSI, USB and FireWire allow users to connect many peripherals at the same time. If your computer needs extra storage, this means you can simply purchase additional hard drives as you need them and connect them to your PC via a USB or FireWire connection.



FIGURE 5B.9

Many external storage devices, like this one from Maxtor, can be plugged into a PC's FireWire or USB port.

Urheberrechtlich geschütztes Material

Summary ::

- In storage devices, the average access time is the time it takes a read/write head to move to a spot on the storage medium.
- Diskette drives offer an average access time of 100 milliseconds. Hard drives are many times faster.
- Tape drives provide the slowest average access times of all magnetic storage devices; optical devices are also much slower than hard disks.
- The data transfer rate is a measure of how long it takes a given amount of data to travel from one device to another. Hard disks offer the fastest data transfer rates of any storage device.
- You can optimize the performance of a PC's hard disk by cleaning off unneeded files, scanning the disk for errors, and defragmenting the disk.
- File compression technology is used to shrink the size of files so that they take up less disk space.
- By using compression utilities, you can shrink multiple files into a single archive file. Some utilities enable you to compress the entire contents of a hard disk.
- Two drive-interface standards are commonly used today: EIDE and SCSI.
- Many storage devices can be connected to a PC's USB or FireWire port.

Key Terms ::

archive file, 191
average access time, 188
data compression, 190
data transfer rate, 188
defragmentation, 190
disk controller, 192
disk optimization, 189
enhanced integrated drive electronics (EIDE), 193
extract, 191
file compression, 190
fragmentation, 190
millisecond (ms), 188
nanosecond (ns), 188
seek time, 188
small computer system interface (SCSI), 193
temporary (temp) file, 189
throughput, 188
uninstalling, 190

Urheberrechtlich geschütztes Material

Key Term Quiz

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. The amount of time a storage device takes to position its head over any spot on the medium is called _____ .
2. For storage devices, access times are measured in _____ .
3. For memory devices, access times are measured in _____ .
4. _____ may be measured in megabytes per second or megabits per second.
5. Any PC that gets used a lot should get routine disk maintenance, or _____ .
6. Over time, hundreds of _____ files can collect on your computer's hard disk.
7. _____ occurs when a file is stored in noncontiguous sectors on a disk's surface.
8. When you use a file compression utility to compress several files together, a special file, called a(n) _____ , is the result.
9. The term *EIDE* stands for _____ .
10. The term *SCSI* stands for _____ .

Urheberrechtlich geschütztes Material

Multiple Choice

Circle the word or phrase that best completes each statement.

1. This lets you fit more data onto a magnetic disk.
   a. extraction b. defragmentation c. compression d. scanning
2. Which of the following connects a disk drive to the computer's bus?
   a. a hard disk b. a drive interface c. a sensor d. a standard
3. To remove a program from your computer, you can _____ it.
   a. uninstall b. delete c. store d. transfer
4. If a file is _____, its pieces are scattered across the surface of a disk.
   a. compressed b. archived c. defragmented d. fragmented
5. Which of the following is a common drive interface standard used in PCs?
   a. AEIOU b. ETC c. EIDE d. EIEIO
6. Which must you do to return compressed files to their uncompressed state?
   a. delete them b. extract them c. archive them d. Zip them
7. If a disk has a bad spot on its surface, the spot can be called a _____.
   a. disk crash b. disk error c. disk scanner d. disk sector
8. Which drive-interface standard supports data transfer rates of 66 MBps?
   a. EIDE b. SCSI c. USB d. FireWire
9. What does the term *SCSI* stand for?
   a. small computer software interface b. small computer storage interface c. small computer system interface d. small computer standard interface
10. Although it is not a drive interface per se, this type of connection does support storage devices.
    a. EIDE b. USB c. SCSI d. MBps

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What is the primary purpose of file compression utilities such as WinZip?
2. What is another name for the IEEE 1394 interface?
3. What is data transfer rate?
4. What is the most effective way to measure the average access time of a hard disk?
5. What is the average access time for a diskette drive?
6. What are average access times like for hard disks?
7. List three tasks you can perform that can improve the performance of a computer's hard disk.
8. How can fragmentation harm a system's performance?
9. Why is there confusion about the EIDE and SCSI drive-interface standards?
10. How are the SCSI, USB, and FireWire interfaces similar?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. Learn what kind of hard disk controllers are installed in your computer.
   a. Open the Control Panel window, as directed by your instructor.
   b. Double-click the System icon to open the System Properties dialog box.
   c. Click the Device Manager tab. Click the plus sign (+) in front of Hard Disk Controllers. (Note: Depending on which version of Windows you use, you may need to access the Device Manager in a different way. Ask your instructor for specific directions.)
   d. Click to highlight an item listed under Hard Disk Controllers (depending on your OS, this item may be listed as one or more specific types of controllers); then click the Properties button. Write down the data for the selected controller, and then click Cancel.
   e. Repeat step D for each controller listed. When finished, click Cancel to close the System Properties dialog box. Then close the Control Panel window.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Find your optimization tools. If you use Windows 98 or a later version, you can use the operating system's built-in disk optimization tools to remove unneeded files from a disk, to defragment a disk, and to scan a disk for errors.

   To use Disk Cleanup in Windows 98, Me, 2000, or XP:

   a. Click the Start button, open the Programs menu, click Accessories | System Tools | Disk Cleanup.
   b. When the Select Drive dialog box appears, click the drop-down arrow and select your primary hard disk. (This should be drive C:. If you are not sure which drive to select, ask your instructor for assistance.
   c. Click Ok.
   d. In the Disk Cleanup for dialog box, select all the check boxes in the Files to Delete list.
   e. If you want to see any of the files before deleting them, click the type of files you want to see, then click the View Files button. Close any windows that open to return to the Disk Cleanup for dialog box.
   f. Click Ok in the Disk Cleanup for dialog box.
   g. Windows may display a message box asking if you are sure you want to delete the files. If so, click the Yes button.

      Windows deletes the files.

   To scan your disk for errors:

In Windows 98 or Me:

A. Click Start button | Programs, click Accessories | System Tools | click ScanDisk.

B. When the ScanDisk dialog box opens, select your computer's primary disk drive. (This should be drive C:. If you are not sure which drive to choose, ask your instructor for help.)

C. Set other options in the ScanDisk dialog box, as directed by your instructor, then click Start.

D. Watch as Windows scans the disk for errors.

E. Click the CANCEL button when your instructor tells you to. Then click CLOSE to close the ScanDisk dialog box.

If you use Windows 2000 or XP:

A. Launch either Windows Explorer or My Computer, depending on your preference.

B. When the Windows Explorer or My Computer window opens, select your computer's primary disk drive. (This should be drive C:. If you are not sure which drive to choose, ask your instructor for help.)

C. Right-click the selected drive's icon. When the shortcut menu appears, click Properties.

D. When the Properties dialog box appears, click the Tools tab. Under Error-checking, click the Check Now button.

E. When the Check Disk dialog box appears, set options as directed by your instructor, then click Start.

F. Watch as Windows performs the scan. The actions Windows takes will depend on the options you selected in step E. When the scan is complete, close all open dialog boxes, then close the Windows Explorer or My Computer window.

Urheberrechtlich geschütztes Material

To defragment your hard disk with Windows' Disk Defragmenter:

In Windows 98 or Me:	If you use Windows 2000 or XP:
A. Click Start button | Programs | Accessories | System Tools | Disk Defragmenter.	A. Click Start | Programs | Accessories | System Tools | Disk Defragmenter.
B. When the Select Drive dialog box opens, select your computer's primary disk drive. (This should be drive C:. If you are not sure which drive to choose, ask your instructor for help.)	B. When the Disk Defragmenter window opens, select your computer's primary disk drive. (This should be drive C:. If you are not sure which drive to choose, ask your instructor for help.)
C. Click the Settings button.	C. Click the Analyze button, and then watch the Analysis display pane as Windows determines the status of your disk drive.
D. In the Disk Defragmenter Settings dialog box, select options as directed by your instructor, then click OK.	D. When analysis is complete, click the Defragment button. Click the Stop button when your instructor tells you to.
E. When the Select Drive dialog box reappears, click OK.	E. Click the View Report button.
F. Windows begins defragmenting the disk. You can watch its progress by clicking the Show Details button.	F. Review the report of your disk's status, and then click Close to close the report.
G. Click the Stop button when your instructor tells you to. Then click Exit to close Disk Defragmenter.	G. Click the Close button to close Disk Defragmenter.

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Why do you think a basic truth in computing is that one never has enough storage space? What factors contribute to this situation? As hard disks get larger and larger, do you think we will reach a point where the standard desktop computer has more than enough storage space for the average user's needs? Have we reached that point already?
2. Suppose that your class is actually one department within a medium-sized company. You need to adopt a backup system for the department's data. As a group, what factors should you consider in making this decision? What backup technologies should you consider? What type of backup schedule should you follow?

Urheberrechtlich geschütztes Material

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- The growth in capacity of PC storage devices, from the 1980s to the present.
- The consequences of compressing an entire hard disk's contents, using a utility such as DriveSpace.
- Holographic memory and its potential uses.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

Many storage device options are available. These choices are beneficial for many users, but they also can be drawbacks for software companies, music publishers, and others. With this thought in mind, discuss the following questions in class:

1. CD-R and CD-RW devices are getting cheaper and more popular. They let you create backups and store data in a safe format. However, people also use them to make illegal duplicates of software and audio CDs. If you had a CD-R or CD-RW device, would you consider making illegal duplicates? Do you think such copying should be illegal? Defend your answer.
2. You have seen that large companies store gigabytes of data about their customers. Do you know that many companies sell this information to other companies? As more organizations build databases about individuals, do you believe they should be free to exchange or sell this information? Why?

Urheberrechtlich geschütztes Material



CHAPTER 6

Using Operating Systems

CHAPTER CONTENTS

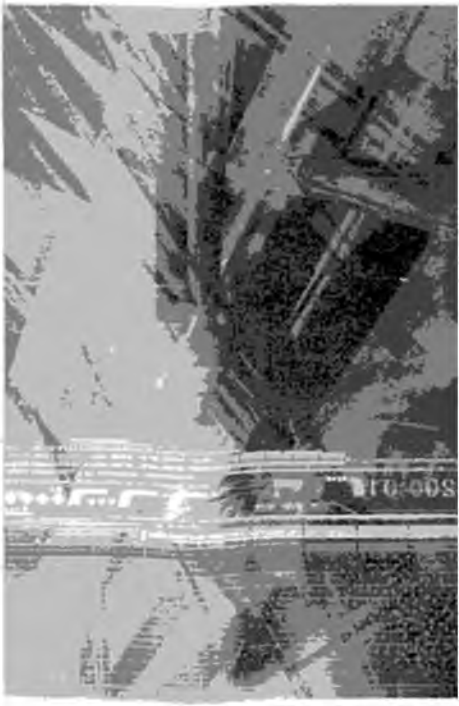
This chapter contains the following lessons:

Lesson 6A:
Operating Systems Basics

- Types of Operating Systems
- Providing a User Interface
- Running Programs
- Managing Hardware
- Enhancing an OS with Utility Software

Lesson 6B:
Survey of PC and Network Operating Systems

- PC Operating Systems
- Network Operating Systems
- Embedded Operating Systems



LESSON // 6A

Operating System Basics

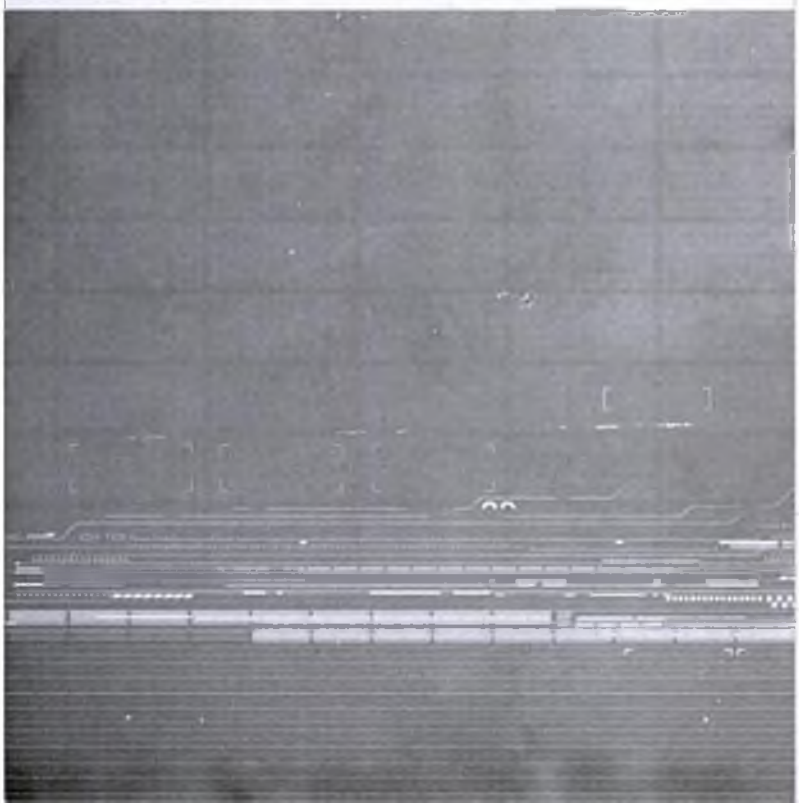
Overview: The Purpose of Operating Systems

An operating system (OS) is a software program, but it is different from word processing programs, spreadsheets, and all the other software programs on your computer. As you may recall from Chapter 1, the OS is an example of system software—software that controls the system's hardware and that interacts with the user and application software. In short, the operating system is the computer's master control program. The OS provides you with the tools (commands) that enable you to interact with the PC. When you issue a command, the OS translates it into code that the machine can use. The OS ensures that the results of your actions are displayed on screen, printed, and so on. The operating system also acts as the primary controlling mechanism for the computer's hardware.

The operating system performs the following functions:

- Displays the on-screen elements with which you interact—the user interface.
- Loads programs (such as word processing and spreadsheet programs) into the computer's memory so that you can use them.
- Coordinates how programs work with the computer's hardware and other software.
- Manages the way information is stored on and retrieved from disks.

In this lesson you will learn about the types of operating systems and the services they provide. Then you will learn about some of the enhancements you can make to your OS using utility software.



OBJECTIVES ::

- List the four primary functions of an operating system.
- List the four types of operating systems.
- Identify four components found in most graphical user interfaces.
- Describe the operating system's role in running software programs.
- List three ways the operating system manages the computer's hardware.
- Name three types of utilities that enhance an operating system's capabilities.

Urheberrechtlich geschütztes Material

Types of Operating Systems

Operating systems can be organized into four major types: real-time, single-user/single-tasking, single-user/multitasking, and multi-user/multitasking. The following sections describe each type of OS.

Real-Time Operating Systems

A real-time operating system is a very fast, relatively small OS. Real-time OSs are often also embedded OSs, when they are built into the circuitry of a device and are not loaded from a disk drive. A real-time operating system is needed to run real-time applications; it may support multiple simultaneous tasks, or it may only support single-tasking. A real-time application is an application that responds to certain inputs extremely quickly—thousandths or millionths of a second (milliseconds or microseconds, respectively). Real-time applications are needed to run medical diagnostics equipment, life-support systems, machinery, scientific instruments, and industrial systems.

Norton ONLINE

For more information on types of operating systems, visit: **http://www.mhhe.com/petemorton**

FIGURE 6A.1

A single user can only run a single program in a single-user/single-tasking operating system.



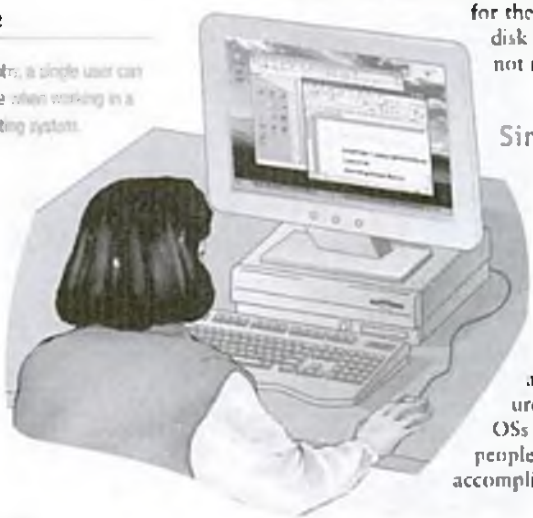
Single-User/Single-Tasking Operating Systems

An operating system that allows a single user to perform just one task at a time is a single-user/single-tasking operating system. To a user, a "task" is a function such as printing a document, writing a file to disk, editing a file, or downloading a file from a network server. To the operating system, a task is a process, and small and simple OSs can only manage a single task at a time.

MS-DOS is one example of a single-tasking OS, and the Palm OS, used on the Palm handheld computers, is another (see Figure 6A.1). Although such operating systems are limited by this characteristic, there is still a use for them, because they take up very little space on disk or in memory when they are running and do not require a powerful and expensive computer.

FIGURE 6A.2

In many types of jobs, a single user can be more productive when working in a multitasking operating system.



Single-User/Multitasking Operating Systems

A single-user/multitasking operating system is one that allows a single user to perform two or more functions at once. It takes a special operating system to keep two or more tasks running at once. The most commonly used personal computers usually run such OSs, including Microsoft Windows and the Macintosh Operating System (see Figure 6A.2). The multitasking features of these OSs have greatly increased the productivity of people in a large variety of jobs because they can accomplish more in a shorter period of time. For

Urheberrechtlich geschütztes Material

instance, to an office worker, it is important to be able to send a large document to a printer and be able to do other work on his or her computer while it is being printed. It is also helpful for many types of workers to be able to have two or more programs open, to share the data between the two programs, and to be able to instantly switch between the two programs.

A disadvantage of a single-user/multitasking operating system is the increased size and complexity it needs to support multitasking, while keeping the related features users have come to expect, such as a graphical user interface, and the ability to share data between two or more open programs.

Multi-User/Multitasking Operating Systems

A multi-user/multitasking operating system is an operating system that allows multiple users to use programs that are simultaneously running on a single network server, called a terminal server. This is not at all the same as connecting to a network server for the sake of accessing files and printers. As you will learn in Chapter 7, "Networks," when a computer is connected to a server to access document files to edit, the client computer performs the processing work locally. Not so with a multi-user OS, which gives each user a complete environment, called a user session, on the server. Each user's applications run within their user session on the server separate from all other user sessions. The software that makes this possible is called a terminal client. In a multi-user/multitasking operating system environment, all or most of the computing occurs at the server (see Figure 6A.3). Examples of multi-user OSs include UNIX, VMS, and mainframe operating systems such as MVS.



FIGURE 6A.3

A multi user/multitasking operating system runs on a computer to which many users connect, each user can run his or her own session on the server.

Urheberrechtlich geschütztes Material

The advantage of these operating systems is that they can be managed by simply making changes to one server, rather than to many desktop computers. They also allow the user to work with applications that require a more powerful computer than the user needs on the desktop to run the client. A disadvantage is that if the network connection to the server is broken, the user cannot do any work in the applications on the server.

Providing a User Interface



Norton ONLINE

For more information on user interfaces, visit http://www.mhhe.com/petermorton

When you work on a computer, you see and use a set of items on the screen. Taken together, these items are called the user interface. The two most common types of user interfaces are graphical and command line.

Graphical User Interfaces

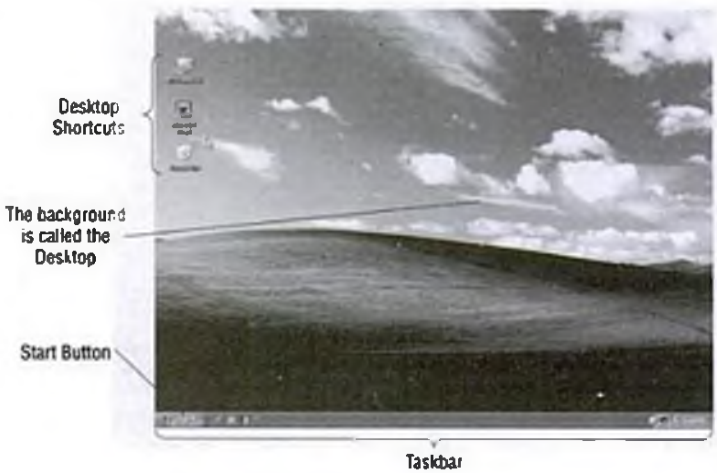
simnet™

Most current operating systems, including all versions of Windows, the Macintosh operating system, OS/2, and some versions of UNIX and Linux, provide a graphical user interface (GUI, pronounced GOO-ee). Graphical user interfaces are so called because you use a mouse (or some other pointing device) to work with graphical objects such as windows, menus, icons, buttons, and other tools. These graphical tools all represent different types of commands; the GUI enables you to issue commands to the computer by using visual objects instead of typing commands. This is one of the key advantages of a graphical user interface; it frees you from memorizing and typing text commands.

Windows is one of several GUIs that use the desktop metaphor in which the background of the GUI is said to be a desktop on which you have your graphical tools and within which you can store your work. Figure 6A.4 shows the Windows XP desktop. The small pictures on the desktop—called shortcuts—represent links to resources on the PC or network. Although shortcuts are often called icons, an icon actually is only the tiny graphic that represents an object, such as programs, folders, files, printers, and shortcuts. Using your mouse or other pointing device, you can move the pointer (a small graphic that moves in reaction to mouse movements) and choose (or activate) a shortcut, telling Windows you want to use the resource that the shortcut represents. For example, you can choose the Microsoft Word shortcut to launch that program. The items that appear on the desktop

FIGURE 6A.4

The Windows XP GUI has several standard features, including the desktop, taskbar, and Start button. Shortcuts may appear in any of these areas.



Urheberrechtlich geschütztes Material

depend on the contents of the computer's disks, the resources it can access, and the user's preferences; therefore, any two Windows desktops can look different.

Certain elements always appear on the Windows desktop. As shown in Figure 6A.4, the taskbar appears at the bottom of the Windows desktop; it is used to launch and manage programs. The Start button is a permanent feature of the taskbar; click it to open the Start menu. The Start menu contains shortcuts for launching programs and opening folders on a computer (see Figure 6A.5). Shortcuts can be added to the desktop, the Start menu, and other areas. When you start a program in Windows, a button representing it appears on the taskbar.

You also can launch programs by clicking icons on the Quick Launch bar, a special section at the left end of the taskbar where you can add icons for the purpose of quickly starting programs. Once you start a program, a button appears on the taskbar. When you have several programs on the desktop, one way in which you can switch between them is to click the program's button on the taskbar.



FIGURE 6A.5

The Start menu contains shortcuts to programs and folders on your computer. After a program is launched, it will have a button on the taskbar.

When you right-click an object in Windows, a small menu usually appears containing the most common commands associated with that object. Depending on the version of Windows you are using, and whether you are using a specific application, this type of menu may be called a shortcut menu or a context menu. Either way, its function is the same: to provide quick access to commonly used commands related to the item you have right-clicked. Figure 6A.6 shows the shortcut menu that appears when you right-click the desktop in Windows XP Professional.



FIGURE 6A.6

The desktop shortcut menu in Windows XP.

When you launch a program, it is loaded into memory and begins to run. A running program may take up the whole screen, it may appear in a rectangular frame called a window, or it may appear only as a shortcut on the taskbar.

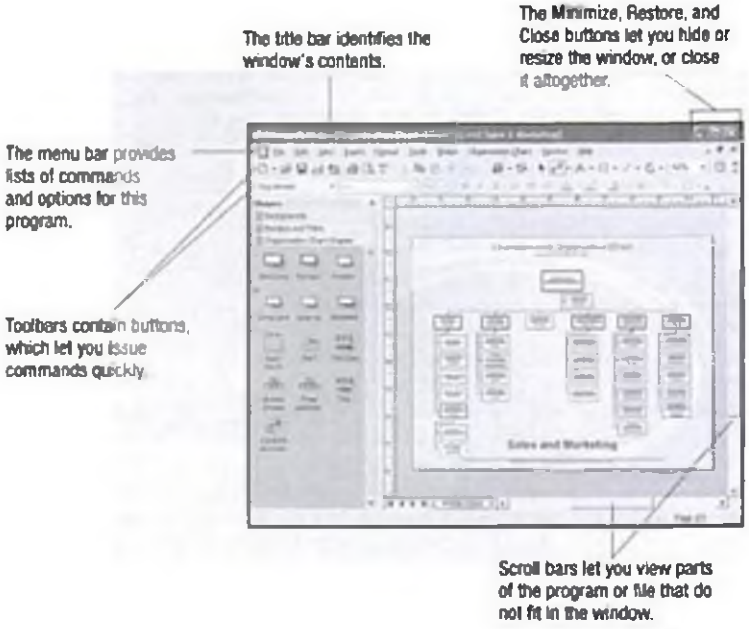
You access all the resources on your computer through windows. For example, you can view the contents of a disk in a window, run a program and edit a document in a window, view a Web page in a window, or change system settings in a window. A different window appears for each resource you want to use. Figure 6A.7 shows Microsoft Visio running in a window. Some menus and buttons, such as the ones shown here, appear in nearly every window you open. In the Windows GUI, programs share many of the same features, so you see a familiar interface no matter what program you are using. Among the common GUI features are the title bar, menu bar, toolbars, scroll bars, and various buttons. The title bar identifies the windows' contents and it also contains the Minimize, Restore, and Close buttons, which let you hide the window, resize it, or close it altogether. The menu bar provides lists of commands and options for this specific program. Toolbars contain buttons that let you issue commands quickly. Scroll bars let you view parts of the program or file that do not fit in the window.

A graphical operating system lets you have multiple programs and resources running at the same time, but you can work in only one window at a time. The window that is currently in use is called the active window; its title bar appears in

Urheberrechtlich geschütztes Material

FIGURE 6A.7

Most Windows applications feature the tools shown here.



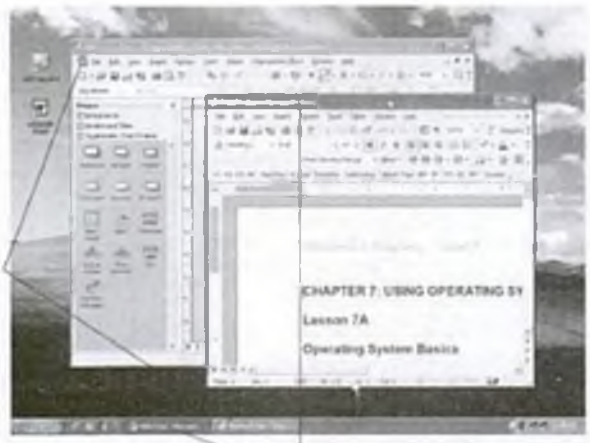


FIGURE 6A.8

When multiple windows are visible on the desktop, visual cues tell you which is the active window.

a deeper color shade than that of other visible open windows, and its taskbar button appears highlighted or "pressed in." Unless all open windows are arranged side by side, the active window will appear on top of any inactive windows. You must select the window you want to use before you can access its contents. The process of moving from one open window to another is called task switching. You can either click an open window to activate it or click an open program's taskbar button to activate its window. In Figure 6A.8, Microsoft Word is the active program and Microsoft Visio is in the background. Its title bar is lighter in color, and its taskbar button is not highlighted or pressed in.

You initiate many tasks by clicking icons and toolbar buttons, but you also can perform tasks by choosing commands from lists called menus. In most program windows, you open menus from a horizontal list called the menu bar. As shown in Figure 6A.9, many programs feature a File menu, which typically contains commands for opening, closing, saving, and printing files. To execute or run one of the menu commands, you click it. In many cases, you can issue menu commands by using keyboard shortcuts instead of the mouse.

Urheberrechtlich geschütztes Material

Dialog boxes are special-purpose windows that appear when the OS or application needs to give you some status and possible choice of actions or you need to tell a program (or the operating system) what to do next. A dialog box is so named because it conducts a "dialog" with you as it seeks the information it needs to perform a task. A dialog box can even have more than one page, in which case the pages are made available through tabs and look like a stack of tabbed pages. Figure 6A.10 shows a dialog box from Microsoft Word and describes some of the most common dialog box features.

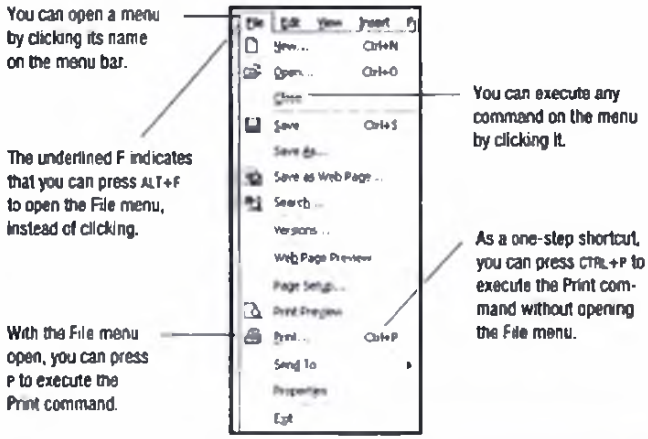


FIGURE 6A.9

A typical File menu

Command-Line Interfaces

Some older operating systems (such as MS-DOS) and some current versions of UNIX and Linux feature a command-line interface, which uses typewritten commands—rather than graphical objects—to execute tasks. A command-line interface displays in character mode—using only equal-sized alphanumeric and other simple symbols. Users interact with a command-line interface by typing strings of characters at a prompt on the screen. In DOS, the prompt usually includes the identification for the active disk drive (a letter followed by a colon), a backslash (\), and a greater-than symbol (>), as in C:\>. As much as people prefer to work in a GUI, a command-line interface gives you a quick way to enter commands, and even now Windows has an optional command-line interface, called the Command Prompt (see Figure 6A.11). This command prompt, however, is not DOS, and is most often used by administrators to run non-GUI programs for managing and troubleshooting Windows. In fact, any program that can be run in Windows can be launched from here, opening its own GUI window, if necessary.

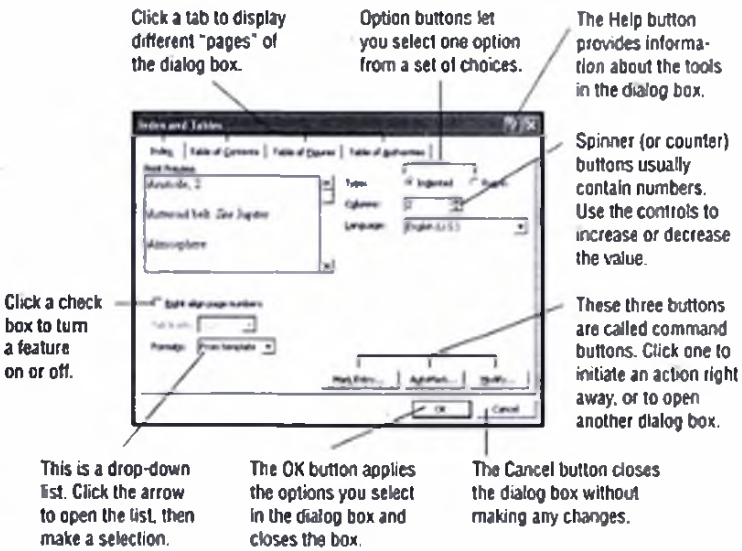


FIGURE 6A.10

This dialog box includes multiple tabs and a variety of methods for selecting options.

Urheberrechtlich geschütztes Material

FIGURE 6A.11

The Windows XP Command Prompt can be used to launch any program that will run in Windows, even a GUI program that will open its own window.



SELF-CHECK ::

Circle the correct answer for each question.

1. An operating system is an example of this type of software.
   a. multitasking b. system c. utility
2. Which of the following is most likely to use an embedded OS?
   a. computerized life-support system b. Macintosh computer c. desktop PC
3. The "desktop" of a GUI operating system is not a real desktop, but simply a _____.
   a. simile b. metaphor c. analogy

Running Programs

The operating system provides a consistent interface between application programs and the user. It is also the interface between those programs and other computer resources such as memory, a printer, or another program. Programmers write computer programs with built-in instructions—called system calls—that request services from the operating system. They are known as "calls" because the program has to call on the operating system to provide some information or service.

For example, when you want your word processing program to retrieve a file, you use the Open dialog box to list the files in the folder that you specify (see Figure 6A.12). To provide the list, the program calls on the operating system. The OS goes through the same process to build a list of files whether it receives its instructions from you (via the desktop) or from an application. The difference is that when the request comes from an application, the operating system sends the results of its work back to the application rather than to the desktop.

FIGURE 6A.12

The Open dialog box in Microsoft Word.



Urheberrechtlich geschütztes Material

Some other services that an operating system provides to programs, in addition to listing files, include

- Saving the contents of files to a disk.
- Reading the contents of a file from disk into memory.
- Sending a document to the printer and activating the printer.
- Providing resources that let you copy or move data from one document to another, or from one program to another.
- Allocating RAM among the running programs.
- Recognizing keystrokes or mouse clicks and displaying characters or graphics on the screen.

Sharing Information

Many types of applications let you move chunks of data from one place to another. For example, you may want to copy a chart from a spreadsheet program and place the copy in a document in a word processing program (see Figure 6A.13). Some operating systems accomplish this feat with a feature known as the Clipboard. The Clipboard is a temporary holding space (in the computer's memory) for data that is being copied or moved. The Clipboard is available for use by applications running under the operating system. For example, if you want to

Norton ONLINE

For more information on data sharing, visit **http://www.mhhe.com/peternorton**

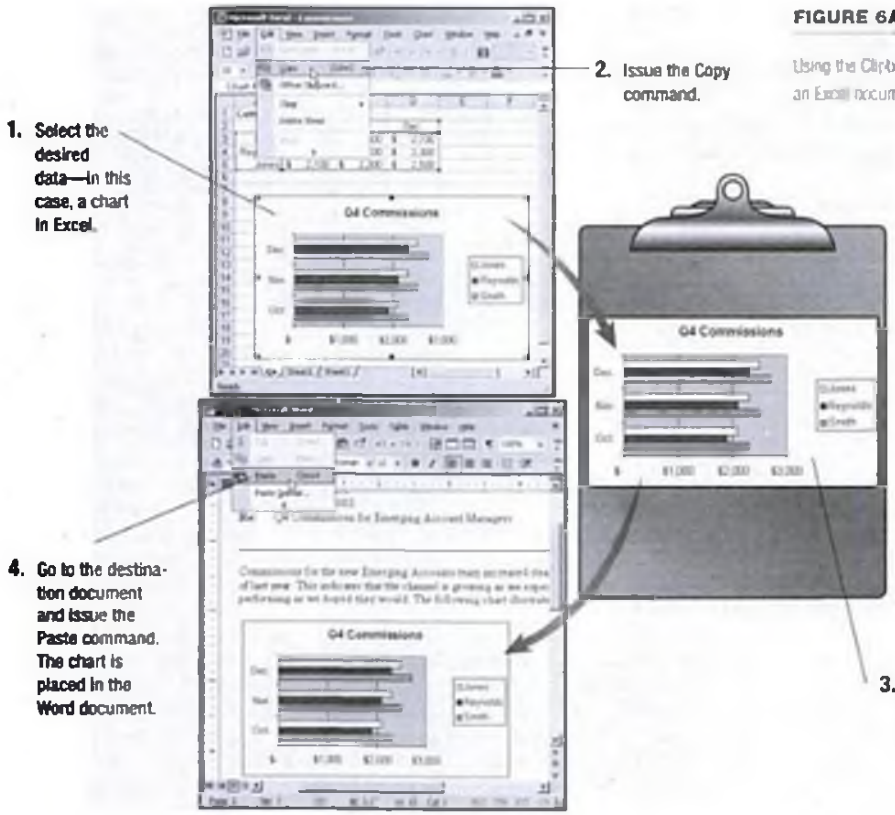


FIGURE 6A.13

Using the Clipboard to copy a chart from an Excel document to a Word document.

Urheberrechtlich geschütztes Material

Productivity Tip

Do-It-Yourself Tech Support

If you want to learn a new feature or need help solving a problem with a software program, the answers may be on your hard disk or the Internet.

Using Local Online Help

Most commercial operating systems and applications include an online help system that is installed on your computer along with the software. New-generation help systems include descriptions, tips, audio/video demonstrations, hyperlinks, and links to Internet-based resources.

To find help on your hard disk, open the help system and look for answers. To get help with the Windows XP operating system, for example, click the Start button and choose Help and Support from the Start menu. In any Windows application, click the Help menu and choose Contents or Help Topics. A Help window appears, providing tools that let you search for help in different ways. Remember the following tips:

- **Be Patient.** You may not find your answer immediately. Be prepared to try again.
- **Learn Different Search Options.** Most Windows-based help systems provide different options for finding help. For example, you may be able to browse a list of help topics that are organized by category. Or you may be able to search the help system for topics that contain certain terms or phrases. Some help systems let you type questions in plain English. If you need help printing a document, for example, you can type the question "How do I print a document?"
- **Think of the Problem in Different Ways.** For example, if you want help with setting up an Internet connection, the terms "Internet," "connection," "modem," and "Internet account" may bring up the right answers.
- **Use Bookmarks and Annotations.** Most help systems let you bookmark specific help topics so you can find them again quickly. You also can add your own notes to specific topics.

Using Remote Online Help

Many software makers provide help resources that you can access over the Internet.

- **Web-Based Technical Support.** Many software companies have a Support or Help link on their Web home page.

move a paragraph in a word processor document, select the paragraph, then choose the Cut command; the data is removed from the document and placed on the Clipboard. (If you want to leave the original data in place, you can use the Copy command; a copy is made of the data, and it is stored on the Clipboard but is not removed from the document.) After placing the insertion point in the document where you want to place the paragraph, you choose the Paste command; the data on the Clipboard is then placed into the document.

The Clipboard also can be used to move data from one document to another. For example, you can copy an address from one letter to another and thereby avoid rekeying the address. The real versatility of the Clipboard, however, stems from the fact that it is actually a part of the operating system and not a particular application. As a result, you can use the Clipboard to move data from one program to another.

The versatility of the Clipboard has been extended further with a feature known in Windows as OLE, which stands for Object Linking and Embedding. A simple cut and paste between applications results in object embedding. The data, which is known as an object in programming terms, is embedded in a new type of document. It retains the formatting that was applied to it in the original application, but its relationship with the original file is destroyed; that is, it is simply part of the new file. Furthermore, the data may be of a type that the open application

Urheberrechtlich geschütztes Material

» **FAQs.** Most software companies have Web sites with lists of frequently asked questions (FAQs).

» **E-Mail Help.** At the company's Web site, you may find an option that lets you describe a problem and submit a request for help. A support technician will investigate the problem, or an automated system will send you a list of possible solutions.

» **Knowledge Bases.** A knowledge base is a sophisticated database containing detailed information about specific topics. To use a knowledge base, you type a term or phrase or describe a problem. After your text is matched against a database, you are presented with a list of possible solutions.

» **Newsgroups.** Large software companies sponsor newsgroups on the Internet. Using your newsreader, you can access these newsgroups, post questions for other users to answer, or participate in discussions about specific products and technical issues.

Before you use any remote online help resource, read all the information the company provides about it. Look for notices about fees, registration, and proof of product ownership.



A program's help system is often the last place users turn for help, when it should be the first place.

cannot change. Therefore, if you want to edit embedded data, simply double-click the embedded object, and the original application that created the data is opened to allow editing of the embedded data.

Object linking adds another layer to the relationship: The data that is copied to and from the Clipboard retains a link to the original document so that a change in the original document also appears in the linked data. For example, suppose that the spreadsheet and memo shown in Figure 6A.13 are generated quarterly. They always contain the same chart updated with the most recent numbers. With object linking, when the numbers in the spreadsheet are changed, the chart in the report will automatically reflect the new figures. Of course, object linking is not automatic; you need to use special commands in your applications to create the link.

Managing Hardware

When programs run, they need to use the computer's memory, monitor, disk drives, and other devices, such as a printer. The operating system is the intermediary between programs and hardware. In a computer network, the operating system also mediates between your computer and other devices on the network.

Urheberrechtlich geschütztes Material

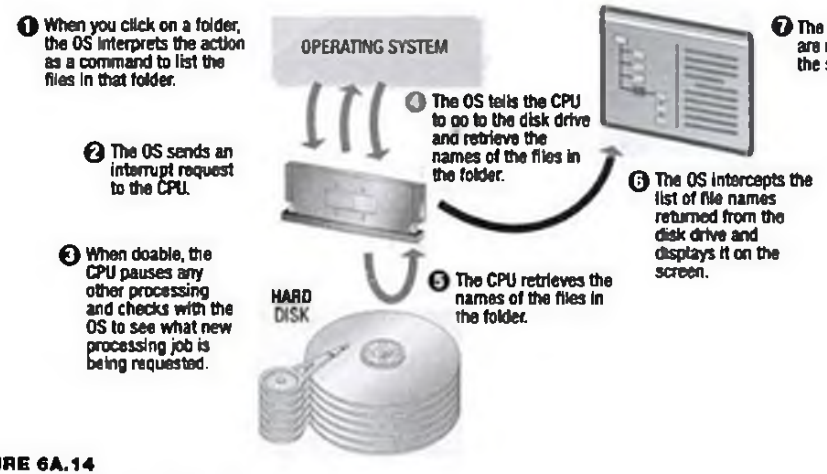


FIGURE 6A.14

How the operating system communicates with the CPU.

Processing Interrupts

The operating system responds to requests to use memory and other devices, keeps track of which programs have access to which devices, and coordinates everything the hardware does so that various activities do not overlap causing the computer to become confused and stop working. The operating system uses interrupt requests (IRQs) to help the CPU coordinate processes. For example, Figure 6A.14 shows what happens if you tell the operating system to list the files in a folder.

Working with Device Drivers

In addition to using interrupts, the operating system often provides programs for working with special devices such as printers. These programs are called drivers because they allow the operating system and other programs to activate and use—that is, "drive"—the hardware device. Most new software you buy will work with your printer, monitor, and other equipment without requiring you to install any special drivers.

Enhancing an OS with Utility Software



Norton ONLINE

For more information on utility software, visit http://www.mhhe.com/petemorton

Operating systems are designed to let you do most of the tasks you normally would want to do with a computer, such as managing files, loading programs, printing documents, and so on. But software developers are constantly creating new programs—called utilities—that enhance or extend the operating system's capabilities, or that simply offer new features not provided by the operating system itself. As an operating system is improved and updated, the functionality of popular utilities is included with subsequent releases of the OS. There are thousands of different utility programs, and you can find many on the Internet—some free and some at a price ranging from very inexpensive to hundreds of dollars.

While it is difficult to give a definitive list of utility software categories, the most common types that ordinary people use are disk and file management, Internet security, and OS customization tools. To complicate matters further, there are many packaged utility suites that combine two or more utilities into one bundle. The following sections describe a small selection of popular utilities.

Urheberrechtlich geschütztes Material

Backup Utilities

For safekeeping, a backup utility can help you copy large groups of files from your hard disk to another storage medium, such as tape or a CD-R disc. Many newer operating systems feature built-in backup utilities (see Figure 6A.15), but feature-rich backup software is available from other sources. These utilities not only help you transfer files to a backup medium, they also help organize the files, update backups, and restore backups to disk in case of data loss.



FIGURE 6A.15

The Windows Backup utility

Antivirus

A virus is a parasitic program that can delete or scramble files or replicate itself until the host disk is full. As you will learn in "Computing Keynotes: Viruses," computer viruses can be transmitted in numerous ways, and users should be especially vigilant when downloading files over the Internet or reusing old diskettes that may be infected. An antivirus utility can examine the contents of a disk or RAM for hidden viruses and files that may act as hosts for virus code. Effective antivirus products not only detect and remove viruses; they also help you recover data that has been lost because of a virus.

Firewall

Your ISP and most corporations employ specialized computers on their Internet connections that are dedicated to examining and blocking traffic coming from and going to the Internet. Such a computer is called a firewall, and manufacturers such as Cisco, 3COM, and others offer these products at a very high price. These firewalls also require highly trained people to manage them. If you work in a corporation where a firewall is protecting the corporate network, leave the firewall function to the experts. At home, however, you will want to be sure to use either a smaller, less-expensive hardware firewall or install a software firewall utility on any computer directly connected to the Internet. Windows XP comes with a simple firewall that you can optionally turn on through the Properties dialog of each network connection. There are many third-party firewall programs, such as Kerio Winroute Pro, shown in Figure 6A.16.



FIGURE 6A.16

Kerio Winroute Pro is one of many inexpensive personal firewall products available today.

Intrusion Detection

While a firewall offers protection from predictable intrusion, intrusion detection software reveals the types of attacks a firewall is thwarting, creating logs of the attempts and (depending on how you configure it) notifying you of certain types of intrusion attempts. In the competitive utility software field, intrusion detection is often added as a feature to firewall or bundled Internet security programs.

Screen Savers

Screen savers are popular utilities, although they serve little purpose other than to hide what would otherwise be displayed on the screen. A screen saver automatically appears when a keyboard or pointing device has not been used for a

Urheberrechtlich geschütztes Material

Norton Notebook

Changing Your PC's Operating System



The operating system market has expanded over the past few years, freeing PC users to choose different operating systems. Users no longer feel locked into the OS provided by the PC's manufacturer.

Any newer-model PC (if it has sufficient resources) can run almost any currently available operating system. For example, if you have a Pentium II–class or later computer with 128 MB of RAM and a large hard disk, you do not necessarily need to run Windows 9x. Instead, you can use Windows NT or 2000, OS/2, Linux, and some versions of UNIX (but not the Mac OS). You might even be able to run Windows XP. If you have a Macintosh, you also may be able to run some versions of UNIX or Linux (but not Windows).

Consider Your Needs First

Consider your need for a new operating system. Do you need a different OS to use a specific application? Is the OS used in your workplace or school, or do you need to be OS-compliant with a workgroup? Do you plan to develop or test applications that run on a specific operating system? Or will a different operating system allow better performance from your computer? If you answer yes to any of these questions, a new OS may be a good idea.

Compatibility Is a Must

Before installing an OS, make sure that your hardware is completely compatible with it. If you have any doubts, check with the manufacturers of your computer and any devices attached to it. Check with the operating system's developer to see if a "hardware compatibility list" is available. This document may answer all your hardware-related questions and may be found on the developer's Web site. If you suspect a problem, weigh the costs of replacing the hardware against installing a new OS.

If your hardware is compatible, make sure you have adequate resources for the new OS. Having adequate resources can be a problem for some operating systems, such as Windows 2000 and XP, which consume a great deal of system resources. Make sure your PC has enough power, memory, and storage, not just for the OS, but also for your applications and data.

Next, make a list of all the applications you use or plan to use, and make sure they will run under the new OS. Be sure to include your utilities, Internet tools, and others. You may need to upgrade or replace some or all of your software to accommodate the new OS. Again, weigh this cost against the need for a new OS.

specified period of time. Screen savers display a moving image on the screen and were originally created to prevent displayed images from "burning" into the monitor. Today's monitors do not suffer from this problem, but screen savers remain a popular utility because they can add personality to the user's system. Figure 6A.17 shows a Windows screen saver that comes with the newer versions of Windows. Screen savers are available from many sources, and you can even use your own picture and graphic files with most screen saver programs.



FIGURE 6A.17

When the Windows 3D Pipes Screen Saver is active, it draws pipes with lots of bends.

Urheberrechtlich geschütztes Material

Taking the Big Step

Before you install anything, take these precautions:

- **Back Up Your Hard Disk.** If you plan to install the OS on your existing hard disk, make a complete backup beforehand. If the installation goes wrong, you can restore the disk to its previous state. Before you back up, test the disk for errors (by using ScanDisk or a similar utility), defragment the drive, and run a full virus scan.
- **Decide Whether to Reformat.** You may want to reformat the disk completely before installing a new OS. Reformatting erases everything related to the previous operating system, and it may make installation easier. If you do not know how to format a hard disk, look in your current operating system's help system and follow the directions closely.
- **Call for Help If You Need It.** If you have never installed a new OS, you may not be prepared for all the pitfalls involved. If the upgrade is essential, then it is worth doing right, so get help from an experienced user or a computer technician before you start. Most computer manufacturers have extensive customer service support, but be prepared to wait some time before talking to a "real" person. If your questions are answered, then it is worth the wait.



Many operating systems, such as Windows 2000 and XP, walk you through the upgrade process. They can even tell you if your existing hardware and software are compatible with the new OS.

Urheberrechtlich geschütztes Material

Summary ::

- An operating system is system software that acts as a master control program, controlling the hardware and interacting with the user and application software.
- An operating system performs the following functions:
  - Displays the on-screen elements with which you interact—the user interface.
  - Loads programs into the computer's memory so that you can use them.
  - Coordinates how programs work with the computer's hardware and other software.
  - Manages the way information is stored on and retrieved from disks.
- The four major types of operating systems are real-time operating systems, single-user/single-tasking operating systems, single-user/multitasking operating systems, and multi-user/multitasking operating systems.
- Most modern operating systems feature a graphical user interface (GUI). You control a GUI-based system by clicking graphical objects on the screen. In a typical GUI, all objects and resources appear on a background called the desktop.
- In a GUI, you access programs and other resources in rectangular frames called windows. Applications running under the same operating system use many of the same graphical elements, so you see a familiar interface no matter what program you are using.
- Some older operating systems use a command-line interface, which the user controls by typing commands at a prompt.
- The operating system manages all the other programs that run on the PC, and it provides services such as file management, memory management, and printing to those programs.
- Some operating systems enable programs to share information using a feature known as the Clipboard. This lets you create data in one program and use it again in other programs.
- The Object Linking and Embedding feature in Windows extends its data-sharing capabilities, allowing you to embed data into a document while working in an application that cannot, on its own, manipulate the data.
- The OS uses interrupt requests (IRQs) to maintain organized communication with the CPU and other hardware.
- Each hardware device is controlled by another piece of software, called a driver, that allows the OS to activate and use the device.
- A utility is a program that extends or enhances the operating system's capability. It may add a new capability to the operating system.

Urheberrechtlich geschütztes Material

Key Terms ::

activate, 208
active window, 209
antivirus utility, 217
backup utility, 217
choose, 208
Clipboard, 213
command-line interface, 211
context menu, 209
Copy command, 214
Cut command, 214
desktop, 208
dialog box, 211
driver, 216
graphical user interface (GUI), 208
icon, 208
intrusion detection software, 217
menu, 210
menu bar, 209
multitasking, 206
multi-user/multitasking operating system, 207
Object Linking and Embedding (OLE), 214
Paste command, 214
pointer, 208
prompt, 211
Quick Launch bar, 209
real-time application, 206
real-time operating system, 206
screen saver, 217
scroll bar, 209
shortcut, 208
shortcut menu, 209
single-user/multitasking operating system, 206
single-user/single-tasking operating system, 206
Start button, 209
Start menu, 209
system call, 211
task switching, 210
taskbar, 209
terminal client, 207
terminal server, 207
title bar, 209
toolbar, 209
user interface, 208
user session, 207
utility, 216
window, 209

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. The small pictures on the desktop—called _____—represent links to resources on the PC or network.
2. _____ is the ability to perform two or more tasks at the same time.
3. You interact with a command-line interface by typing strings of characters at a(n) _____ .
4. A running program may take up the whole screen or it may appear in a rectangular frame, called a(n) _____ .
5. A program that lets you back up data files is an example of a(n) _____ .
6. In a graphical user interface, you use a mouse (or other pointing device) to move a(n) _____ _____ around the screen.
7. A(n) _____ supports an application that responds to certain input very, very quickly.
8. The process of moving from one open window to another is called _____ .
9. In Windows, when you right-click some objects on the screen, a special _____ appears.
10. In a GUI _____ let you view parts of a program or file that do not fit in the window.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. In a GUI, the window that is currently in use is called the _____ window.
   a. top b. active c. biggest d. framed
2. A list of command choices in an operating system or application is called a _____ .
   a. command line b. check box c. drop-down list d. menu
3. DOS and some versions of UNIX are examples of _____ interfaces.
   a. old-fashioned b. GUI c. command-line d. parallel
4. To remove data from one document and place it in another, you can use the _____ and _____ commands.
   a. Cut, Paste b. Copy, Paste c. File, Open d. Delete, Paste
5. In many GUI-based programs, a _____ displays buttons that let you issue commands quickly.
   a. command bar b. scroll bar c. menu bar d. toolbar
6. From what you learned in this chapter, select the type of operating system you would expect to be used in a computerized heart monitor.
   a. multi-user/ multitasking b. real-time c. single-user/ multitasking d. single-user/ single tasking
7. Which of the following is *not* a type of utility software?
   a. customization tools b. disk and file management c. tabbed dialog box d. Internet security
8. The operating system is the intermediary between programs and _____ .
   a. user interface b. utilities c. ether d. hardware
9. An operating system keeps track of which programs have access to which hardware devices and uses _____ to help the CPU coordinate processes.
   a. interrupt requests (IRQs) b. disk drives c. multitasking d. user interface
10. What type of operating system allows multiple users to connect over the network to a special server and work with their programs in separate sessions, and allows each user to run multiple programs?
    a. single-user/ multiple computers b. real time c. multi-user/ multitasking d. single-user/ single-tasking

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What are the four primary functions that an operating system performs?
2. What device is used to work with graphical objects in a GUI?
3. When working with Windows, what happens when you right-click on most objects?
4. What is the function of windows in a GUI?
5. Why is task-switching a necessary feature of a multitasking operating system?
6. What is a dialog box?
7. Describe the Clipboard and its use.
8. What is the difference between object linking and object embedding?
9. Explain the value of running a screen saver.
10. Explain what a driver does.

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Use your online help system to learn more about Windows. Click the START button, and then choose Help and Support from the Start menu. Explore the Help window to learn more about the tools provided by the help system in your particular version of the operating system. (The exact features vary from one version of Windows to another.) When you are comfortable with the Help window, use any method you prefer to search for information on these topics: *operating system*, *GUI*, *command*, *dialog box*, *menu*, and *multitasking*. When you are finished, close the Help window.
2. Practice using the DOS command prompt:
   a. Click the START button.
   b. If you use Windows 9*x* or 2000, point to Programs, then click the MS-DOS prompt on the Programs menu. If you use Windows XP, choose All Programs | Accessories | Command Prompt. Either way, the command prompt appears in a new window.
   c. At the prompt, type **DIR** and press ENTER. Review the results. Then type the **VER** command, press ENTER, and review the results. Close the window.

Unautorisiertes geschütztes Material

LESSON // 6B

Survey of PC and Network Operating Systems

OBJECTIVES ::

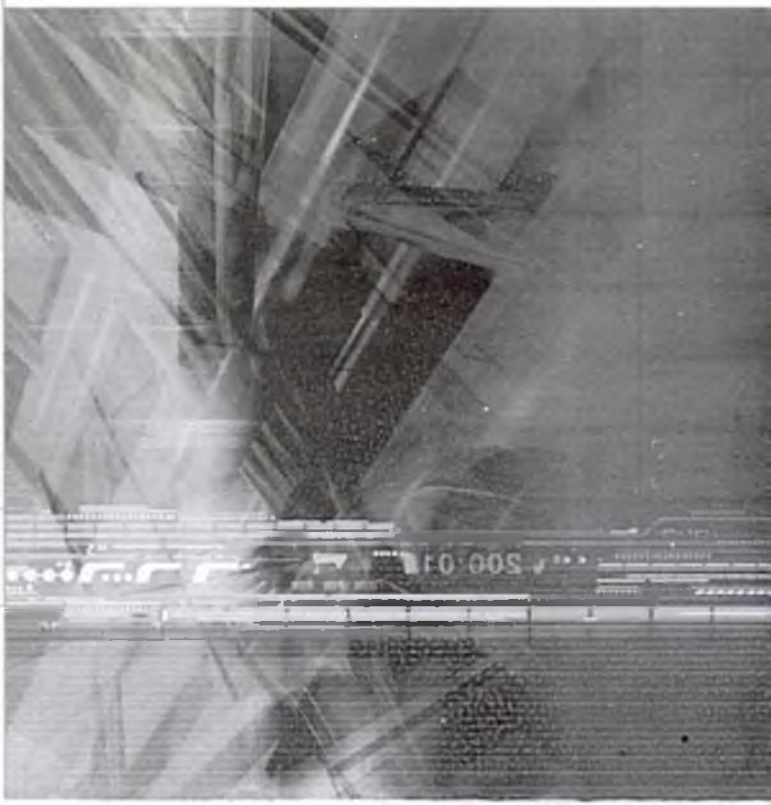
- List all the current PC operating systems.
- List and differentiate the various versions of Windows.
- Describe the role of network operating systems.
- Identify three current embedded operating systems.

Overview: Operating Systems Yesterday and Today

The personal computer (PC) has come a long way in a relatively short time, and much of the progress is due to the continuing advancements in operating systems. Over the past 30 years, the evolution in operating systems has made PCs easier to use and understand, more flexible, and more reliable. Today, in addition to the operating systems that consume hundreds of megabytes of disk space on personal computers, miniaturized operating systems fit into tiny handheld portable digital assistants (PDAs) and even cellular telephones.

Computer users have several choices when it comes to operating systems, although the choice is not always easy. The vast majority of new PCs are sold with some version of Windows installed, but many users (especially in business) are choosing to run UNIX or Linux. Apple Macintosh computers and the proprietary Mac OS have a small but important share of the desktop OS market.

This lesson is a survey of the primary operating systems used on personal computers and network servers today, describing the basic features of each.



PC Operating Systems

Microsoft's Windows operating system continues to thrive on PCs all over the world and has the largest market share of any competitor. At this writing, even management at Apple Computers admits that the Macintosh has just 5 percent of the desktop OS market share, but Linux is making inroads on the desktop.

The following sections provide a brief survey of the many operating systems being used on desktop computers. Although some of these OSs—such as DOS and Windows 95—may seem out of date, they are still widely used and deserve to be included in this discussion.

Norton ONLINE

For more information on PC operating systems, visit http://www.mhhe.com/pelternorton

simnet™

DOS

Even though is has been around for decades, DOS (which stands for *disk operating system*) is still in use today for a variety of reasons. DOS originally came into widespread use in the 1980s, with the appearance of the IBM PC, which was the first personal computer to catch on with consumers and businesses.

Two versions of DOS reigned as the desktop operating system of choice throughout the 1980s. The first was PC DOS, which IBM released with its computers. The other was Microsoft's version of DOS, known as MS-DOS (Microsoft DOS), which was used on millions of "IBM-compatible" PCs, or "clones." (These terms describe any PC that is based on the same architecture used by IBM's personal computers.)

Despite its dominance in the PC market for more than a decade, DOS suffered some weaknesses. For example, it supported only one user at a time, and could run only one program at a time. It had no built-in support for networking, and users had to manually install drivers any time they added a new hardware component to their PC. DOS was also limited in the amount of RAM and storage space it could support. Finally, even today, DOS supports only 16-bit programs, so it does not take full advantage of the power of modern 32-bit (and 64-bit) processors. Finally, DOS used a command-line interface that forced users to remember cryptic command names.

So, why is DOS still in use? Two reasons are its size and simplicity. It does not require much memory or storage space for the system, and it does not require a powerful computer. Therefore, it is sometimes used as an embedded OS for devices that run very simple, single-tasking applications. Another reason for its continued use is that many businesses still have custom applications either written as a one-of-a-kind application for their business or written for their special needs and marketed to similar businesses. A restaurant may still be using the employee scheduling application written for it 10 or 15 years ago (see Figure 6B.1), or a small picture framing business may still use the same program to calculate the cost of the frames it builds and sells.



FIGURE 6B.1

DOS applications, like this one for employee scheduling, are still in use today. They are often custom applications written years ago for a certain industry or company.

Windows NT Workstation

Microsoft released Windows NT, a 32-bit operating system for PCs, in 1993. Windows NT (New Technology) was originally designed as the successor to DOS, but

Urheberrechtlich geschütztes Material

by the time it was ready for release, it had become too large to run on most of the PCs used by consumers at the time. As a result, Microsoft repositioned Windows NT to be a high-end operating system for powerful workstations and network servers used in business. (After releasing Windows NT, Microsoft went back to the drawing board to create a more consumer-oriented version of Windows to replace DOS on home and office PCs. Windows 95, which is discussed later, was the result.)

Because high-end networked computers fall into two primary categories, Microsoft separated Windows NT into two products: Windows NT Workstation and the first Windows version for network servers, Windows NT Server. The server product was optimized to run on dedicated network servers (see the discussion later in this chapter on NT Server).

FIGURE 6B.2

The interface for Windows NT Workstation 4.0, the last version of Windows to use "NT" in its name.



Although Windows NT Workstation 4.0 looks almost identical to Windows 95 (see Figure 6B.2), its underlying operating system is different; it's almost completely devoid of MS-DOS code that had been present in earlier versions of Windows. Windows NT Workstation is typically used on stand-alone PCs that may or may not be part of a network. While Windows NT Workstation supports networking and can be used as a server in peer-to-peer networks, it generally is not used on network servers. At first, "power users" made up a large part of the market for Windows NT Workstation. As a result, it can be found in such varied places as architectural firms, audio and video production studios, and graphics studios. Windows NT Workstation continues to be on desktops in large organizations, but it is being replaced by newer versions of Windows or by Linux.

Windows 9*x*

The term Windows 9*x* is used when referring to any member of the closely related threesome: Windows 95, Windows 98, and Windows Me. Although these versions of Windows are considered obsolete by many experts in the computer industry, they are still widely used, especially by consumers with older PCs. In fact, many businesses still run Windows 9*x* on their desktop PCs.

In 1995, Microsoft released Windows 95, a complete operating system that did not require MS-DOS to be installed separately before it was installed, unlike its predecessors (Windows 3.0, 3.1, and 3.11—collectively known as Windows 3.*x*). Windows 95 installs the necessary MS-DOS operating system components that it needs and has additional programming code that takes advantage of the more advanced capabilities of newer CPUs and maintains a GUI. Windows 3.x, by contrast, was an operating environment, which ran on top of DOS to provide a GUI and additional capabilities.

In addition to some MS-DOS program code that allows it to run DOS applications, Windows 95 contains 16-bit code that enables it to run programs originally designed for Windows 3.*x* (see Figure 6B.3). If a company had already invested in many such programs, it could continue to use its familiar programs while migrating to the new operating system.

Windows 95 has several other attractions as well. First, for programs designed with 32-bit processing, it can exchange information with printers, networks, and

Urheberrechtlich geschütztes Material

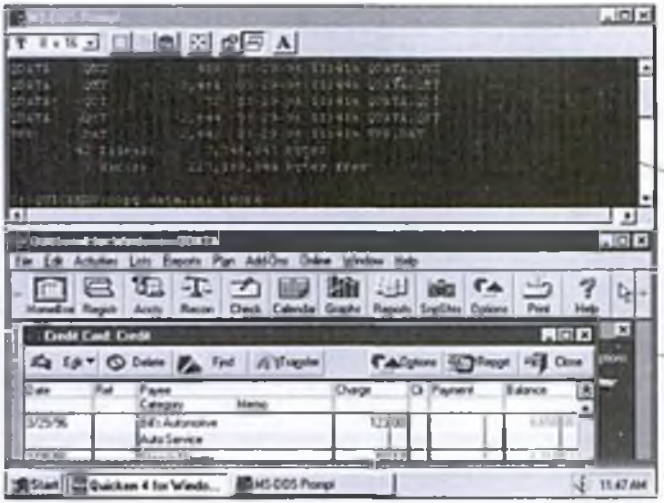


FIGURE 6B.3

Windows 95 runs 32-bit applications, but it can run older 16-bit applications designed for Windows 3.x and DOS.

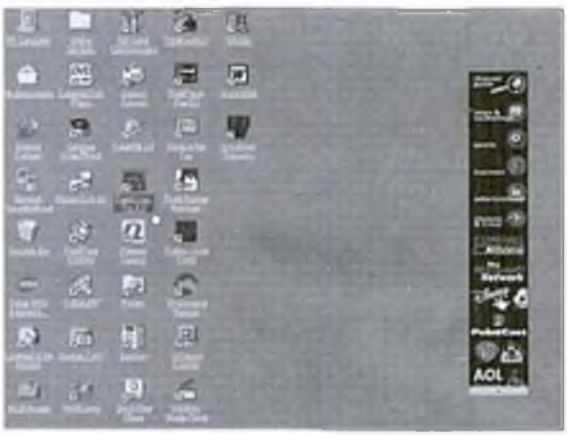
files in 32-bit pieces instead of 16-bit pieces (as in Windows 3.*x* and DOS). For moving information around in the computer, the effect was like doubling the number of lanes on an expressway. Windows 95 has improved multitasking, compared to previous versions of Windows, and it was the first version of Windows to support the Plug and Play standard for connecting new hardware. With integrated networking support and improvements to the GUI, such as the taskbar and START button, Windows 95 remains popular with individual users, in spite of newer versions with even more improvements.

Many experts considered Windows 98 (so-named for the year it was introduced—1998) to be an update to Windows 95 rather than a major Windows operating system upgrade. In other words, the differences from Windows 95 to Windows 98 are not as significant as the differences from Windows 3.*x* to Windows 95. However, one key change in Windows 98 is the inclusion of the Internet Explorer Web browser with a new feature, the Active Desktop, that lets users browse the Internet and local computer in a similar manner (see Figure 6B.4). Active Desktop enables users to integrate Internet resources such as stock tickers and news information services directly on the Windows desktop.

In 2000, Microsoft released Windows Me (Millennium Edition), the last member of the Windows 9*x* family of consumer-grade operating systems. Windows Me offers several notable enhancements over its predecessors, such as improved multimedia capabilities, built-in support for digital video editing, and enhanced Internet features. But like Windows 95 and 98, Windows Me still contains a lot of 16-bit code that supports old DOS and Windows 3.*x* applications. As a result, Windows Me was not much more stable or robust than Windows 95 or 98, and it was subject to frequent crashes.

FIGURE 6B.4

The Windows 98 Active Desktop lets the operating system function like a Web browser.



Urheberrechtlich geschütztes Material

Windows 2000 Professional



FIGURE 6B.5

The Windows 2000 desktop is the same in all four versions of Windows 2000, including Windows 2000 Professional and the three server versions.

Released in 2000, Windows 2000 combines the user-friendly interface and features of Windows 98 with the file system, networking, power, and stability of Windows NT and some new and improved features. This combination of features makes Windows 2000 both powerful and easy to use.

Microsoft developed four versions of Windows 2000: Windows 2000 Professional for the desktop and three versions especially for network servers, discussed later in this chapter (see Figure 6B.5).

Like its predecessor, Windows NT Workstation, Windows 2000 Professional is designed primarily for PCs in offices and small businesses. (Note that Microsoft did not release a version of Windows 2000 specifically for home or casual users.) It includes support for symmetric multiprocessing (SMP) with up to two processors.

Windows XP

Windows XP, released in October 2001, is the latest in the Windows suite of PC operating system families. The desktop has a more three-dimensional look, with rounded corners and more shading. It also offers some brighter color choices (see Figure 6B.6). Windows XP is available in several different products: Windows XP Professional, Windows XP Home, Windows XP Media Center Edition, and Windows XP Embedded. Microsoft also created 64-bit Windows XP for use with AMD's Opteron and Athlon 64 CPUs. With Windows XP, Microsoft consolidated its consumer-grade and enterprise desktop operating systems into one environment. For home users, this means added security and an operating system that is far less likely to stall or crash than Windows 9*x*. Here are some of the features that have been upgraded in Windows XP:

- **Digital Media Support.** Through the use of Windows Media Player 9, users of XP can take advantage of digital broadcast support, as well as video and audio rendering for multimedia projects.
- **Advanced Networking and Communications.** Windows XP takes advantage of universal Plug and Play support, which enables the PC to find and use hardware connected via a network, without forcing the user to configure the system or install drivers. It also makes use of Internet Connection Sharing, which allows users to connect multiple computers to the Internet via a single connection.
- **Advanced Mobile Computing.** Through the use of features like Automatic Configuration, you can connect an XP-based laptop to a desktop PC without needing to know different types of network settings. XP's IrComm modem support lets you use a cellular telephone to connect to the Internet.

FIGURE 6B.6

The Windows XP desktop, shown here in its colorful default mode.



Urheberrechtlich geschütztes Material

The Macintosh Operating System

The fact that the Macintosh operating system (or Mac OS) works only on Macintosh computers has long been considered one of the operating system's biggest drawbacks. Although it has a small market share, the Mac remains the first choice of many publishers, multimedia developers, graphic artists, and schools. The current version is called Mac OS System X (ten), which has had four major releases. The latest release is Mac OS X Panther, also called version 10.3. It has the same desktop, with upgrades to the OS and various components, such as the Finder, Mail, and Address Book. Figure 6B.7 shows the Mac OS X Panther desktop, customized by a user.



FIGURE 6B.7

The Mac OS System X desktop

UNIX for the Desktop

It is difficult to pin UNIX down to one class of computer, because it runs on such a wide range, including supercomputers, notebook PCs, and everything in between. Although UNIX does not have an important place in the market for desktop operating systems, thanks to its power and its appeal to engineers and other users of CAD and CAM software, UNIX has been popular for high-powered workstations.

UNIX is not for the faint of heart because of its command-line interface, cryptic instructions, and the fact that it requires many commands to do even simple tasks. However, those who have worked with UNIX have found the power and stability of this OS worth the effort to learn the commands.

Linux for the Desktop

Even though Linux is considered a "freeware" operating system, industry experts have been impressed by its power, capabilities, and rich feature set. Linux is a full 32-bit, multitasking operating system that supports multiple users and multiple processors. Linux can run on nearly any computer and can support almost any type of application. Linux uses a command-line interface, but windows-based GUI environments, called shells, are available.

The biggest nontechnical difference between UNIX and Linux is price. Anyone can get a free copy of Linux on the Internet, and disk-based copies are often inserted in popular computer books and magazines. Commercial versions of Linux, which are inexpensive when compared to the cost of other powerful operating systems, are also available from a variety of vendors who provide the Linux code for free and charge for the extras, such as utilities, GUI shells, and documentation. At this writing, the most popular Linux vendors are Red Hat and Novell, and both offer special Linux bundles for desktop computers as well as for servers.

For all these reasons, Linux has become a popular OS in certain circles. Students and teachers have flocked to Linux not just for its technical advances but to participate in the global community that has built up around the operating system. This community invites Linux users and developers to contribute modifications and enhancements, and it freely shares information about Linux and Linux-related issues. Although Linux is typically considered to be a server platform, an increasing number of software companies are writing new desktop applications or modifying existing ones for Linux.

Norton ONLINE

For more information on the Macintosh operating system, visit http://www.mhhe.com/petemorton

Norton ONLINE

For more information on UNIX and Linux, visit http://www.mhhe.com/petemorton

Urheberrechtlich geschütztes Material

At Issue

Controlling Computers with the Mind

The idea that humans could control computers with little more than their thoughts is the stuff of science fiction. Or is it?

Now a team of doctors, scientists, and programmers have developed a device that does exactly that. For the first time, a severely paralyzed—or "locked-in"—patient has the ability to control a computer directly with his or her thoughts.

The device, called the Brain Communicator, was created by Neural Signals, Inc., and allows a locked-in user (who is alert and intelligent but unable to move or speak due to stroke, disease, or injury) to control his or her personal computer without the need for a manual keyboard, voice recognition system, or other standard means of control. No voluntary movement is necessary.

Neural interface devices (NIDs) such as the Brain Communicator allow users to take advantage of small electrical signals generated spontaneously in the body. These signals can be obtained either directly or indirectly. Direct methods of collecting the signals involve surgical implantation in the user's body; indirect methods can utilize the user's muscle movements, eye movements, or EEG brain waves.

In the case of the Brain Communicator, a tiny, hollow glass cone filled with wires and chemicals approximately the size of the tip of a ballpoint pen is implanted onto the patient's brain. This "neurotrophic electrode" transmits the brain's electrical signals to a receiver that descrambles the signals and then translates them into corresponding digital outputs, so computer software can recognize them. This software, in turn, allows the user to control a cursor and special electronic devices that are attached to the computer.

With NIDs, simply by imagining movement, locked-in patients can use a word processor or speech synthesizer, surf the Internet, or access environmental controls such as lights, music, and TV. Medicine and computer technology combine to open the horizons of their locked-in world.

The idea for Neural Signals grew out of a research project of neural researcher and founder Dr. Phillip Kennedy. Today,



FIGURE 6B.8

Linux with an optional GUI desktop.

Figure 6B.8 shows the version of Linux released by Red Hat, with the KDE Desktop environment. Red Hat has grown into one of the most popular Linux releases, complete with its own community of followers, as well as their own Linux certification program, known as the Red Hat Certified Engineer (RHCE) program.

Network Operating Systems

A network operating system (NOS) is an OS that is designed to run on a network server dedicated to providing various services to other computers on the network. The "other" computers are called client computers, and each computer that connects to a network server must be running client software designed to request a specific service. If you are connecting to a server to store and retrieve files, your computer must have the client software that allows it to connect to that server for that purpose. Further, the specific client software needed varies based on the NOS running on the server.

All of today's desktop operating systems include support for some basic services, such as file and print sharing, over a network. But desktop operating systems are best reserved for the humdrum work of the average business or home user. They really don't work that well as servers. If you work in a small office and want to share a printer connected to your desktop computer with your coworkers, you can do this, whether you are running Windows, Linux, or Mac OS X, in

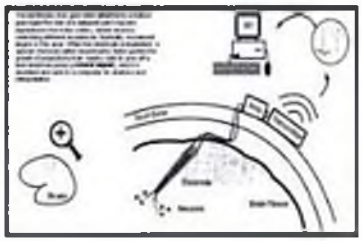
simnet™

Urheberrechtlich geschütztes Material

the company develops its neural interfacing technology as a collaborative project with researchers at Georgia Tech, Emory University, and Georgia State University. Dr. Kennedy plans to use his brain-to-computer (BCI) technologies to help the over 125,000 quadriplegics in the United States as well as the 30,000 ALS patients immobilized on respirators. In addition, Neural Signals hopes to move into movement restoration and other markets for the technology.

Even as the future looks bright, the field of neural interfacing technology is still in its infancy and the practical applications of the technology have yet to be realized. Perhaps, someday soon, personal computers will come bundled with biological signal sensors and thought-recognition software just as commonly as the word processing and educational programs of today.





which case your computer is providing a network service.

Network operating systems are optimized to provide network services—with support for multiple processors and support for redundancy—both locally in the form of data redundancy on drives and specialized network redundancy, such as schemes in which one network server is a "mirror" of another server and is available immediately if the first server fails. There are many other "under-the-hood" enhancements that enable a NOS to provide reliable service.

SELF-CHECK ::

Circle the correct answer for each question.

1. Which operating system first appeared with the IBM PC?
   a. Windows b. DOS c. Linux
2. The START button appeared in this version of Windows.
   a. Windows 95 b. Windows 98 c. Windows Me
3. The biggest nontechnical difference between UNIX and Linux is _____.
   a. size b. price c. power

Windows NT Server

While it shares the same core as Windows NT Workstation, Windows NT Server has additional capabilities. Microsoft fine-tuned Windows NT Server so it would function as an operating system for servers. It has security features for grouping and authenticating users and controlling their access to network resources. It supports the use of many hard disks, working together to store huge amounts of data. It also can be configured to provide redundancy of data, writing the same data to multiple disks, so it is preserved in case one disk fails. All these features make it possible for Windows NT Server to ensure disk and data security even in the event of a catastrophic failure of a hard disk.

Norton ONLINE

For more information on network operating systems, visit **http://www.mhhe.com/petemorton**

Urheberrechtlich geschütztes Material



FIGURE 6B.9

The Windows 2000 Server GUI is identical to that of the Professional version.

Windows 2000 Server

Introduced in 2000, Microsoft Windows 2000 Server is available as three products, all of which support managing very large stores of data about the users of the network and the computer resources of the network. A generic term for such a specialized database is enterprise directory (not to be confused with the term *directory* sometimes used when talking about disk folders). One of the many things Windows 2000 Server can do that Windows 2000 Professional cannot is to manage a directory with a specialized service called Active Directory. All three server products have the same user interface as Windows 2000 Professional, as shown in Figure 6B.9.

- **Server Standard Edition.** This version is fine-tuned for use as a network server for the average business, with SMP support for up to two processors.
- **Advanced Server.** This is a more powerful version of the server edition. It includes support for SMP with up to four processors, enhanced balancing of network and component loads, and support for more RAM. Another important feature is print server clustering. With clustering, Windows 2000 can group print servers to provide alternate printers if one print server fails.
- **Data Center Server.** This version is the most powerful of the server editions, optimized for use as a large-scale application server, such as a database server. It includes the Advanced Server features, plus support for SMP with up to 32 processors. This product is not sold separately, but is sold through computer manufacturers, bundled with the very expensive, powerful servers.

Windows Server 2003

Microsoft extended its Windows Server system line with Windows Server 2003, introduced in April 2003 as two products:

- **Windows Server 2003 Standard Edition.** This version is fine-tuned for use as a network server for the average business, with SMP support for up to two processors.
- **Data Center Server.** This version is the most powerful of the server editions, optimized for use as a large-scale application server, such as a database server. It includes the Advanced Server features, plus support for SMP with up to 32 processors.

Windows Server 2003 has a Windows XP–style interface that hides a very beefed up server OS that Microsoft hopes will compete with UNIX, which dominates the very high-end enterprise network servers. This server OS was designed to support a set of technologies Microsoft dubbed the .NET Framework. In a nutshell, this means it is designed to support Web-based applications, large databases, e-commerce servers, and distributed applications, which are applications with parts that run on different computers, *distributing* the work and data across the network. The network, in this case, can be the Internet or a corporate intranet, or an extranet. (Intranets and extranets are discussed in Chapters 7, 8, and 9.)

Novell NetWare

NetWare (developed by Novell, Inc.) was one of the earliest and most popular network operating systems in terms of number of installations through the 1980s

Urheberrechtlich geschütztes Material

and into the 1990s. Although its market share has declined in recent years, Novell still has a strong following and continues to bring out new network products. NetWare server is now just one server operating system offered by Novell. Novell offers two Linux Server products, SuSE Enterprise and SuSE Standard, in addition to the Novell NetWare server product. The benefit of the NetWare server product is the long-term reliability of the product and the loyal network administrators of its installed base of servers that have been running earlier versions of NetWare servers for many years. The SuSE Linux products offer both a basic, department / small business NOS in SuSE Standard, and in SuSE Enterprise, a powerful operating system that can run on a broad range of computers, up to mainframes. The NetWare and SuSE Enterprise products support distributed applications.

UNIX for Servers

Because of its ability to work with so many kinds of hardware and its reliability (it rarely crashes), UNIX remains a very frequently chosen operating system for Internet host computers.

In the business world, UNIX remains a popular network operating system, especially among organizations that manage large databases shared by hundreds or thousands of users. Many types of specialized database-specific software programs have been developed for the UNIX platform and are deeply entrenched in industries such as insurance, medicine, banking, and manufacturing. The various versions of UNIX have collectively "owned" the market for very large, mission-critical servers in the largest of enterprises. UNIX is also widely used on Web servers, especially those that support online transactions and make heavy use of databases. In addition, UNIX has long been the OS of choice for the most critical servers of the Internet, such as those that maintain the lists of Internet domain names.

Linux for Servers

Linux has garnered a large share of the small business and home market as a server OS for providing Internet and networking services. An open operating system, it is a cost-effective alternative to other operating systems for sharing files, applications, printers, modems, and Internet services. There is a large number of Linux servers hosting Web sites and performing other roles on the Internet.

In the last few years, more and more vendors have brought out products bundled with Linux targeting large (enterprise) organizations; among them are Red Hat and Novell. Novell's venture into Linux products is expected to help bring about the eventual dominance of Linux on a wide range of servers, competing with both Microsoft and UNIX NOSs.

Embedded Operating Systems

An embedded operating system is one that is built into the circuitry of an electronic device, unlike a PC's operating system, which resides on a magnetic disk. Embedded operating systems are now found in a wide variety of devices, including appliances, automobiles, bar-code scanners, cell phones, medical equipment, and personal digital assistants. The most popular embedded operating systems for consumer products, such as PDAs, include the following:

» **Windows XP Embedded.** One of two embedded OSs currently available from Microsoft, Windows XP Embedded is based on the Windows XP Professional OS, but it is not an off-the-shelf operating system so much as it is a do-it-yourself kit for device manufacturers who wish to pick and choose the parts of the Windows XP Professional OS their products need.

Notice ONLINE



For more information on embedded operating systems, visit **http://www.mhhe.com/petermorton**

Urheberrechtlich geschütztes Material

Computers In Your Career

Help Desk and Technical Support Specialists

Mark Barry knows that when he picks up a phone line in his office, there's a good chance that the caller will be edgy, and possibly even on the verge of tears, over the fact that his or her hardware or software may never work properly again. Part-counselor, part-computer technician, Barry asks questions about the problem itself, positions himself in front of the same application or piece of hardware in his own office, then helps the caller find a workable solution.

"It's always great to be able to help someone take care of a technology problem," says Barry, president and owner of Configured PC in Whitinsville, Massachusetts. "There's a lot of personal satisfaction in befriending someone, and making their day." A graduate of Clark University's Computer Career Institute, Barry holds a CompTIA A+ certification. Prior to starting his own firm, which specializes in technical sales and support, he was a technical trainer for CompUSA.

With the assistance of one technical support professional and an office manager, Barry has made a career out of helping people work through their technology problems. He fills a gap in the industry where vendor technology support personnel often leave off: being able to communicate well with customers and walk them through diagnostic and repair steps via telephone. When he's not on the phone, Barry helps walk-in customers, makes house calls, and consults with clients in need of customized technology solutions.

Barry predicts a healthy demand for IT types who can communicate with customers—be they internal customers (those calling to an internal help desk) or outside customers (such as the ones he works with)—and walk them through technical problems with their hardware and software. Both help desk workers and technical support specialists share the same goal of helping others use their computers, but generally work in different environments:

- Help desk professionals are usually employed by a company to help its other employees with the computer systems they use at work. Suppose, for example, that you work for a large retailer and use its specialized order management or customer relationship management (CRM) software. If you need help using the program, you can call the company's internal help desk to ask for assistance.

- **Windows CE .NET.** The second Windows embedded product is Windows CE .NET. Also provided as a kit to manufacturers, it is not based on the Windows desktop products but is the latest version of Windows CE, which was designed especially for embedded devices requiring a real-time OS. Although a small OS, it supports wireless communications, multimedia, and Web browsing. It also allows for the use of smaller versions of Microsoft Word, Excel, and Outlook. Microsoft is positioning a version of Windows CE for the automotive market, calling it Windows Automotive.
- **Palm OS.** Palm OS is the standard operating system for Palm-brand PDAs as well as other proprietary handheld devices (see Figure 6B.10). For several years the Palm OS was the more popular option for handheld devices and there were many manufacturers offering PDAs with the Palm OS. More recently, only Palm and Sony continue to make PDAs that run the Palm OS, but they have a significant market share and, as a result, users have a large degree of choice in terms of software that can be used with this embedded system. The Palm OS continues to be used in other systems, such as cell phones and other small devices.



FIGURE 6B.10

Like many other handheld computing devices, the Palm line of personal digital assistants uses the Palm OS

Urheberrechtlich geschütztes Material



» Technical support specialists are usually employed by a company to help its customers use the products they have purchased from the company. If you have ever had trouble with a computer program and called the manufacturer for help, then you probably spoke with a technical support specialist.

According to the Bureau of Labor Statistics, computer support specialists are projected to be among the fastest-growing occupations over the 2000–2010 period, with job prospects being optimal for college graduates who are up to date with the latest skills and technologies; certifications and practical experience are essential for persons without degrees. Median annual earnings of computer support specialists were $36,460 in 2000, with the middle 50 percent earning between $27,680 and $48,440.

» **Pocket PC OS.** Pocket PC OS is a specific type of operating system that Microsoft developed to use in direct competition with the Palm OS on PDAs. These devices are targeted at the business and corporate market rather than consumers. The latest version gives users the ability to securely access data from a business network via a handheld device, and it gives system administrators the ability to manage and control a PC or server via a wireless network connection.

» **Symbian.** Symbian is an OS found in "smart" cell phones from Nokia and Sony Ericsson that feature options such as touch screens, games, multimedia functions, and Internet connectivity. In addition to the conventional cell phone functions, you can play games and view Web pages (in color) with a full browser over a high-speed mobile network.

Urheberrechtlich geschütztes Material

Summary

- Among the strengths of DOS are its small size, reliability, stability, simple command-line interface, and minimal system requirements.
- Windows NT was originally meant as a replacement for DOS. Microsoft issued two versions of the operating system: Windows NT Workstation and Windows NT Server.
- Windows 95 was Microsoft's first true GUI-based, 32-bit operating system for PCs. It supported multitasking and could run older programs that were written for DOS and Windows 3.*x*.
- Windows 2000 includes the interface and features of Windows 98, with the file system, networking, power, and stability of Windows NT. Microsoft released several versions of Windows 2000, each targeting a specific user or computing environment.
- Windows XP was released in 2001, and it marked the end of Microsoft's consumer-grade operating systems. This means that all computer users, including casual and home users, can have an operating system with enhanced security, networking support, and stability.
- The fact that the Mac OS works only on Macintosh computer hardware has long been considered one of the operating system's biggest drawbacks, but Mac remains the first choice of many publishers, multimedia developers, graphic artists, and schools.
- UNIX runs on a wide range of computers, including supercomputers, notebook PCs, and everything in between, but it does not have an important place in the market for desktop operating systems.
- Linux is a separate OS from UNIX, but it shows the UNIX influence and characteristics. Linux OS code is free, but it is also available through companies such as Novell and Red Hat, who bundle the OS code with utilities and documentation, charging for everything but the OS itself.
- Network operating systems are optimized to provide network services—with support for multiple processors and support for redundancy. This redundancy support occurs both locally in the form of data redundancy on drives and specialized network redundancy such as schemes in which one network server is a "mirror" of another server and is available immediately if the first server fails.
- Popular Network OSs include Microsoft server products, UNIX, Novell NetWare, and Linux.
- Embedded operating systems, such as the Palm OS, Symbian OS, and the Microsoft products—Windows XP Embedded, Windows CE .NET, and Pocket PC OS—are miniaturized OSs designed to run on small computing devices, such as handheld computers.

Urheberrechtlich geschütztes Material

Key Terms ::

distributed application, 232
DOS, 225
embedded operating system, 233
enterprise directory, 232
Linux, 229
Macintosh operating system (Mac OS), 229
.NET Framework, 232
network operating system (NOS), 230
Palm OS, 234
Pocket PC OS, 235
shell, 229
Symbian, 235
UNIX, 229
Windows, 225
Windows 9x, 226
Windows 95, 226
Windows 98, 227
Windows 2000, 228
Windows CE .NET, 234
Windows Me, 227
Windows NT Server, 231
Windows NT, 225
Windows NT Workstation 4.0, 226
Windows XP, 228
Windows XP Embedded, 228
Windows XP Home, 228
Windows XP Media Center Edition, 228
Windows XP Professional, 228

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. _____ was originally designed as the successor to DOS.
2. The term _____ is used when referring to Windows 95, Windows 98, and Windows Me.
3. Microsoft introduced the Active Desktop feature with the _____ operating system.
4. _____ is the latest in the Windows suite of desktop operating system families.
5. The _____ operating system runs only on Macintosh computers.
6. The _____ operating system runs on a wide range of computers, including supercomputers, notebook PCs, and everything in between.
7. _____ is considered to be a "freeware" operating system.
8. A(n) _____ is an OS that is designed to run on a network server dedicated to providing various services to other computers on the network.
9. A(n) _____ is a specialized database that contains data about the users of a network and the computer resources of the network.
10. A(n) _____ application is a program with parts that run on different computers, distributing the work and data across the network.

Urheberrechtlich geschütztes Material

Multiple Choice

Circle the word or phrase that best completes each statement.

1. The acronym DOS stands for _____ .
   a. distributed operating system b. driver operating system c. disk operating system d. diskless operating system
2. Windows NT was released as a _____-bit operating system in 1993.
   a. 8 b. 16 c. 32 d. 64
3. One reason for the popularity of Windows 95 was its ability to run applications that were developed for this operating system.
   a. DOS b. UNIX c. Linux d. Mac OS
4. Windows 95 was the first version of Windows to support the _____ standard for connecting new hardware.
   a. GUI b. Plug and Play c. Enterprise Directory d. OS
5. Which feature of Windows 98 enables users to integrate Internet resources directly on the Windows desktop?
   a. Plug and Play b. Internet Explorer c. START button d. Active Desktop
6. Which version of Windows 2000 was intended for use on desktop computers?
   a. Professional b. Server c. Enterprise Edition d. Data Center Server
7. Microsoft has created a 64-bit version of this operating system, for use with AMD's Opteron and Athlon 64 CPUs.
   a. MS-UNIX b. Linux c. Windows XP d. DOS
8. The current version of the Macintosh operating system is called _____ .
   a. Max OS System I b. Mac OS System X c. Mac OS System Y d. Mac OS System N
9. How many processors are supported by the Data Center Server edition of Windows Server 2003?
   a. 8 b. 16 c. 32 d. 64
10. Which network operating system has long been the OS of choice for the most critical servers of the Internet, such as those that maintain the lists of Internet domain names?
    a. DOS b. UNIX c. Windows NT Professional d. Mac OS

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. Name two versions of DOS that were popular during the 1980s.
2. What is a "clone"?
3. Explain why DOS is still in use.
4. Why didn't Windows NT replace DOS, as originally planned?
5. How is Windows NT Workstation different from Windows 95?
6. What was the primary use for Windows 2000 Professional?
7. UNIX may be described as being difficult to use. Why?
8. What purpose would a "shell" serve in Linux?
9. Windows Server 2003 supports the .NET Framework. What does this mean?
10. What is the Palm OS?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. Use your operating system's search tools to find files on your computer's hard disk. Note that the following steps apply if you are using Windows XP. If you use a different version of Windows or a different operating system than Windows, ask your instructor for directions.
   a. Click Start | Search. The Search Results window opens.
   b. Click All files and folders.
   c. Click in the All or part of the file name text box, and type ***.txt**. This tells windows to search for all files with the filename extension *txt*.
   d. From the Look in drop-down list, select your computer's hard disk (typically C:).
   e. Click Search. Windows conducts the search and displays the results in the right-hand pane of the Search Results window.
   f. Repeat the search, specifying ***.html**, ***.doc**, and ***.gif** as your search criteria. When you are finished, close the Search Results window.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Create a file system. Suppose that you work for a soft drink company. Your manager has asked you to create a business proposal for a new product—a fun, caffeine-free soda for kids under the age of eight. The proposal will be about 50 pages in length and will include several supporting documents, such as reports, memos, budgets, customer lists, research on the product's safety, focus group results, taste tests, and so on. These different documents will be created in several forms, including word processing documents, spreadsheet files, databases, presentations, and so on.

   Your first task is to create a file system on your computer's hard disk where you can store and manage all these files. Using a piece of paper, design a set of folders (and subfolders, if needed) to store all the files in a logical manner. Be prepared to share your file system with the class and to discuss the logic behind your file system.

2. Get the latest on Windows XP. If you do not have Windows XP yet, chances are good that you will be using it in the future. Get a jump on the OS by finding the latest information about it on the Web.

   Visit the following Web sites for more information:

   Microsoft Corporation. Visit Microsoft's main Windows XP page at http://www.microsoft.com/windowsxp/default.asp.

   ***PC Magazine*.** For a series of articles and reviews about Windows XP, visit http://www.pcmag.com/winxp.

3. Learn more about Linux. If you are curious about Linux, or want to install Linux on your system, you can find everything you need on the Internet. Visit the following Web sites for more information on Linux and learn where you can get a free copy. (*Note:* Do *not* download any files from the Internet without your instructor's permission.)

   Linux Online. Hosted by Linux.Org, this site provides a comprehensive array of resources. Visit http://www.linux.org.

   The Linux Gazette. An online newsletter for Linux users of all levels can be found at http://www.linuxgazette.com/.

   Linux Planet. For articles, reviews, technical information, and links to Linux resources, visit http://www.linuxplanet.com/.

Urheberrechtlich geschütztes Material

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Discuss the benefits of using the object linking and embedding (OLE) capabilities of newer operating systems. Can you think of a task where OLE would be helpful? What types of documents can someone create using OLE? Give examples.
2. What does multitasking mean to the average computer user?

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- The benefits of using a command-line interface rather than a graphical user interface.
- The story behind the creation of the Linux operating system.
- A cost comparison of currently available desktop operating systems.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

Many people believe that operating systems have more features and capabilities than they really need. With this thought in mind, discuss the following questions in class:

1. The Windows Update feature has been part of the Windows operating system since the release of Windows 98. This tool enables the operating system to notify the user when updated features are available for downloading on the Internet. Some observers think that future operating systems will be able to update themselves automatically without first notifying the user. How do you feel about this possibility? What dangers could it pose to users?
2. Many observers believe that by including so many features (such as disk defragmenters, file management tools, and Internet applications) in its operating systems, Microsoft has taken market share away from other companies that might develop and sell such tools to Windows users. Do you agree with this criticism, or do you feel that an operating system should include such "extras"?

Urheberrechtlich geschütztes Material



CHAPTER 7

Networks

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **7A:**
Networking Basics

- The Uses of a Network
- Common Types of Networks
- Hybrid Networks
- How Networks Are Structured
- Network Topologies and Protocols

Lesson **7B:**
Data Communications

- Data Communications with Standard Telephone Lines and Modems
- Using Digital Data Connections
- Wireless Networks



LESSON // 7A

Networking Basics

Overview: Sharing Data Anywhere, Anytime

When PCs first appeared in businesses, software programs were designed for a single user. There were few obvious advantages to connecting PCs, and the technology was not adequate for doing so. As computers spread throughout business, developers began offering complex software designed for multiple users. Many organizations quickly learned the importance of connecting PCs. Data communications—the electronic transfer of information between computers—became a major focus of the computer industry. During the past decade, networking technology has become the most explosive area of growth in the entire computer industry. The demand for larger and faster high-capacity networks has increased as businesses have realized the value of networking their computer systems.

Networks come in many varieties. When most people think of a network, they imagine several computers in a single location sharing documents and devices such as printers. But a network can include all the computers and devices in a department, a building, or multiple buildings spread over a wide geographic area, such as a city or even a country. By interconnecting many individual networks into a massive single network, people around the world can share information as though they were across the hall from one another. The information they share can be much more than text documents. Many networks carry voice, audio, and video traffic, enabling videoconferencing and types of collaboration that were not possible just a few years ago. The Internet is an example of one such network and is possibly the single largest network in existence today.



OBJECTIVES ::

- Identify at least three benefits of using a network.
- Differentiate between LANs and WANs.
- Identify at least three common network topologies.
- Name two common network media.
- Identify network hardware and linking devices.

Urheberrechtlich geschütztes Material



FIGURE 7A.1

Most office PCs are connected together to form a network.

The Uses of a Network

A network is a set of technologies—including hardware, software, and media—that can be used to connect computers together, enabling them to communicate, exchange information, and share resources in real time (see Figure 7A.1).

You should think of a network as a group of technologies. Nearly all networks require hardware, software, and media—such as wires—to connect computer systems together.

Networks allow many users to access shared data and programs almost instantly. When data and programs are stored on a network and are shared, individual users can substantially reduce the need for programs on their own computers. Networks open up new ways to communicate, such as e-mail and instant messaging. By allowing users to share expensive hardware resources such as printers, networks reduce the cost of running an organization.

Simultaneous Access

There are moments in any business when several workers may need to use the same data at the same time. A good example is a company's quarterly sales report, which needs to be viewed and updated by several managers. Without a network that allows workers to share files, workers must keep separate copies of data stored on different disks by each worker who accesses the data. When the data is modified on one computer, data on the other computers becomes outdated. It becomes difficult to determine which copy of the data is the most current.

Companies can solve this problem by storing commonly used data at a central location, usually on a network server (also called a server). A network server is a central computer with a large storage device and other resources that all users can share. You learned about the kinds of computers that can function as network servers in Chapter 1.

If the server stores data files for users to access, it is commonly called a file server. The business can store a single copy of a data file on the server that employees can access whenever they want (see Figure 7A.2). Then, if one user makes a change to the file, other users will see the change when they use the file, and no one needs to figure out who has the latest copy of the data. Advanced software is needed to allow simultaneous access to the same file.

In addition to using many of the same data files, most office workers also use the same programs. In an environment where PCs are not networked, a separate copy of each program must be installed on every computer. This setup can be

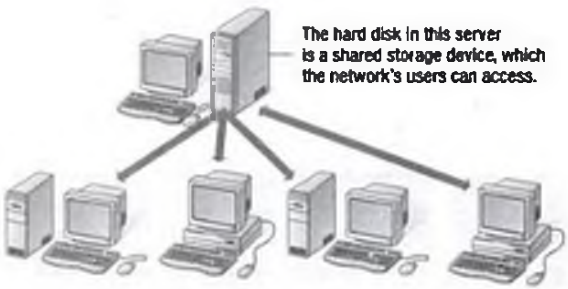


FIGURE 7A.2

Users can share data stored on a central file server.

Norton ONLINE

For more information on networks, visit http://www.mhhe.com/petemorton

simnet™

Urheberrechtlich geschütztes Material

costly for two reasons. First, software can be expensive, especially when you must buy many dozens or hundreds of copies. Second, installing and configuring a program on many different computers can take a lot of time and labor, and maintaining many separate installations of a program is an ongoing expense. There are two basic solutions to this problem:

» **Site Licenses.** One solution to this problem is to purchase a site license for an application. Under a site license, a business buys a single copy (or a few copies) of an application and then pays the developer for a license to copy the application onto a specified number of computers. Under a site license, each user has a complete, individual copy of the program running on his or her PC, but the business generally pays less money than it would by purchasing a complete copy of the software for each user.

» **Network Versions.** Another solution is to connect users' computers to a central network server and enable users to share a network version of a program. In a network version, only one copy of the application is stored on the server, with a minimum number of supporting files copied to each user's PC. When workers need to use a program, they simply load it from the server into the RAM of their own desktop computers, as shown in Figure 7A.3.

There are trade-offs with placing applications on a centrally located server. In some networks, and with certain types of programs, the user's computer handles all the processing tasks required by the application, even though the application's core files are stored on the network. In other cases, the network server also handles some or all of the processing tasks. In these cases, the network server may be called an application server because it handles some application processing as well as storage.

Shared Peripheral Devices

The ability to share peripheral devices (especially expensive ones such as high-volume laser printers, which can cost thousands of dollars) is one of the best reasons for small businesses to set up a network. Although printers are more affordable than they were a few years ago, it is still too expensive to provide every worker with a personal printer. Aside from the cost of buying multiple printers, maintenance contracts and supplies increase the total cost of ownership. When several people can share a printer on a network, printing becomes less expensive and easier to manage (see Figure 7A.4).

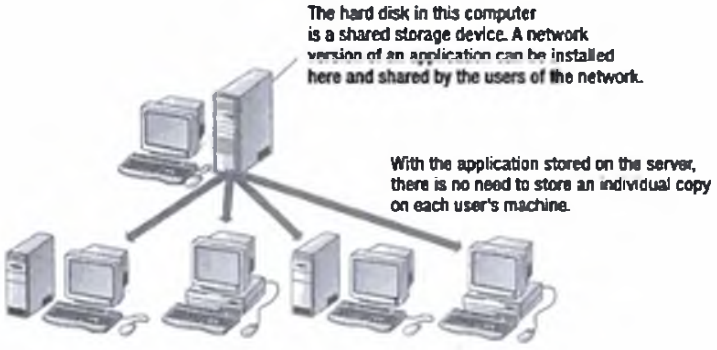


FIGURE 7A.3

Using a network version of an application.

Urheberrechtlich geschütztes Material

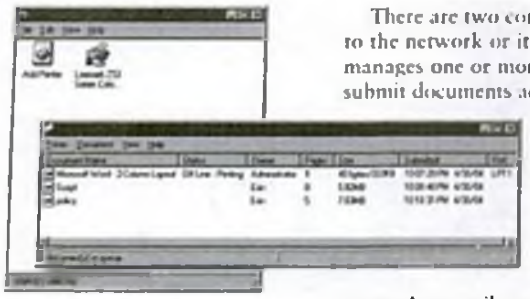


FIGURE 7A.4

This print server is displaying a queue where a user named Erin is waiting to print two documents behind the user named Administrator.

There are two common ways to share a printer. A printer can connect directly to the network or it can be attached to a print server, which is a computer that manages one or more printers. Either way, users on desktop PCs will be able to submit documents across a network to a printer.

Personal Communications

One of the most far-reaching applications of data communications is electronic mail (e-mail), a system for exchanging written messages (and, increasingly, voice and video messages) through a network.

In Chapter 8, you learned how e-mail travels over the Internet. An e-mail system in a company's network functions in much the same way (see Figure 7A.5). Such systems may be purely internal, but many companies connect their private networks to the Internet so workers can send messages to and receive messages across the Internet from people outside the company's network.

In addition to e-mail, the spread of networking technology is adding to the popularity of teleconferencing. A teleconference is any kind of multiway communication carried out in real time using telecommunications or computer networks and equipment. In a teleconference, audio and video signals travel across a local area network through the use of cables and switches or across the network's Internet connections to remote sites located throughout the world. Subcategories of teleconferencing include

- **Videoconferencing.** Videoconferencing enables real-time communication over a distance by allowing people at two or more sites to communicate with each other by seeing a video picture of the people at the other sites. Each site has one or more cameras, microphones, loudspeakers, and monitors, as well as a CODEC (compressor/decompressor), which processes the audio and video. It aims to create a sense of a person at a distant site appearing to be there in the same room, an effect that has been called virtual presence.
- **Audio-conferencing.** Audio-conferencing provides an audio link similar to that of a conventional telephone, except that it offers much higher-quality audio and enables more than two sites to be linked together. Using hands-free audio units with sensitive microphones and sophisticated echo-cancellation software, audio-conferencing enables communication between groups of participants.
- **Data-conferencing.** Data-conferencing enables participants at two or more sites to have a shared workspace on their computer desktops. This might be a shared "whiteboard" where they can draw, write, or import and manipulate images collaboratively in real time. Or it might be "application sharing," where a piece of software can be run and controlled by both users.

Norton ONLINE

For more information on e-mail and network conferencing technologies, visit **http://www.mhhe.com/petermorton**

FIGURE 7A.5

Sending and receiving e-mail over a typical network.



Urheberrechtlich geschütztes Material

Data-conferencing is often used in conjunction with video- or audio-conferencing and can be useful when users at different sites want to work together on documents.

Another developing area of integrated communication is Voice over Internet Protocol (VoIP). VoIP systems bypass the need for the cost of regular telephone service by using the company's internal network to send and receive phone calls. VoIP transmits the sound of your voice over a computer network using the Internet Protocol (IP) rather than sending the signal over traditional phone wires. The PC that sits on a user's desk will share the same wire as a VoIP phone. This can work on a private network for interoffice calls or over the Internet.

The interoffice type of connection is called pure VoIP (see Figure 7A.6). The destination computer is identified by its IP address or by a name, which the company translates into an IP address. With the other method, VoIP-to-POTS, there exist special-purpose servers called plain old telephone service (POTS) gateways (see Figure 7A.7). These servers have one foot in the IP world (i.e., they are servers on the Internet or the intranet) and one foot in the POTS world (i.e., they have POTS line circuitry). POTS gateways allow phone calls to jump the gap between the POTS and the Internet.

Norton ONLINE

For more information on Voice over Internet Protocol, visit http://www.mhhe.com/peternorton

Easier Data Backup

In business, data is extremely valuable, so it is important that employees back up their data. One way to assure that data is backed up is to keep it on a shared

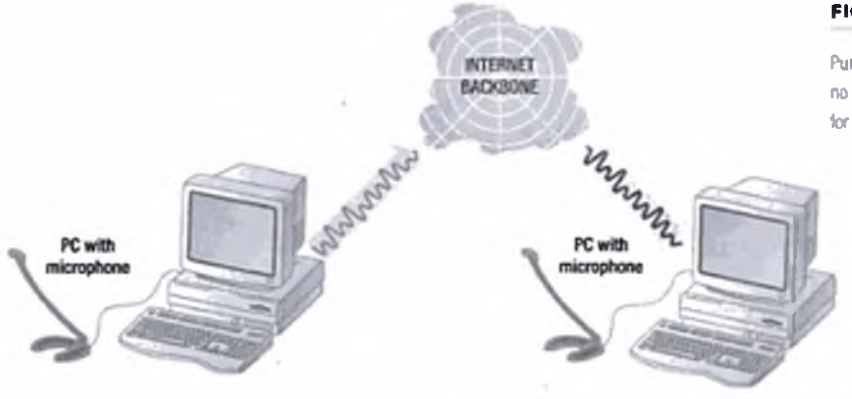


FIGURE 7A.6

Pure VoIP (Voice over IP) system. There's no cost for the telephone call, only a cost for the Internet connection.

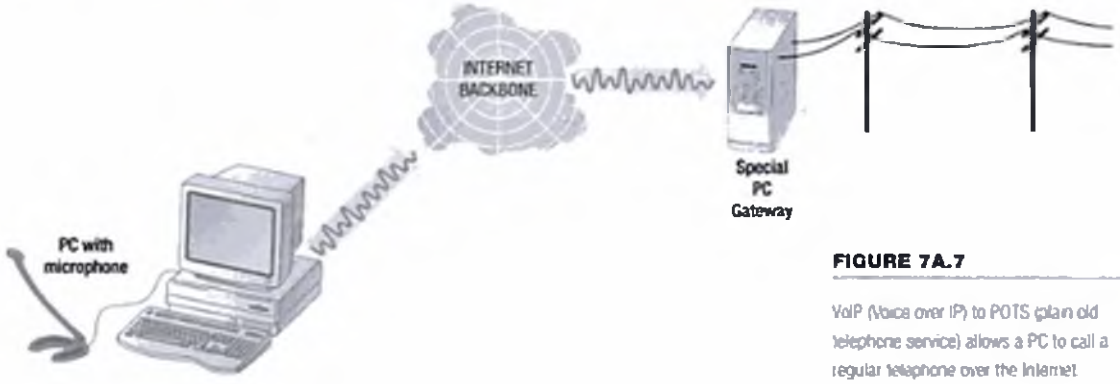


FIGURE 7A.7

VoIP (Voice over IP) to POTS (plain old telephone service) allows a PC to call a regular telephone over the Internet.

Urheberrechtlich geschütztes Material

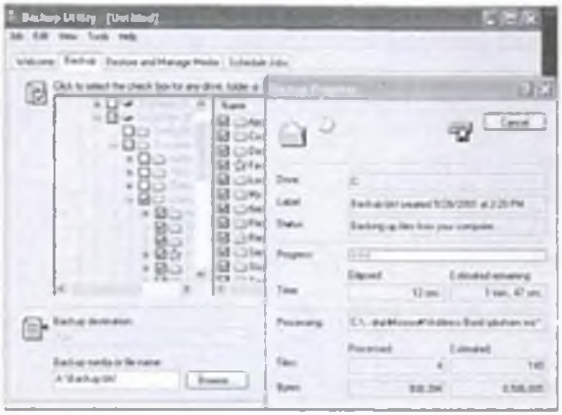


FIGURE 7A.8

Backup systems like this one can be used to back up a server and individual personal computers on the network.

storage device that employees can access through a network. Often the network manager makes regular backups of the data on the shared storage device (see Figure 7A.8).

Managers also can use special software to back up files stored on employees' hard drives from a central location. With this method, files do not have to be copied to the server before they can be backed up.

Common Types of Networks

If you want to understand the different types of networks and how they operate, you need to know how networks are structured. There are two main types of networks: local area networks (LANs) and wide area networks (WANs).

Local Area Networks (LANs)

A local area network (LAN) is a data communication system consisting of several devices such as computers and printers. This type of network contains computers that are relatively near each other and are physically connected using cables, infrared links, or wireless media. A LAN can consist of just two or three PCs connected together to share resources, or it can include hundreds of computers of different kinds. Any network that exists within a single building, or even a group of adjacent buildings, is considered a LAN. A LAN is not a system that connects to the public environment (such as the Internet) using phone or data lines.

It is often helpful to connect separate LANs together so they can communicate and exchange data. In a large company, for example, two departments located on the same floor of a building may have their own separate LANs, but if the departments need to share data, then they can create a link between the two LANs.

Wide Area Networks (WANs)

Typically, a wide area network (WAN) is two or more LANs connected together, generally across a wide geographical area. For example, a company may have its corporate headquarters and manufacturing plant in one city and its marketing office in another. Each site needs resources, data, and programs locally, but it also needs to share data with the other sites. To accomplish this feat of data communication, the company can attach devices that connect over public utilities to create a WAN. (Note, however, that a WAN does not have to include any LAN systems. For example, two distant mainframe computers can communicate through a WAN, even though neither is part of a local area network.)

These remote LANs are connected through a telecommunication network (a phone company) or via the Internet through an Internet service provider (ISP) that contracts with the telecommunication networks to gain access to the Internet's backbone.

Hybrid Networks

Between the LAN and WAN structures, you will find hybrid networks such as campus area networks (CANs) and metropolitan area networks (MANs). In addition, a new form of network type is emerging called home area networks (HANs). The need to access corporate Web sites has created two classifications known as intranets and extranets. The following sections introduce these networks.

Norton ONLINE

For more information on local LANs, WANs, and other common types of networks, visit **http://www.mhhe.com/petemorton**

simnet™

Urheberrechtlich geschütztes Material

Campus Area Networks (CANs)

A campus area network (CAN) follows the same principles as a local area network, only on a larger and more diversified scale. With a CAN, different campus offices and organizations can be linked together. For example, in a typical university setting, a bursar's office might be linked to a registrar's office. In this manner, once a student has paid his or her tuition fees to the bursar, this information is transmitted to the registrar's system so the student can enroll for classes. Some university departments or organizations might be linked to the CAN even though they already have their own separate LANs.

Metropolitan Area Networks (MANs)

The metropolitan area network (MAN) is a large-scale network that connects multiple corporate LANs together. MANs usually are not owned by a single organization; their communication devices and equipment are usually maintained by a group or single network provider that sells its networking services to corporate customers. MANs often take the role of a high-speed network that allows for the sharing of regional resources. MANs also can provide a shared connection to other networks using a WAN link. Figure 7A.9 shows the relationship between LANs, MANs, and WANs.

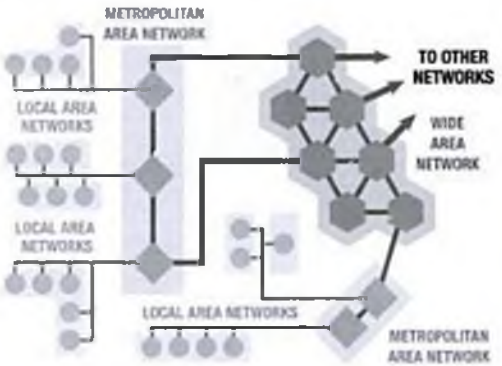


FIGURE 7A.9

The relationship between LANs, MANs, and WANs.

Home Area Networks (HANs)

A home area network (HAN) is a network contained within a user's home that connects a person's digital devices, from multiple computers and their peripheral devices, such as a printer, to telephones, VCRs, DVDs, televisions, video games, home security systems, "smart" appliances, fax machines, and other digital devices that are wired into the network.

Intranets and Extranets

Much of the technology available on the Internet is also available for private network use. The company's internal version of the Internet is called an intranet. As you learned in Chapter 8, an intranet uses the same Web server software that gives the public access to Web sites over the Internet. The major difference is that an intranet usually limits access to employees and selected contractors having ongoing business with the company.

Web pages have become very popular and, using integrated software, many operating systems offer complete Web server software or at least a personal Web server. This gives users the ability to create Web pages on their local computers that can be viewed by other members of the same network. Just like on the Internet, users can allow others (again, usually employees) to browse their Web site and to upload or download files, video clips, audio clips, and other such media. Users also can set controls and limit who may access the Web site.

Extranets are becoming a popular method for employees to exchange information using the company's Web site or e-mail while traveling or working from home. An extranet is a partially accessible internal company Web site for authorized users physically located outside the organization. Whereas an intranet resides completely within the company's internal network and is accessible only to people that are members of the same company or organization, an extranet provides various levels of accessibility to outsiders. You can access an extranet only if you have a valid username and password, and your identity determines which parts of the extranet you can view.

Urheberrechtlich geschütztes Material

Norton ONLINE

For more information on common network structures, visit http://www.mhhe.com/petemorton

simnet™

How Networks Are Structured

Networks can be categorized by the roles the servers and PCs play in terms of hierarchical and security interaction. Some networks use servers (server-based networks) and some do not (peer-to-peer networks). These terms are defined in detail in the following sections.

Server-Based Networks

To understand a server-based network, it is important to know the meaning of the term *node* in a network. A node is a processing location that can be a PC or some other device such as a networked printer. Usually, server-based networks include many nodes and one or more servers, which control user access to the network's resources.

As described earlier, this central computer is known as the file server, network server, application server, or just the server. Files and programs used by more than one user (at different nodes) are often stored on the server.

A file server network (see Figure 7A.10) is a fairly simple example of this kind of nodes-and-server network. This arrangement gives each node access to the files on the server, but not necessarily to files on other nodes. When a node needs information from the server, it requests the file containing the information. The server simply stores files and forwards (sends) them to nodes that request them.

One way to identify a server-based network is the point at which network resources such as files are made available to users. In this environment, users gain access to files, printers, and other network-based objects by obtaining rights and permissions given through a centrally controlled server or groups of servers. Users must "log on" to the network to gain access to its resources.

Client/Server Networks

One popular type of server-based network is the client/server network, where individual computers share the processing and storage workload with a central server. This arrangement requires special software for the nodes and the server. It does not, however, require any specific type of network. Client/server software can be used on LANs or WANs, and a single client/server program can be used on a LAN where all the other software is based on a simple file server system.

The most common example of client/server computing involves a database that can be accessed by many different computers on the network. The database is stored on the network server, along with a portion of the database management

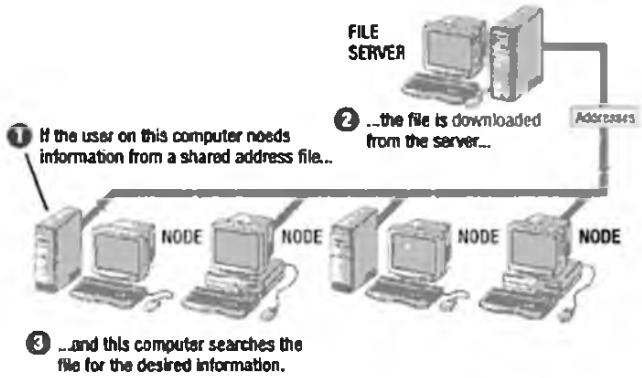


FIGURE 7A.10

A simple LAN with a file server.

Urheberrechtlich geschütztes Material

system (DBMS)—the program that allows users to work with the database. The user's computer (which can be called the node, workstation, or client) stores and runs the client portion of the DBMS. When a user needs to find information in the database, he or she uses client software to send a query to the server, which searches the database and returns the information to the user's PC (see Figure 7A.11).

Peer-to-Peer Networks

In a peer-to-peer network (abbreviated as "P2PN" and sometimes called a workgroup), all nodes on the network have equal relationships to all others, and all have similar types of software that support the sharing of resources (see Figure 7A.12). In a typical peer-to-peer network, each node has access to at least some of the resources on all other nodes. If they are set up correctly, many multi-user operating systems give users access to files on hard disks and to printers attached to other computers in the network. Many client operating systems, such as Windows 9*x*, Windows 2000 Professional, Windows Me, Windows XP, and the Macintosh OS, feature built-in support for peer-to-peer networking. This enables users to set up a simple peer-to-peer network using no other software than their PCs' own operating systems.

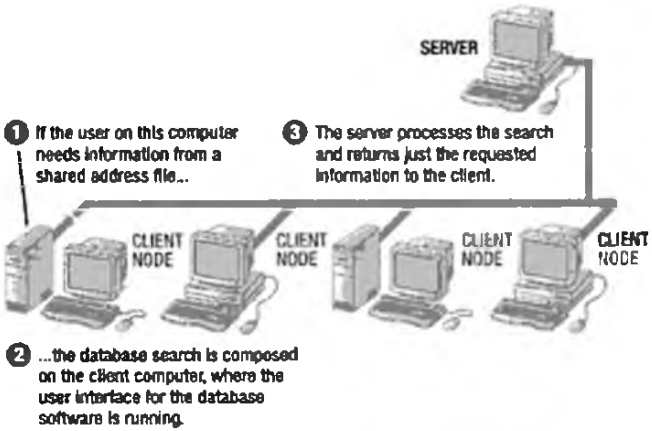


FIGURE 7A.11

Processing information in a client/server computing model.

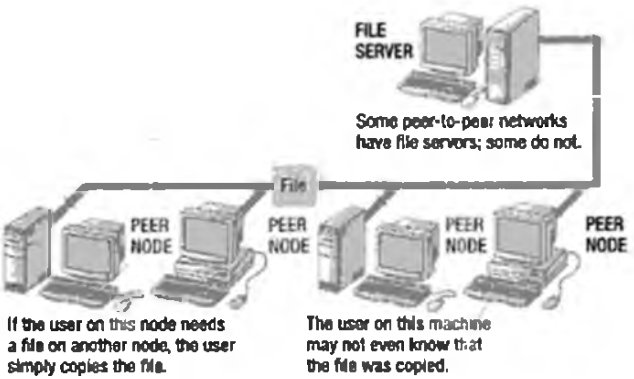


FIGURE 7A.12

A peer-to-peer network.

Urheberrechtlich geschütztes Material

At Issue

Catching "Cyberslackers" on the Job

Imagine that you run a small company that has 12 employees. To make the workers more productive, you invest in cutting-edge computers, network services, and Internet connections for each of them.

One day, you learn that two of your employees are using their PCs and Internet access a great deal, but not for work-related purposes. One employee, you learn, is using the system to collect pornographic pictures on the Internet and is e-mailing them to friends. The other employee has started her own real estate business on the side and is using your company's computers to run her new business.

Such on-the-job behaviors are called "cyberslacking"—using company computers for personal or recreational purposes instead of work. It is a growing problem in the United States, and many companies are taking a stand against cyberslacking employees. Here's why:

- Some kinds of cyberslacking can lead to lawsuits. If a worker is using the company's computers to distribute pornography, the company can be implicated because it "supported" the person's activities. If someone sees or receives one of the images and is offended by it, a lawsuit could result.
- Careless use of the Internet can invite viruses and hacking.
- A company's reputation is put at risk by such activities. How would clients and the community react if you are sued? It could take years to recover from the embarrassment and regain trust.
- If the two employees devote just one hour a day to their "hobbies," that's 10 hours per week of lost productivity. As the employer, you are paying for those hours, but no work for your company is getting done; in fact, you may be paying the cyberslackers to harm your company.

Companies Taking Action

Companies can institute policies against all kinds of computer use. For example, an employer can forbid workers from

- Visiting Web sites not directly related to their job.
- Using the company's e-mail system to send or receive personal messages.
- Participating in chat rooms or newsgroups.
- Downloading or installing any type of software on a company computer.
- Creating or storing certain types of documents on corporate systems.

One of the main distinguishing characteristics of the peer-to-peer network is the management and control point of access to shared resources such as files and printers. With peer-to-peer networks, access is controlled on the local PC by the user setting passwords on shared folders and printers. For example, if a user wants to gain access to a shared resource such as a Word document stored on another user's PC, the requesting user must ask the user with the document to share the file. The user sharing the Word document also may require that the requesting user utilize a password to access it.

A peer-to-peer network also can include a network server. In this case, a peer-to-peer LAN is similar to a file server network. The only difference between them is that the peer-to-peer network gives users greater access to the other nodes than a file server network does.

Some high-end peer-to-peer networks allow distributed computing, which enables users to draw on the processing power of other computers in the network.

SELF-CHECK ::

Circle the word or phrases that best complete each statement.

1. _____ is one of the benefits of using a network.
   a. File security b. Peripheral sharing c. Protection from viruses
2. If a server stores data files for users to access, it is commonly called a(n) _____.
   a. file server b. application server c. folder server
3. A(n) _____ generally does not connect to the public environment using phone or data lines.
   a. WAN b. Internet c. LAN

Urheberrechtlich geschütztes Material

Policies alone, however, may not be enough to protect businesses. For this reason, managers are using sophisticated tools to combat cyberslacking, especially involving the Internet. Such tools include

- **Web Filters.** Filtering software enables companies to block employee access to certain Web sites.
- **Surveillance Software.** This type of software enables managers to review an employee's Internet activities in real time. If the user visits any Web sites, uploads or downloads files, lurks in newsgroups, or joins chat discussions, the software logs the actions.
- **Proxy Servers.** While not its primary purpose, this type of software (or hardware/software combination) can be configured to trap network traffic that is coming from or going to an unauthorized source.
- **Packet Sniffers.** Packet sniffers examine all packets being transmitted over a network. Packet sniffers are effective at detecting traffic bound for Internet services such as Usenet, IRC, and FTP, among others.

Some employers go so far as to purchase "keystroke capturing" software. When installed on a PC, the program actually captures each keystroke as the user types and directs the keystroke to a hidden file on the user's disk or network.



Be careful when using an employer's computer. Misusing it can lead to trouble.

For example, a user can transfer tasks that take a lot of CPU power—such as creating computer software or rendering a 3-D illustration—to other computers on the network. This leaves the user's machines free for other work.

Network Topologies and Protocols

An important feature of any LAN is its topology—the logical layout of the cables and devices that connect the nodes of the network. Network designers consider several factors when deciding which topology or combination of topologies to use: the type of computers and cabling (if any) in place, the distance between computers, the speed at which data must travel around the network, and the cost of setting up the network.

Data moves though the network in a structure called packets. Packets are pieces of a message broken down into small units by the sending PC and reassembled by the receiving PC. Different networks format packets in different ways, but most packets have two parts: the header and the payload. The header is the first part of the packet, which contains information needed by the network. The header identifies the node that sent the packet (the source), and provides the address of the node that will receive the packet (the destination). The network reads each packet's header to determine where to send the packet and, in some cases, to determine the best way to get it to its destination. The header also holds

Norton ONLINE

For more information on network topologies and protocols visit http://www.mhhe.com/pelernorton

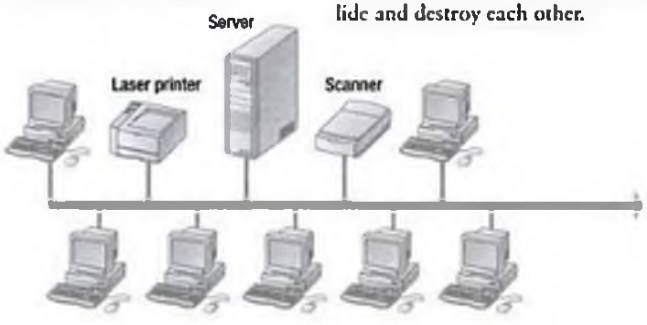
Urheberrechtlich geschütztes Material

control data that helps the receiving node reassemble a message's packets in the right order. The payload is the actual data that is being transmitted between the two nodes. (In the Internet environment, packets are called datagrams.)

A network's topology and related technologies are important for two reasons. First, a correctly designed network, using the most appropriate topology for the organization's needs, will move data packets as efficiently as possible. Second, the network's topology plays a role in preventing collisions, which is what happens when multiple nodes try to transmit data at the same time. Their packets can collide and destroy each other.

FIGURE 7A.13

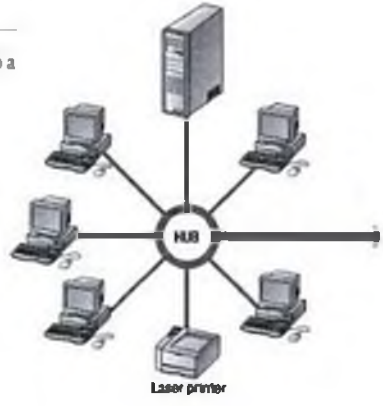
In a bus topology network, one cable connects all the devices together.



A bus topology network uses one cable (see Figure 7A.13). All the nodes and peripheral devices are connected in a series to that cable. A special device, called a terminator, is attached at the cable's start and end points, to stop network signals so they do not bounce back down the cable. This topology's main advantage is that it uses the least amount of cabling of any topology. In a bus topology network, however, extra circuitry and software are used to keep data packets from colliding with one another. A broken connection can bring down all or part of the network.

FIGURE 7A.14

The star topology connects all nodes to a hub or switch.



The star topology (see Figure 7A.14) is probably the most common topology. In a star network, all nodes are connected to a device called a hub and communicate through it. Data packets travel through the hub and are sent to the attached nodes, eventually reaching their destinations. Some hubs—known as intelligent hubs—can monitor traffic and help prevent collisions. In a star topology, a broken connection between a node and the hub does not affect the rest of the network. If the hub is lost, however, all nodes connected to that hub are unable to communicate.

FIGURE 7A.15

The ring topology is a linked circular chain.



The ring topology (see Figure 7A.15) connects the network's nodes in a circular chain, with each node connected to the next. The last node connects to the first, completing the ring. Each node examines data as it travels through the ring. If the data—known as a token—is not addressed to the node examining it, that node passes it to the next node. There is no danger of collisions because only one packet of data travels the ring at a time. If the ring is broken, however, the entire network is unable to communicate.

The mesh topology (see Figure 7A.16) is the least-used network topology and the most expensive to implement. In a mesh environment, a cable runs from every computer to every other computer. If you have

Urheberrechtlich geschütztes Material

four computers, you must have six cables—three coming from each computer to the other computers. The big advantage to this arrangement is that data can never fail to be delivered; if one connection goes down, there are other ways to route the data to its destination.



FIGURE 7A.16

In a meshed topology, all nodes are connected to each other.

Network Media

With computer networks, *media* refers to the means used to link a network's nodes together. There are many different types of transmission media, the most popular being twisted-pair wire (normal electrical wire), coaxial cable (the type of cable used for cable television), and fiber optic cable (cables made out of glass). In wireless networks, the atmosphere itself acts as the medium because it carries the wireless signals that nodes and servers use to communicate. The following sections examine wire-based and wireless media.

Norton ONLINE

For more information on network media, visit **http://www.mhhe.com/petermorton**

simnet™

Wire-Based Media

Twisted-pair cable (see Figure 7A.17) normally consists of four pairs of wires. The individual pairs have two wires that are separately insulated in plastic, then twisted around each other and bound together in a layer of plastic. (Our telephone system uses this type of wiring, usually containing only two or three pairs for the most part.) Except for the plastic coating, nothing shields this type of wire from outside interference, so it is also called unshielded twisted-pair (UTP) wire. Some twisted-pair wire is encased in a metal sheath and therefore is called shielded twisted-pair (STP) wire. Twisted-pair wire was once considered a low-bandwidth medium, but networks based on twisted-pair wires now support transmission speeds up to 1 Gbps (gigabit per second).



FIGURE 7A.17

Twisted-pair cable wires are insulated and twisted around each other. They are usually used to connect hubs/switches to PCs in a star topology.

Like the cabling used in cable television systems, coaxial cable (see Figure 7A.18) has two conductors. One is a single wire in the center of the cable, and the other is a wire mesh shield that surrounds the first wire, with an insulator between. Because it supports transmission speeds up to 10 Mbps (megabits per second), coaxial cable can carry more data than older types of twisted-pair wiring. However, it is also more expensive and became less popular when twisted-pair technology improved.



FIGURE 7A.18

One-inch coaxial cables are usually found in older networks. The large cables shown here are used for crossing greater distances such as the ocean.

A fiber-optic cable (see Figure 7A.19) is a thin strand of glass that transmits pulsating beams of light rather than electric current. Fiber-optic cable can carry data at more than a billion bits per second. Because of improvements in transmission hardware, however, fiber-optic transmission speeds now approach 100 Gbps. Fiber-optic cable is immune to the

Urheberrechtlich geschütztes Material



FIGURE 7A.19

Although very fast, fiber-optic cables are not easy to cut and cannot be bent to accommodate sharp angles.

electromagnetic interference that is a problem for copper wire. Fiber-optic cable not only is extremely fast and can carry an enormous number of messages simultaneously, but it is a very secure transmission medium.

Wireless Media

Wireless networks use radio or infrared signals that travel through the air (called *ether*) for transmitting data. Office LANs can use radio signals to transmit data between nodes in a building. Laptops equipped with cellular modems allow users to connect to the office network when they travel. Corporate WANs often use microwave transmission to connect LANs within the same metropolitan area (see Figure 7A.20). WANs that cover long distances often use satellites and microwave communication.



FIGURE 7A.20

This wireless network is using line-of-site dishes to link locations together.

Network Hardware

As data moves between PCs, it needs to be channeled properly to reach its final destination. To make this possible, the proper hardware must be attached to and between all PCs.

Network Interface Cards (NICs)

Regardless of the wiring and topology used, each computer on the network needs a hardware component to control the flow of data. The device that performs this function is the network interface card (NIC) (see Figure 7A.21), also known as a network adapter card or network card. This printed circuit board fits into one of the computer's expansion slots and provides a port where the network cable is attached.

In the case of a wireless NIC, there will not be a port, an antenna will be showing, or a light will indicate that an internal antenna is activated (see Figure 7A.22). Network software works with the operating system and tells the computer how to use the NIC. Both the network software and the NIC must adhere to the same network protocols, which are explored later in this chapter.

FIGURE 7A.21

Network interface card.



Network Linking Devices

To create a network, some type of linking mechanism is needed to interconnect at least two computers. Sometimes this device can be as simple as a special cable, called a crossover cable, that is attached to two computers (NIC to NIC). Although now you have a network, it is barely a network. If you want to add more devices, then something more than a crossover cable is required. Most servers, nodes, and printers are

Urheberrechtlich geschütztes Material

attached by a linking device or a series of linking devices. These linking devices are connected together using cables such as the Category 5 cable, which is discussed in more detail below. Linking devices have ports where cables connect them to the nodes, printers, or other devices that have ports or NICs installed. The various linking devices that are available include

- **Hubs.** A hub is an affordable connection point for different types of devices on a network. This is not a particularly fast connection because it broadcasts the packets it receives to all nodes attached to its ports. Due to the substantial reduction in the cost of switches (explained below), this technology is slowly becoming obsolete.
- **Bridges.** A bridge is a device that connects two LANs or two segments of the same LAN. A bridge looks at the information in each packet header and forwards data that is traveling from one LAN to another. Bridges are becoming a less-relied-upon technology because they use an older method for determining which nodes are sending and receiving data and their functions are now integrated into more advanced devices.
- **Switches.** A switch is a device that learns which machine is connected to its port by using the PC, printer, or other devices' IP address. This is a very popular and sought-after device used to connect a LAN. A switch substantially reduces the amount of broadcast traffic and is currently the most popular network-linking device. Modern switches can even function as routers (see below), allowing multiple LANs to be interconnected by linking each LAN's switches together. This is called an uplink.
- **Routers.** A router is a complicated device that stores the routing information for networks (see Figure 7A.23). A router looks at each packet's header to determine where the packet should go and then determines the best route for the packet to take toward its destination. A router will not allow broadcast traffic to cross the device unless modified to do so. Thus, a packet must be addressed to a specifically identified destination to pass through the router. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect. Today, routers can come with a built-in hub or switch, which also allows computers on the small company's network, or intranet, to share files without having to buy multiple pieces of equipment. Routers also provide a security element as well. They can include several forms of firewall security. One form of protection comes from the NAT (Network Address Translation) table, which hides the company's internal node IP addresses from the Internet. Usually, an ISP will provide the company or home user with an IP address for the WAN side of the router that will serve as the port connecting to the Internet.

To create a connection between different types of networks, you need a gateway, placed at a junction (gateway) between two or more networks (see Figure 7A.24). Gateways have several meanings within the networking environment. In its simplest form, a gateway is a node on a network that serves as an entrance to another network. In the small business or home network, the gateway is the device that routes data from a local PC to an outside network such as the Internet. The router intercepts then redirects and filters (if necessary) any data packets passing through. Packets from different types of networks have different kinds of information in their headers, and the information can be in various formats. The gateway can take a packet from one type of network, read its header, and then



FIGURE 7A.22

Typical wireless NIC.



FIGURE 7A.23

A router.

ONLINE

For more information on network linking devices, visit http://www.mhhe.com/peternorton

Urheberrechtlich geschütztes Material

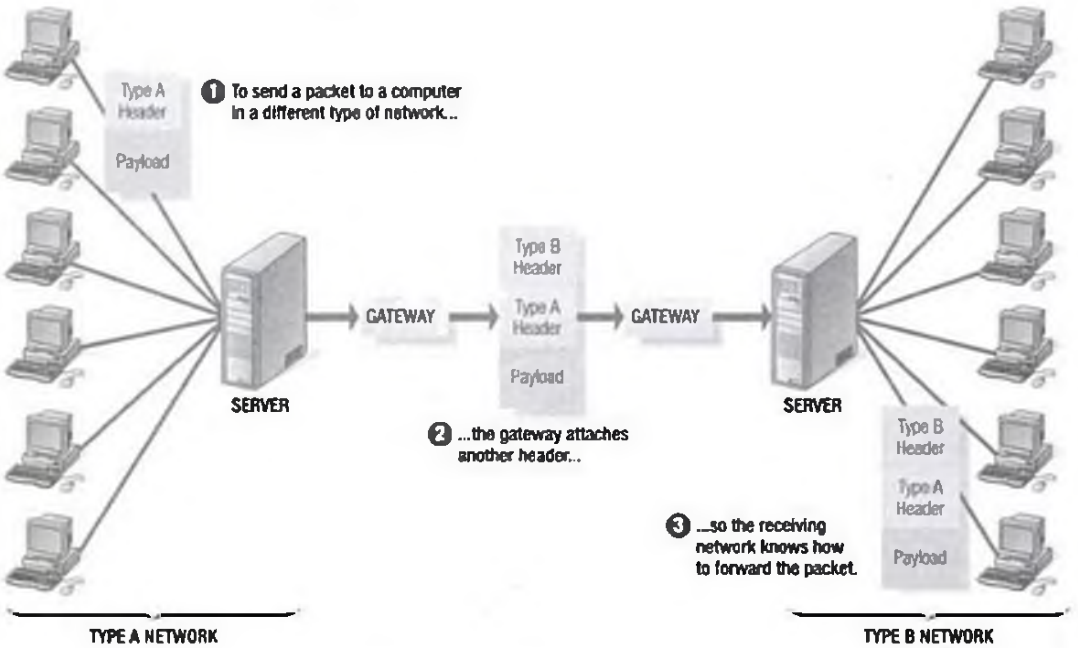


FIGURE 7A.24

This is an example of the simplest form of gateway. The gateway forwards a packet from one type of network to a different type of network.

add a second header that is understood by the second network. When configuring your internal network to allow an Internet connection, you need to point the PC to the gateway's IP address.

This gateway address does not have to be manually added to each computer thanks to advances with server and router software. Today, users can simply enable Dynamic Host Control Protocol (DHCP) on the computer and the LAN port of the router (or server acting as a router) and the device will automatically assign all necessary Internet configurations. DHCP is also referred to as dynamic addressing.

Building a typical network is possible by bringing together many of the components presented in this section. Figure 7A.25 shows an example of the connections needed to complete a network.

Cabling Equipment

Tying together the linking devices, servers, nodes, printers, and other network equipment into an actual LAN is the cabling equipment. Cabling equipment is designed to work with a certain kind of network topology, and each one has certain standard features.

In network communications, the quality of media refers to the distance and speed data can travel down wires, cables, fiber optics, or other communication media. For example, consider Category 5 (Cat5) cable, a popular type of twisted-pair wiring that contains four twisted pairs. A Cat5 cable can carry data 100 meters without attenuation; this means that for up to 100 meters, the signal will not drop off enough so that that data packet cannot be read properly. Sometimes network media are compared by the amount of data they can carry, a factor commonly referred to as bandwidth. Simply stated, the higher a medium's bandwidth, the more data it can transmit at any given time. Bandwidth is expressed in cycles per second (Hertz) or in bits per second. With Cat5 cable, data can move at a speed up to 100 Mbps. Data can only move as fast as the narrowest point will

Urheberrechtlich geschütztes Material

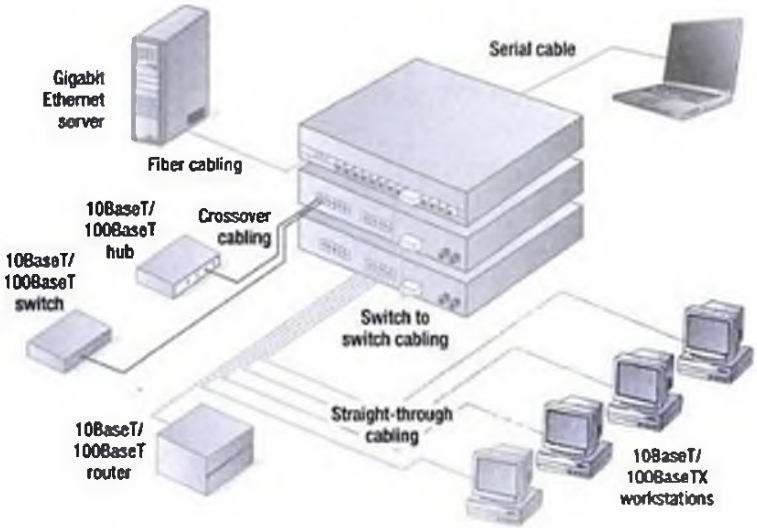


FIGURE 7A.25

Bringing all the connections together.

allow. If all nodes are using Cat5 100 Mbps cable and 100 Mbps network adapter cards but are attached to a 10 Mbps hub, then they will receive data at the rate of 10 Mbps.

The most common types of network technologies include

» **Ethernet.** The most common network technology in use. The original implementations of Ethernet used coaxial cable and were called 10Base-5 and 10Base-2. The most popular implementation of Ethernet—called 10Base-T—uses a star topology and twisted-pair wires and can achieve transmission speeds up to 10 Mbps (megabits per second). Most new network installations use an Ethernet star topology with either twisted-pair or fiber-optic cables as the medium. With Ethernet, if two nodes transmit data at the same instant, the collision is detected and the nodes retransmit one at a time.

» **Fast Ethernet.** Fast Ethernet (also called 100Base-T) is available using the same media and topology as Ethernet, but different NICs are used to achieve speeds of up to 100 Mbps. This type of network commonly uses the Category 5 network cable described previously. (Figure 7A.26 shows a typical Cat5 cable with the RJ45 connector.) A new standard is called Category 6 (Cat6). The general difference between Cat5 and Cat6 is in the transmission performance. This improvement provides a higher signal-to-noise ratio, allowing higher reliability for current applications and higher data rates for future applications.



FIGURE 7A.26

A typical Cat5 cable with the RJ45 connector.

» **Gigabit Ethernet.** Gigabit Ethernet is a version of Ethernet technology that supports data transfer rates of one gigabit per second. It evolved from the same 10 Mbps Ethernet technology that was created in the 1970s. Although capable of transferring 10 Gbps, a standard that became more affordable and popular is 1000Base-T or 1 Gbps. Another standard that is popular is the 5 Gbps fiber-optic cable that is used to connect switches together (see Figure 7A.27). The Ethernet protocol can allow

Urheberrechtlich geschütztes Material

Norton Notebook

Fighting Hackers



It may sound too alarming, but experts say there is a good chance that your home computer has already been visited by hackers via the Internet. In fact, if your home computer has broadband, always-on Internet access through a high-speed connection—such as an ISDN, DSL, or cable modem connection—it is almost certain that hackers have found your system and determined whether it can be invaded. Because these connections are always "on" (meaning your system remains connected to the Internet as long as the power is on), they give hackers plenty of time to find your system on the Internet and look for ways to get inside.

Networking experts say that home PCs have a number of vulnerabilities that can grant a hacker easy access. These include security holes in Windows itself, as well as Internet applications such as browsers. Further, most users fail to password-protect any part of their systems.

Hackers, Crackers

Malicious hackers (sometimes called "crackers") spend a great deal of time mapping the Internet; that is, trying to identify as many vulnerable computers as they can. To accomplish this, they use a variety of software tools.

At the very least, a hacker or cracker can "ping" your computer to see if it is turned on and connected to the Internet. This is like walking through a neighborhood and trying to open the front door to each house. In pinging, someone sends a message to your computer; if it responds, the sender knows your computer is active and connected to the network. Pinging is usually the first step in the invasion process, and experts say that a typical PC gets pinged several times each week.

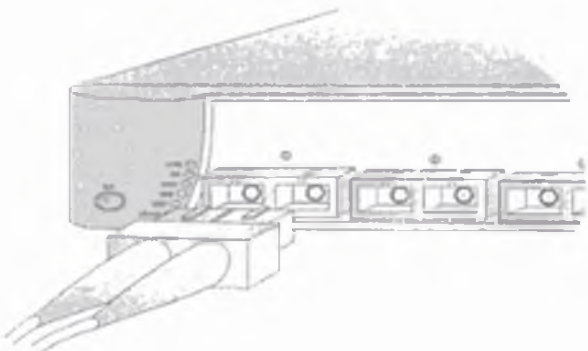
Once an invader finds a way to access your system's resources, there may be no limit to the damage that can be done. Files containing important data can be moved, renamed, deleted, or copied. Hackers may try to use your PC's resources without your knowledge.

Keeping Invaders at Bay

If you connect to the Internet through a standard modem and a dial-up connection, and if you stay connected for only short periods, then you may not need to worry about an invader getting into your system. However, if you leave your dial-up connection active for long periods, or if you have a perpetual connection through a high-speed link,

FIGURE 7A.27

A fiber optic switch connector



a network administrator to back up 2 TB (terabytes) of data in about 27 minutes. Gigabit Ethernet also can carry approximately 900 video signals at once, at about 1.5 Mbps of digital video. With advanced audio, video, and telephone applications coming into the market every day, it will not be long before the Gigabit Ethernet standard will become the norm for high-bandwidth tasks and processes.

» **Token Ring.** The controlling hardware in a Token Ring network transmits an electronic token—a small set of data—to each node on the network many

Urheberrechtlich geschütztes Material



If you connect to the Internet through a high-speed connection, a personal firewall is one of your best defenses against hackers.

then you should take a serious look at your system's security.

Here are a few basic steps you can take to keep crackers out of your system:

» **Plug Windows' Security Holes.** This means turning off file and printer sharing, at the very least, unless you need these features to be activated for a LAN or home network connection. To learn more about these features, open the Windows help system and look for information on file sharing and printer sharing.

» **Use Passwords and Manage Them Effectively.** Windows enables you to password-protect a variety of resources. If you use any network features, you should password-protect them and change your passwords frequently. Experts advise that you use long passwords (more than eight characters), and do not use passwords that could be easily guessed. Never use a "blank" password.

» **Get a Personal Firewall.** As you may recall, a firewall is a hardware and/or software tool that prohibits unauthorized access to a network, especially over the Internet. Personal firewalls are available in a wide range of prices and features, but you can get a good one for about $50. Some are even available for free.

» **Ask Your Internet Service Provider (ISP) for Help.** Check your ISP's Web site for security-related information. If you still have questions, call the ISP and talk to a technical support person. List your concerns about security and see what kind of answers you get.

NORTON NOTEBOOK

times each second if the token is not already in use by a specific node. A computer can copy data into the token and set the address where the data should be sent. The token then continues around the ring, and each computer along the way looks at the address until the token reaches the computer with the address that was recorded in the token. The receiving computer then copies the contents of the token and sends an acknowledgment to the sending computer. When the sending computer receives the acknowledgment from the receiving computer, it resets the token's status to "empty" and transmits it to the next computer in the ring. The hardware for a Token Ring network is expensive; Token Ring adapter cards can cost as much as five times more than other types of network adapters. Token Ring networks once operated at 4 or 16 Mbps, but like Ethernet, new standards for Token Ring have increased the transmission rate, which is now up to 100 Mbps.

Protocols

Each LAN is governed by a protocol, which is an agreed-upon format for transmitting data between two devices. There are many standard protocols. Each has particular advantages and disadvantages. Some protocols are simpler than others, some are more reliable, and some are faster. To effectively communicate, a user must have the same protocol installed on the local PC and the remote PC to make a connection.

Protocols take the form of software or hardware that must be installed on every computer on the network. For an Ethernet network, usually the operating

Urheberrechtlich geschütztes Material

system software tells the computer exactly how to break up, format, send, receive, and reassemble data using the TCP/IP, NetBIOS/NetBEUI, or IPX/SPX protocols. Without such software installed, a computer cannot participate in the network.

Protocols, using their own methods, break data down into small packets in preparation for transportation. Linking devices pass these packets to the various pieces of equipment, including other computers and printers that are attached to the network. As discussed earlier in this chapter, a packet is a data segment that includes a header, payload, and control elements that are transmitted together (see Figure 7A.28). The receiving computer reconstructs the packets into their original structure. A typical Ethernet packet is structured as in Figure 7A.29.

A single LAN may utilize more than one protocol. Some of the most common protocols in use today include

» **TCP/IP.** Originally associated with UNIX hosts, TCP/IP is the protocol of the Internet and is required on any computer that must communicate across the Internet. TCP/IP is now the default networking protocol of Windows 2000 Professional (client) and Server editions, Windows XP, Windows Server 2003, and many other operating systems.

» **IPX/SPX.** A proprietary protocol of Novell, IPX/SPX has been used in most versions of the NetWare network operating system for networking offices throughout the world. Newer versions of NetWare also support TCP/IP.

» **NetBIOS/NetBEUI.** A relatively simple protocol that has no real configurable parameters, NetBIOS/NetBEUI sends messages to every computer that can receive them. It is an excellent protocol for networking small offices or homes, but it does not expand well into larger environments.

FIGURE 7A.28

An e-mail message is divided up into packets.

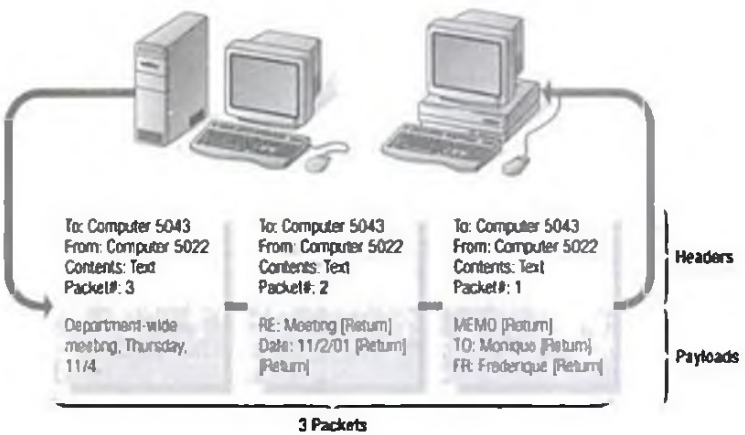
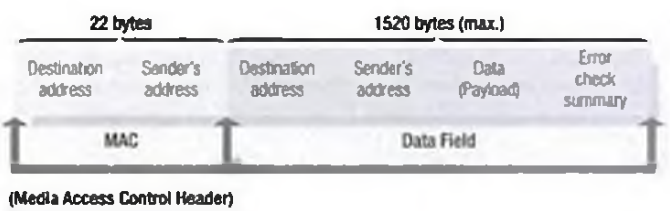


FIGURE 7A.29

Standard Ethernet packets are made up of 0s and 1s—called bits—that are combined in groups of eight bits to form a byte.



Urheberrechtlich geschütztes Material

Summary ::

- A network is a way to connect computers for communication, data exchange, and resource sharing.
- Many networks are built around a central computer called a server, which provides storage and other resources that users can share.
- A local area network (LAN) consists of computers that are relatively close to one another. A LAN can have a few PCs or hundreds of them in a single building or several buildings.
- A wide area network (WAN) results when multiple LANs are connected through public utilities such as phone lines or microwave systems.
- Many networks are built around a central server. The PCs and other devices that connect to the server are called nodes.
- In a file server network, the server provides storage and file-sharing services for the nodes.
- An application server is a server that is used to run applications from a centralized location on the network to free up resources on the nodes.
- In a client/server network, nodes and the server share the storage and processing tasks.
- A peer-to-peer network is a small network that usually does not include a central server. In a peer-to-peer network, users can share files and resources on all the network's nodes.
- A topology is the physical layout of the cables and devices that connect the nodes of a network. Topologies get their names—such as bus, star, or ring—from the shape of the network they create.
- When used in the context of networks, the term *media* refers to the wires, cables, and other means by which data travels from its source to its destination.
- The most common media for data communications are twisted-pair wire, coaxial cable, fiber-optic cable, and wireless links.
- The performance of network media is measured by the amount of data they can transmit each second. This value is called bandwidth. The higher a network's bandwidth, the more data it can carry.
- A protocol is an agreed-upon format for transmitting data between two devices. Some popular protocols include TCP/IP (the Internet protocol), IPX/SPX, and NetBIOS/NetBEUI.

Urheberrechtlich geschütztes Material

Key Terms ::

10Base-T Ethernet, 259
application server, 245
attenuation, 258
bandwidth, 258
bridge, 257
bus topology, 254
campus area network (CAN), 249
client/server network, 250
coaxial cable, 255
datagrams, 254
distributed computing, 252
dynamic addressing, 258
Dynamic Host Control Protocol (DHCP), 258
Ethernet, 259
Fast Ethernet (100Base-T), 259
fiber-optic cable, 255
file server, 244
file server network, 250
gateway, 257
Gigabit Ethernet, 259
home area network (HAN), 249
header, 253
hub, 257
local area network (LAN), 248
mesh topology, 254
metropolitan area network (MAN), 249
network, 244
network interface card (NIC), 256
network server, 244
network version, 245
node, 250
packet, 253
payload, 254
peer-to-peer network, 251
print server, 246
protocol, 261
ring topology, 254
router, 257
server, 244
site license, 245
star topology, 254
switch, 257
teleconference, 246
terminator, 254
token, 254
Token Ring, 260
topology, 253
twisted-pair cable, 255
videoconference, 246
Voice over Internet Protocol (VoIP), 247
wide area network (WAN), 248
wireless networks, 256
wireless NIC, 256

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. A(n) _____ is a network of computers that serves users located relatively near each other.
2. If you connect computers together to communicate and exchange information, the result is called a(n) _____ .
3. The physical layout of wires and devices that connect the network's nodes is called the network's _____ .
4. In a bus topology network, a special deviced called a(n) _____ is placed on each end of the cable.
5. A(n) _____ is a thin strand of glass that transmits pulsating beams of light at speeds that approach 100 Gbps.
6. A(n) _____ is the device that is added to a PC that allows it to connect to a LAN.
7. A centralized computer that allows multiple remote users to share the same printing device is referred to as a _____ .
8. _____ cables have two conductors: one is a single wire in the center and the other is a wire mesh shield that surrounds the first wire.
9. A(n) _____ is a popular device used to connect a LAN. It substantially reduces broadcast traffic.
10. High-end peer-to-peer networks allow for _____ . This lets users access the power of multiple computers to process programs such as 3-D illustration software.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each sentence.

1. Companies store data on a network server because it is _____ .
   a. easier to track changes made to important data
   b. less convenient for the user to access the data from home
   c. easier to download or retrieve large video files
   d. more difficult for users to access programs

2. In a _____ network, all devices are connected to a device called a hub and communicate through it.
   a. bus
   b. star
   c. ring
   d. mesh

3. A solution that connects users' computers to a central network server that enables them to share programs is called _____ .
   a. single-user version programs
   b. PC license programs
   c. site license programs
   d. network version programs

4. When software is stored and run from a centralized location, the computer containing such software is called a(n) _____ .
   a. file server
   b. print server
   c. application server
   d. CD server

5. A _____ is an agreed-upon format for transmitting data between two devices.
   a. protopology
   b. protoplasm
   c. prototype
   d. protocol

6. _____ means any kind of multiway communication carried out in real time using telecommunications or computer network equipment.
   a. Videoconferencing
   b. Data-conferencing
   c. Teleconferencing
   d. Serial-conferencing

7. A _____ is two or more LANs connected together, generally across a large geographical area.
   a. WAN
   b. SAN
   c. CAN
   d. HAN

8. An extranet is like an intranet except that it allows company employees access to corporate Web sites from the _____ .
   a. employee's desktop PC
   b. supervisor's PC
   c. employee's fax/printer device
   d. Internet

9. A _____ is a type of network usually found where students and school administrators have a need to share files across several buildings.
   a. wide area network (WAN)
   b. metropolitan area network (MAN)
   c. campus area network (CAN)
   d. local area network (LAN)

10. An arrangement where user accounts are centralized on a server and PCs gain access to network resources by accessing this server is called a _____ .
    a. client/server network
    b. peer-to-peer network
    c. server-to-server network
    d. client/client network

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

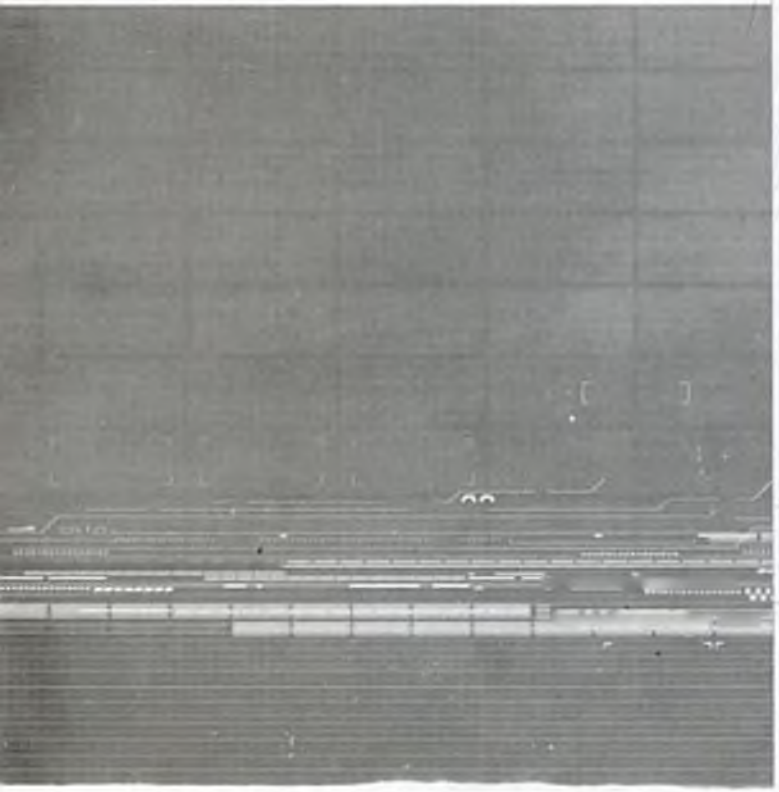
1. List four benefits that networks provide to their users.
2. How can a network help a small business save money on printing?
3. Name four types of media used to link networks.
4. List four types of network topologies used in wire-based networks.
5. Name three common LAN protocols.
6. A network is a set of technologies that can be used to connect computers together. What three general components are needed to set up a network?
7. What are packets and how do they work?
8. What distinguishes a peer-to-peer network?
9. Companies use their own Web sites to support operations. What is the distinction between an intranet and an extranet?
10. Companies are attempting to save telephone communication costs by implementing this technology. What is the technology called?

Lesson Labs ::

Complete the following exercise as directed by your instructor. (Note: This exercise assumes you are using Windows XP or Windows 2000. If you have a different version of Windows, ask your instructor for specific directions.)

1. Explore your network.
   a. On your Windows desktop, double-click the My Network Places icon. The My Network Places window opens. This window lets you access all the computers, folders, files, and devices on the network.
   b. Find the icon named Entire Network and double-click it. What do you see? Because every network is unique, the contents of this window will vary from network to network.
   c. Following your instructor's directions, click icons and open new windows to explore your network. How many network resources can you access?
   d. When you finish exploring, close all open windows.

Urheberrechtlich geschütztes Material



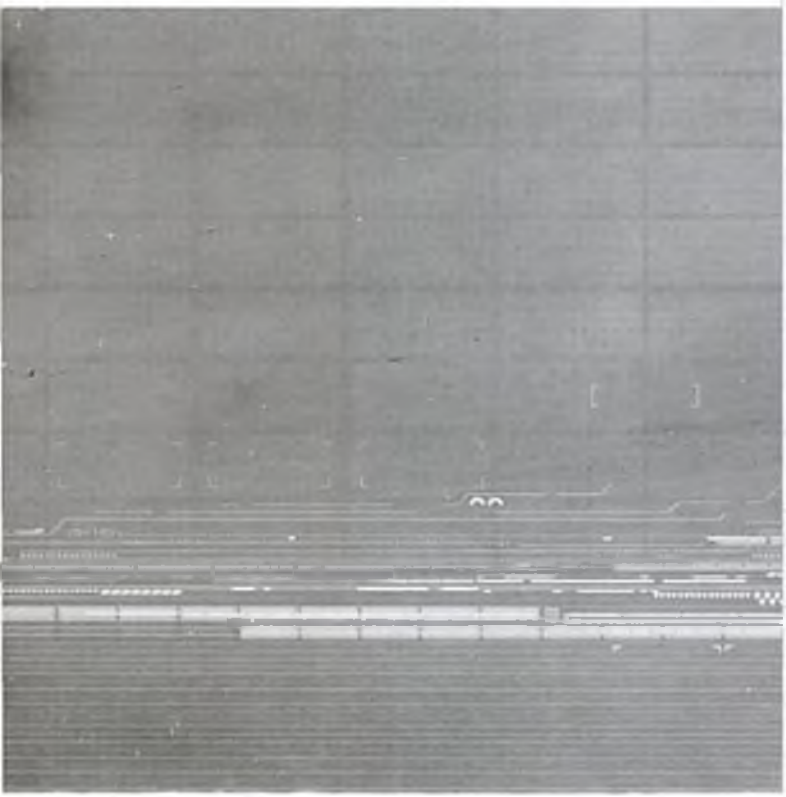
Graphics and Multimedia

Overview: Graphics, Graphics Everywhere

You may not realize that many of the images you see are created on a computer. From postage stamps to magazine illustrations, from billboards to television programs, all kinds of graphics are created and edited using computers and graphics software. Graphics programs—and the designers who use them—have become so polished that it is often impossible to tell a photograph or hand-drawn illustration from a computer-generated graphic.

With the computer's capability to mimic traditional artists' media, graphics software allows artists to do with a computer what they once did with brushes, pencils, and darkroom equipment. Similarly, architects and engineers now do most of their design and rendering work on computers—although many were trained in traditional paper-based drafting methods. By using the computer, they produce designs and renderings that are highly accurate and visually pleasing.

Graphics software has advanced a great deal in a short time. In the early 1980s, most graphics programs were limited to drawing simple geometric outlines, usually in one color. Today, graphics software offers advanced drawing and painting tools and almost unlimited color control. You can see the products of these powerful tools everywhere you look. Their results can be subtle or stunning, obviously artificial, or amazingly lifelike.



OBJECTIVES ::

- Define the terms *bitmap* and *vector* and differentiate these file types.
- List some of the most commonly used file formats for bitmap and vector images.
- Identify four ways to load graphic files into a computer.
- List five types of graphics software and their uses.
- Define the terms *multimedia* and *interactivity*.

Urheberrechtlich geschütztes Material

Understanding Graphics File Formats

Computers can create many, many kinds of graphics—from simple line drawings to three-dimensional animations. But all graphics files fall into one of two basic categories, known as bitmapped and vector files.

Bitmap and Vector Graphics

Graphics files are made up of either

- A grid, called a bitmap, whose cells are filled with one or more colors, as shown in Figure 10B.1. The individual cells in the grid can all be filled with the same color or each cell can contain a different color. The term raster is sometimes used to describe bitmap images. Bitmap images also may be referred to as *bitmapped images*. The easiest way to imagine how bitmaps work is to think of your computer's monitor. It displays images as collections of individual colored pixels. Each pixel is a cell in the grid of a bitmapped image. In fact, the individual pieces that make up a bitmapped image are often called *pixels*.
- A set of vectors, which are mathematical equations describing the size, shape, thickness, position, color, and fill of lines or closed graphical shapes (see Figure 10B.2).

Some types of graphics programs work with bitmaps; some work with vectors; and some can work with both. Each type of graphics file has its own advantages and disadvantages. Whether you use a bitmap- or vector-based program depends on what you are trying to do. For example, if you want to be able to retouch a photo, create seamless tiling textures for the Web or for 3-D surfaces, or create an image that looks like a painting, you will choose bitmap-based software (see Figure 10B.3).

Vector-based software is your best choice if you want the flexibility of resizing an image without degrading its sharpness, the ability to reposition elements easily in an image, or the ability to achieve an illustrative look as when drawing with a pen or pencil.

Strictly speaking, vectors are lines drawn from one point to another, as shown in Figure 10B.4. Vector-based software can use mathematical equations to define the thickness and color of a line, its pattern or fill, and other attributes. Although a line on the screen is still displayed as a series of blocks (because that is how all monitors work), it is an equation to the computer. Thus, to move the line from location A to location B, the computer substitutes the coordinates for location A with those for location B. This substitution saves the effort of calculating how to change the characteristics of thousands of individual pixels.

File Formats and Compatibility Issues

Perhaps more than other types of computer-generated documents, graphics files require users to understand and work with different types of file formats. A file format is a standardized method of encoding data for storage. File formats are important because they tell the program what kind of data is contained in the file and how the data is organized.

File formats may be proprietary or universal. The structure of a proprietary file format is under the sole control of the software developer who invented the for-

ONLINE

For more information on graphic files and formats, visit **http://www.mhhe.com/petemorton**



FIGURE 10B.1

If you magnify a bitmap, you can see its individual pixels.



FIGURE 10B.2

This vector is defined as a line stretching between two endpoints, rather than as a set of pixels.



FIGURE 10B.3

Working with a digitized photograph in Paint Shop Pro, a popular bitmap-based graphics program.

Urheberrechtlich geschütztes Material

mat. Universal file formats are based on openly published specifications and are commonly used by many different programs and operating systems. For example, Adobe Photoshop, by default, saves images in its proprietary PSD format, but it also can save files in several universal formats, such as TIF, GIF, JPEG, PICT, and TGA. Word processing programs can read and save files in specific formats such as DOC or RTF, or TXT.

Nearly all bitmap-based graphics programs can use any of the file formats listed in Table 10B.1. For this reason, these formats are said to be compatible with such programs. For example, most bitmap-based programs can open, read, and save a file in GIF format and convert it to a different bitmap format, such as TIF.

Most vector-based programs create and save files in a proprietary file format. These formats are either incompatible with (cannot be used by) other programs, or they are not totally supported by other programs. The problem with incompatibility led developers to create universal file formats for vector-based programs. Only a handful of common file formats, such as DXF (Data Exchange Format) and IGES (Initial Graphics Exchange Specification) exist for vector graphics.

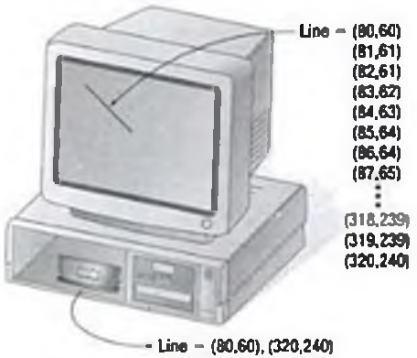


FIGURE 10B.4

To the monitor, a line is just a long list of individual pixels. With vector-based software, the CPU can represent the same line using just the endpoints.

TABLE 10B.1

Standard Formats for Bitmap Graphics

Format	Description
BMP	(BitMaP) A graphics format native to Microsoft Windows, BMP is widely used on PCs for icons and wallpaper. Some Macintosh programs also can read BMP files. The BMP file format supports up to 24-bit depth color, or over 16 million different colors.
PICT	(PICTure) This is the native format defined by Apple for use on Macintosh computers. It is widely used on Macs but is not usually used on PCs.
TIFF	(Tagged Image File Format) TIFF is a bitmap format defined in 1986 by Microsoft and Aldus (now part of Adobe) and widely used on both Macs and PCs. This format is usually the best to use when exchanging bitmap files that will be printed or edited further.
JPEG	(Joint Photographic Experts Group) JPEG is often abbreviated as JPG (pronounced JAY-peg). This bitmap format is common on the World Wide Web and is often used for photos and other high-resolution (24-bit or millions of colors) images that will be viewed on screen.
GIF	(Graphic Interchange Format) Like JPEG images, GIF images are often found on World Wide Web pages. Unlike JPEG images, GIF images can contain only 256 or fewer unique colors.
EMF	(Windows Enhanced Metafile) This format was originally developed for the Microsoft Office suite of applications. It uses the Windows built-in graphics device interface, or GDI, to create images that can be scaled to display at the highest-possible resolution on any device selected—screen or printer. This technology creates something of a hybrid between the vector graphics and bitmap types, since EMF bitmaps can be resized without any loss of quality.

Urheberrechtlich geschütztes Material

Getting Images into Your Computer

simnet™

Nearly all graphics programs let you create images from scratch by building lines and shapes into complex graphics. But artists and designers do not always start from scratch; they often begin with an existing image and then edit or enhance it by using graphics software. There are several ways to load images into a computer for editing, but the most common methods are

» **Scanners.** An image scanner is like a photocopy machine, but instead of copying an image onto paper, it transfers the image directly into the computer (see Figure 10B.5). A scanned image is usually a bitmap file, but software tools are available for translating images into vector format.



FIGURE 10B.5

Scanning an image into a computer for editing.

» **Digital Cameras.** A digital camera stores digitized images for transfer into a computer. The resulting file is generally a bitmap.

» **Digital Video Cameras.** A digital video camera captures and stores full-motion video on small tapes or optical discs. You can copy the content onto a computer for editing or transfer to another storage medium, such as DVD.

» **Clip Art.** The term clip art originated with large books filled with professionally created drawings and graphics that could be clipped from the pages and glued to a paper layout. Today, clip art provides an easy way to enhance digital documents. Many software programs (especially word processors) feature built-in collections of clip art, and collections are also available on CD-ROM and the Internet (see Figure 10B.6). Clip art can be in either bitmap or vector format.



FIGURE 10B.6

The clip art collection from Microsoft Word 2003.

Graphics Software

simnet™

Creating a digital image or manipulating an existing image can involve a complex array of processes. Since even the most sophisticated graphics program cannot perform all the operations that may be required for some types of graphics, designers frequently use more than one of the five major categories of graphics software to achieve their goals, including

» Paint programs.

» Photo-editing programs.

» Draw programs.

» Computer-aided design (CAD) programs.

» 3-D modeling and animation programs.

Urheberrechtlich geschütztes Material

Of the five, the first two are bitmap-based paint programs; the rest are vector-based draw programs (although 3-D programs commonly work with vectors or bitmaps).

Paint Programs

Paint programs are bitmap-based graphics programs. You already may be familiar with a paint program, like Windows Paint. Paint programs range from the very simple (with only a handful of tools) to the very complex, with tools that have names such as paintbrush, pen, chalk, watercolors, airbrush, crayon, and eraser. Because paint programs keep track of each and every pixel placed on a screen, they also can perform tasks that are impossible with traditional artists' tools—for example, erasing a single pixel or changing every pixel in an image from one color to another color.

Paint programs provide the tools for creating some spectacular effects. More sophisticated paint programs can make brush strokes that appear thick or thin, soft or hard, drippy or neat, opaque or transparent. Some programs allow you to change media with a mouse click, turning your paintbrush into chalk or a crayon or giving your smooth "canvas" a texture such as rice paper or an eggshell (see Figure 10B.7).





FIGURE 10B.7

Watercolors and textures are a few of the effects available in sophisticated paint programs.

Draw Programs

Draw programs are vector-based graphics programs that are well suited for work when accuracy and flexibility are as important as coloring and special effects. You see the output of draw programs in everything from cereal box designs to television show credits.

Simply by clicking and dragging in a draw program, you can change a shape into a different shape, move it, or copy it (see Figure 10B.8). Paint programs don't provide this flexibility because they do not recognize lines, shapes, and fills as unique objects.

Draw programs are sometimes referred to as object-oriented programs because each item drawn—whether it is a line, square, rectangle, or circle—is treated as a separate and distinct object from all the others. (Some designers and draw programs use the term *entity* rather than *object*, but the concept is the same.) All objects created in draw programs consist of an outline and a fill. The fill can be nothing at all, a solid color, a vector pattern, a photo, or something else. For example, when you draw a square with a draw program, the computer remembers your drawing as a square of a fixed size at a specific location, which may or may not be filled—not as a bunch of pixels in the shape of a square.

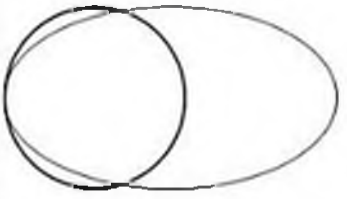


FIGURE 10B.8

Changing a circle into an oval by dragging, in a draw program.

Photo-Editing Programs

When scanners made it easy to transfer photographs to the computer at high resolution, a new class of software was needed to manipulate these images on the screen. Cousins to paint programs, photo-editing programs now take the place of a photographer's darkroom for many tasks. Because photo-editing programs (like paint programs) edit images at the pixel level, they can control precisely how a

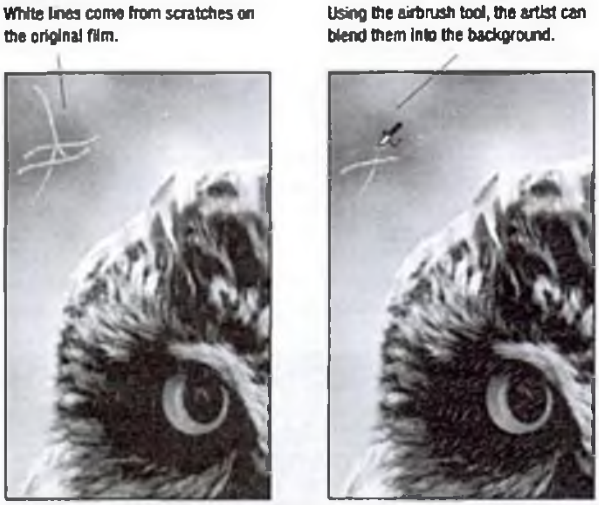
Norton ONLINE

For more information on all types of graphics software, visit **http://www.mhhe.com/peternorton**.

Urheberrechtlich geschütztes Material

FIGURE 10B.9

Repairing a scratched image with an airbrush tool.



picture will look. They also are used to edit nonphotographic images and to create images from scratch.

FIGURE 10B.10

This image demonstrates how a photo-manipulation program can be used to combine two photos together to create a striking effect.



Photo-editing programs are used most often for simple jobs such as sharpening focus, adjusting contrast, or removing flaws from digitized images. In Figure 10B.9, for example, software is being used to hide a scratch in a scanned photo. But photo-editing programs are also used to modify photographs in ways far beyond the scope of a traditional darkroom, as shown in Figure 10B.10.

Computer-Aided Design Programs

Computer-aided design (CAD), also called *computer-aided drafting* or *computer-aided drawing*, is the computerized version of the hand-drafting process that used to be done with a pencil and ruler on a drafting table (see Figure 10A.11). CAD is used extensively in technical fields such as architecture and in mechanical, electrical, and industrial engineering. CAD software also is used in other design disciplines, such as textile and clothing design and product and package design.

FIGURE 10B.11

Construction documents—commonly known as blueprints—are commonly created in CAD programs and used as the basis for buildings, engineering projects, and countless manufactured products.



Vector-based CAD drawings are usually the basis for the actual building or manufacturing process of houses, engine gears, or electrical systems, for example.

Urheberrechtlich geschütztes Material

To satisfy the rigorous requirements of manufacturing, CAD programs provide a high degree of precision. If you want to draw a line that is 12.396754 inches long or a circle with a radius of 0.90746 centimeter, a CAD program can fulfill your needs. In fact, CAD programs are so precise, they can produce designs accurate to the micrometer—or one-millionth of a meter.

3-D and Animation Software

You are constantly exposed to elaborate 3-D imaging in movies, television, and print. Many of these images are now created with a special type of graphics software, called 3-D modeling software. Fast workstations or PCs coupled with 3-D modeling programs can lend realism to even the most fantastic subjects.

Digital 3-D objects can be modified to any shape using electronic tools much like those used in woodworking. For example, holes can be drilled into computer-based 3-D objects, and corners can be made round or square by selecting the appropriate menu item. Three-dimensional objects also can be given realistic textures and patterns (see Figure 10B.12), or they can be animated or made to fly through space.



FIGURE 10B.12

A three-dimensional gear, created in a 3-D modeling program.

An outgrowth of the 3-D explosion is computer-based animation. Since the creation of filmmaking, animation was possible only through a painstaking process of hand-drawing a series of images (called cells), as shown in Figure 10B.13, and then filming them one by one. Each filmed image is called a frame. When the film is played back at high speed (usually around 30 frames per second for high-quality animation), the images blur together to create the illusion of motion on the screen. The process of manually creating a short animation—even just a few seconds' worth—can take weeks of labor.

Computer-generated imaging (CGI) has changed the world of animation in many ways. Although computer animation works on the same principles as traditional animation (a sequence of still images displayed in rapid succession), computer animators now have highly sophisticated tools that take the drudgery out of the animation process and allow them to create animation more quickly than ever. Computer animators also have the advantage of being able to display their animation on the computer screen or output them to CD-ROM, videotape, or film.

An added bonus of computer animation is the ability to animate three-dimensional characters and create photorealistic scenes. (The computer-generated image looks so realistic that it could be mistaken for a photograph of a real-life object.) These capabilities make computer-generated characters difficult to distinguish from real ones. Some examples are the character Gollum in *The Lord of the*

FIGURE 10B.13

Images from a traditional, manually drawn animation. Although computers speed up the animation process tremendously, they still work on the same idea: generate hundreds or thousands of individual frames and then display them in rapid succession to create the illusion of motion.



Urheberrechtlich geschütztes Material

Computers In Your Career

Careers in Multimedia

No two workdays are alike for Corby Simpson, senior programmer at Toronto-based creativePOST Inc., a post-production facility offering creative solutions for broadcast television and interactive media that has worked with clients such as The Discovery Channel and General Motors.

Simpson may start the day programming a CD-ROM filled with video content and then switch to designing a CD-ROM label for distribution, authoring a DVD, or developing content for use on a personal digital assistant (PDA) later in the day.

When he's not handling one of those projects, he's updating his skills and learning about new technologies.

"Keeping up with the new trends can be a full-time job in itself," says Simpson, who completed a three-year media arts program and a one-year interactive multimedia postgraduate program at Sheridan College.

For Simpson, the multimedia field is most enjoyable for the creative outlet it provides. "It's one of the only industries where you can invent things with no cost attached to them, just time," says Simpson. "You can also invent other people's ideas, and if they're successful, you get a piece of that pie too."

Sometimes, the creative aspect also can pose challenges for Simpson, who recently was under pressure to learn how to change the way 50,000 lines of computer code worked. "The application was our own invention, so we couldn't outsource it," says Simpson. "Under normal conditions somebody would go to school for three years to learn what we did in less than a month." Simpson sees opportunities in the multimedia field as growing, thanks to an increase in Web-based applications and wireless development.

Careers in multimedia are as varied and as numerous as multimedia products, with the workload typically shared by a team, helmed by a creative director who is responsible for developing and refining the overall design process from start to finish. The creative director is also responsible for integrating that design process into the developmental process of the company. The team members of a multimedia project usually include some or all of the following:

- **Art Director** Directs the creation of all art for the project.
- **Technical Lead** Ensures that the technological process of a project works and that it accommodates all project components and media.

pages of text and pictures. In a multimedia version, however, the encyclopedia's pictures can move, a narrator's recorded voice can provide the text, and the user can move around at will by clicking hypertext links and using navigational tools. By combining different types of media to present the message, the encyclopedia's developer improves the chances that users will understand and remember the information.



FIGURE 10B.15

Speech is the most basic and universal medium for communicating thoughts and ideas. After centuries of practice, people find speech a natural and effective way to communicate.

Of course, the same point can be made about television programming because it uses various media at the same time. Computer technologies, however, enable PC-based multimedia products to go one step further. Because the computer can accept and respond to input from the user, it can host interactive multimedia events, involving the user unlike any book, movie, or television program.

Interactivity has been defined in many ways, but in the realm of multimedia, the term means that the user and program respond to one another: the program contin-

Urheberrechtlich geschütztes Material



- Interface **Designer** Directs the development of the user interface for a product, which includes not only what users see but also what they hear and touch.
- **Instructional Designer** Designs the instructional system for the product, which determines how material is taught, if the product is educational.
- **Visual Designer** Creates the various art forms, usually within a specialized area.
- Interactive **Scriptwriter** Weaves the project's content among various media and forms of interactivity.
- Animator Uses 2-D and 3-D software to create animation and effects.
- **Sound Producer** As a manager, creative artist, and programmer, a sound producer designs and produces all the audio in a product.
- **Videographer** Creates the video footage that interfaces with the interactive technology of the product.
- **Programmer/Software Designer** Designs and creates the underlying software that runs a multimedia program and carries out the user's commands.

The Bureau of Labor Statistics reports that job opportunities for multimedia professionals are expected to grow as fast as average for all occupations through the year 2010. Median annual earnings of salaried multimedia artists and animators were $41,130 in 2000, with the middle 50 percent earning between $30,700 and $54,040.

ually provides the user with a range of choices that the user selects to direct the flow of the program. This level of interactivity is the primary difference between computer-based multimedia programs and other kinds of multimedia events. Most television programs, for example, require the viewer only to sit and observe. Computers, however, make it possible to create interactive media, which enable people to respond to—and even control—what they see and hear. By using the PC to control the program, the user can make choices, move freely from one part of the content to another, and in some cases customize the content to suit a specific purpose.

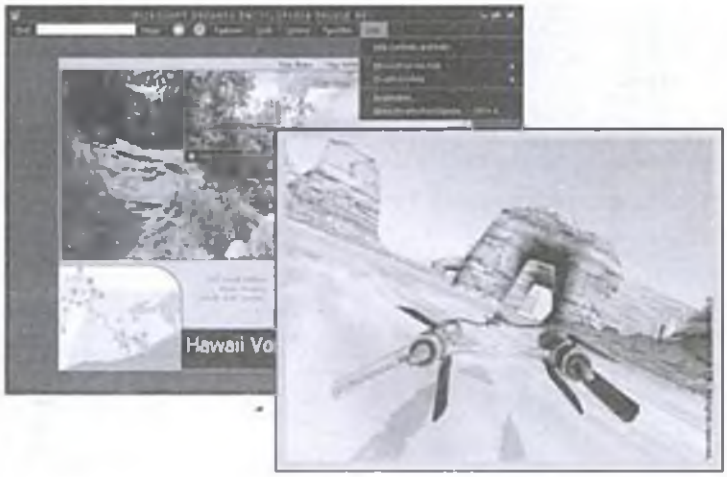


FIGURE 10B.16

Because they provide the user with different types of content and options for navigating and displaying that content, computer-based games and references are highly interactive.

Interactive media are effective (and successful) because they provide this give-and-take with the user. You will find this level of interactivity in practically any popular multimedia product, whether the program is a video game, a digital reference tool, an electronic test bank, or a shopping site on the Web (see Figure 10B.16).

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A(n) _____ image is defined as a grid whose cells are filled with color.
   a. bitmap b. vector c. printed d. interactive
2. A _____ image consists of mathematical equations describing the size, shape, thickness, position, color, and fill of lines or closed graphical shapes.
   a. raster b. large c. vector d. complex
3. Graphics _____ can be proprietary or universal.
   a. images b. file formats c. bitmaps d. programs
4. A _____ can convert a printed image into digital format.
   a. photocopier b. digital camera c. scanner d. computer
5. The _____ graphics file format was defined for use on Macintosh computers.
   a. JPEG b. TIFF c. IGES d. PICT
6. If a program and a file format cannot work together, they are said to be _____ .
   a. incompatible b. compatible c. universal d. proprietary
7. You can use a paint program to change every _____ in an image from one color to another color.
   a. frame b. pixel c. CAD d. format
8. _____ is the computerized version of the hand-drafting process.
   a. Multimedia b. Interactivity c. CAD d. Painting
9. The term *media* is the plural form of _____ .
   a. medium b. multimedia c. multimedium d. multimediocre
10. Although television is an example of multimedia, it is not _____ .
    a. plural b. interactive c. active d. passive

Urheberrechtlich geschütztes Material



CHAPTER 11

Database Management

CHAPTER CONTENTS

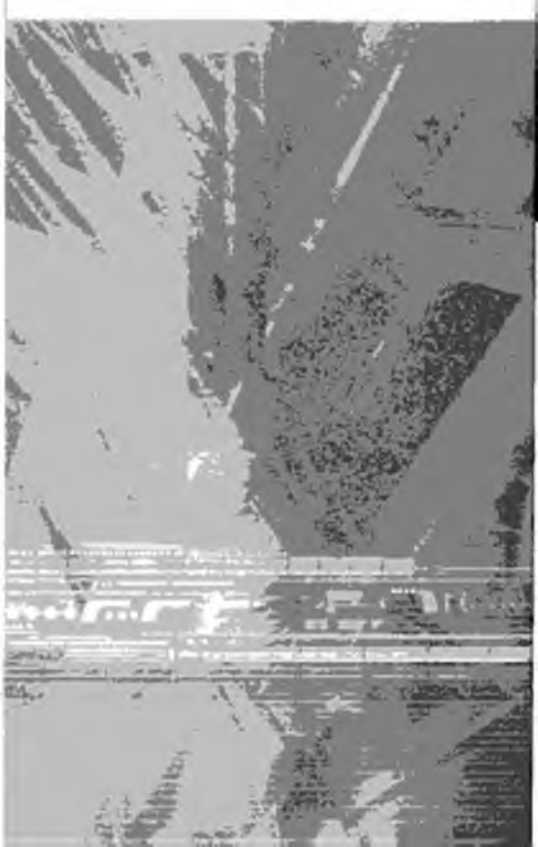
This chapter contains the following lessons:

Lesson **11A:**
Database Management Systems

- Databases and Database Management Systems
- Working with a Database

Lesson **11B:**
Survey of Database Systems

- Enterprise Software
- Databases at Work
- Common Corporate Database Management Systems



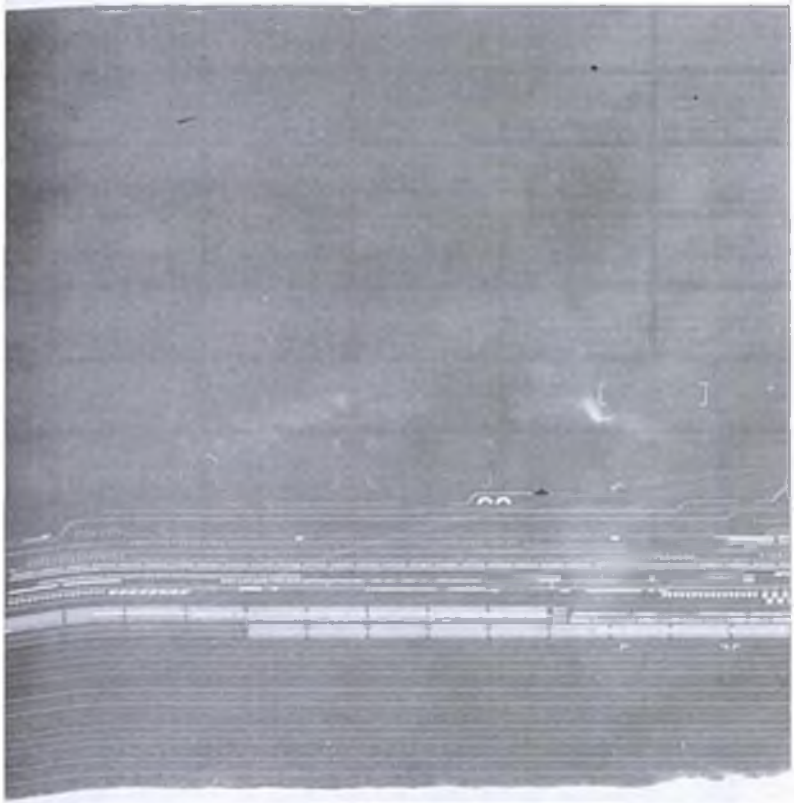
Database Management Systems

Overview: The Mother of All Computer Applications

People need data, so we create all kinds of lists to store and organize it. A grocery list, a phone book, a library's card catalog, and an instructor's list of students are all organized lists of data. Likewise, computers can be used to store and manage lists of data, and this is the reason for the computerized database. In fact, many early attempts to build and program computers grew out of a need to manage large lists of data. That's why you probably have heard the phrase *data processing*—computers manipulate (or *process*) data. And that data is usually stored in databases.

Today's computers are much more sophisticated than early computers, but they still need an organized data source. This need applies to just about every type of computer program. For example, a word processor maintains several databases—such as a dictionary of words for the spell checker and thesaurus, a list of available fonts, and other types of data.

Practically every application—even if it has nothing to do with words or organized lists—has grown from earlier programs that stored and processed data. Large commercial applications (such as facilities management or sales support software) may look very different from a common word processor, but there is still a database at the heart of each operation. In short, you can think of the database as the mother of all computer applications. This lesson introduces you to the basics of computerized databases and database management systems.



OBJECTIVES ::

- Define the terms *database* and *database management system* (DBMS).
- List at least three tasks that a DBMS enables users to do.
- Differentiate between flat-file databases and relational databases.
- List three steps needed to create a database.
- Explain the purpose of filters and forms.
- List three examples of query languages.

Urheberrechtlich geschütztes Material

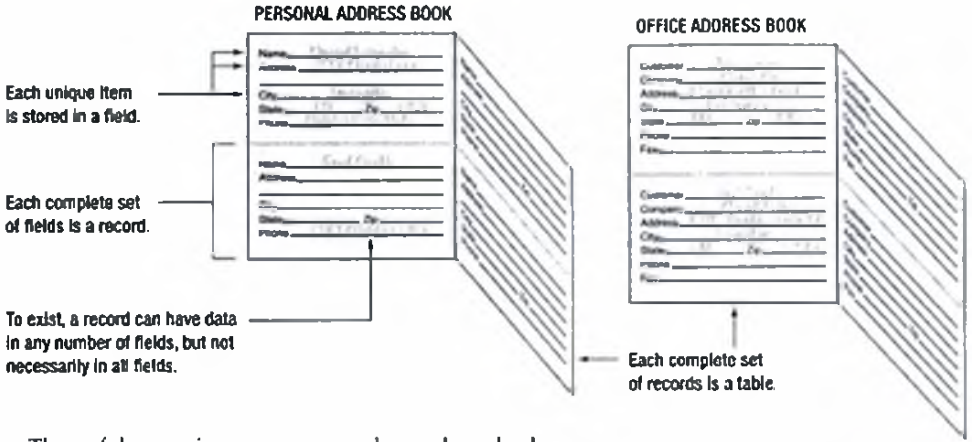


FIGURE 11A.2

Data is stored in tables. A table is divided into records, and each record is divided into fields.

Three of the most important terms to know about databases are

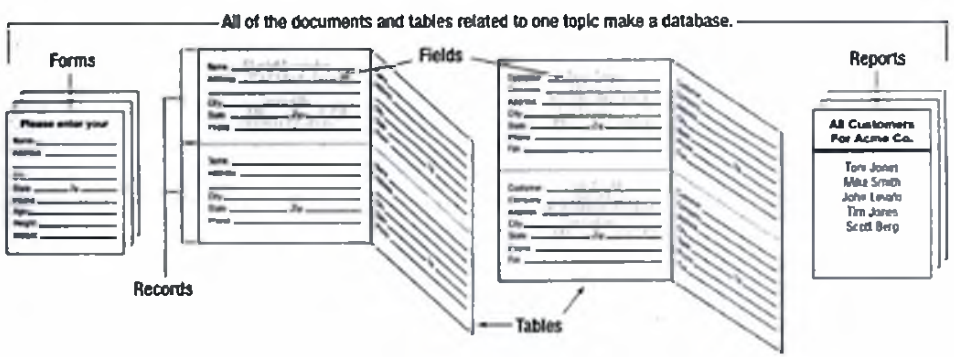
- **Fields.** Notice in Figure 11A.2 that each piece of data in the address book is stored in its own location, called a field. For example, each entry has a field for Name, as well as fields for Address, City, State, ZIP code, and Phone. Each unique type of data is stored in its own field. (The term *column* is sometimes used instead of *field*. IBM uses *column* fairly consistently, and Microsoft now uses it increasingly.)
- **Records.** One full set of fields—that is, all the related data about one person or object—is called a record. Therefore, all the information for the first person is record 1, all the information for the second person is record 2, and so on. (The term *row* is sometimes used instead of *record* by IBM and Microsoft.)
- **Tables.** A complete collection of records makes a table.

Once you have a structure for storing data, you can add new data, create reports, and perform other tasks with the data. For example, you might create a customer report that groups customers by ZIP code. These extra documents—forms and reports—along with the tables, collectively form a database, as shown in Figure 11A.3. Two of the most common elements of a database are forms and reports:

- Forms are documents that are filled in to create records.
- Reports are documents that display a select portion of a database's information in an easily read format. Such a report might list all overdue accounts.

FIGURE 11A.3

A database consists of tables and all the supporting documents.



Urheberrechtlich geschütztes Material

Flat-File and Relational Database Structures

Many early database applications and some current low-end applications access and manipulate only one table at a time. These applications store each table in its own file. When dealing with such databases, there is no reason to use the term *table* because the table and the database are one and the same. Very often, the table is simply called a file or just "the database."

To be more precise, however, a database file that consists of a single data table is called a flat-file database. Flat-file databases are useful for certain single-user or small-group situations, especially for maintaining lists such as address lists or inventories. Data that is stored, managed, and manipulated in a spreadsheet is similar to a flat-file database. (Notice that the table in Figure 11A.4 looks like a spreadsheet. If this table were stored by itself or not associated with any other database tables, it would be a flat-file database.)

Although they are easy to learn and use, flat-file database systems can be difficult to maintain and are limited in their power. When numerous files exist (one for each table or related document), there is often a lot of data redundancy, which increases the chance for errors, wastes time, and uses excess storage space. Adding, deleting, or editing any field requires that you make the same changes in every file that contains the same field.

In a relational database—a database made up of a set of tables—a common field existing in any two tables creates a relationship between the tables. As shown in Figure 11A.5, a Customer ID field in both the Customers table and the Orders table links the two tables, while a Product ID field links the Orders and Products tables.

The relational database structure is easily the most prevalent in today's business organizations. In a business, a typical relational database would likely contain separate tables with information on customers, employees, vendors, orders, and inventory.

Multiple tables in this kind of database make it possible to handle many data management tasks, for example:

- The customer, order, and inventory tables can be linked to process orders and billing.
- The vendor and inventory tables can be linked to maintain and track inventory levels.
- The order and employee tables can be linked to control scheduling.



FIGURE 11A.5

Linked fields in relational database tables are indicated by red lines.

The DBMS

As you have seen, a database is basically a collection of data. A database management system is a program, or collection of programs, that allows any number of users to access and modify the data in a database. A DBMS also provides tools that enable users to construct special requests (called queries) to find specific records in the database. Data management tasks fall into one of four general categories:

- Entering data into the database.
- Housekeeping tasks, such as updating data, deleting obsolete records, and backing up the database.

Norton ONLINE

For more information on database management systems, visit http://www.mhhe.com/pelternorton

Urheberrechtlich geschütztes Material

Norton Notebook

Data Warehouses



For years, companies have gathered and managed vast amounts of data of every imaginable kind. Because data truly is the lifeblood of a corporation, you can think of the corporation's data storage system as its heart. The bigger and stronger that system is, the more information it can handle and the more effectively it will operate.

Large and medium-sized companies are taking new approaches to storing and managing their huge collections of data. On the storage side of the equation is the data warehouse—a massive collection of corporate information, often stored in gigabytes or terabytes of data. Setting up a data warehouse is much more complicated than simply dumping all kinds of data into one storage place. Companies must consider several factors such as the following before investing in a data warehousing structure:

» **Storage Space.** One of the most popular mass-storage schemes is based on a redundant array of independent disks (RAID). RAID is a storage system that links any number of disk drives so that they act as a single disk. In this system, information is written to two or more disks simultaneously to improve speed and reliability, and to ensure that data is available to users at all times. Large-scale RAID systems offer up many terabytes of storage and incredibly fast access and data transfer times.

» **Processing Scheme.** Generally, two technologies are used to control data warehouses: symmetrical multiprocessing (SMP) and massively parallel processing (MPP). Using special RAID controllers, such systems can rapidly collect data, check it for errors, and retrieve a backup copy of the data if necessary.

» **Backup Strategy.** RAID's capabilities are based on three basic techniques: (1) mirroring, (2) striping, and (3) striping-with-parity. In a mirrored system, data is written to two or more disks simultaneously, providing a complete copy of all the information on a drive in the event one drive should fail. Striping provides the user with a speedy response by spreading data across several disks. Striping alone, however, does not provide backup if one of the disks in an array fails. Striping-with-parity provides the

» Sorting the data—that is, arranging or reordering the database's records.

» Obtaining subsets of the data.

The last type of data-management task—finding records—is extremely important. Because database files can grow very large (many gigabytes—millions of records—on large systems), finding data quickly is not a trivial matter. A DBMS, especially when it is running on powerful hardware, can find any speck of data in an enormous database in minutes, sometimes even in seconds or fractions of a second. Equally important, a DBMS provides the means for multiple users to access and share data in the same database by way of networked computer systems.

Working with a Database

The DBMS interface presents the user with data and the tools required to work with the data. You work with the interface's tools to perform these data management functions:

» Creating tables

» Viewing records

» Sorting records

» Creating queries

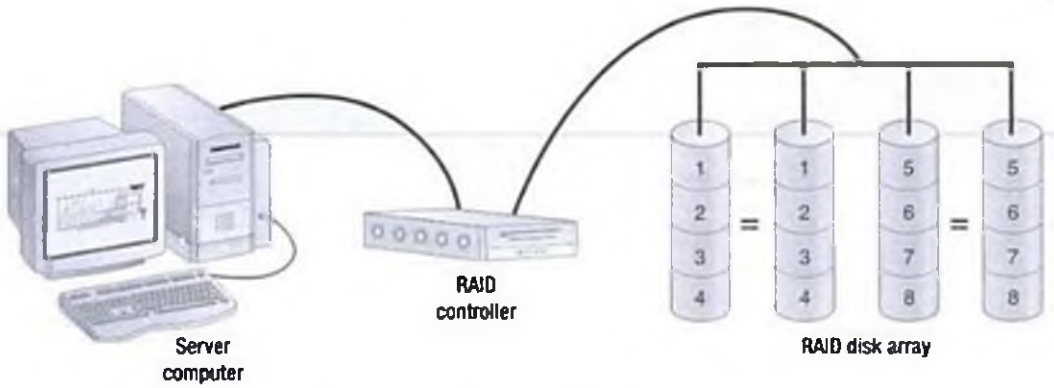
» Generating reports

SELF-CHECK ::

Circle the correct answer for each question.

1. Flat-file databases are most useful for _____.
   a. Large-scale databases b. Banking c. Single-user or small-group situations
2. In most database applications, a table can _____.
   a. Hold only one field b. Store any number of records c. Never be updated
3. A relational database includes _____.
   a. More than one table b. A single, large table c. A table with large records

Urheberrechtlich geschütztes Material



In a simple RAID array like this, data is written to two or more disks at once, resulting in multiple copies. This protects the data in case one disk fails. In more sophisticated RAID configurations, data from a single file is spread over multiple disks, and duplicates are made. Error-checking is also provided in such arrays.

speed of striping with the reliability of mirroring; in this scenario, the system stores parity information that can be used to reconstruct data if a disk drive fails.

» **Speed.** Newer data-warehousing systems not only incorporate huge disk drives, but some interconnect the drives with fiber-optic lines rather than standard wire-based buses. Fiber-optic lines use beams of pulsing light to transmit data and operate many times faster than standard data-bus technologies.

Huge data warehouses can supply the data requirements for tens of thousands of users in a large organization. They also are used to store and support thousands or millions of transactions per day on active Web sites, such as the popular electronic auction and retail Web sites.

Creating Database Tables

The first step in building any database is to create one or more tables. To create a new database, you must first determine what kind of data will be stored in each table. In other words, you must define each field in the table by following a three-step process:

1. Name the field.
2. Specify the field type.
3. Specify the field size.

Understanding Field Types

When naming a field, indicate as briefly as possible what the field contains. Figure 11A.6 shows a database table with clearly named fields.

Specifying the field type requires knowledge of what kind of data the DBMS can understand. Most modern database systems can work with various predefined field types. Figure 11A.7 shows examples of several common field types.

FIGURE 11A.6

Clearly named fields in a database table.

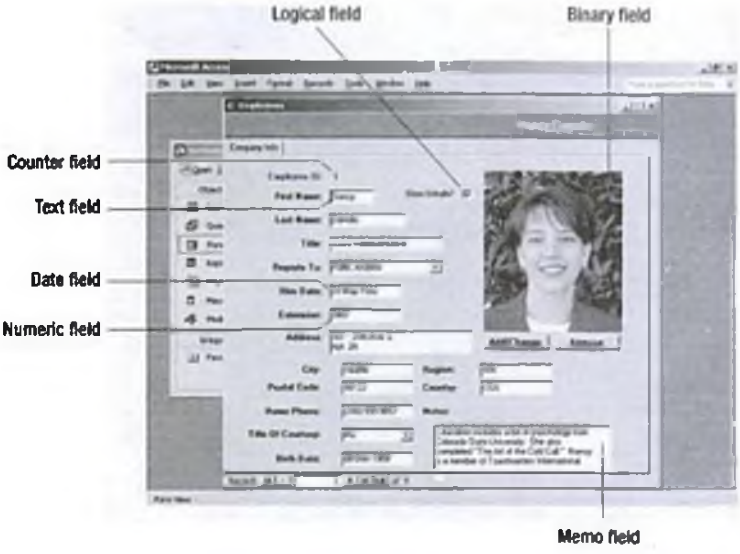
	Stock No	Vendor No	Equipment Class	Model	Part No	Description
1	900.00	3,820.00	Vehicle	DV-100	T-5100	Underwater Diver Vehicle
2	912.00	2,014.00	Vehicle	18-DV	7160-00	Underwater Diver Vehicle
3	1,313.00	3,511.00	Air Regulators	MK-200/G200	12-200-000	Regulator System
4	1,314.00	5,641.00	Air Regulators	TR-300	6832-14A	Second Stage Regulator
5	1,316.00	3,511.00	Air Regulators	MK-10/G200 B	12-502-000	Regulator System

Field name

Urheberrechtlich geschütztes Material

FIGURE 11A.7

Field types.



Text fields (also called string fields, character fields, or alphanumeric fields) accept any string of letters or numbers that are not used in calculations. Such an entry might be a person's name, a company's name, an address, a phone number, or any other textual data.

Numeric fields store purely numeric data. The numbers in a numeric field might represent currency, percentages, statistics, quantities, or any other value that can be (but is not necessarily) used in calculations. The data itself is stored in the table strictly as a numeric value, even though the DBMS can display the value with formatting characters such as dollar or percent signs, decimal points, or commas. Sometimes a numeric data field is required to have certain mathematical characteristics, such as integer (whole numbers), floating point (fractions), and so on.

A date field or time field stores date or time entries. These field types convert a date or time entry into a numeric value, just as dates and times are stored internally as serial numbers in spreadsheet cells. In most database systems, a date value represents the number of days that have elapsed since a specific start date. When you enter a date in a date field, the DBMS accepts your input, displays it in the format of a date (such as 9/9/2003), and converts it to a number (such as 37873) that it stores in the database. Date and time fields typically include automatic error-checking features. For instance, date fields can verify a date's accuracy and account for the extra day in a leap year. Date and time fields are handy for calculating elapsed time periods, such as finding records for invoices 31 days overdue.

Logical fields (also called Boolean fields) store one of only two possible values. You can apply almost any description for the data (yes or no, true or false, on or off, and so forth). For example, a Catalog field in a Customer table can tell a customer service representative whether a customer has ordered a new catalog (Yes) or not (No).

Binary fields store binary objects, or BLOBs. A BLOB (binary large object) can be a graphic image file such as clip art, a photograph, a screen image, a graphic, or formatted text. A BLOB also can be an audio file, video clip, or other object, as shown in Figure 11A.8.

In some DBMSs, counter fields (sometimes called index or autonumber fields) store a unique numeric value that the DBMS assigns to each record. Because it is

Urheberrechtlich geschütztes Material

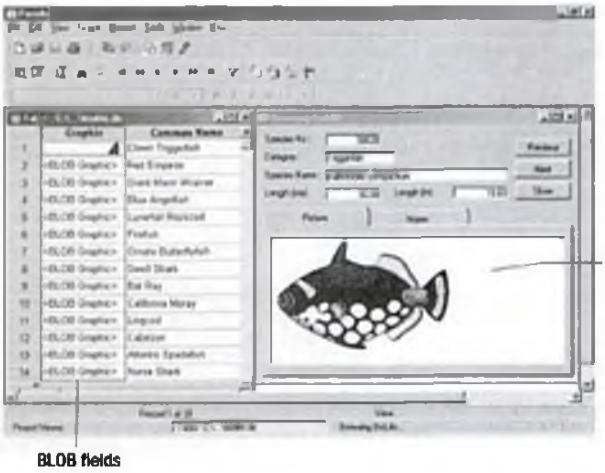


FIGURE 11A.8

Binary fields allow graphics and other nontext items to be stored in a database.

possible for two records to have identical data in some tables (such as two employees with the same name), a counter field ensures that every record will contain at least one completely unique piece of data. Counter fields also may be used for creating records that number sequentially, such as invoices.

Because most field types have fixed lengths that restrict the number of characters in an entry, memo fields (also called description fields) provide fields for entering notes or comments of any length. With a memo field, you don't specify the size of the data.

Entering Data in a Table

After the table has been set up, data can be entered. In most cases, entering data is a matter of typing characters at the keyboard. Entering data in a database table is much like entering data in a spreadsheet program. The process can have more pitfalls than you might expect, however, especially if it is being carried out by someone other than the table's designer. For example, the DBMS might not handle a number correctly if the user enters it with a dollar sign—even though the number will be displayed as a dollar amount. If the data is entered with an inconsistent mix of upper- and lowercase letters, the DBMS may not be able to sort the data or locate specific records.

Most DBMSs allow you to create a data entry form to make data entry easier (see Figure 11A.9). A form is nothing more than a custom view of the table that typically shows one record at a time and includes special controls and labels that make data entry less confusing. For example, the form's designer can include controls that automatically move the insertion point to the next field when the typist presses the ENTER or TAB key. This makes it easy for a typist to move from one field to the next without having to take a hand off the keyboard and reach for the mouse. Or the form can convert all the input into capital letters to maintain data consistency. A form can even direct input into multiple tables, which really makes life easier for a typist who does not know about the underlying structure of the DBMS and database tables.

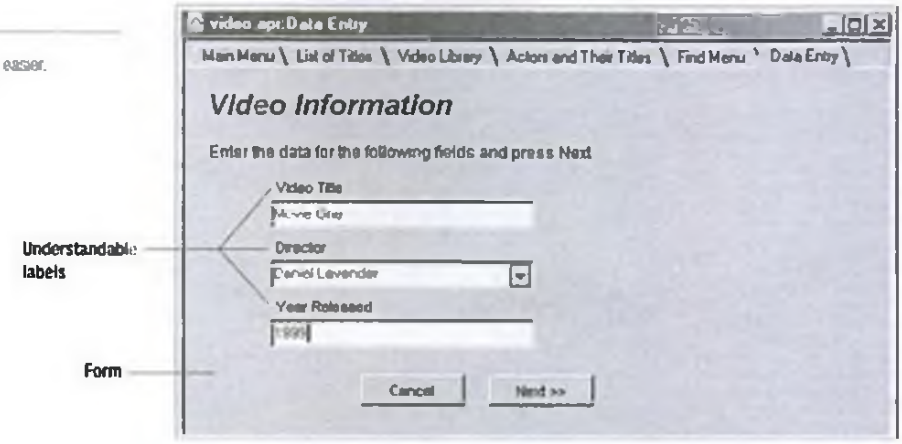
Viewing Records

The way data appears on screen contributes to how easily users can work with it. You have already seen examples of data presented in two-dimensional, worksheet-style tables. With many DBMS products, you use the table view (sometimes

Urheberrechtlich geschütztes Material

FIGURE 11A.9

Forms make data entry easier.



called the datasheet view) to create a database table and to modify field specifications. This view is also suitable for seeing a list of records that you request to view in some meaningful way, such as all customers who live in the same city.

Sometimes viewing the entire table is unwieldy because there are too many entries. Filters are a DBMS feature for displaying a selected list or subset of records from a table. The visible records satisfy a condition that the user sets. It is called a filter because it tells the DBMS to display those records that satisfy the condition while hiding—or filtering out—those that do not. For example, you can create a filter that displays only those records that have the data "Gold" in the Status field, as shown in Figure 11A.10.

FIGURE 11A.10

When you view a data table in datasheet view, you can see all records and fields at the same time—or as many as will fit on the screen.



As shown in Figure 11A.11, a DBMS also allows you to create forms for viewing records. These forms are similar in design to those used in data entry, but they are used to display existing data instead of receiving new data. By using forms, you can create simple, easily understood views of your data that show just one record at a time. You also can create complex forms that display related information from multiple tables.

Sorting Records

One of the most powerful features of a DBMS is the ability to sort a table of data, either for a printed report or for display on the screen. Sorting arranges records according to the contents of one or more fields. For example, in a table of products, you can sort records into numerical order by product ID or into alphabetical order by product name. To obtain the list sorted by product name, you define the condition for the Product Name field that tells the DBMS to rearrange the records in alphabetical order for this data (see Figure 11A.12). You can sort the same list on another field, such as Supplier, as shown in Figure 11A.13.

When sorting records, one important consideration is determining the sort order. An ascending sort order arranges records in alphabetical order (from A to Z), numerical order (from 0 to 9), or chronological order (from

Urheberrechtlich geschütztes Material



Norton ONLINE

For more information on database queries and query languages, visit **http://www.mhhe.com/petemorton**.

Querying a Database

In a manner similar to entering sort conditions, you can enter expressions or criteria that

- Allow the DBMS to locate records.
- Establish relationships or links between tables to update records.
- List a subset of records.
- Perform calculations.
- Delete obsolete records.
- Perform other data management tasks.

Any of these types of requests is called a query, a user-constructed statement that describes data and sets criteria so that the DBMS can gather the desired data and construct specific information. In other words, a query is a more powerful type of filter that can gather information from multiple tables in a relational database.

For example, a sales manager might create a query to list orders by quarter. The query can include field names such as Customer and City from a Customers table, and Order Date from an Orders table. To obtain the desired information, the query requires the specific data or criteria that will isolate those records (orders received during a given period) from all the records in both tables. In this case, the sales manager includes a range of dates during which the orders shipped.

Some database systems provide special windows or forms for creating queries. Generally, such a window or form provides an area for selecting the tables the query will work with and columns for entering the field names where the query will obtain or manipulate data.

It should be possible to generate a single language that can, in theory, query any database. If such a language were developed, a user who knew the language could query any database, regardless of who created the database or what software was used in the creation. Mainframe database developers created the Structured English QUEry Language (SEQUEL) in the mid 1970s to solve this dilemma. SEQUEL, and its later variant SQL, are English-like query languages that allow the user to query a database without knowing much about the underlying database structure (see Figure 11A.14).

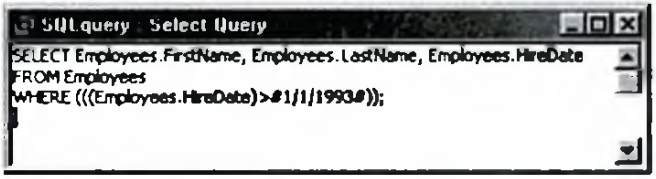


FIGURE 11A.14

This SQL query opens the Employees table and extracts a list of all employees whose hire date is after 01/01/1993.

SQL (Structured Query Language, pronounced "ess-cue-el" or "sequel") is a powerful tool and nearly all PC-based database management systems include it. Because each DBMS application has its own special features, however, developers have a tendency to create dialects of SQL that do not quite meet the standard for a universal database querying language. Sometimes the developers add commands; other times they limit the commands or some of the command options. Nevertheless, SQL is useful and you will see it available in relational DBMSs such as SQL Server, Oracle, DB2, Microsoft Access, and others.

In addition to SQL, PC-based databases sometimes use a query/programming language called Xbase (see Figure 11A.15). Like SQL, Xbase is somewhat English-like, but it is more complicated because its commands cover the full range of database activities, not just queries. As with SQL, software developers have a

FIGURE 11A.15

An Xbase query to generate a list of employees hired after 01/01/1993.

```
Use Employees
List FirstName, LastName for HireDate >"01/01/93"
```


Urheberrechtlich geschütztes Material

tendency to create dialects of Xbase to suit their software's needs, so each version of Xbase may be a little different from its peers.

Some DBMS programs provide an interface, like a form or a grid, that collects the facts about a query from the user and composes the SQL or query statements behind the scenes. This feature allows a user to query by example (QBE) or to perform "intuitive" queries. With QBE, you specify the search criteria by typing values or expressions into the fields of a QBE form or grid (see Figure 11A.16).

Field:	LastName	FirstName	HireDate
Table:	Employees	Employees	Employees
Sort:			
Show:	☑	☑	☑
Criteria:			>#1/1/93#
or:			

FIGURE 11A.16

A QBE query to generate a list of employees hired after 01/01/1993.

Whether a DBMS uses SQL, Xbase, or QBE, or offers all three, the results of a query are always the same (see Figure 11A.17).

Hire Dates Post 1-1-93 : Sele...

	Last Name	First Name	Hire Date
▶	Peacock	Margaret	03-May-93
	Buchanan	Steven	17-Oct-93
	Suyama	Michael	17-Oct-93
	King	Robert	02-Jan-94
	Callahan	Laura	05-Mar-94
	Dodsworth	Anne	15-Nov-94
*			

Record: 1 of 6

FIGURE 11A.17

The results of the SQL, Xbase, or QBE query showing a list of employees hired after 01/01/1993.

Generating Reports

Not all DBMS operations have to occur on screen. Just as forms can be based on queries, so can reports. A report is printed information that, like a query result, is assembled by gathering data based on user-supplied criteria. In fact, report generators in most DBMSs create reports from queries.

Reports can range from simple lists of records to customized formats for specific purposes, such as invoices. Report generators can use selected data and criteria to carry out automated mathematical calculations as the report is printed. For example, relevant data can be used to calculate subtotals and totals for invoices or sales summaries. Reports are also similar to forms because their layout can be customized with objects representing fields and other controls, as shown in Figure 11A.18.

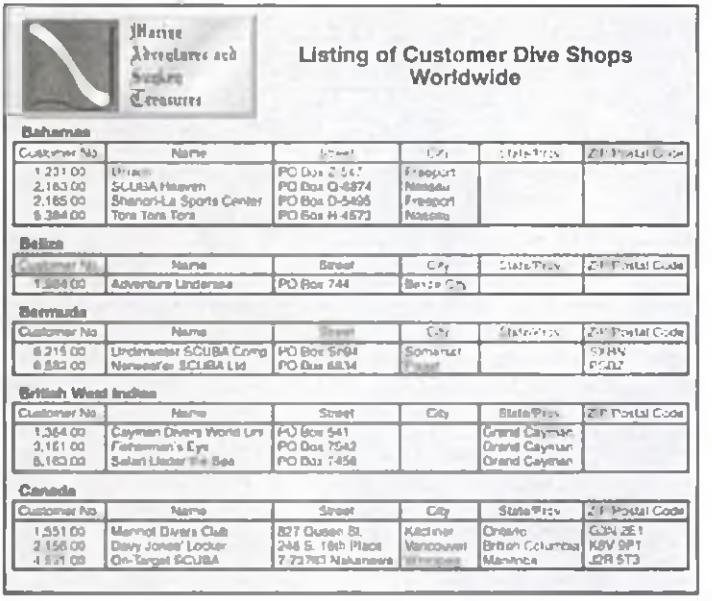


FIGURE 11A.18

This polished looking summary is a relatively simple database report.

Urheberrechtlich geschütztes Material

At Issue

Play Ball! Baseball Enters the Information Age

What if a batter knew the probability pitcher Curt Shilling would throw a high-and-inside fast ball on a 3 and 2 count in the third inning? What if the pitcher knew player Bernie Williams swings at curve balls that are high and outside 62 percent of the time when he's behind the count and hits .033 when he does? What if Major League Baseball coaches and players could access such information—all while playing a game?

Now they can. Using a complex database of baseball statistics and special software, teams today have a new, high-tech weapon in the highly competitive world of MLB.

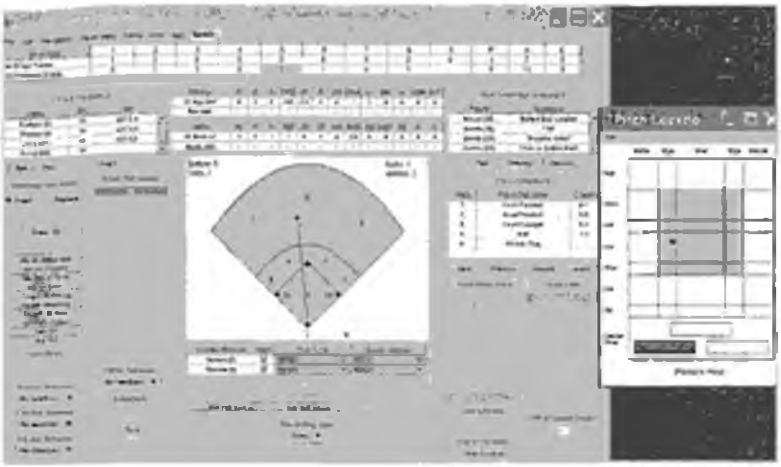
Software company Tendu has created a complex archival database system for use by professional ball players and their coaches and managers. With the software, a coach can check his laptop for exactly the info he needs to instruct his players before taking the field, including a player's ZR (zone rating) and RF (range factor), a hitter's OPS (on-base percentage plus slugging percentage), and a pitcher's WHIP (walks and hits allowed per inning pitched).

Not that keeping and tracking statistics is anything new. Baseball stats are an almost sacred part of the national pastime. Computer-generated analysis has been part of the game for at least a decade, with the industry leader STATS, Inc., dominating the market. But the Washington-based Tendu is working to bring a level of precision and detail to stat-keeping as yet unseen.

Tendu relies on a team of 17 former collegiate and professional ballplayers who spend hours reviewing games off satellite feeds and inputting everything that happens into Tendu's computers. *Everything*: type, speed, movement, and location of each pitch; where and how hard the ball was hit; player performance; and the results of every play. Each of the season's 2,400 games takes up to 12 hours to log. Overnight, teams are updated on the most complex statistical minutiae imaginable.

Tendu's application consists of a data-collection interface, an application architect, a developer, swing components, a flat-file database, a homegrown app server, an

Urheberrechtlich geschütztes Material



Tendu software can keep track of every baseball statistic imaginable.

Apache Web server, TiVo systems for data input, and the Java runtime environment.

So far, only the NY Mets and the Oakland A's have adopted the new system, but Tendu promises many more teams will do so next season.

The question is, will Tendu and similar start-ups revolutionize the way baseball is played? Or are they just high-tech toys to be utilized by a few pioneers? Some question whether technology has a role in the tradition of baseball, where hunches and judgment calls are the rule.

But Tendu and other high-tech advocates hope to convince teams that using advanced technology is the future of the game. As Boston Red Sox president Larry Lucchino said, "We've lived through an information revolution that has affected every aspect of our lives. Why shouldn't baseball be similarly impacted by the sea of change?"

Urheberrechtlich geschütztes Material

Summary ::

- A database is a repository for collections of related data or facts.
- A database management system (DBMS) is a software tool that enables many users to add, view, and work with the data in a database.
- Flat-file databases are two-dimensional tables of fields and records. They cannot form relationships with other tables.
- Relational databases are powerful because they can form relationships among different tables.
- To create a database, you must first set up its tables and define the types of fields each table will contain.
- Forms are custom screens for displaying and entering data that can be associated with database tables and queries.
- Filters let you browse through selected records that meet a set of criteria.
- Sorting arranges records in a table according to specific criteria.
- Queries are user-constructed statements that set conditions for selecting and manipulating data.
- Reports are user-generated sets of data usually printed as a document.

Urheberrechtlich geschütztes Material

Key Terms ::

binary field, 408
binary large object (BLOB), 408
counter field, 408
database, 402
database management system (DBMS), 402
date field, 408
field, 403
filter, 410
flat-file database, 405
form, 409
logical field, 408
memo field, 409
numeric field, 408
query, 412
query by example (QBE), 413
record, 403
relational database, 405
report, 413
sort, 410
SQL, 412
table, 403
text field, 408
time field, 408
Xbase, 412

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. In a database table, each row represents a(n) _____ .
2. In a record, it is not necessary for every _____ to contain data.
3. A(n) _____ contains a single table.
4. Index or autonumber fields are also called _____ .
5. _____ is an English-like query language used by nearly all PC-based database management systems.
6. A(n) _____ is a DBMS feature used to display a selected list or subset of records from a table.
7. A(n) _____ field allows you to enter text of any length.
8. You can create printed _____ from the data in a database.
9. DBMS means _____ .
10. The term *column* is sometimes used instead of the more popular term _____ .

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A _____ is an example of a database.
   a. telephone book b. form c. field d. report
2. A _____ is a complete collection of records.
   a. table b. field c. DBMS d. row
3. A _____ database is made up of a set of tables where a common field in any two tables creates a relationship between the tables.
   a. flat-file b. large c. relational d. DBMS
4. A _____ can store an object, such as a picture, rather than text or numeric data.
   a. counter field b. binary field c. logical field d. numeric field
5. A _____ tells the DBMS to display records that satisfy a condition while hiding those that do not.
   a. form b. column c. filter d. report
6. Clerks or other data entry personnel fill in a _____ .
   a. filter b. report c. SQL d. form
7. You use a(n) _____ sort order to arrange records alphabetically, from A to Z.
   a. rising b. falling c. ascending d. descending
8. A unique numeric value that the DBMS assigns to each record is called a _____ .
   a. counter field b. query c. binary field. d. time field
9. A _____ field can hold only one of two values, such as Yes or No.
   a. two-way b. binary c. logical d. counter
10. Characters that are not used in calculations are usually stored in a _____ .
    a. database b. text field c. date field d. binary field

Urheberrechtlich geschütztes Material

LESSON // 11B

Survey of Database Systems

Overview: When Applications Grow Huge

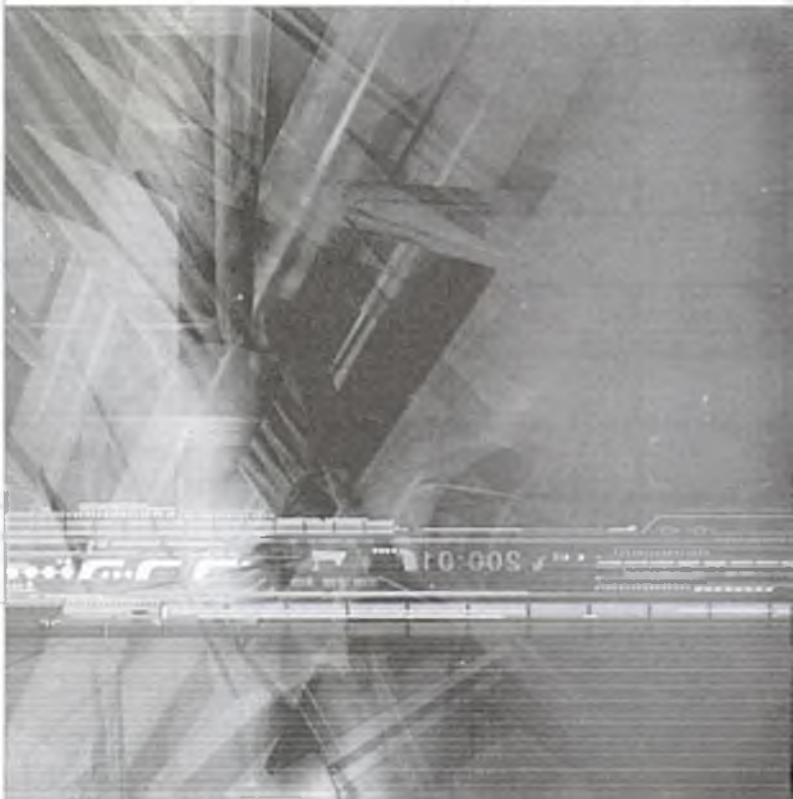
You've probably used a variety of computer applications: a word processor, an Internet browser, games, and so on. These are relatively small programs, designed to be installed on a single computer's hard drive, to run within that computer, and generally to interact with only a single user at any one time. That's the traditional computer application model, and it's still the largest category of computer programs.

But there's another category—called *enterprise software*—and it's becoming ever more popular. Enterprise software can be any type of large-scale program that is meant to handle the needs of many users. One hallmark of enterprise software is that it is almost always networked—made available to users via a large private network or the Internet. Another characteristic of many enterprise applications is the fact that they are based on very large, complex databases. In some organizations, thousands of users may access the same enterprise application, but for a wide range of different purposes.

This lesson introduces you to enterprise software and discusses its importance in today's organizations. You will also learn about the various types of database management systems that lie at the heart of these applications.

OBJECTIVES ::

- Define the terms *enterprise*, *distributed application*, and *tier*.
- Provide at least two examples of how software can handle many users at once.
- Explain how databases are used by businesses and individuals.
- Compare the four most popular corporate database management systems.



Enterprise Software

You could use the word *enterprise* to describe any organization. However, people who work with computers use the term enterprise to mean organizations with large hardware installations running large software applications. In other words, an enterprise system is a very large-scale computer system. Enterprise software is typically a suite of applications used by hundreds, or even thousands, of people at the same time, which handles millions of records, or both.

Sometimes an enterprise application looks very much like the DBMS that drives it, as is the case with many inventory management programs. Other times the underlying database is mostly hidden, as is the case in many order entry systems.

Because enterprise systems are so large, it is tempting to think of them as mainframe tools and not a major concern for PC users. However, today's PCs are as powerful as mainframes were a few years ago, and many large-scale DBMS applications—such as Oracle, IBM's DB2, and Microsoft's SQL Server—run just fine on PC servers and networks. So it is possible that, in a business or educational environment, you might run into enterprise software, particularly where a network is used. And even if a single PC does not have a huge application running on it, that PC might be part of a group of PCs working together to execute various parts of a single huge application. The Internet, and improvements in communications and security, make it possible for applications to be divided into parts that reside on different PCs—even if those PCs are in separate locations around the world. An application that executes on separate PCs like this is called a distributed application.

The word tier is another term used to describe distributed applications. For instance, if you divide the job of managing a database between two computers (a client and server), it is called a two-tier application. You also find three-tier applications: one computer displays a visible user interface for data entry; a second computer executes the business logic (figuring out what data is needed from the database, how to connect to the database, and so on); and a third computer holds the database itself. Some database applications—called *n*-tier applications—divide among even more than three machines.

Norton ONLINE

For more information on enterprise software, visit http://www.mhhe.com/petermorton

Meeting the Needs of Many Users

Some enterprise applications must be able to handle a great deal of traffic, from users who may be located all over the place. For example, two users with identical software can access the same data source and perform the same tasks, even if they are on opposite sides of town—or opposite sides of the world. It is also possible for users to work with different software but still access the same central data source. One example of this is when people using different Internet browsers place orders from the same online database, as shown in Figure 11B.1.

Here's another example. One popular type of enterprise software is called an electronic document management (EDM) system. It tracks documents, keeps related ideas together, and aids in facilities management. Using such an application, a maintenance worker can display line drawings of a factory floor to see what changes are necessary for an impending project. The same software also allows a secretary to record text notes from a project meeting and link them to the line drawings of the factory



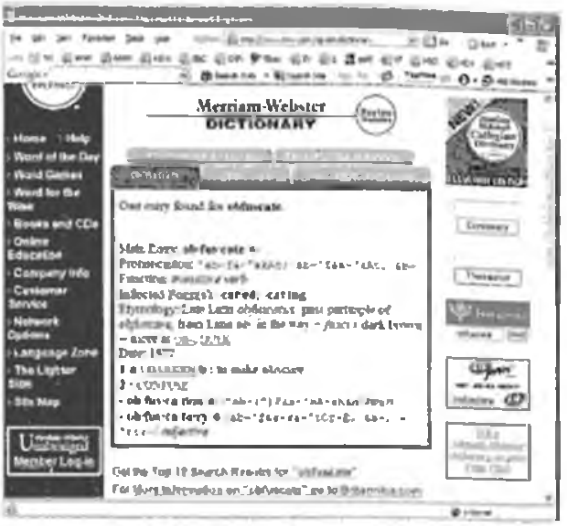
FIGURE 11B.1

Enterprise applications may need to service many thousands of users simultaneously, such as the database system underlying eBay.

Urheberrechtlich geschütztes Material

FIGURE 11D.5

After you click the Look It Up button, the dictionary's database is searched and results are displayed instantly.



some of their operations. Obvious productivity boosts result from using databases for inventory management, payroll, order fulfillment, and other clerical tasks. Perhaps less obvious are the sometimes startling ideas that bubble up when the new database analysis technique called data mining is used.

Knowledge discovery is a type of database utility designed to analyze data and report back with useful information. Data mining is one type of knowledge discovery where a program searches a database, discovering hidden information. Using statistics, artificial intelligence, modeling techniques, and other tools, data mining can predict trends or relationships that likely would never be noticed by a human analyst—even a really skilled, hardworking analyst.

Data mining can provide a company with suggestions about improving efficiency, predict trends, and otherwise offer wise and useful ideas. Notice that data mining doesn't just provide *facts*; it provides actual *ideas*—and there is a difference.

For example, data mining can give you answers to questions you didn't ask. Traditional data analysis requires that you first ask a question, such as "give me a list of all overdue accounts." SQL can get answers to practically any specific question you want to ask of a database.

Data mining, however, works differently. It searches a database all by itself, discovering "gems" of information and bringing them to your attention.

For example, data mining might tell you that 78 percent of the people who bought your tea kettle returned to your Web site within two weeks to buy a tea strainer. With information like this, you can store these items together in the warehouse, saving your company some money. And you can modify your catalog to suggest to your tea kettle customers that they might want to purchase the strainer at the same time, saving your customers shipping and handling costs. Everybody wins.

Organizations accumulate huge amounts of data, and usually within that giant collection of information are relationships that—once revealed via data mining—can be used to improve efficiency. Traditionally, you had to know what to look for before you could begin an analysis of a database. You had to know what questions to ask of the data. Data mining discovers subtle, sophisticated, and sometimes essential information that nobody would have noticed. It can alert you, for

Urheberrechtlich geschütztes Material

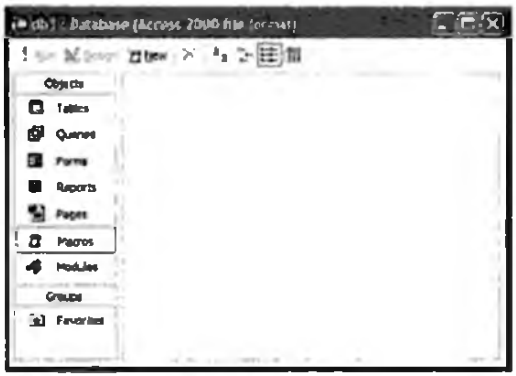
Productivity Tip

Database Macros

If you often use Access—or indeed most other applications—it's sometimes useful to create macros. If there's some task that you frequently repeat, consider creating a macro to do that job for you quickly and automatically. For example, instead of having to move the mouse around, clicking down through a series of menus, you can simply create a macro that does the job for you. In this section, you see how to display a personal message showing any information you want.

In many Microsoft applications, you can turn on a "recorder" that watches you as you accomplish some task, and then memorizes the steps you followed. Access doesn't offer this recorder option, but you can easily create Access macros nonetheless.

To see how to create a macro, start Access and choose File | New. Then click Blank Database to create a new, empty database. Click the Create button in the File New Database dialog box. The dialog box closes. Click Macros in the left pane of the database window. This highlights the Macros option, as shown here.



This is where you can start building a macro

Click the New button in the database window. A macro window opens where you can specify the steps that the macro will take to complete its task. Click the down-arrow button in the Action column in the macro window and you see a list of the available steps and tasks a macro can accomplish. You can choose 58 different behaviors—from simple beeping to running an entire application.

Click the Msgbox option in the Action drop-down list. Notice that a description of this action appears in the lower right pane of the macro window. (To add additional behaviors for this macro, just move down one line by clicking the line below the word MsgBox.)

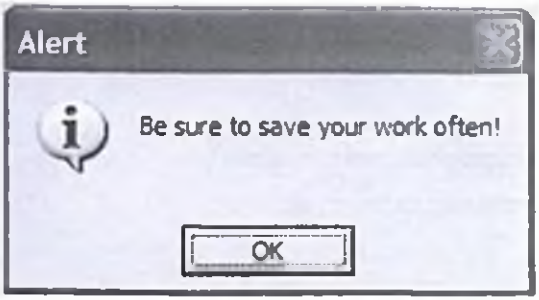
After you've built your personal database, you can then reap the benefits of computerization:

- Search your collection by a variety of criteria (by particular ingredients, or combinations of ingredients; calorie content; ethnic cuisine; appliance used such as crock pot; category such as desserts; preparation time; and so on).
- Print out a list of ingredients to take to the supermarket.
- Easily adjust a recipe that feeds four to make it feed eight—with a click of the mouse.

You'll get similar benefits from building databases for other kinds of collections: coins, books, CDs, or whatever your hobby is. And don't forget that today's databases can include photos as well as text—so you can make your personal database even more useful. Figure 11B.8 shows a personal cookbook database.

Microsoft Access is the clear leader for personal databases—it's easy to use and comes bundled with some versions of Microsoft Office (see Figure 11B.9). However, Access isn't really usable for large-scale, enterprise databases because it can host only, in the worst case, 10 users simultaneously, and the biggest database it can manage is two billion bytes. That might seem like a lot, but recall that *enterprise* means *huge* in the DBMS world, and enterprise database software such as Oracle (discussed later in this section) can handle trillions of bytes (terabytes) and

Urheberrechtlich geschütztes Material



Your personal message macro can be used to display any information you wish.

A MsgBox is designed to display a message, so you see a list of available "arguments" (qualities) you can give to your message box. Find the set of Action Arguments on the lower left of the macro window and type **Be sure to save your work often!** in the Message field. Leave the Beep argument as is; it will cause the computer to beep whenever this message box is displayed. Click the Type field and notice that you can choose a variety of message box styles from a drop-down list. Choose the Information style, which adds a little icon to the message. In the Title field, type **Alert**. All these arguments are optional. But a message box with no message isn't too useful.

Now save your macro by choosing File | Save and when asked what Macro name you want to give it, replace the default Macro1—which isn't very descriptive—by typing **SaveWarning**. Click Ok and notice that the top of your macro window has changed to display the new name for this macro.

It's time to test your creation! Choose Run | Run and you see your excellent custom message box, as shown here. You can make the message quite large if you want to. For example, you might want to type in a list of frequently used phone numbers, macros, shortcut keys, or whatever. Then, any time you run this macro, you can see your list.

You can run macros several ways. One quick way is to click the Macros option in the database window. Look at the database window now—you'll see that Access has listed your SaveWarning macro, ready for you to double-click to execute it. You also can execute macros from the Tools menu, or even assign a shortcut key combination, such as CTRL+M, that when pressed runs the macro. Look in Access Help for details on how to assign keys.



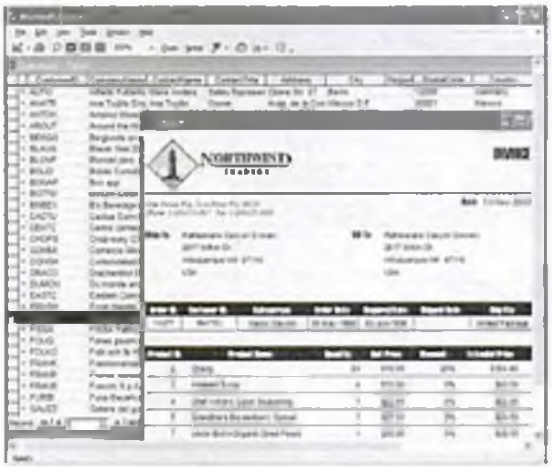
FIGURE 11B.8

Track, manage, and search any collection you enjoy. Here's a personal cookbook database.

Urheberrechtlich geschütztes Material

FIGURE 11B.9

Microsoft Access is the most popular personal and small business database system.



SELF-CHECK ::

Circle the correct answer for each question.

1. Enterprise software means _____ .
   a. a very large-scale computer system
   b. business software
   c. personal software
2. The data analysis technique that can give you answers to questions you didn't even ask is called _____ .
   a. database management
   b. data diving
   c. data mining
3. Microsoft Access can efficiently accommodate _____ simultaneous updating users.
   a. 3
   b. 10 to 30
   c. 2,000

simnet™

simultaneously handle thousands of users. *Your* personal collection doesn't need this power, but eBay does.

Nonetheless, for home and small business database management, Access is likely to be your DBMS of choice.

Common Corporate Database Management Systems

Over the years, database management systems have come and gone. In the early 1980s, dBASE was the dominant commercial database system, but today enterprise systems dominate the scene: Oracle Corp.'s Oracle Database, IBM Corp.'s DB2, and Microsoft Corp.'s SQL Server. Each has its strengths; in this section, you learn the primary differences between these three traditional DBMSs. Also, MySQL is introduced; it can be used for free, and is especially popular for new Internet database work.

Norton ONLINE

For more information on Oracle, visit **http://www.mhhe.com/petermorton**

Oracle

First introduced more than 25 years ago, the Oracle database system has become the most popular enterprise-level DBMS in the world, with around 40 percent of this market. Oracle—like DBMS competitors Microsoft and IBM—offers a large suite of applications, utilities, and languages that can be used together to solve business problems and manage data. However, Oracle is losing market share to rivals IBM and Microsoft. Oracle has a reputation as the most flexible enterprise DBMS, but with this flexibility comes its equally famous complexity. In addition, Oracle is capable of running on various operating systems—Windows, UNIX, Macintosh, and Linux—a capability sometimes known as platform independence.

Urheberrechtlich geschütztes Material

Key Terms ::

Access, 426
business logic, 421
crawler, 425
data mining, 424
DB2, 429
disconnected dataset, 421
distributed application, 421
EDM (electronic document management), 421
enterprise software, 421
enterprise system, 421
knowledge discovery, 424
MySQL, 429
n-tier application, 421
Oracle, 428
platform independence, 428
scalability, 429
SQL Server, 429
tier, 421
two-tier application, 421

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. When an application is divided into several parts running on different computers, it's called a(n) _____ .
2. If a program can run on various operating systems, it is described as having _____ .
3. A(n) _____ is a portion of a database that a user can "check out" without maintaining a connection to the database.
4. A distributed application with two components is described as being a(n) _____ application.
5. A program's ability to adjust in drastic changes in usage levels is known as _____ .
6. _____ is the most popular enterprise DBMS for the "open source" community.
7. Automated programs that roam the Internet, gathering information such as the addresses of active Web sites, are called _____ .
8. _____ is IBM's suite of database programs used mostly for high-volume, enterprise systems.
9. _____ refers to an application that either manages large amounts of data or handles large numbers of users simultaneously, or both.
10. In a three-tier application, one computer may be responsible for executing the _____ which is figuring out what data is needed from the database, and other issues.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. Applications that can handle high-volume traffic are called _____ .
   a. *n*-tier b. SQL c. enterprise d. DBMS
2. An application's ability to successfully manage changes in scale is known as _____ .
   a. scalability b. durability c. efficiency d. robustness
3. _____ is the most popular enterprise DBMS for the "open source" community.
   a. SQL Server b. Oracle c. DB2 d. MySQL
4. If a distributed application is divided among more than three machines, it is called a(n) _____ application.
   a. multi-tier b. *x*-tier c. *n*-tier d. *y*-tier
5. The Internet can be seen as one huge _____ .
   a. Google b. database c. enterprise d. application
6. When a user "checks out" a disconnected dataset, the connection to the database is _____ .
   a. maintained b. reversed c. sped up d. broken
7. Today's three most popular enterprise DBMSs are DB2, Oracle, and _____ .
   a. SQL Server b. MySQL c. Access d. EDM
8. Database programs often provide _____ that resemble familiar paper forms.
   a. tables b. interfaces c. filters d. datasets
9. _____ is a type of database utility designed to analyze data and report back with useful information.
   a. Knowledge discovery b. Expert discovery c. Answer discovery d. Solution discovery
10. Many commercial Web sites access a _____ .
    a. mainframe computer b. macro c. disconnected dataset d. database

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. Explain why data mining is often useful in making business decisions.
2. What is business logic?
3. What is data mining?
4. How do disconnected datasets help improve database performance?
5. What is platform independence?
6. Explain why Access is not a good choice for high-volume, large-scale enterprise systems.
7. What is an EDM system?
8. Why might you call the Internet a super-database?
9. What's the difference between MySQL and SQL Server?
10. Why do some database professionals favor platform-independent DBMSs such as Oracle?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Learn more details about the features offered by today's powerhouse enterprise DBMSs. Look at Oracle Corp.'s Oracle Database at this Web site: http://www.oracle.com/database. What is the latest version Oracle offers? Locate links on the Oracle Web site that offer demos, comparisons with other DBMSs, reviews by database experts, performance analysis, migration information, and so on. Explore these topics with a view to making a recommendation about why Oracle would, or would not, be a good choice for a small company that averages three visitors per day to its Web site. (*Note*: Don't download any files from the Internet without your instructor's permission.)
2. Compare the features offered by Microsoft's SQL Server (http://www.microsoft.com/sql) with the features offered by Oracle. Which system do you think seems best suited to a company that plans to move from Windows to Linux within the next five years? Explain your reasoning.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Design a database. You can create an outline for a database by using a word processor. Imagine that you own a small business that sells gourmet coffees. You want to create a database system to store information about products, vendors, customers, employees, accounts paid and received, and so on. Open your word processor and, in a blank document, list the tables you would include in your database. Under the name of each table, create a list of the fields the table should contain. Use your word processor's drawing tools to show the relationships between the tables. When you are finished, print the document and save the file under the name "Design." Close the word processor.
2. Create user documentation for the database you designed in the previous exercise. Assume that your database will be used on an Internet site, so some of its tables and fields will be displayed on the site's pages for customers to see. Open a word processor and write a paragraph explaining to a database professional how to implement your database. Then list the data type of each field in the database. Describe which tables and fields should be made public on the Web site and which should be hidden from the public and used only internally by the company.
3. Explore privacy issues. Given that the Internet is the greatest research tool the world has ever known, answers to your questions are often only a few seconds away. Try searching for "Patriot Act" to see what the ACLU and others are saying about the potential dangers in today's database-driven world. See if you can find the actual document that Congress passed: H.R. 3162 (October 25, 2001). It begins like this: "To deter and punish terrorist acts in the United States and around the world, to enhance law enforcement investigatory tools, and for other purposes."

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Describe a scenario in which a large organization might use a database management system. What types of tables would the organization's database contain? What kinds of relationships would exist among the tables? What types of forms would be needed, and by what users? What types of queries and reports would managers want to run on this database?
2. Discuss the advantages of using a database in your personal life. What hobbies would benefit from computerization? How hard would it be to type in all the data for various kinds of collections—stamps, buttons, coins, books, and so on? When designing a personal database, how would you divide the data into tables, and then divide the tables into fields?

Urheberrechtlich geschütztes Material

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- SQL and its uses in business.
- The advantages of relational databases, compared to flat-file databases.
- Explain several ways that XML is used in business databases today.

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

Businesses and governments now maintain huge databases filled with information about individuals. With this thought in mind, discuss the following questions in class.

1. You submit information about yourself whenever you apply for a credit card, subscribe to a magazine, or register a product that you have purchased. Should businesses and government agencies be allowed to keep this data permanently? How much information should they be allowed to collect about individuals? Do you feel the practice of maintaining—and even selling—your personal data is wrong or should be illegal? Why or why not?
2. Credit agencies, banks, and other institutions commonly sell information about their customers, which is then used to create direct-marketing lists. Some people feel only you should decide whether or not to sell your private information. Do you share this view? Why or why not?

Urheberrechtlich geschütztes Material



CHAPTER 12

Software Programming and Development

CHAPTER CONTENTS

This chapter contains the following lessons:

Lesson **12A:**
Creating Computer Programs

- What Is a Computer Program?
- Hardware/Software Interaction
- Planning a Computer Program
- How Programs Solve Problems
- Structured and Object-Oriented Programming

Lesson **12B:**
Programming Languages and the Programming Process

- The Evolution of Programming Languages
- World Wide Web Development Languages
- The Systems Development Life Cycle for Programming



Creating Computer Programs

Overview: What Is a Computer Program?

Software, as you learned in Chapter 1, provides the instructions that run the hardware in a computer. Without software, the computer cannot function—it is nothing more than a bunch of parts. Some software commands may be built into select pieces of hardware (like CPUs and ROM chips), but even in these cases, the programming is simply a "hard-coded" version of software. An example of such hard-coding can be found in something as typical as a digital watch. Although you may not even think of it, some kind of software is built into the watch's circuitry that makes it work. Because software is such an integral part of any computer system, it is important to understand what software is and where it comes from.

The term *software* can be used generically, as in the statement "Software tells the computer what to do." The term can be used more specifically to describe an operating system or application. For example, you might say, "Windows XP is a piece of software," or "PhotoShop is a piece of software." On any one computer, the software usually consists of the operating system, various utilities (sometimes considered part of the operating system), and applications.

The following sections explain what programs are and how they function. They describe some of the processes and tools that software developers use when creating computer programs.



OBJECTIVES ::

- Define the term *computer program*.
- Describe the use of flowcharts and pseudocode in programming.
- Identify two ways in which a program can work toward a solution.
- Differentiate the two main approaches to computer programming.
- List and describe three elements of object-oriented programming.

Urheberrechtlich geschütztes Material

simnet™

What Is a Computer Program?

A computer program is a set of instructions or statements (also called *code*) to be carried out by the computer's CPU. Programs, or software, come in many forms. These can be broken down into three major categories: operating systems, utilities, and applications (see Figure 12A.1).

A program is typically composed of a main module and submodules. These modules are stored as a collection of files; large programs can contain thousands of individual files, each serving a specific purpose. Some of the files contain instructions for the computer, while other files contain data. For Windows-based PCs, some common extensions for program files include the following:

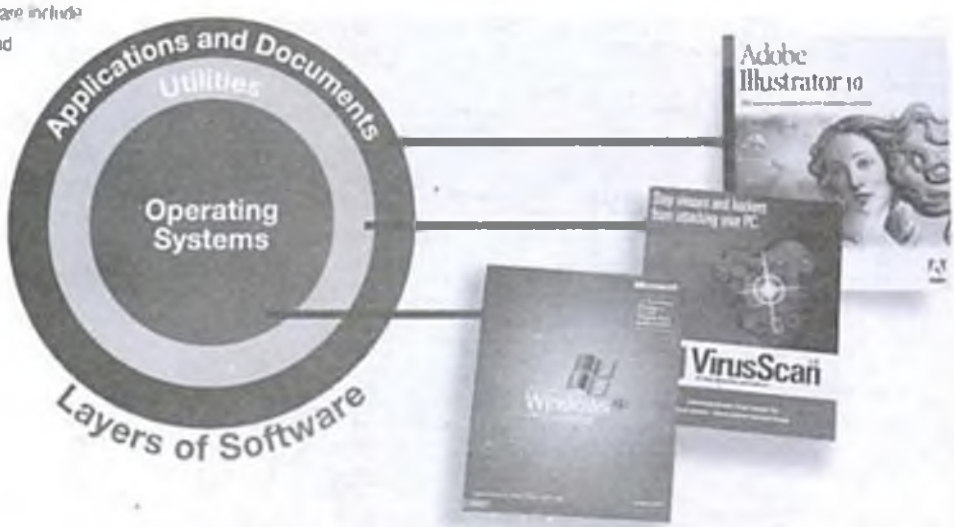
- **Executable Files.** An executable (.exe, .com) file is the part of a program that actually sends commands to the processor. In fact, when you run a program, you are running the executable file. The processor executes the commands in the file—thus the name *executable file*. Executable files usually (but do not always) have the filename extension .exe.
- **Dynamic Link Library Files.** A dynamic link library (.dll) file is a partial .exe file. A .dll file will not run on its own; instead, its commands are accessed by another running program. Because .dll files can contain parts of an executable program, they provide programmers with an effective way of breaking large programs into small, replaceable components. This feature makes the entire program easier to upgrade. In addition, .dll files also can be shared by several programs at one time.
- **Initialization Files.** An initialization (.ini) file contains configuration information, such as the size and starting point of a window, the color of the background, the user's name, and so on. Initialization files help programs start running or contain information that programs can use as they run. Although initialization files are still in use, many newer programs store user preferences and other program variables in the Windows Registry—a special database that holds information about the computer's user, installed programs, and certain hardware devices.
- **Help Files.** A help (.hlp, .chm) file contains information in an indexed and cross-linked format. By including a help file, programmers can provide the user with online help information.

Norton ONLINE

For more information on executable, dynamic link library, initialization, and help files, visit **http://www.mhhe.com/petemorton**

FIGURE 12A.1

The major categories of software include operating systems, utilities, and applications.



Urheberrechtlich geschütztes Material

» **Batch Files.** A batch (.bat) file automates common or repetitive tasks. A batch file is a simple program that consists of an unformatted text file containing one or more operating system commands. If you type a batch file's name at a command prompt, your operating system will execute the commands in the file.

By default, most program files are stored in a folder that bears the application's name or an abbreviation of it. However, some programs' files may be placed in other folders. For example, the .dll files on Windows XP are usually stored in the c:\windows\system32 folder. To view a list of most of the files needed to run an application, you can open that application's folder. Figure 12A.2 shows a typical software directory, in this case, for a hypothetical program called CoolToys version 1.3.

Hardware/Software Interaction

Software is the reason people purchase computers. A program's instructions execute at the hardware level, mainly on the CPU. The program, for example, may tell the CPU to retrieve a specific piece of information from memory. If the program tells the CPU to play a sound file, then the program generates an interrupt. An interrupt is a signal to the CPU to execute a series of preprogrammed steps as a response to the interrupt. In this case the hardware would send the sound file to the audio output device.

A highly trained individual called a computer programmer creates this list of instructions. The list is often called code, and the process of writing the list is usually called coding.

Code

The term code refers to statements that are written in any programming language, as in machine code or higher-level code. As you saw in Chapter 4, computers think and speak in the binary number system. Of course, binary is too cryptic for humans to deal with for any length of time. This is why computer-programming languages



FIGURE 12A.2

Applications usually have executable, help, initialization, and document files.

Urheberrechtlich geschütztes Material

You will learn more about specific programming languages later in this chapter.

Compilers and Interpreters

After creating a piece of source code, the programmer must convert the source code into machine code (break it down into a series of 1s and 0s) before it can run on a computer. The job of converting the source code is handled by one of two types of programs:

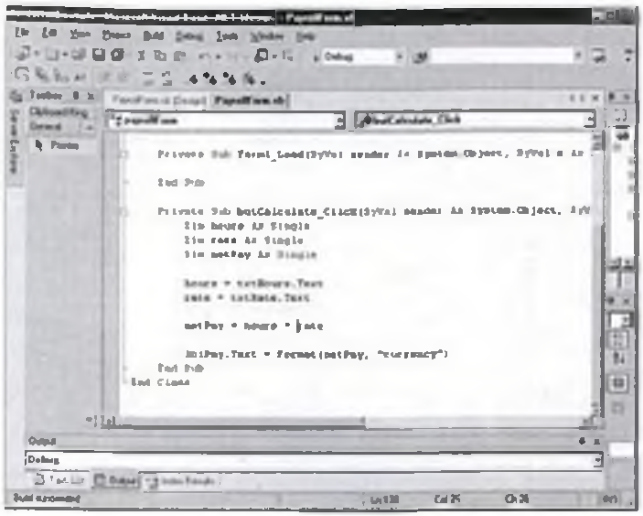


FIGURE 12A.5

An example of source code for an application created in Visual Basic.NET.

- A compiler converts all the source code into machine code, creating an executable file. The output of the compiler is called object code. In some languages the object code must then be linked to produce a true executable file. In other languages the object code itself is directly executable. The programmer can copy the executable object code onto any similar system and run the program. In other words, once compiled, the program is a stand-alone executable file that no longer needs the compiler to run. Of course, each programming language requires its own compiler to translate code written in that language. For example, the programming language C++ requires a C++ compiler, while the language Pascal requires a Pascal compiler. Figure 12A.6 shows an example of a compiler.
- An interpreter also converts source code to machine code. Instead of creating an executable object code file, however, the interpreter translates and then executes each line of the program, one line at a time. Interpreters translate code on the fly, so they have a certain flexibility that compilers lack. The interpreted code runs slower than compiled code because the code must be interpreted each time it is run, and a copy of the interpreter must accompany the

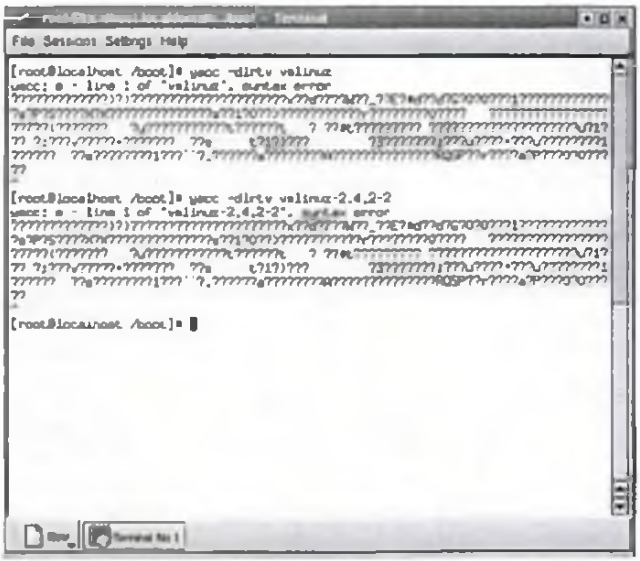


FIGURE 12A.6

The Yet Another C Compiler (YACC), which is found in many versions of Linux.

Urheberrechtlich geschütztes Material

FIGURE 12A.7

An example of a Perl clock script.

```
sub divide (@months = ('January','February','March','April','May','June','July','August','Se
@days = ('Sunday','Monday','Tuesday','Wednesday','Thursday','Friday','Saturday');
($sec,$min,$hour,$day,$month,$year,$day2) = (localtime(time))[0,1,2,3,4,5,6];
if ($sec < 10) { $sec = "0$sec"; }
if ($min < 10) { $min = "0$min"; }
if ($hour < 10) { $hour = "0$hour"; }
if ($day < 10) { $day = "0$day"; }
$year += "1900";
if ($order) { &time; &divide; &date; }
else { &date; &divide; &time; }
sub date {
        if ($dateformat) {
                if ($weekday) { print "$days[$day2], "; }
                if ($dateformat == 1) { print "$months[$month] $day, $year"; }
                else {
                        $month++;
                        print "$month/$day/$year";
                }
        }
}
sub time {
        if ($timeformat == 2) { print "$hour:$min:$sec"; }
        elsif ($timeformat == 1) {
                if ($hour >= 12) { $ss = "P.M."; }
                else { $ss = "A.M."; }
                if ($hour == 0) { $hour = 12; }
                if ($hour > 12) { $hour -= 12; }
                print "$hour:$min:$sec $ss";
        }
}
sub divide {
```

code everywhere it goes. Therefore, every system that needs the program must have a copy of the interpreter as well as the source code. Some popular interpreted languages include LISP, BASIC, and Visual Basic. Figure 12A.7 illustrates a clock program written in Perl.

Planning a Computer Program



Norton ONLINE

For more information on planning a computer program, visit http://www.mhhe.com/petermorton

Programs can be extremely difficult to write. Without a plan, the programmer will typically either write a bad program or fail entirely at the task. If planned, the programmer will have an idea of what needs to be done and know where to start. Two planning tools that programmers often use are input-processing-output (IPO) charts and pseudocode.

The IPO chart helps the programmer determine what is needed to write the program. It consists of three columns. In the first column, the programmer lists what data is needed to solve the task. In the last column, the programmer lists the desired output. The middle column is the hard part. Here the programmer lists the steps needed to get the desired output. Typically the steps are written in pseudocode.

Pseudocode is natural language statements that look like programming code. The idea is to write in English what needs to happen in code. Quite often the programmer is unsure how to write each step of the program. At least in describing the code, the programmer has a head start and can start thinking about how to implement the code.

TABLE 12A.1

The IPO Chart for a Program that Calculates Gross Pay for an Hourly Employee

Input	Processing	Output
Hours worked	Input hours worked	Gross pay
Hourly wage	Input hourly wage	
	Validate data	
	Pay = hours worked * hourly wage	
	Display gross pay	

Table 12A.1 shows an IPO chart detailing a payroll application. The program will calculate gross pay for an hourly employee. For simplicity's sake, overtime wages are ignored.

To solve the problem, the programmer must determine how many hours the employee worked and his or her hourly pay. This is handled in steps 1 and 2 of the processing section. A wise programmer will then check to ensure that this data makes sense. Step 3 performs this check. Valid hours could be between 0 and 40 hours. A person claiming to work more than 100 hours in a week is an example of invalid data. The program must respond to this error. Step 4 calculates the answer. Finally, step 5 prints the answer on the screen.

Urheberrechtlich geschütztes Material

The algorithm simply samples each square on the grid—one square at a time—and compares the results with the current highest peak. The process is slow, but it always finds the highest point.

Algorithms have many other uses. A spreadsheet program, for instance, might contain an algorithm to display the sum of cells highlighted by the user. Such an algorithm would allow the user to highlight cells, read the numbers in those cells, total the numbers, and display them on the screen. Another algorithm within the spreadsheet program might look for the longest word in a column and then adjust the width of the column to fit the text.

Heuristics

Norton ONLINE

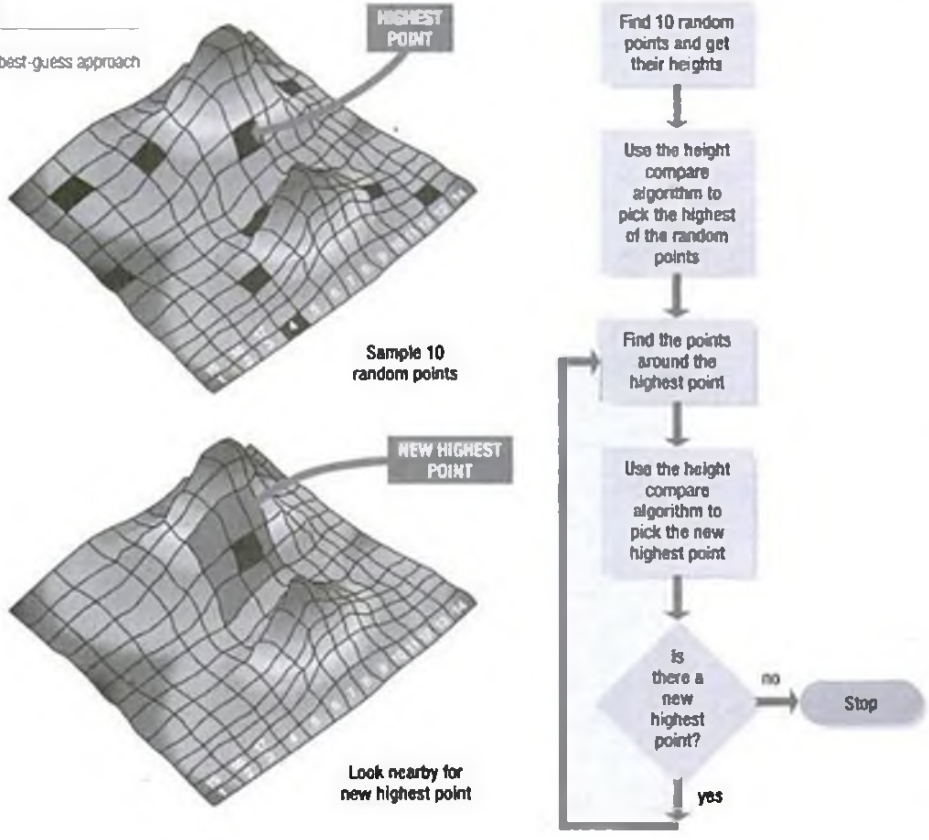
For more information on heuristics, visit http://www.mhhe.com/pelternorton

Sometimes, no algorithm exists to solve a problem, or the algorithm is so complex or time-consuming that it cannot be coded or run. In these cases, programmers rely on heuristics to help solve problems or perform tasks. Heuristics are like algorithms; they are a set of steps for finding the solution to a problem. But unlike an algorithm, a heuristic does not come with a guarantee of finding the best possible solution. Heuristics offer a good chance of finding a solution, although not necessarily the best one.

Figure 12A.9 shows a heuristic for finding the highest peak on a topographical map. The heuristic works under the assumption that mountains build up from

FIGURE 12A.9

Heuristics provide a best-guess approach to problem solving.



Urheberrechtlich geschütztes Material

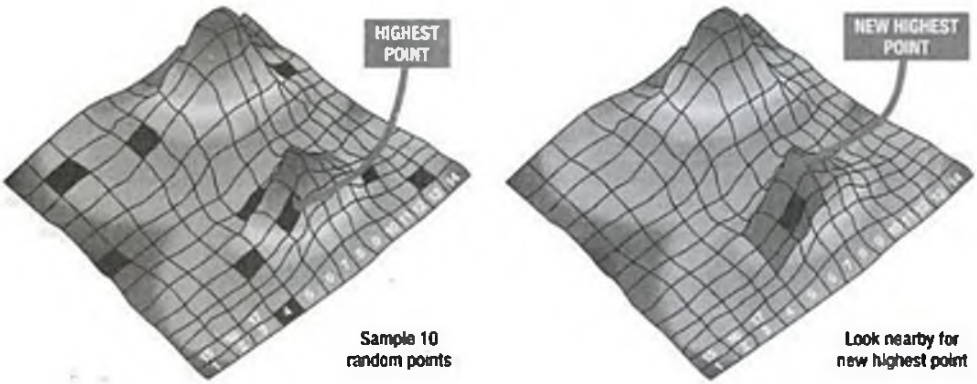


FIGURE 12A.10

Heuristics are not always guaranteed to find the best possible answer.

foothills and that the peak cannot be standing in a square by itself in the middle of a valley. Following this heuristic, the program samples 10 random spots on the map and compares them to see which is the highest.

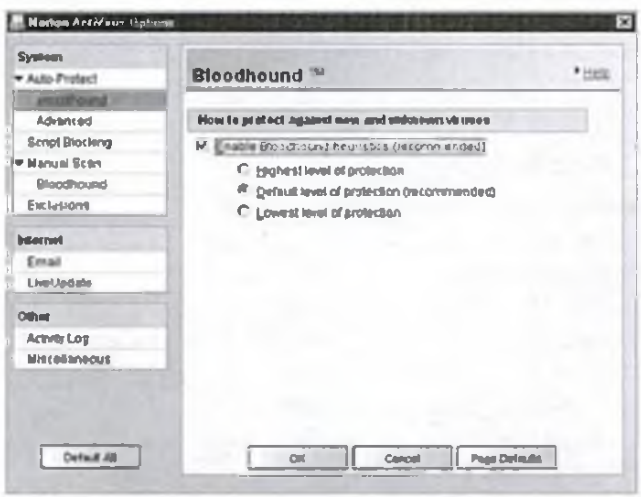
The heuristic assumes that, because you have to go up to reach the peak, the current highest point must lead up to the peak. To find the next step to the peak, the program samples a few spots immediately around the current highest point and compares them. Once the program has found a new highest point, it repeats the process of sampling around the current high point and looking for a new highest point. In this way, the heuristic climbs the mountain to the peak. As you can see, the heuristic always climbs up—and only up. It is possible that, based on the original starting points, the heuristic may climb the shorter mountain. While the heuristic supplies a solution, it may not supply the best solution every time. Figure 12A.10 shows the heuristic climbing the wrong peak.

Heuristics are less likely to appear in ordinary applications (such as a spreadsheet or word processor) because these applications rarely require a task to be performed for which there is no definite solution. Heuristics are extremely common in more advanced programs that track vast quantities of data in complex ways. For example, software that helps forecasters predict the weather cannot possibly process every piece of available data in every possible form. Even if the program could process all the data, it still could not hope to accurately predict something as complex as the weather. By using heuristics, however, the programs can cull the weather-related data to find useful information and then create a reasonably accurate guess at the weather based on that data.

Some programs use both heuristics and algorithms. Antivirus software utilizes algorithms to find well-known viruses like MS Blaster and CodeRed. Newer viruses are caught using heuristics that look for virus-like patterns. These include files that attempt to write to portions of the hard drive or that open Outlook. The nastier viruses are those that know how the heuristics work and avoid them. Figure 12A.11 shows the configuration screen for Norton AntiVirus's Bloodhound Heuristics.

FIGURE 12A.11

Norton AntiVirus includes heuristics to protect your machine from new viruses.



Urheberrechtlich geschütztes Material

At Issue

Hot and Oh-So-Cool: Technology Forecasts the Weather

Even though weather conditions can change in an instant, forecasting the weather hadn't changed much since World War II.

It took cutting-edge Java programming and Internet connectivity to break free of tradition to re-create the meteorology model and allow meteorologists to get the most out of today's new technologies. Gone are the paper-based weather map and charts. In their place are highly scaleable dynamic graphical interfaces and information systems.

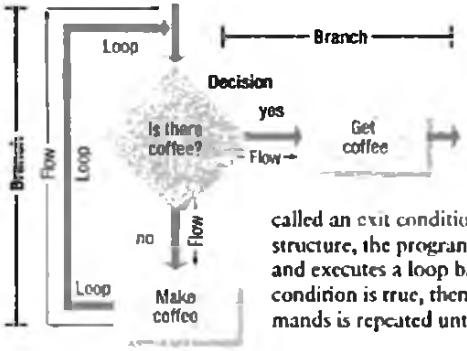
One company leading the way is the San Francisco–based WeatherLabs, Inc. (www.weatherlabs.com). WeatherLabs provides both meteorology information services to electronic publishing industries, as well as the software architecture and development solutions needed to analyze, present, and disseminate this weather data. Its weather content is delivered through broadcast on the Internet, via wireless and mobile technologies, and over satellite broadcast.

WeatherLabs' success is based on a proprietary Java technology–based weather forecasting and content creation system. In fact, the central, server-side engine permeates every aspect of WeatherLabs, responsible for weather and climate forecasting intelligence, numerical analysis, and forecasting algorithms, packaged directly inside JavaBeans components.

With the new meteorology model, just a dozen meteorologists and programmers can now do the job of a staff of 100. Meteorologists can now spend their time monitoring the weather data for quality-control purposes rather than worrying about pouring over the tons of weather data observed from around the globe, or developing the presentation of

FIGURE 12A.12

In structured programming, control flows the code sequentially along a branch of code.



» Repetition structures (or looping structures) are based on constructs called loops. A loop is a piece of code that repeats again and again until some condition—called an exit condition—is met. In a repetition structure, the program checks a condition statement and executes a loop based on the condition. If the condition is true, then a block of one or more commands is repeated until the condition is false.

Norton ONLINE

For more information on object-oriented programming, visit http://www.mhhe.com/petermorton

Object-Oriented Programming

Concepts of object-oriented programming, such as objects and classes, can seem abstract at first, but many programmers claim that an object orientation is a natural way of thinking about the world. Because OOP gives them an intuitive way to model the world, they say, programs become simpler, programming becomes faster, and the burden of program maintenance is lessened.

Objects

Look around you—you are surrounded by objects. Right now, the list of objects around you might include a book, a computer, a light, walls, plants, pictures, and so on.

Think for a moment about what you perceive when you look at a car on the street. Your first impression is probably of the car as a whole. You do not focus on the steel, chrome, and plastic elements that make up the car. The entire unit, or object, is what registers in your mind.

Urheberrechtlich geschütztes Material



the weather data. The server-side technology does it for them.

The WeatherLabs' system is highly automated and created to be user-friendly. Based on HTML templates, basic weather content is transmitted to all customers, "cookie-cutter" fashion. Then, users edit and personalize the templates as desired to create unique user interfaces, wrapping their custom content around the core weather data. The end result is weather content as varied as satellite and Doppler radar imagery, ski reports, airport delay forecasts, anecdotes from historical weather almanacs, search tools, and personalized editorial content from around the globe. This allows CondeNet's chic travel weather center to have its own look and feel, very different than the family-oriented Prodigy or Netscape, or the highly graphical interface used by Excite.

So, while many online providers may look as if each has its own in-house staff of meteorologists, under the covers, all these sites are based on the same server-side Java technology–based applications.

Now, how would you describe that car to someone sitting next to you? You might start with its attributes, such as the car's color, size, shape, top speed, and so on. An attribute describes the characteristics of an object. You might then talk about what the car can do; that is, you describe its functions. For example, the car moves forward, moves backward, opens its windows, and so on. Together, the attributes and the functions define the object. In the language of OOP, every object has attributes and functions that may encapsulate (contain) other objects.

When you look more closely at the car, you may begin to notice many smaller component objects. For example, the car has a chassis, a drive train, a body, and an interior. Each component is, in turn, composed of other objects. The drive train includes an engine, transmission, rear end, and axle. So an object can be either a whole unit or a component of other objects. Objects can include other objects. Figure 12A.13 shows a car replete with attributes, functions, and encapsulated objects.

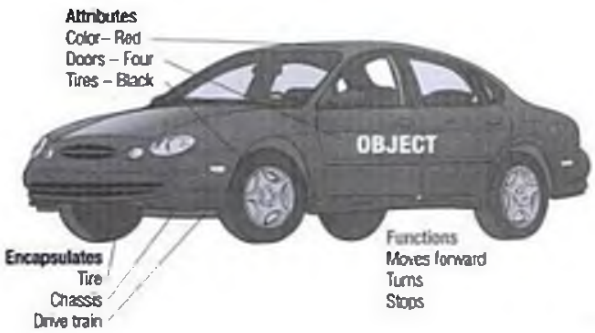


FIGURE 12A.13

The car object has both attributes and functions; the car also encapsulates other objects, such as tires, chassis, and drive train—each with its own unique attributes and functions.

Urheberrechtlich geschütztes Material

Summary ::

- Software contains the commands that run the hardware in a computer.
- A computer program is a set of commands that tell the CPU what to do. Software may contain only an executable program file, or it may have several other supporting files such as dynamic link library (.dll), initialization (.ini), and help (.hlp) files.
- To create a program, a programmer writes source code, which is compiled or interpreted to create object code.
- Object code, also known as machine code, is the binary language file that tells the CPU what to do.
- The order in which program statements are executed is called program control flow.
- Programmers translate algorithms and heuristics into programs designed to solve problems.
- Structured programming uses functions built up along a logical program flow to perform each task in the algorithm or heuristic.
- Object-oriented programming allows a programmer to think modularly because programs are assembled into components, called objects.
- In programming, an object is a self-contained unit that includes functions and attributes.

Urheberrechtlich geschütztes Material

Key Terms ::

algorithm, 445
attribute, 451
batch (.bat) file, 441
branch, 449
code, 441
compiler, 443
conditional statement, 449
dynamic link library (.dll) file, 440
encapsulate, 451
executable (.exe, .com) file, 440
exit condition, 450
flowchart, 445
help (.hlp, .chm) file, 440
heuristic, 446
initialization (.ini) file, 440
interpreter, 443
interrupt, 441
input-processing-output (IPO) chart, 444
loop, 450
looping structure, 450
machine code, 442
machine language, 442
object, 449
object code, 443
object-oriented programming (OOP), 449
program control flow, 445
programming language, 442
pseudocode, 444
repetition structure, 450
selection structure, 449
sequence structure, 449
source code, 442
structured programming, 448

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. A(n) _____ file contains configuration information that helps a program run.
2. Programmers use _____ to convert all the source code for a program into machine code, thus creating an executable file.
3. To plan a program, a programmer might use a(n) _____ chart.
4. A(n) _____ is a set of steps that always leads to a solution.
5. _____ programming arose in the 1960s as a way to help developers avoid creating "spaghetti code."
6. A(n) _____ does not come with a guarantee of finding the best possible solution.
7. A(n) _____ converts source code to machine code, but does not create an executable object code file.
8. A(n) _____ is a statement that determines what the program should do next.
9. The building blocks of object-oriented programming are reusable blocks of code called _____ .
10. C++ and BASIC are examples of a _____ .

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. A computer program is a collection of _____ that are carried out by the computer's CPU.
   a. instructions b. loops c. steps d. algorithms
2. Programming languages enable programmers to describe programs. This description is called _____.
   a. an OOP b. source code c. an interpreter d. an object
3. _____ is a simplified natural-language version of a program.
   a. Pseudocode b. Control flow c. Algorithm d. A flowchart
4. A loop repeats until a(n) _____ is met.
   a. object b. error c. exit condition d. syntax
5. One goal of _____ is development of readable code.
   a. programming languages b. interpreters c. compilers d. structured programming
6. _____ builds on and enhances structured programming.
   a. A compiler b. A programming language c. Object-oriented programming d. Program control flow
7. A(n) _____ is steps to solve a problem that is not guaranteed to provide an answer.
   a. algorithm b. IPO chart c. heuristic d. flowchart
8. The 1s and 0s that CPUs can understand is called its _____.
   a. syntax b. interrupt c. interpreter d. machine language
9. A(n) _____ file is a partial .exe file that has its commands accessed by other programs.
   a. .ini b. .dll c. .bat d. .dat
10. The order in which program statements are executed is called _____.
    a. program control flow b. program syntax c. programming language d. program execution

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What goes into the three columns of an IPO chart?
2. Describe the difference between a compiler and an interpreter.
3. Why were programming languages developed?
4. Conditional statements and loops are examples of what?
5. What is an executable file?
6. Describe how reusing code can simplify a programmer's job.
7. What is the benefit of planning code before trying to write it?
8. What are the advantages of using dynamic link library (.dll) files in a program?
9. What is a flowchart?
10. What is the difference between an algorithm and a heuristic?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. Take the following steps to see how many executable files are stored in your computer's Windows folder:
   a. Launch Windows Explorer. (The procedure for doing this depends on which version of Windows is installed on your computer. Ask your instructor for assistance, if necessary.)
   b. In the left pane of the Exploring window, find and click the Windows folder. The folder's contents appear in the window's right pane.
   c. In the right pane, click the Type column heading. This action arranges the pane's contents by file or folder types.
   d. List all the executable (.exe) files in the folder. The exact number of executable files may vary from system to system. Compare the number of executable files on your system to other students'.
   e. Find the Notepad.exe file in the Windows folder and double-click the file. The Notepad text editing program will open on your screen.
   f. Close Notepad, and then close the Exploring window.

Urheberrechtlich geschütztes Material

LESSON // 12B

Programming Languages and the Programming Process

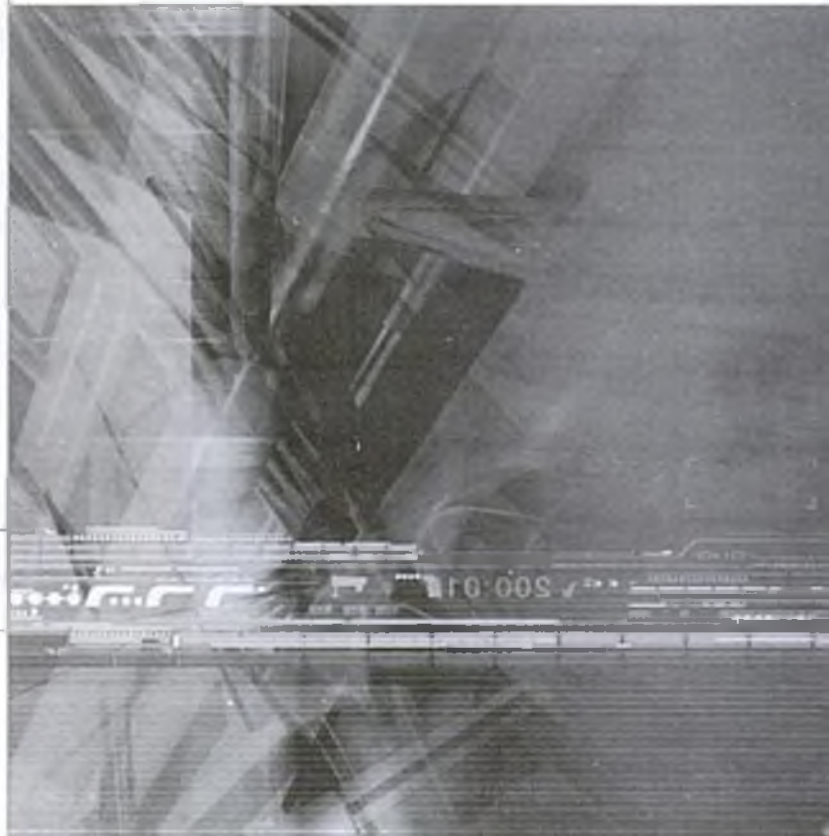
OBJECTIVES ::

- Identify the three main categories of programming languages.
- Describe the five generations of programming languages.
- Name at least five major programming languages.
- Describe a visual programming environment and how it is used.
- List the five phases of the systems development life cycle for programming.

Overview: The Keys to Successful Programming

Programming can be a complex process; it requires training, planning, and some specialized tools. If you think this task sounds like any other construction process, you are right; creating a software program is like building an office building or a shopping center. You have to study the market, create a plan, hire a crew, get special tools, and then (finally) build the building. But the work does not stop there. You must continually update your creation to meet the changing needs of the people who use it.

Successful programmers are knowledgeable in two key areas: programming tools (the software and languages used to develop applications) and the programming process (the step-by-step procedures that programmers follow to ensure consistent, well-developed products). Software developers of all backgrounds—and in many different working environments—follow a uniform set of procedures in their work. Thus, programmers can work together more easily on large projects and they can accurately predict how their programs will work. You will learn more about the development process later in this lesson. First, you will learn about the programmer's special tools: programming languages.



The Evolution of Programming Languages

Norton ONLINE

For more information on the history of programming languages, visit **http://www.mhhe.com/peternorton**.

simnet™

As you learned earlier in this chapter, programming is a way of creating a set of instructions for the computer. To create these instructions, programmers use rigidly defined programming languages to create source code; then they convert the source code into machine (or object) code for the computer.

Machine code—those 1's and 0's—is the only language that a computer understands. People, however, have difficulty understanding machine code. To make software development easier, researchers developed progressively more sophisticated programming languages. This evolution in development tools allowed programmers to focus less on strings of numbers and more on command sequences. In other words, developers could think about their programs in human terms rather than the computer's terms. As a result, today's programmers can create command sequences that you can read like any other language. The programming tools handle the tedious chore of converting the humanlike instructions into strings of numbers that computers can understand.

As you will learn in this lesson, programmers can choose from many development tools that differ greatly in capability, flexibility, and ease of use. Despite their differences, however, most programming languages share one characteristic: each programming language requires the programmer to follow some very strict rules. For example, programming languages require developers to

- Provide information in a certain order and structure.
- Use special symbols.
- Use punctuation (sometimes).

These rules are called the syntax of the programming language, and they vary a great deal from one language to another. Figure 12B.1 shows a piece of source code written in a programming language called C++.

Notice that in Figure 12B.1, each line of code includes special abbreviations, spacing, or punctuation. This special writing style is the syntax of the C++ programming language. If the code were written in a different language, you would see differences in spacing, phrasing, punctuation, and so on. Regardless of which language the programmer uses, however, he or she must follow the correct syntax for that language. If the syntax is not correct, the compiler or interpreter will issue errors and warnings and will not be able understand the source code. It also will either fail or create incorrect object code.

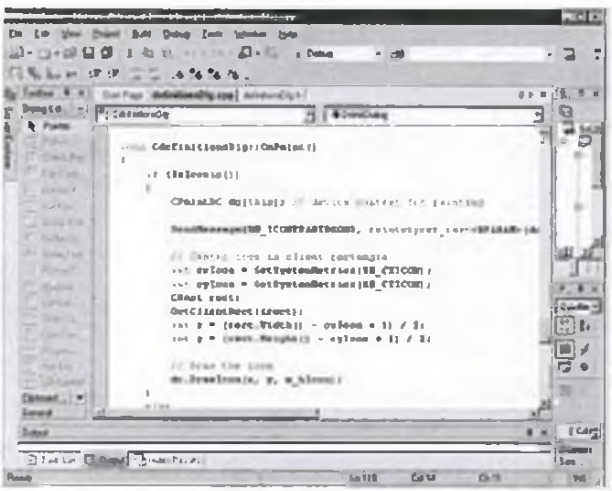


FIGURE 12B.1

The syntax of each programming language dictates the exact spacing, symbols, words, and punctuation used in the code.

Categories of Programming Languages

Hundreds of programming languages are currently in use around the world. Some are highly specialized and used in only one branch of science or industry, while others are well known and used almost everywhere. Some languages are obsolete and used only to maintain older systems, while others are so new that many programmers do not even know that they exist.

You can group programming languages in several different ways. For example, you might group them into those that use structured programming and those that do not. Or you might group them by those used in business versus those used in scientific circles. Programming languages are usually grouped, however, by their

Urheberrechtlich geschütztes Material

place in the evolution of programming languages. Based on evolutionary history, programming languages are divided into three broad categories:

» Machine languages
» Assembly languages
» Higher-level languages

Machine and Assembly Languages

Machine languages are the most fundamental of languages. Using a machine language, a programmer creates instructions in the form of machine code (1's and 0's) that a computer can follow. Machine languages are defined by hardware design. In other words, the machine language for a Macintosh is not the same as the machine language for a Pentium PC. In fact, the machine language for different Pentium versions is slightly different. A computer understands only its native machine language—the commands in its instruction set. These commands instruct the computer to perform elementary operations such as loading, storing, adding, and subtracting.

Assembly languages were developed by using short, English-like, abbreviations to represent common elements of machine code. To develop software with an assembly language, a programmer uses a text editor (a simple word processor) to create source files. To convert the source files into object code, the developer uses a special translator program, called an assembler, to convert each line of assembler code into one line of machine code. This is where the name *assembly language* comes from. Although assembly languages are highly detailed and cryptic, they are still much easier to use than machine language. About the only time programmers write programs of significant size in an assembly language is when then are concerned with the code being efficient and fast. (One example of this rule is action games, where the program's speed is critical.) Instead, programmers use assembly languages to fine-tune important parts of programs written in a higher-level language.

There is not much you can tell by looking at machine code (1s and 0s), and you would have to know a huge amount of specialized information before you could write it. Assembly code, however, is a bit less cryptic . . . but only a bit. As you can see in Figure 12B.2, assembly code uses specialized English-like phrases along with hardware-specific numbers.

ONLINE

For more information on machine and assembly languages, visit **http://www.mhhe.com/peternorton**

FIGURE 12B.2

Machine code is just 1s and 0s, but assembly code is a step closer to English.

Higher-Level Languages

Higher-level languages were developed to make programming easier. These languages are called higher-level languages because their syntax is more like human

Assembly Code

```
;CLEAR SCREEN USING BIOS
CLR: MOV AX,0600H        ;SCROLL SCREEN
     MOV BH,3E           ;COLOUR
     MOV CX,0000         ;FROM
     MOV DX,184FH        ;TO 24,79
     INT 10H             ;CALL BIOS:
:INPUTTING OF A STRING
KEY: MOV AH,0AH          ;INPUT REQUEST
     LEA DX,BUFFER       ;POINT TO BUFFER WHERE STRING STORED
     INT 21H             ;CALL DOS
     RET                 ;RETURN FROM SUBROUTINE TO MAIN PROGRAM;
; DISPLAY STRING TO SCREEN
SCR: MOV AH,09           ;DISPLAY REQUEST
     LEA DX,STRING       ;POINT TO STRING
     INT 21H             ;CALL DOS
     RET                 ;RETURN FROM THIS SUBROUTINE;
```

Machine Code

```
0001010010110101010101010101
1110111010101010101011110000
0010100101010001011110101111
1000101001011010101010101010
0110101001100010111101011111
0001000101011101010100010001
1010100101010001010111010111
0001010010110101010101010101
```


Urheberrechtlich geschütztes Material

environment for the Internet. Later, Sun added on the ability to write programs that did not run inside a browser. With Java, Web designers can create interactive and dynamic programs (called applets) for Web pages.

» ActiveX. Microsoft's answer to Java is ActiveX. ActiveX code creates self-contained functions similar to Java applets that may be accessed and executed by any other ActiveX-compatible program on any ActiveX system or network. ActiveX can create signed applications. A signed application is one that has been verified as being safe to run on a computer. At present, ActiveX is implemented on Windows 9x, Windows NT, Windows 2000, Windows XP, and Macintosh systems, and there are plans for supporting UNIX also.

Fourth-Generation Languages

Fourth-generation languages (4GLs) are easier to use than third-generation languages. Generally, a 4GL uses either a text environment, much like a 3GL, or a visual environment.

In the text environment, the programmer uses English-like words when generating source code. Typically, a single statement in a 4GL may perform the same tasks as many lines of a 3GL.

In a 4GL visual environment, the programmer uses a toolbar to drag and drop various items like buttons, labels, and text boxes to create a visual definition of an application. Once the programmer has designed the program's appearance, he or she can assign various actions to the objects on the screen. For example, a programmer may place a button on the screen and assign an action like "Open Customer table." Figure 12B.4 shows a visual development environment, in this case, Visual Basic.NET.

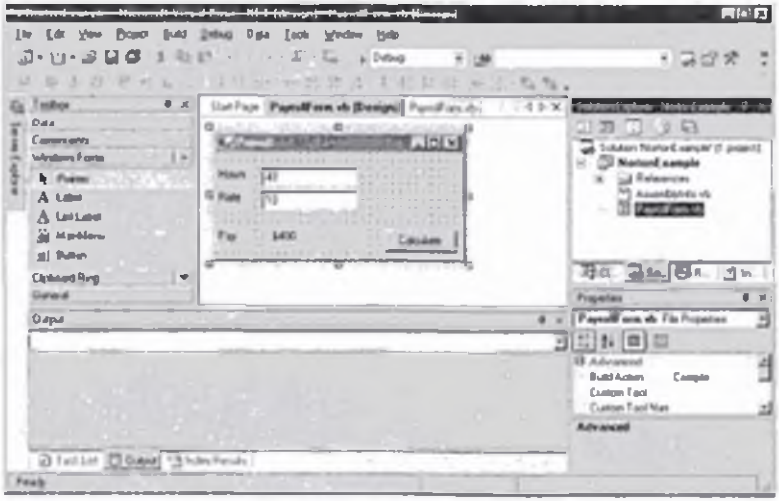
Most 3GLs and 4GLs allow the programmer to work in an integrated development environment, or IDE. IDEs provide the programmer with all of the tools needed to develop applications in one program. Compilers and run-time support for their applications are present. Microsoft's Visual Studio and Sun's Java Studio are two professional IDEs.

Fourth-generation languages include the following:

» .NET. .NET is Microsoft's newest entry into the programming arena. It combines several programming languages into one IDE. Included are Visual Basic, C++, C#, and J#. .NET is poised to be the developers' only environment. Using .NET, developers can write programs for Windows, the World Wide

FIGURE 12B.4

Creating a form using visual tools. For example, to place a box on a form, Visual Basic programmers simply drag the box from a toolbox onto the form. They can adjust the length of the box by dragging its borders.



Urheberrechtlich geschütztes Material

Web, and PocketPC. (As discussed in Chapter 6, PocketPC is a version of Windows designed for PDAs.) .NET makes authoring programs for all of these environments easier. Figure 12B.5 lists some of the application types that can be created in the Educational version of Visual Studio .NET.

» **Authoring Environments.** Authoring environments are special-purpose programming tools for creating multimedia applications, computer-based training programs, Web pages, and so on. One example of an authoring environment is Macromedia Director (which uses the Lingo scripting language). You can use it to create multimedia titles combining music clips, text, animation, graphics, and so forth. As with other visual development environments, much of the code is written automatically. However, most of the robust authoring environments also include their own languages, called scripting languages, which provide tools for added control over the final product. The programs used to create World Wide Web pages fall into another category of tools that are often lumped together with authoring environments. Some of these programs include Microsoft FrontPage, Netscape Visual JavaScript, and NetObjects Fusion.

» **Sun Studio One.** Sun Studio One is a visual editor for Java and Swing applets. An applet is a program that runs inside of a Web page. Studio One provides a complete IDE as well as several wizards to automate common tasks such as creating an applet. Studio One has an advantage over other Java environments: it is developed by Sun, the creators of Java.

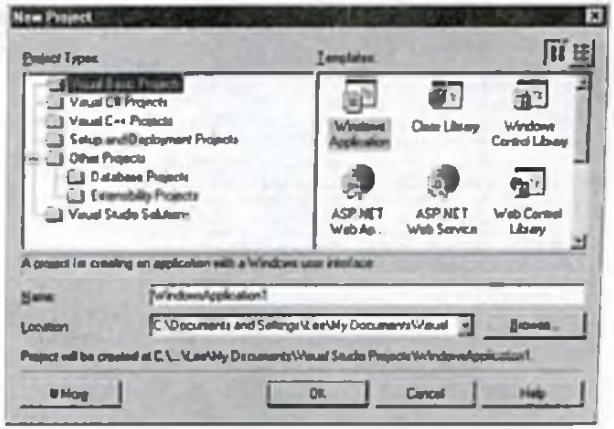


FIGURE 12B.5

Visual Studio .NET is a very flexible environment, supporting most programmers' needs.

Fifth-Generation Languages

Fifth-generation languages (5GLs) are actually something of a mystery. Depending on which expert you ask, they may or may not even agree that 5GLs exist. Some experts consider the more advanced authoring environments to be 5GLs, while others do not. In principle, a 5GL would use artificial intelligence to create software based on your description of what the software should do. This type of system is proving more difficult to invent than the code it was intended to create.

World Wide Web Development Languages

Few technology components of late have affected our culture like the Internet and the World Wide Web. The Internet has evolved from simple text-based messages to complex Web sites that are visual, interactive, and responsive. Likewise, Web-related development tools have evolved in power and capabilities. Therefore, it is impossible to talk in a contemporary context about programming and development without talking about tools that make Web development possible.

» **Hypertext Markup Language (HTML).** Hypertext Markup Language is the programming language used to create documents for the World Wide Web. Using HTML, you define a Web document's structure by using such components as attributes and tags. Tags, as you will recall from the earlier discussion of Web pages, provide links to other points of the document, to other documents on the same site, or to documents on other sites. HTML tags also are used to format a Web page's look, to position graphics and multimedia elements, and to incorporate components created in other programming languages such as Java or Flash.

Norton ONLINE

For more information on World Wide Web development languages, visit **http://www.mhhe.com/petermorton**

simnet

Urheberrechtlich geschütztes Material

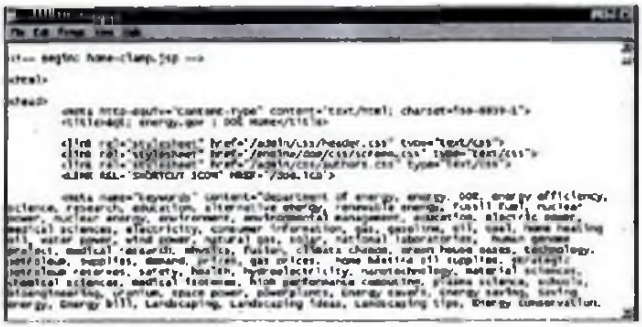


FIGURE 12B.6

An example of HTML code from the U.S. Department of Energy Web site.

Because HTML lacks several critical features of formal programming languages, such as the ability to make selections, most programmers don't feel HTML is a true programming language.To a programming novice, however, HTML can be made to do wondrous things in a Web page. One fact about HTML that makes it so easy to use is that you can write HTML code in a simple text editor (such as Notepad) or any word processing program. In fact, many word processors have an HTML option where you can save your document as HTML for placement on the Web. Many other types of common application programs, such as spreadsheets and presentation programs, also can automatically convert a standard document into HTML format, complete with hyperlinks and other navigation tools. Professional Web designers, however, usually use HTML editing programs such as Microsoft FrontPage to create Web pages. Figure 12B.6 shows an example of HTML tags in a Web document.

» **Extensible Markup Language (XML).** A next-generation Web content development language, Extensible Markup Language (XML) typically refers to a new markup language that allows developers to describe a page in such a way that one source document can be presented in several different formats such as a Web page, a printable document, and a PDF file. In structure, XML looks like HTML, but the developer is free to create new tags. XML is not a replacement for HTML. XML needs HTML and other technologies to properly display its data. Figure 12B.7 shows an XML database of multiple-choice questions. Each question has four choices. The correct tag describes which of the choices is correct; 0 is the first choice.

FIGURE 12B.7

This XML database holds multiple-choice questions. Notice that the tags are easy to understand.

```
<?xml version="1.0" ?>
- <testbank>
  - <question>
      <query>Arithmetic operations that take
        two arguments are said to be ___
        operators.</query>
      <choice1>unary</choice1>
      <choice2>binary</choice2>
      <choice3>summary</choice3>
      <choice4>boolean</choice4>
      <correct>1</correct>
    </question>
  - <question>
      <query>An if statement inside of another if
        statement is known as ___.</query>
      <choice1>nested</choice1>
      <choice2>double selection</choice2>
      <choice3>dual alternate slection</choice3>
      <choice4>ugly</choice4>
      <correct>0</correct>
    </question>
  - <question>
```

» **Extensible HTML (XHTML).** XHTML is the newer version of HTML. It is very similar in all aspects to HTML. However, the rules are more strict. HTML allows for very "loose" coding. XHTML requires that all items be "well formed." This means the developer must write perfect XHTML code every time. XHTML is becoming the standard language of Web developers.

» **Extensible Style Sheet Language (XSL).** Extensible Style Sheet Language (XSL) is one of the XML technologies. Its purpose is to display and format XML documents for HTML browsers like Internet Explorer. The XSL document is composed of several rules that dictate how the document should be formatted. Once the XML document is opened in a browser, the XSL rules are applied. The user sees only a normal HTML page. Using XSL it is relatively simple to have one XML document with several different views.

» **Extensible Markup Language Mobile Profile (XHTML MP).** In recent years, more and more people have begun using tiny devices (such as PDAs) to connect to the Internet using a wireless technology, such as cellular modems. This demand has created the need for new development environments such as Extensible Markup Language Mobile Profile (XHTML MP), formerly known as Wireless Markup Language (WML). Web designers can use WML

Urheberrechtlich geschütztes Material

to create documents that can be viewed by handheld devices such as Web-enabled cell phones, PDAs, and even digital pagers. As miniature hardware makes greater gains in display quality and bandwidth-processing capabilities, languages such as XHTML MP will become commonly used.

» **Dreamweaver.** Macromedia Dreamweaver is an HTML editor that allows the developer to visually write Web pages. Developers can use Dreamweaver to create forms, tables, and other components for HTML pages. Dreamweaver goes beyond standard HTML editors, however, by utilizing Dynamic HTML (DHTML) to add such functionality as timeline animation and absolute positioning of content. Like many HTML editors, Dreamweaver can do most of the coding tasks behind the scenes; the user does not need to know DHTML to create powerful Web pages. Figure 12B.8 shows the Dreamweaver development environment.

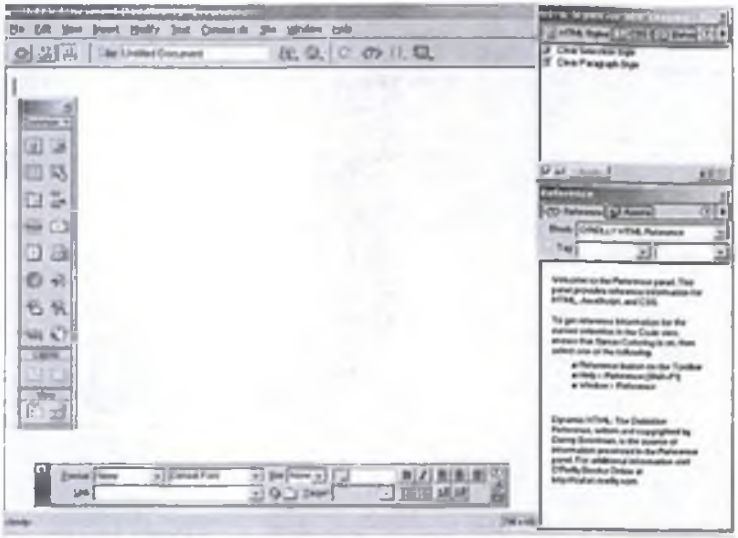


FIGURE 12B.8

The Dreamweaver development environment.

» **Flash.** Macromedia's Flash is a development tool for creating very sophisticated Web pages, which can include moving graphics, animation, sound, and interactivity. Figure 12B.9 shows a simple example of Flash in use.

» **Director.** Macromedia's Director is a full-fledged multimedia authoring environment that is part of the Macromedia Shockwave Studio suite of programs. Director gives multimedia program and Web developers the ability to create

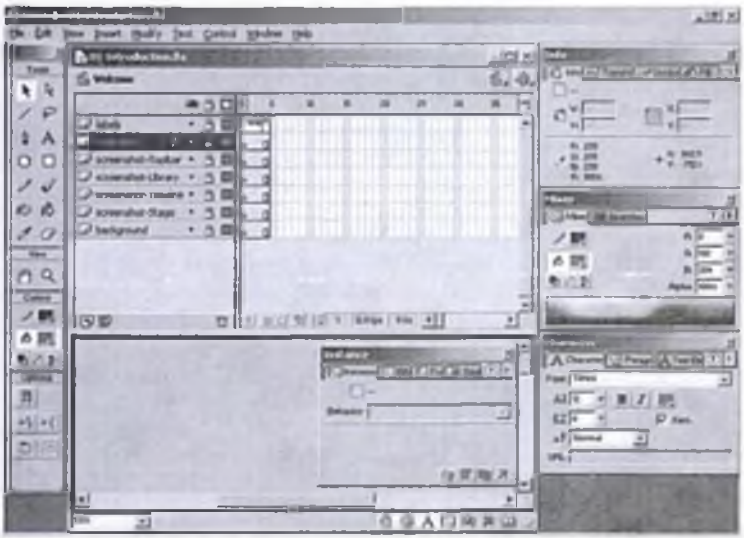


FIGURE 12B.9

The Flash 5 authoring tool in use.

Urheberrechtlich geschütztes Material

» **Active Server Pages (ASP).** Active Server Pages (ASP) is Microsoft's entry into the Web scripting arena. Based on Visual Basic, ASP is particularly good at accessing Microsoft databases. This makes it a good candidate for online storefronts. ASP can only work if the Web site is hosted on a Windows server. The most current version is ASP.NET

» **Practical Extraction and Reporting Language (Perl),** one of the first scripting languages, originating on UNIX systems as a way to automate administrative tasks. It has morphed into a Web scripting language. Perl, an open source language, is found on most UNIX/Linux–based Web providers and most Windows servers as well. Since Web sites using Perl can be hosted on both platforms, Perl is a good language for a Web developer to learn.

» **Hypertext Preprocessor (PHP).** Hypertext Preprocessor (PHP) is a very popular scripting language. It runs on UNIX/Linux or Windows servers. PHP is especially good at reading databases such as Oracle and MySQL. The compiler and code are offered to the general public as open source software, making it free to use. PHP is offered at most Web hosting sites. Like Perl, PHP is a good language for a Web developer to learn.

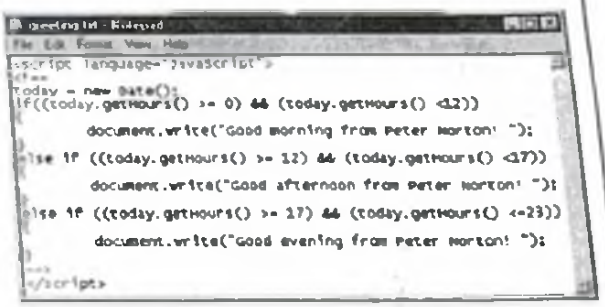


FIGURE 12B.12

The greeting changes based on the time of day.

SELF-CHECK ::

Circle the correct answer for each question.

1. All programming languages require users to follow certain rules of _____.
   a. style b. syntax c. grammar
2. The process of making object code from one system work on another type of system is called _____.
   a. porting b. designing c. developing
3. Dreamweaver goes beyond standard HTML editors by using _____.
   a. Dynamic Perl b. Dynamic XML c. Dynamic HTML

The Systems Development Life Cycle for Programming

Programs are the building blocks of information systems. When they create software products, programmers follow a process—or life cycle—that is similar to the life cycle for entire information systems. The systems development life cycle (SDLC) is detailed in. The similar software development life cycle is discussed here.

Norton ONLINE

For more information on the SDLC for programming, visit **http://www.mhhe.com/petermorton**

» **Phase 1: Needs Analysis.** Needs analysis is the stage when a need or problem is identified and understood. At this early stage, the programmer looks at the program design to see what the user needs for an interface and starting point and what the user needs the program to do. Typically, the end-user should have a lot of input in the needs analysis stage. Once the programmer has determined the program's starting and stopping points, he or she can begin to design the code.

» **Phase 2: Program Design.** Program design is the stage at which programmers begin roughing out the logic they will use when the actual coding begins. Many tools are used in the program design process, although programmers often rely on whiteboards and the backs of napkins. Three of these design tools are IPO charts (for structured programming), circles and message pipes (object-oriented programming), and pseudocode. Figure 12B.13 shows a simple set of objects and message pipes, like those a programmer might develop when designing an object-oriented program.

Urheberrechtlich geschütztes

Norton Notebook

Artificial Intelligence: Will Computers Ever Think?



Artificial intelligence (AI) can be defined as a program or machine that can solve problems or recognize patterns. A more "pure" definition of AI might be a computer or program that can fool a human into thinking he or she is dealing with another human. Such a computer could both learn and reason; thus, another definition of artificial intelligence might be a computer that can learn and reason.

Artificial intelligence software is used in many real-world applications, from determining if banks should grant loans to voice recognition and terrain-following missile guidance systems. Even applications such as word processors and e-mail make use of AI concepts. For example, a word processor's grammar checker attempts to understand and correct a language concept that most users cannot fully explain themselves. Regardless of the actual task, artificial intelligence is used in two basic areas:

» **Problem Solving.** In problem solving, the artificial intelligence program must look at a problem or collection of data and determine what to do next. For example, a bank may use an artificial intelligence system to look at your credit history and lifestyle before deciding whether or not to lend you money. This type of system is called an expert system.

» **Pattern Recognition.** In pattern recognition, the artificial intelligence program must look for repeated or known occurrences of data. Examples include artificial vision and speech recognition.

Of course, many artificial intelligence programs combine elements of both areas to solve a problem. For example, a data compression utility must look for repeated patterns in the data and then decide how to rewrite the data to eliminate the duplications.

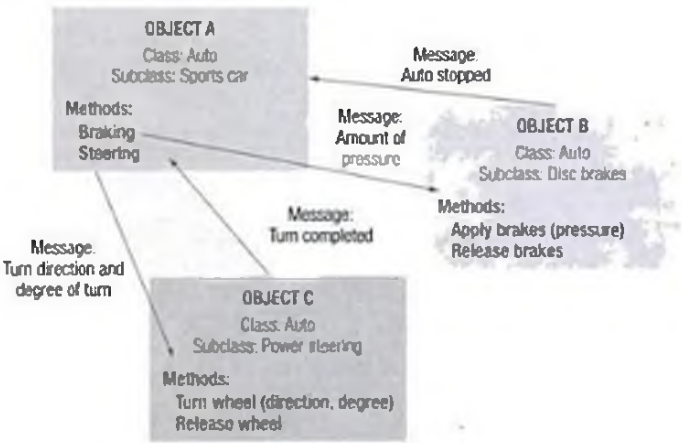
Some Examples of AI Techniques

Artificial intelligence may be applied in many different ways depending on the problem to be solved and the resources available. Some common techniques include the following:

» **Decision Trees.** These software guides are simply maps that tell the computer what to do next based on each decision it makes. Each decision leads to a new branch with new decisions and consequences.

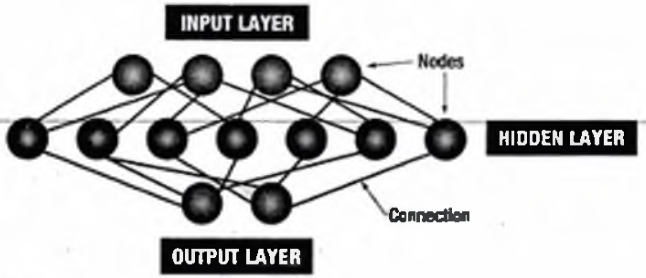
FIGURE 12B.13

In the design phase, object-oriented programmers use objects and message pipes to design their programs.



» **Phase 3: Development.** Development (also called coding) involves writing and testing source code. The software development phase is similar to the system life cycle's development phase, but instead of determining the system's overall layout, the programmer writes the code that implements the user's requirements. The programmer might write source code in a text editor and

Urheberrechtlich geschütztes Material



Neural networks are modeled after real neural connections in the human brain.

» **Rules-Based Systems.** These systems work by following a set of rules given by the programmer. So long as the programmer has anticipated every possible circumstance that the program may encounter, it can solve any problem.

» **Feedback.** This technique is used to modify programs. Basically, a feedback system monitors the results of a solution to see if the solution worked or in what areas it failed.

» **Knowledge-Based Systems.** These systems are similar to a rules-based system, but they use feedback to learn from their mistakes. As a result, knowledge-based systems can actually learn to solve new problems.

» **Heuristics.** This software technique is something like a recipe for a problem-solving approach rather than an algorithm that solves a specific problem.

Building an Artificial Brain

To create a true artificial intelligence, scientists could try building an artificial brain called a neural network. The human brain consists of billions and even trillions of neurons, each with as many as a million connections to other neurons. Scientists have identified hundreds of different types of neurons and more than 50 different patterns of neuron connections. This level of complexity is simply beyond any computer currently in existence. Even the most powerful parallel computers with tens of thousands of processors do not come close to equaling the number or variety of connections in a human brain.

then compile the code, or he or she may use a visual editor and create a picture of the application before compiling the code. Most of the effort required to complete a program is spent in this phase using the programming languages you have been learning about.

Despite their best efforts, programmers inevitably create errors, or bugs, in their programs. There are two main types of errors: syntax errors and logic errors. Syntax errors violate the rules of the programming language. Finding syntax errors is relatively easy because the compiler or interpreter will point them out to the programmer. Logic errors, actual mistakes in the algorithm, are more difficult to find and may not even show up until weeks or months after the program has been implemented. The process of identifying and eliminating these errors is called debugging. Figure 12B.14 shows a list of syntax errors found by a C++ compiler. You can see by their cryptic nature that the programmer has to have some special knowledge to understand the errors and fix them.

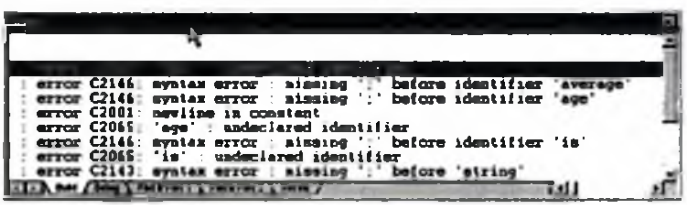


FIGURE 12B.14

Compilers help programmers locate and fix syntax errors.

Urheberrechtlich geschütztes Material

Computers In Your Career

Careers in Programming

In Douglas McDowell's world, a few simple keystrokes will tweak an application or software program and make a client's eyes light up, knowing that his or her technology problems are solved. A principal consultant with IT consulting firm Intellinet in Atlanta, McDowell works one-on-one with customers, using his programming and business intelligence expertise to create technology solutions.

"As a programmer, I'm solving problems that bring high value to companies almost instantaneously," says McDowell, a professional chef who graduated from Wheaton College and earned his Masters in information technology. He changed careers after a back injury sidelined his restaurant career and says he was drawn to the analytical problem solving and business problem evaluation that a career in programming served up.

McDowell spends his 10-hour days handling the project management side of database development by working one-on-one with Intellinet's clients. He first conducts business analysis to figure out what technology the company already has in place and how he can create and integrate new systems or solutions that will help the infrastructure run more productively.

One of McDowell's recent projects involved a network monitoring a data warehouse for a cable company. The project earned Intellinet a Certified Partner Award for business intelligence solution using Microsoft technologies.

"It's a matter of understanding what they need from an application or solution that I will build, and figuring out what problem it needs to solve," says McDowell, whose certifications include .NET architecture and development; Windows, Windows Exchange, Security, and Systems; business intelligence with a focus on SQL Server; MCP; and MCSE. "Then, I complete the solution according to those requirements."

The growth in the economy and the popularity of graphics games and the Internet are driving a programming boom. Not only are programming jobs available, but also they are getting more and more interesting. Programming jobs tend to be grouped into the following broad categories:

» **Scientific Programmer.** These programmers use a specialized knowledge of science and engineering to develop high-tech programs. Scientific programmers work in fields like aerospace engineering, meteorology, oceanography, and astronomy.

» **Phase 4: Implementation.** Implementation involves installing software and allowing users to test it. This step often includes a lot of documenting, both inside the code and in the form of manuals for the users. Many programmers also will tell you that they do most of their debugging at this stage. Certainly the implementation stage is when any misconceptions the programmer had about the code are found and fixed.

» **Phase 5: Maintenance.** Maintenance starts as soon as the program is installed. Work continues on products for several reasons. Some minor bugs may not have been fixed at the time the program was released. The programmers also may add major new functioning, in response to either market demands or user requests. This is the longest phase of the program development life cycle, sometimes spanning many years.

Urheberrechtlich geschütztes Material



- **Business Programmer.** Almost every business has a need for computers, and every computer needs programs. Thus, there is a strong demand for programmers who combine a knowledge of programming with a knowledge of business operations.
- **Operating System Programmer.** Of course, every computer and computer-controlled machine needs an operating system and some kind of programmed control. In some cases, such as PCs, the programmers develop operating systems like DOS, Windows, or UNIX.
- **Entertainment Programmer.** Game programmers develop everything from educational software to video games. In every case, the programmers must combine a strong knowledge of game theory with graphics and multimedia programming.
- **Web Programmer.** The World Wide Web has created a whole new programming field. Naturally, the existence of the Web has created a demand for HTML and Java programmers. However, the Web also fuels a demand for programmers who can develop tools that allow the Web to provide multimedia content. Because the Web is still in its infancy, no one can predict what Web content is likely to develop or what will be popular and what will fail.

The Bureau of Labor Statistics expects the programming field to grow about as fast as the average for all occupations through 2010, with jobs for both systems and applications programmers most plentiful in data processing service firms, software houses, and computer consulting businesses. Median annual earnings of computer programmers were $57,590 in 2000, with the middle 50 percent earning between $44,850 and $74,500 a year.

Urheberrechtlich geschütztes Material

Summary ::

- The only real computer language is machine language, which is a series of 1s and 0s that is understood by computers but meaningless to people.
- Programming languages can be placed into one of three basic categories: machine languages, assembly languages, and high-level languages.
- Higher-level languages allow the programmer to create programs using English-like words and phrases. Some fourth-generation languages include visual environments that allow the programmer to draw a program's interface and then assign actions to the interface's components.
- Many newer development environments have been created for Web design and multimedia programming, and some are very sophisticated. These range from basic HTML editors to feature-rich multimedia environments like Flash and Director, which allow the developer to merge animations and sound with interactive elements.
- Pure HTML creates static Web pages. Dynamic pages are created by using a scripting language like JavaScript or Perl.
- XML is a series of technologies that allow the storage and view of data on Web pages. XML holds the data. XSL and its subsets format the document for view.
- When creating software programs, developers follow a development cycle that is modeled on the systems development life cycle used in information systems development. The software development life cycle is broken into the same five stages.
- Needs analysis is the stage when a need or problem is identified or understood.
- During program design, programmers use pseudocode and message pipes to plan the programming process.
- Program development includes writing and testing the actual software code, compiling or interpreting, and debugging.
- During the implementation phase, the software is installed and users are allowed to test it.
- After implementation, the maintenance phase begins. During this stage of the software development life cycle, programs are maintained with bug fixes and updates.

Urheberrechtlich geschütztes Material

Key Terms ::

Active Server Pages (ASP), 465
applet, 460
assembler, 458
assembly language, 458
bug, 467
Director, 463
Dreamweaver, 463
dynamic, 464
Extensible Markup Language (XML), 462
Extensible Markup Language Mobile Profile (XHTML MP), 462
Extensible Stylesheet Language (XSL), 462
fifth-generation language (5GL), 461
first-generation language, 458
Flash, 463
fourth-generation language (4GL), 460
higher-level language, 458
Hypertext Preprocessor (PHP), 465
integrated development environment (IDE), 460
JavaScript, 464
logic error, 467
.NET, 460
Perl, 465
port, 459
portable, 459
second-generation language, 458
static, 464
syntax, 457
syntax error, 467
third-generation language (3GL), 458
Wireless Markup Language (WML), 462

Key Term Quiz ::

Complete each statement by writing one of the terms listed under Key Terms in each blank.

1. In historical terms, assembly languages are referred to as _____ languages.
2. A(n) _____ is a mistake that can cause a program to run in an unexpected or incorrect way.
3. Animation for Web sites is often handled using Macromedia _____ .
4. _____ languages are so called because their syntax is closer to human language than either machine or assembly language.
5. The XML technology _____ is designed to format XML documents for display on the Web.
6. The newer version of WML is _____ .
7. Initially developed by Netscape, _____ allows scripting within the HTML document.
8. Microsoft's entry into the Web scripting market is _____ .
9. Visual Studio .NET and Dreamweaver are examples of an _____ , which simplifies the development of a program or Web site.
10. The _____ language is especially good at developing Web sites from databases.

Urheberrechtlich geschütztes Material

Multiple Choice ::

Circle the word or phrase that best completes each statement.

1. The newest version of HTML is _____.
   a. WML b. XHTML c. XML d. XSL
2. _____ are seldom used except to fine-tune important parts of programs written in a high-level language.
   a. Compilers b. Assembly languages c. Interpreters d. Front ends
3. C++ and Java are examples of _____ languages.
   a. first-generation b. third-generation c. fourth-generation d. fifth-generation
4. _____ programming languages use familiar words rather than the detailed strings of digits that make up machine instructions.
   a. Machine b. Assembly c. Higher-level d. All
5. Programmers begin roughing out the logic they will use in the _____ stage of the software SDLC.
   a. program design b. development c. implementation d. testing
6. Which of the following is a language that is commonly used to write .cgi scripts for web pages?
   a. JavaScript b. C++ c. Visual Basic d. Perl
7. Applets for the Web are written in the _____ language.
   a. Java b. .NET c. PHP d. C++
8. In a 4GL _____ environment, the programmer uses a toolbar to drag and drop items like buttons and text boxes to create a definition of an application.
   a. visual b. text c. scripting d. coding
9. _____ looks like HTML, but the developer is free to create new tags.
   a. Perl b. XML c. Java d. CGI
10. This product is an IDE for Java.
    a. Visual Studio b. Netscape Visual JavaScript c. Macromedia Director d. Sun Studio One

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. What is meant by "porting" code from one type of computer system to another?
2. How do XML and HTML work together?
3. Describe the disagreement that some programmers have, regarding fifth-generation programming languages.
4. What are the five phases of the systems development life cycle as applied to software development?
5. What happens during the implementation phase of the software SDLC?
6. Describe the difference between HTML and XHTML.
7. Why is object-oriented programming considered to be a very natural manner of programming?
8. What would a developer build using PHP?
9. What are the keys to being a successful programmer?
10. How does an IDE make it easier for a developer to write a program?

Lesson Labs ::

Complete the following exercises as directed by your instructor.

1. Using a text editor like Notepad (or a piece of paper) and the given commands, write a pseudocode algorithm that goes through a short list of numbers and places all the even numbers into one list and all the odd numbers in another list. Use the following commands: While, get number, if/then/else, put number in even list, put number in odd list.
2. Using Notepad (or another piece of paper), review the pseudocode you created in the first exercise and create documentation to explain what the pseudocode does. Remember, the more documentation you add, the easier it will be for others to understand your logic.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercise using a computer in your classroom, lab, or home.

1. Create a Web page trick. Web pages can be filled with lines of simple code that create special effects or cause the page to behave in certain ways. In many cases, you do not need to be a programmer or even use a real programming language to build "tricks" into a Web page. This exercise shows you an example of a cool trick you can add to any Web page by typing a few lines of code. It may not be actual programming, but you will feel like a programmer when you're done. In the following steps, you will create a small HTML page that displays the word *mhhe*. What is the trick? When you view the page in a browser, and your mouse pointer touches the text, the word *mhhe* will change color and font and the background color behind the text will also change. Once you create the file, you will test it in your Web browser. (*Note:* This exercise assumes that you use Microsoft Internet Explorer 5.0 or later, or Netscape Navigator 5.0 or later. If you use an older version of either browser, the mouseover may not work.)
   a. Open Notepad and type in the following code, exactly as shown here, including the blank spaces:

```
<html>
<head>
<title>Mouse Rollover</title>
</head>
<body>
<p>
<a href="http://www.mhhe.com">mhhe</a></p>
</body>
</html>
```

   b. Save the file as Test.html in any folder you like.
   c. Launch Internet Explorer or Netscape Navigator and open the Test.html file. You should see the word *mhhe* on your screen.
   d. Click mhhe and watch your screen change to the mhhe Online Web site.
   e. Now we will insert the code to write the rollover trick. Position your cursor on the line between </title> and </head>. Enter the following code exactly as it appears here.

```
<style>
<!-
a: link  {
font-family: arial, sans-serif;
font-weight: normal;
          }
a:hover {
color:#FF0000;
background:#00FF00;
font-family: arial, sans-serif;
font-weight: bold;
          }
-->
</style>
```


Urheberrechtlich geschütztes Material



CHAPTER 13

Protecting Your Privacy, Your Computer, and Your Data

CHAPTER CONTENTS ::

This chapter contains the following lessons:

Lesson **13A:**
Understanding the Need for Security Measures

- Basic Security Concepts
- Threats to Users
- Threats to Hardware
- Threats to Data

Lesson **13B:**
Taking Protective Measures

- Protecting Yourself
- Keeping Your Data Secure
- Safeguarding Your Hardware



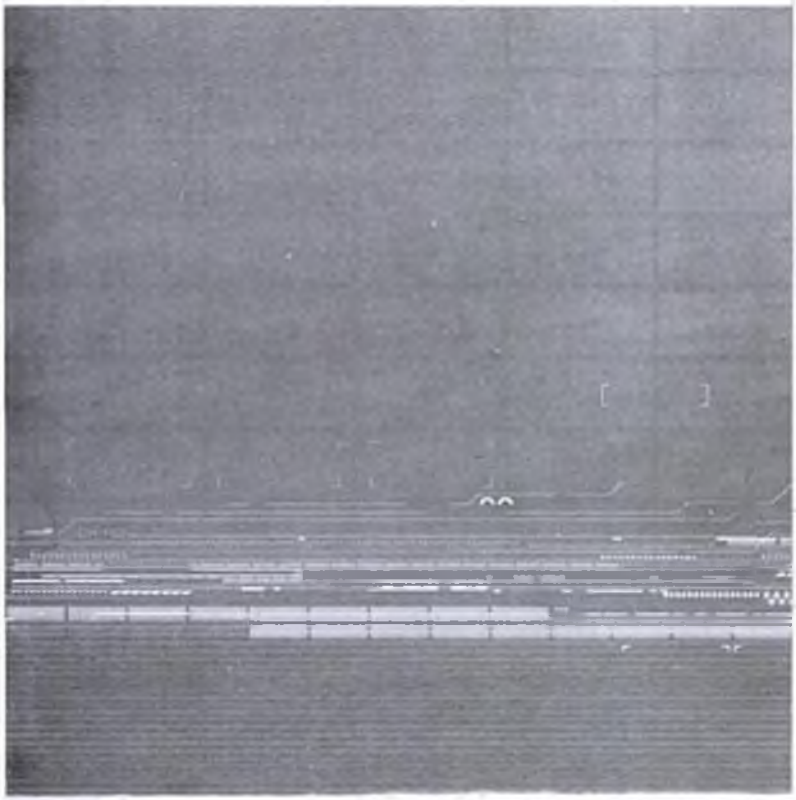
Understanding the Need for Security Measures

Overview: The Need for Computer Security

While reading this book, you have discovered how important computers and their contents are to everyone. Safeguarding your computer and its valuable information is important. Just imagine what your life would be like if all your financial records, schoolwork, and personal correspondence were suddenly changed, destroyed, or made public. What would you be willing to do to prevent this from happening?

You are aware that cars are stolen every day, so you probably take measures such as locking the doors, parking in a garage, or using a car alarm. In the same way, you should be aware of the threats facing your computer and data, and take measures to protect them as well. By taking some precautionary steps, you can safeguard not only your hardware, software, and data, but yourself.

The first step to good computer security is awareness. You should understand *all* the dangers that specifically threaten your computer system. You need to know how each threat can affect you and prioritize them accordingly. This lesson introduces you to some of the most common threats to your privacy, data, and hardware. The following lesson shows you how to protect yourself and your system.



OBJECTIVES ::

- Define the terms *threat*, *vulnerability*, and *countermeasure* in the context of computer security.
- Describe four specific threats that computer users face.
- Describe three specific threats to computer hardware.
- Describe three specific threats to data.

Urheberrechtlich geschütztes Material



FIGURE 13A.1

A vacant house with an open window is not only vulnerable to threats, but invites them. Is your home burglar-proof?

Basic Security Concepts

You will see certain terms throughout this chapter, so it is best to become familiar with them before going any further.

Threats

The entire point of computer security is to eliminate or protect against threats. A threat is anything that can cause harm. In the context of computer security, a threat can be a burglar, a virus, an earthquake, or a simple user error.

By itself, a threat is not harmful unless it exploits an existing vulnerability. A vulnerability is a weakness—anything that has not been protected against threats, making it open to harm (see Figure 13A.1). For instance, an unlocked car is vulnerable to theft. The vulnerability is meaningless unless a thief is in the neighborhood. But you probably always lock your car or park it in a safe place anyway . . . just in case a thief should happen to come along.

Degrees of Harm

That said, it's important to realize that threats, and the harm they can cause, are a matter of degree. If you live on top of a mountain, for example, there is probably no threat of flooding. If you don't use antivirus software, however, there is a very good chance that your computer will become infected, especially if it stays connected to the Internet. Because you can gauge the degree of harm that different threats can cause, you can prioritize them. That is, you can decide which threats are more likely to "get you" and take precautions against them.

When people think of the ways their computer system can be damaged, they may think only of damage to the hardware or the loss of data. In reality, computer systems can be damaged in many ways. And remember, as you learned in Chapter 1, you (the user) are part of the computer system. You, too, can suffer harm of various kinds, from the loss of important data, to the loss of privacy, to actual physical harm.



FIGURE 13A.2

If your home were to catch fire, what would happen to your important data? How can you protect data from a fire or flood?

When protecting your computer system, it pays to think in the broadest possible terms about the types of harm that could affect you. A nasty virus or hacker can wipe out your programs as well as your data. If your PC is connected to a network, other systems on the network could suffer similar problems. Damages to your home or office—such as a fire or flood—can easily extend to your computer and everything stored on it (see Figure 13A.2).

Countermeasures

A countermeasure is any step you take to ward off a threat—to protect yourself, your data, or your computer from harm. For example, regularly backing up your data is a countermeasure against the threat of data loss. A firewall is a countermeasure against hackers.

There are two classes of countermeasures. The first shields the user from personal harm, such as threats to personal property, confidential information, financial records, medical records, and so forth. The second safeguard protects the computer system from physical hazards such as theft, vandalism, power problems, and natural disasters or attacks on the data stored and processed in computers.

Urheberrechtlich geschütztes Material

The thief wins when he finds items that have account numbers or personal information.

Some ID thieves are brazen enough to swipe documents right out of your mailbox. Some of the most important documents you use come to you in the mail every month: bills, account statements, credit card offers, financial records, and many others. On a good day, a thief could snag everything he needs right from your mailbox.

» **Social Engineering.** This method is not as sophisticated as it sounds, but can still be effective. In social engineering, the ID thief tricks victims into providing critical information under the pretext of something legitimate. The thief can call an unwary victim, for example; claim to be a system administrator at the Web site of the victim's bank; and ask for the victim's user ID and password for a system check. With this information in hand, the thief can go online and access the victim's account information directly through the bank's Web site.

» **High-Tech Methods.** Sophisticated ID thieves can get information using a computer and Internet connection. For instance, Trojan horses can be planted on a system or a person's identity may be snagged from unsecured Internet sites. Although nor common, it happens. One reason it is not common is because of the general use of security technologies such as Secure Sockets Layer (SSL) and Secure HTTP (S-HTTP) to ensure the integrity and confidentiality of credit card and financial transactions. Because so much attention is paid to protecting transmitted data, social engineering and low-tech swindles are the predominant sources of identity theft.

Loss of Privacy



FIGURE 13A.5

Many of the purchases you make are logged in corporate databases.

Did you know that your buying habits are tracked electronically, in a range of commercial systems? This doesn't apply just to online transactions either. Any time you use a "store loyalty" card to rent movies or buy groceries, the purchases are logged in a database (see Figure 13A.5). Your medical, financial, and credit records are available to anybody authorized to view them.

Many of the companies you deal with every day—from your local supermarket to your insurance company—maintain databases filled with information about you. You might expect these firms to know your name and address, but you might be surprised to learn that they know how many times each month you put gas in your car or buy a magazine. And a lot of companies do not keep this information confidential; they may sell it to other companies who are interested in knowing about you.

Personal information is a business commodity that supports a huge shadow industry called data mining. Data mining is a business-intelligence-gathering process that every large organization, from banks to grocery stores, employs to sift through computerized data. Companies spot useful patterns in overall behavior to target individuals for special treatment. Data mining is a $200-million-a-year industry, and it is growing rapidly because it pays big dividends.

Public Records on the Internet

Your personal information is available to anybody who has the few dollars required to buy it from commercial public record services. For a minimal price, companies such as Intelius and WhoWhere.com will give you detailed reports about most people. These reports contain such detailed information as

» **Criminal records,** including sex offender registry, felonies, misdemeanors, and federal and county offenses

Norton ONLINE

For more information on accessing public records, visit **http://www.mhhe.com/petemorton**

Urheberrechtlich geschütztes Material

» **Background information, including marriage records, divorce records, adoption records, driving records, credit history, bankruptcies in the past 20 years, tax liens, small claims, past address history, neighbors, property ownership, mortgages, and licenses.**

Records such as marriage licenses and divorce records are public records. This means that they, along with many other kinds of legal records, are available to anybody who wants to view them. There are a number of companies that collect public records, package them, and sell them to anyone who wishes to purchase them (see Figure 13A.6).



FIGURE 13A.6

You can obtain background information on most people in the United States by accessing an Internet public records source.

Internet Monitoring, Profiling, and Spying

When using the Internet, you should be aware that your interests and habits are being monitored automatically (see Figure 13A.7). The monitoring activity can be carried out by programs running on your own computer or a connected server. This might not seem to be a problem since "if you aren't doing anything wrong you have nothing to fear." However, the interpretation of why you visit a particular site is in the eye of the beholder. You may not be aware of how your browsing habits are interpreted by others. A single visit to one of the ubiquitous advertiser banner ads at the top of your browser identifies you as someone with an interest in related products.

Data about when you visited, what you looked at, and how long you stayed is used by most commercial Web sites. Use of this data is called "online profiling" and is done to build a profile of your interests and habits. It is analyzed to learn more about you. There are commercial profiles for most people in the United States based on the browsing activity of a particular IP address. This address is tied to the name of the owner of that address no matter who is doing the actual browsing. The reports contain information about browsing habits and may contain accompanying marketing conclusions, called psychographic data. This data makes guesses about who you really are based on your surfing behavior and elaborate inferences are drawn about your interests, habits, associations, and other traits. These guesses are available to any organization willing to pay for access to the profile. Online marketers, commercial information service providers, and, in some cases, federal agencies may have access.



FIGURE 13A.7

Even if your online activities are completely innocent, they may be tracked. This tracking allows companies to build profiles of your interests, so they can market products in ways that are most likely to interest you.

Online Spying Tools

Software developers have created a number of ways to track your activities online. Although many of these tools were created for benign purposes—such as helping legitimate Webmasters determine who visits their sites most often—they are also being used in ways most consumers do not appreciate. These tools are described in the following sections. In the next lesson, you will learn some techniques for managing these threats to your privacy.

Cookies

A cookie is a small text file that a Web server asks your browser to place on your computer. The cookie contains information that identifies your computer (its IP address), you (your user name or e-mail address), and information about your visit to the Web site. For instance, the cookie might list the last time you visited the site, which pages you downloaded, and how long you were at the site before

Norton ONLINE

For more information on online spying tools, visit **http://www.mhhe.com/petermorton**

Urheberrechtlich geschütztes Material

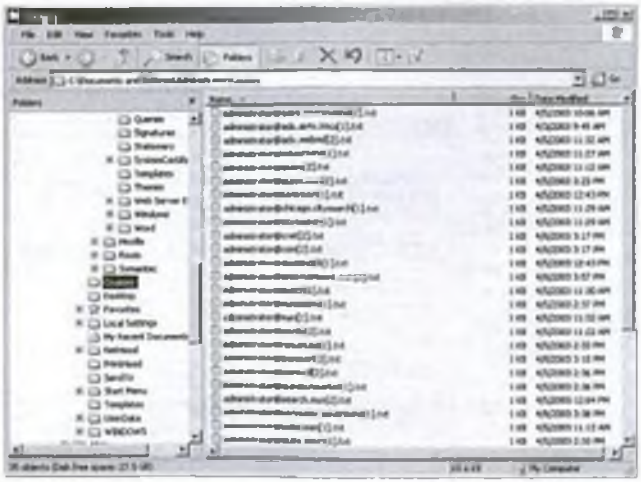


FIGURE 13A.8

A collection of cookies on a typical PC. Windows actually stores copies of cookies in several different folders, making it difficult to find them all. This is why you need special software to manage them.

leaving. If you set up an account at a Web site such as an e-commerce site, the cookie will contain information about your account, making it easy for the server to find and manage your account whenever you visit.

Despite their helpful purpose, cookies are now considered a significant threat to privacy. This is because they can be used to store and report many types of information. For example, a cookie can store a list of *all* the sites you visit. This data can be transferred to the site that placed the cookie on your system, and that information can be used against your wishes. For example, the cookie's maker might use the cookie to determine what kinds of advertisements will appear on your screen the next time you visit the Web site. Many Webmasters use information from cookies to determine the demographic makeup of their site's audience. Even worse, cookies can be used as the basis of hacker attacks.

At any time, your PC may be storing hundreds or thousands of cookies (see Figure 13A.8). If you could examine them, you probably would decide that you didn't want to keep many of them on your system. For this reason, tools have been developed to help users manage cookies and limit the damage they can do.

Web Bugs

A Web bug is a small GIF-format image file that can be embedded in a Web page or an HTML-format e-mail message. A Web bug can be as small as a single pixel in size and can easily be hidden anywhere in an HTML document.

Behind the tiny image, however, lies code that functions in much the same way as a cookie, allowing the bug's creator to track many of your online activities. A bug can record what Web pages you view, keywords you type into a search engine, personal information you enter in a form on a Web page, and other data. Because Web bugs are hidden, they are considered by many to be eavesdropping devices. Upon learning about Web bugs, most consumers look for a way to defeat them. A number of anti–Web bug programs now exist.

Spyware

The term spyware is used to refer to many different kinds of software that can track a computer user's activities and report them to someone else. There are now countless varieties of spyware programs. Another common term for spyware is adware, because Internet advertising is a common source of spyware.

Some types of spyware operate openly. For example, when you install and register a program, it may ask you to fill out a form. The program then sends the information to the developer, who stores it in a database. When used in this manner, spyware-type programs are seen as perfectly legitimate because the user is aware that information is being collected.

More commonly, however, spyware is installed on a computer without the user's knowledge and collects information without the user's consent. Spyware can land on your PC from many sources: Web pages, e-mail messages, and pop-up ads are just a few. Once on your machine, spyware can track virtually anything you do and secretly report your activities to someone else. Spyware can record individual keystrokes, Web usage, e-mail addresses, personal information, and

Urheberrechtlich geschütztes Material

other types of data. Generally, the program transmits the collected data via e-mail or to a Web page.

The average computer user may have a dozen or more spyware programs on his or her PC at any given time, according to some reports (see Figure 13A.9). This means that any number of companies can be using spyware to track your online activities. For this reason, anti-spyware software development has exploded, with dozens of spyware-killing products on the market.



FIGURE 13A.9

Cleaning spyware applications from a PC with X-Cleaner, a spyware-removal tool.

Spam

Although the availability of your private information might be troubling, the consequence for most users is something called spam. Spam is Internet "junk mail." After all, your e-mail address is often included in the personal information that companies collect and share. The correct term for spam is unsolicited commercial e-mail (UCE). Almost all spam is commercial advertising (see Figure 13A.10). According to reports filed with Congress in early 2004, about two-thirds of all e-mail traffic was spam messages. In the United States, nearly 80 percent of all e-mail was spam.

You might think that the answer to spam e-mail is simple: just delete the messages when they arrive. But for many computer users, spam is much too big a problem for such a simple solution. Some people receive dozens, even hundreds, of spam messages daily. The problem is huge for businesses, where corporate e-mail servers needlessly store and transfer countless spam messages each month. At the personal level, spam recipients spend time reviewing unwanted messages, in fear they may accidentally delete legitimate mail. This alone costs untold hours of wasted time. The real solution to spam, therefore, is to control it before it reaches all the people who don't want it.

Defining spam is important to controlling it. One person's important message, after all, is another person's spam. This difference makes it hard to establish a legal basis for prevention. Since 2003, the legally accepted definition of the characteristics of spam is commercial e-mail, bulk transmitted to millions of people at a time. The volume and the fact that each message contains substantially the same content define spam.

People who send out these endless streams of spam (spammers) get e-mail addresses in three ways:

- Purchasing lists of e-mail addresses through brokers.
- "Harvesting" e-mail addresses from the Internet.
- Generating random strings of characters in an attempt to match legitimate addresses.

Norton ONLINE

For more information on spam, visit http://www.mhhe.com/petermorton

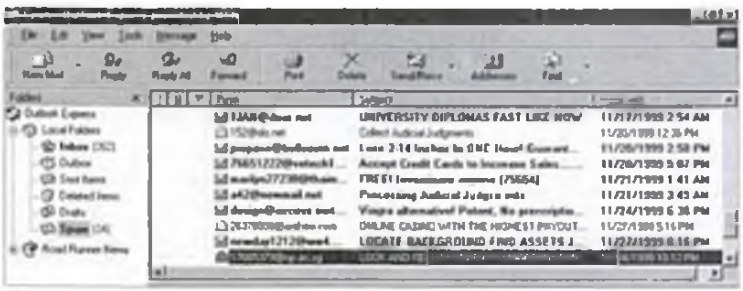


FIGURE 13A.10

A collection of spam messages. For millions of computer users, spam is a vexing, daily problem that robs them of productive time.

Urheberrechtlich geschütztes Material

FIGURE 13A.11

You can learn more about anti-spam laws and citizen movements by visiting anti-spam Web sites such as The SpamCon Foundation's site, at http://spamcon.org.



The U.S. law regulating spam is the Controlling the Assault of Non-Solicited Pornography and Marketing Act of 2003, or the CAN-SPAM Act of 2003 (see Figure 13A.11). It took effect on January 1, 2004, and is based on the concept of affirmative consent. This means that the recipient of the message must give explicit consent to receive a commercial e-mail message. Under this law, it is illegal to

- Send a commercial e-mail message with header information that is false or misleading (such as a subject line that does not state the message's true purpose).
- Spoof the originating address, or relay a message from another computer in order to disguise its point of origin. Spoofing is a social engineering term that describes an attempt by the sender of the message to convince the recipient that the message is from someone else.
- Not clearly identify that the message is an advertisement or solicitation.

The message must provide a conspicuous opportunity to decline further messages. If the recipient declines additional messages, it is illegal to send one that falls within the scope of the request. It is illegal for anyone acting on behalf of the sender to send such a message or for the sender to transfer the address to anybody else.

Computer-Related Injuries

Computer use can cause physical injuries to the user. Prolonged mouse and keyboard use, staring at a monitor for too long, and poor seating conditions are the primary causes of such injuries. For more information on specific computer-related ailments and ways to avoid them, see Chapter 2, "Interacting with Your Computer," and Chapter 3, "Seeing, Hearing, and Printing Data."

Threats to Hardware

Threats to your computer's hardware involve incidents that have an effect on the operation or maintenance of the computer. They range from such routine things as system breakdown and misuse to malicious actions of individuals including theft and vandalism of the equipment. Disasters such as fire and flood are also threats.

Urheberrechtlich geschütztes Material

Productivity Tip

Keeping Your PC Up to Date

Because PC hardware and software are becoming increasingly complex, it is becoming increasingly important to do regular maintenance on them. At the very minimum, this means defragmenting your hard disk, checking for viruses, and performing other basic housekeeping chores to keep your machine humming along. You learned several of these techniques in Chapter 5, "Storing Data." But routine system maintenance includes another step that many users ignore: updating important system and program files.

By making sure that your system software is kept up to date, you reduce the risk of system failures and keep your programs running as well as possible. Device drivers provide a good example. Suppose you update your operating system, then your CD-ROM drive begins functioning poorly. You might be able to fix this problem by installing an updated device driver that is more compatible with your new OS.

Fortunately, you don't need to call a PC technician (or become one yourself) to update critical system files. Thanks to a new breed of automated Web sites, you can sit back and let your PC update itself.

If you are a registered user of Microsoft Windows or Microsoft Office, for example, you can visit Microsoft's product update Web sites and download bug fixes, patches, updated system files, templates, security-related files, and much more. You can visit the Windows Update site at http://windowsupdate.microsoft.com. You can find the Office Update site at http://officeupdate.microsoft.com.

Users of Windows 2000 and Windows XP can configure their operating system to automatically update files. These versions of Windows can find and install updates in the background, whenever the PC is connected to the Internet.

Companies such as Symantec (http://www.symantec.com/downloads), McAfee (http://software.mcafee.com/centers/download/default.asp), and other makers of popular antivirus software and utility programs host product-update sites, too. At these sites, users can download up-to-the-minute versions of virus databases, utilities, drivers, and other products. This updating is extremely important; without the latest virus definitions, your

systems are a good investment, as well, especially when expensive equipment and priceless data are at stake.

Accidental harm is much harder to address, but no less of a threat. Something as simple as spilling a cup of coffee into your system unit provides a spectacular example. This is why most computer rooms have a sign saying "no food or drinks." There are so many ways a human can accidentally damage a computer that it is pointless to attempt to list them all. However, a sound set of safety procedures can handle the typical ones. These procedures are formulated from a thorough threat analysis, conducted under the dictates of Murphy's Law—"whatever can go wrong, will go wrong."

Natural Disasters

Norton ONLINE

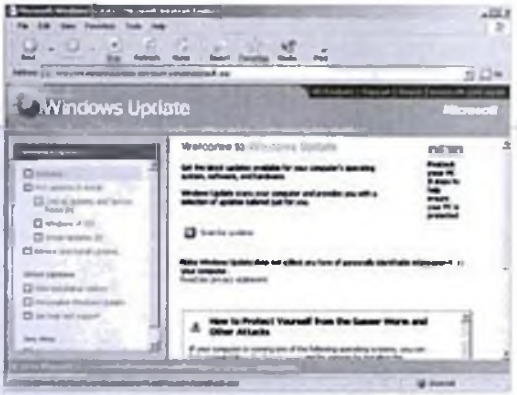
For more information on coping with natural disasters, visit http://www.mhhe.com/petermorton

Disaster planning addresses natural and man-made disasters. It is not called "disaster prevention" because things like earthquakes and hurricanes are hard to predict and impossible to prevent. However, you can plan for them. A well thought-out plan can minimize the loss of information and interruption of work should a disaster occur.

Because natural disasters vary by location, your first step is to make a list of all of the disasters that you think could happen in your area, then prioritize that list. For instance, no matter where you live, fires at home are more likely to happen than tornados. Even though tornados are more destructive, you should have plans for handling the more frequent disasters. Table 13A.1 lists three categories of disasters.

No matter what disasters you include in your list, your countermeasures should include awareness, anticipation, and preparation. The first two are simple:

Urheberrechtlich geschütztes Material



The Windows Update Web site, seen in the Microsoft Internet Explorer browser.

antivirus software cannot protect your system against the latest viruses.

If you use any kind of high-capacity storage device—such as a Zip drive, a CD-RW drive, or a DVD-R/RW drive—you can probably visit the manufacturer's Web site for updated drivers and utilities that can make your drive easier to use or more functional.

If you have purchased a new computer, operating system, application, or peripheral, and if the product is from a major manufacturer, there's a good chance the product offers online support of some kind. To learn what options are available for your specific products, check your online help systems and printed documentation. Look for Web addresses for software update, download, or support pages.

How often should you update? It depends on the software. If you use a new version of Windows, you should configure to check for updates whenever you're online. That way, you won't miss a critical update, which could compromise your system's security. Check for updates to your antivirus software definitions at least once a week; if your antivirus program can receive updates automatically, set it to do so. Otherwise, it's a good idea to check for updated device drivers and support files occasionally, to keep your peripheral devices and other programs running as well as possible.

TABLE 13A.1

Examples of Natural, Site, and Civil Disasters

Natural Disasters	Site Disasters	Civil Disasters
Localized or area floods	Building and forest fires	Car, plane, or train crash
Lightning storms	Water and sewer emergencies	Civil disturbance
Snowstorms and/or extreme cold	Telephone or cable service interruptions	Disease outbreak and quarantine
Tornado	Chemical and gas leaks or spills (both in and external to the building)	War or terrorism
Hurricane	Explosions (both in and external to the building)	
Earthquake	Failure of the building structure	

be aware that a disaster could strike and anticipate it when conditions are right. For example, if you live on the East Coast of the United States, you know when to anticipate a hurricane.

Preparation can mean many steps, and you probably have a lot of options—too many to list here. But ask yourself what you can do quickly to protect your PC and data in a disaster. Could you move the PC to a safe place quickly, without

Urheberrechtlich geschütztes Material

SELF-CHECK ::

Circle the word or phrase that completes each statement.

1. Threats are not harmful unless they exploit an existing _____ .
   a. danger b. vulnerability c. computer
2. A backup is a _____ against data loss.
   a. threat b. security c. countermeasure
3. To assume your identity, an ID thief needs only the right _____ .
   a. information b. computer c. software

putting yourself in danger? Could you get to your backup disks or tapes quickly, so they could be saved? Is fire protection available? Do you know how to turn off the gas, electric, and water services to your home? Having answers to questions like these can make a huge difference when minutes count.

Threats to Data

The purpose of a computer is to process data in some way to create information. The goal of computer security is to protect this process. Because data and information are intangible, this mission is difficult. Despite this, you should try to protect everything of value from every threat you can identify. There are three general categories of threat: malicious code and malware, criminal acts, and cyberterrorism.

Malware, Viruses, and Malicious Programs

Norton ONLINE

For more information on malware, visit http://www.mhhe.com/petemorton

The term malware describes viruses, worms, Trojan horse attack applets, and attack scripts. These virulent programs represent the most common threat to your information.

Viruses are pieces of a computer program (code) that attach themselves to host programs. Worms are particular to networks, spreading to other machines on any network you are connected to and carrying out preprogrammed attacks on the computers. Trojan horses, like their namesake, introduce malicious code under the guise of a useful program. Another form of malware is an attack script that is specifically written, usually by expert programmers, to exploit the Internet. Another threat is posed by Java applets that hide in Web pages. They are launched when the user's browser visits that site.

For more detailed information on combating viruses, worms, Trojan horses, and other types of malicious programs, see the Appendix C section "Computer Viruses," which follows this chapter.

Cybercrime

Norton ONLINE

For more information on cybercrime, visit http://www.mhhe.com/petemorton

Computer crime is aimed at stealing the computer, damaging information, or stealing information. Computer crime is not necessarily technical in origin. Most criminal acts against computers do not directly involve technology. In fact, 72 percent of the computer crimes reported to the FBI in 2003 involved simple hardware theft.

The use of a computer to carry out any conventional criminal act, such as fraud, is called cybercrime and is a growing menace. Cybercrime is growing so rapidly, in fact, that the federal government has created a handful of agencies to deal with computer-related crimes (see Figure 13A.14). Instances of Internet fraud increased in 2002 as compared to 2001. In that year alone, federal officials arrested 135 cybercriminals and seized over $17 million in assets. Criminal actions included setting up fraudulent bank Web sites to steal account information from unsuspecting customers, auction fraud, and nondelivery of merchandise. Credit and debit card fraud were significant in 2002. The losses reported by the victims totaled $54 million, versus $17 million the year before, and complaints referred to law enforcement totaled 48,252, compared to 16,755 in 2001.

Urheberrechtlich geschütztes Material

Hacking

Hacking remains the most common form of cybercrime, and it continues to grow in popularity. A hacker is someone who uses a computer and network or Internet connection to intrude into another computer or system to perform an illegal act (see Figure 13A.15). This may amount to simple trespassing or acts that corrupt, destroy, or change data.

In another form, hacking can be the basis for a distributed denial of service (DDOS) attack, in which a hacker hides malicious code on the PCs of many unsuspecting victims. This code may enable the hacker to take over the infected PCs, or simply use them to send requests to a Web server. If the hacker controls enough PCs, and can get them to send enough requests to the targeted Web server, the server essentially becomes jammed with requests and stops functioning. Successful DDOS attacks can cost targeted companies millions of dollars. The extent of the problem is not known simply because it is so widespread. PricewaterhouseCoopers estimates that viruses and hacking alone cost the world economy upwards of $1.6 trillion in 2003.



FIGURE 13A.14

The federal government tracks computer crime in all its forms. You can learn more about cybercrime and the government's responses to it at Web sites like this one.

At one time, a hacker was just a person who understood computers well; however, hacking now refers to criminal or antisocial activity. Today, hackers' activities are usually categorized by their intent:

- Recreation attacks.
- Business or financial attacks.
- Intelligence attacks.
- Grudge and military attacks.
- Terrorist attacks.



FIGURE 13A.15

Hackers are commonly thought of as young, antisocial people who prefer to stay in the shadows. This is not necessarily true, however. There is a large, thriving network of hackers around the world, some of whom operate in the open.

Other than posing an invasion of privacy, recreational hacking is relatively harmless. In most cases, recreational hackers just attempt to prove their abilities without doing any damage. In business, financial, or intelligence attacks, however, hackers often engage in data diddling—forging or changing records for personal gain, or attempting to copy the data from the penetrated system. Grudge attacks are carried out by hackers with a grievance against an individual or organization, and such attacks are frequently destructive. The harm from terrorist attacks could be catastrophic. The industrial world is highly dependent on its computers and there is evidence that this type of attack may be the tool of future war.

Norton ONLINE

For more information on hacking and hacking methods, visit **http://www.mhhe.com/peternorton**

Common Hacking Methods

Hackers use a variety of methods to break into computer systems. These methods fall into three broad categories:

- **Sniffing.** The term sniffing refers to finding a user's password. There are three ways to sniff a password: password sharing, password guessing, and password capture. Password sharing is the most common and occurs when a victim simply discloses his or her password to a hacker. Passwords are shared out of simple ignorance, when victims do not realize that the password might be used against their wishes or in ways they would never intend. Password guessing is done exactly as the term implies: a hacker tries to guess a user's password and keeps trying until he or she gets it right. Users can safeguard against password guessing by using complex passwords. Network

Urheberrechtlich geschütztes Material

At Issue

Software Piracy

One of the biggest legal issues facing the computer industry is software piracy, which is the illegal copying of computer software. Each year, software companies lose billions of dollars in sales because of piracy, as people illegally copy and use programs instead of paying for them.

Piracy is such a big problem because it is so easy to do. In most cases, it is no more difficult to steal a program than it is to copy a music CD. Software pirates give up the right to receive upgrades and technical support, but they gain the use of the program without paying for it.

You learned about the different ways to acquire software in Chapter 10, "Working with Application Software," and that nearly all software programs come with a license agreement of some sort that defines how the software can be used. Most licenses—especially for commercial programs—place restrictions on copying the program, and many forbid the user to make any copies at all.

Software pirates, however, pay no attention to such restrictions. The vast majority of pirates are actually casual computer users who copy a program as a favor to a friend or family member. These pirates may not even be aware that what they are doing is illegal. At the other end of the spectrum, professional pirates make hundreds or thousands of copies of expensive programs and sell them or distribute them freely over the Internet.

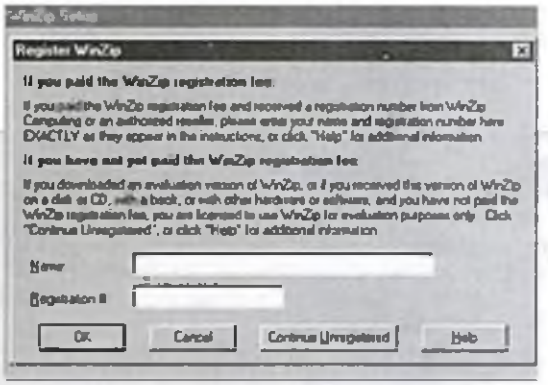
Since licensing agreements don't stop pirates, software developers take other approaches to copy protection. (Copy protection is a device, program, or agreement that attempts to prevent users from illegally copying a program.) A few developers who sell very expensive, special-purpose software require the user to install a device called a hardware lock before installing the program. Such programs won't run if the lock isn't present. Since each lock is uniquely matched to the software, a pirated copy of the program won't run on an unlocked computer.

More commonly, developers require the user to enter a password, a serial number, or some other code when installing the program. Most developers print a code on the

administrators can prevent guessing by limiting the number of attempts anyone can make to log into the network. In password capture, a password is obtained by some type of malware program and forwarded to the hacker. Passwords may be captured electronically if they are sent as text that is not encrypted. For example, during a login session, a hacker may intercept the password data when it is sent to a server even if it is encrypted within the system itself.

- **Social Engineering.** Social engineering used to be called "running a confidence game." The hacker may use any number of frauds to "con" victims out of their passwords. It might be as simple as dumpster diving. Just as in identity theft, a password thief searches the victim's trash in order to find useful access information. Another form of social engineering is the "phone survey," the "application," and the "emergency situation." In these situations, a hacker may contact potential victims by phone or e-mail, and ask the victims to provide password information for an apparently legitimate reason (see Figure 13A.16). This method is sometimes referred to as phishing.
- **Spoofing.** Hackers may alter an e-mail header to make it appear that a request for information originated from another address. This is called spoofing. They can gain electronic entry by pretending to be at a legitimate computer, which is called IP spoofing. Using this technique, the hacker intercepts a message or gains access to the system by posing as an authorized user. On a network, this is done by altering the message information to make it appear that it originated from a trusted computer.

Urheberrechtlich geschütztes Material



Many programs require you to provide a password, special code, or serial number during installation.

program's packaging. Anyone who does not have code may not be able to install the software. Some programs can be installed without the code but they may have some features crippled or may "nag" the user to register the software or provide the code when the program runs.

No antipiracy scheme, however, is foolproof. Sophisticated pirates have found ways to defeat hardware locks, and it's easy to copy an installation code onto a CD case when you copy the CD itself.

With the release of Windows XP and Office XP, Microsoft began a new approach to copy protection: product activation. When you use Windows or Office XP (or Office 2003) for the first time, you are prompted to "activate" it. During the activation process, the software contacts Microsoft via your Internet connection. The Microsoft server checks its records to determine whether anyone else activated your specific copy of the program. If not, the program becomes active and you can use it freely. If not, you need to contact the company and explain yourself. The program will run for only 30 days without being activated; after that, it locks up.

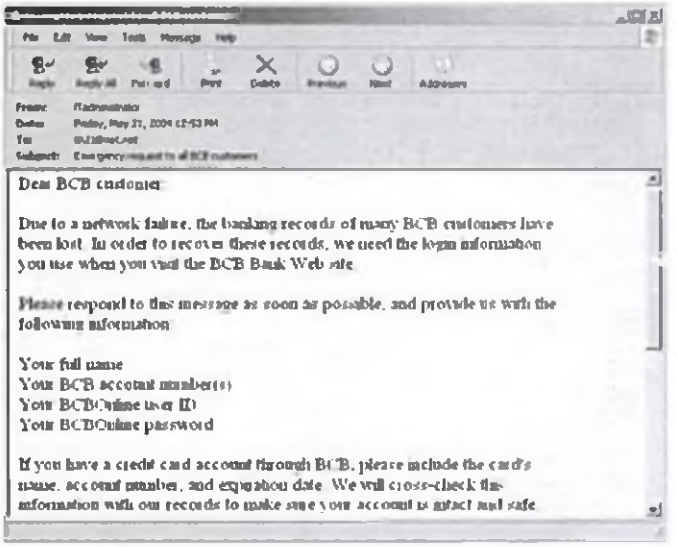


FIGURE 13A.16

If you ever receive a "phish" message from a password thief, it might contain a request like this one.

Urheberrechtlich geschütztes Material

Norton ONLINE

For more information on cyberterrorism, visit http://www.mhhe.com/petemorton

Cyberterrorism

Cyberwarfare and cyberterrorism are new forms of warfare; they attack the critical information infrastructure of the nation. The conventional goal in the case of cyberterrorism is to harm or control key computer systems, or digital controls. It is done to accomplish an indirect aim such as to disrupt a power grid or telecommunications. Typical targets are power plants, nuclear facilities, water treatment plants, and government agencies. However, any site with network-based monitoring and control systems is vulnerable if it is hooked to the Internet.

Cyberterrorism is not a new phenomenon. In 1996, the threat was so credible that the federal government created the Critical Information Protection Task Force, which later became the Critical Infrastructure Protection Board (CIPB). The Information Security Management Act of 2002 set basic security requirements for all government systems; at the same time, the White House issued the first coherent national strategy to secure cyberspace.

This strategy provides an overall direction for the effort to combat cyberterrorism. Solutions need to be formulated by individual businesses and the federal and state agencies designated to deal with this problem. There are many state and federal agencies devoted to developing effective responses to cyberterrorism. In 2002, coordination of this effort became the responsibility of the Department of Homeland Security (DHS) with a budget of more than $2.6 billion for cyberterrorism in 2003. Other effective responses include government-sponsored clearinghouses such as the Computer Emergency Response Team (CERT) Coordination Center (http://www.cert.org) at Carnegie Mellon University and the National Information Assurance Training and Education Center (http://niatec.info) at Idaho State University. These agencies provide essential information and guidance for practitioners and educators (see Figure 13A.17).

FIGURE 13A.17

The CERT Web site and others like it are excellent sources of information on cyberterrorism, viruses, and other technological threats.



Urheberrechtlich geschütztes Material

Summary ::

- The goal of computer security is to eliminate or protect against threats. A threat is anything that can cause harm.
- A countermeasure is any step taken to ward off a threat. Countermeasures are meant to protect data and systems from damage.
- Computer use poses several kinds of threats to users. These include the risk of identity theft, the loss of privacy, the exposure to spam, and even physical injuries.
- In identity theft, an ID thief impersonates someone else by using the victim's name and personal information. A successful ID thief can obtain documents and conduct business transactions in the victim's name.
- Many companies monitor the activities of consumers each day and compile this information for various reasons. The growing amount of personal data that is sold and traded among companies—and which is available for individuals to access—raises concerns about the loss of personal privacy.
- Spam is unwanted, or "junk," e-mail messages. Spam messages are usually commercial in nature and may arrive by the dozens or hundreds in a person's inbox. There are a variety of steps you can take to avoid receiving spam.
- Computer hardware is vulnerable to physical harm from power-related problems, theft, vandalism, and natural disasters. Users can take precautions against some hardware threats, and should plan for others.
- Data may be the most valuable part of a computer system, so it faces many unique threats. These include loss due to malware, viruses, and other malicious programs, as well as hackers, cybercrime, and cyberterrorism.
- Cybercrime is any criminal act that is carried out via a computer. Cybercrime is a growing problem.
- Hacking is a form of cybercrime. A hacker uses a computer and network connection to gain access to other computer systems. Hackers infiltrate systems for many different reasons.
- Cyberterrorism is a form of warfare in which terrorists attempt to harm or gain control of important computer systems, such as the systems that run electrical or communications systems.

Urheberrechtlich geschütztes Material

Key Terms ::

adware, 482
cookie, 481
countermeasure, 478
cybercrime, 488
cyberterrorism, 492
data diddling, 489
distributed denial of service (DDOS) attack, 489
dumpster diving, 479
hacker, 489
hacking, 489
identity (ID) theft, 479
IP spoofing, 490
line conditioner, 485
line noise, 485
malware, 488
password capture, 490
password guessing, 489
password sharing, 489
phishing, 490
power failure, 485
power fluctuation, 485
public record, 481
shoulder surfing, 479
snagging, 479
sniffing, 489
social engineering, 480
spam, 483
spammer, 483
spoofing, 484
spyware, 482
surge suppressor, 485
threat, 478
uninterruptible power supply (UPS), 485
unsolicited commercial e-mail (UCE), 483
vulnerability, 478
Web bug, 482

Key Term Quiz ::

Complete each statement by writing one of the terms from the Key Terms list in each blank.

1. A(n) _____ is a weakness—anything that has not been protected against threats, making it open to harm.
2. _____ occurs when someone impersonates you by using your name, Social Security number, or other personal information.
3. A low-tech ID thief might resort to _____, searching for personal information in garbage cans.
4. In _____, an ID thief tricks victims into providing critical information under the pretext of something legitimate.
5. If a legal record is available to anyone who wants to see it, the record is said to be a(n) _____.
6. The correct term for spam is _____.
7. In _____, the sender of an e-mail message tries to convince the recipient that the message is from someone else.
8. A special device, called a(n) _____, protects equipment from line noise.
9. The term _____ describes viruses, worms, Trojan horses, and attack scripts.
10. The use of a computer to carry out any conventional criminal act, such as fraud, is called _____.

Urheberrechtlich geschütztes Material

Taking Protective Measures

OBJECTIVES ::

- List three ways you can protect your identity from theft.
- Name two precautions you can take to guard your personal information.
- Identify seven federal laws designed to protect an individual's privacy and personal information.
- Describe methods for managing spyware and cookies on your computer.
- List three steps you can take to avoid spam.
- Explain the purpose of a firewall and why you may need one.
- Describe four ways to protect hardware and storage media.

Overview: Keeping Your System Safe

In the preceding lesson, you learned about some of the many threats that can affect you, your privacy, your data, and your computer. Although these threats range from mild to severe, you need to take each of them seriously. This means evaluating the chance that each one might strike you, prioritizing likely threats by severity, and taking the appropriate precautions.

In this lesson, you will learn about specific steps you can take to secure your computer system and your data from a variety of threats. You might be surprised to learn that computer security is not primarily a technical issue, and is not necessarily expensive. For the most part, keeping your system and data secure is a matter of common sense. By mastering a few basic principles and some easy-to-use software programs, you can virtually guarantee the safety of your hardware, software, data, and privacy.



Urheberrechtlich geschütztes Material

Protecting Yourself

The only part of your computer system that needs protection more than your data is you. Remember that if an identity thief strikes or a malicious Webmaster gets hold of your personal information, your computer will keep right on working, but other aspects of your life will be affected.

The following sections revisit some of the threats that computer users face and tell you how to prevent them from becoming a reality.

Avoiding Identity Theft

Norton ONLINE

For more information on avoiding ID theft, visit http://www.mhhe.com/petermorton

Victims of identity theft stand to lose large sums of money, suffer damage to their credit and reputation, and can possibly even lose possessions if the situation is not handled properly. It's important to remember that even if you don't make transactions yourself, you may still be held responsible for them unless you take action quickly.

Recall that ID thieves mainly use nontechnical methods to get the information they need to impersonate someone. Likewise, most of the precautions you can take against ID theft are "low-tech." Further, they all are matters of common sense; you should do these things anyway, even if ID theft were not even possible.

Managing Your Papers

From the moment they enter your mailbox until they reach the landfill, many of your most valuable documents are vulnerable. These include account statements, financial records, bills, credit card applications, and other documents that you receive and handle every week. By handling them wisely, you can keep them out of the hands of an ID thief:

- **Guard Your Mail.** Pick up your mail as soon as possible after it arrives. Never allow mail to sit for a long time in your mailbox. If ID theft is a problem in your area, get a P.O. box and have sensitive documents delivered there. Also, put important outgoing mail in a public mailbox or take it to the post office, where no one can steal it.
- **Check Your Statements Immediately.** Open and check your bank and credit card statements as soon as you get them. Look for suspicious charges, ATM transactions, or checks you did not write; if you find one, report it immediately. The sooner you report suspicious activity, the greater the chance that the company will be able to help you. Some financial institutions place a time limit on reporting unauthorized transactions; after the time limit, your bank or credit card company may ask you to pay for the charge.
- **Discard Important Documents Wisely.** Some documents need to be kept on file for some time. For example, you should keep pay stubs and credit card statements for at least three years, in case you need them for tax purposes. But when you are ready to get rid of any important document, do it right. Shred any document that contains sensitive information such as your Social Security number, account numbers, or passwords (see Figure 13B.1).



FIGURE 13B.1

Shredders are inexpensive and easy to use and render documents useless to an ID thief.

Urheberrechtlich geschütztes Material

Guarding Personal Information

In the course of a normal week, you probably give away all sorts of information about yourself without even thinking about it. It pays to be careful when sharing personal information, to make sure it doesn't fall into the wrong hands:

- Never give anyone an account number over the phone unless you are sure he or she is a legitimate agent. Remember, a bank or legitimate business will never call you and ask for an account number. They should already have this information; if they need it, they will notify you by mail.
- Never give out account numbers, passwords, or other personal information via e-mail. E-mail is not a secure way to transmit data. It can be intercepted, or the recipient can forward it to someone else. Banks and legitimate businesses won't ask you to provide such information via e-mail.
- When buying something online, make sure the Web site is secure before entering any personal information into a form. (For more information on secure online shopping, see Chapter 8, "Presenting the Internet.")

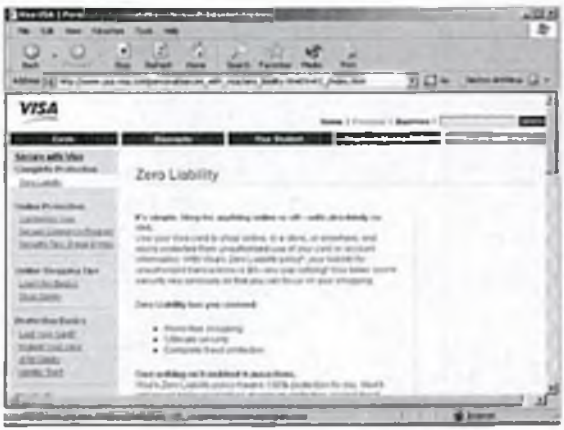
Looking at the Big Picture

You can take additional steps to protect your credit as well as your personal information:

- **Check your credit report at least once a year.** A credit report is a document that lists all your financial accounts that can be a source of credit or that you can use for making purchases or for other transactions. These include bank accounts, mortgages, credit cards, and others. Under certain circumstances, you may be entitled to get a free copy of your credit report one or more times a year. Even if you need to pay for a copy of your credit report, you should get one from each of the three major credit reporting bureaus (Equifax, Experian, and Trans Union) at least once each year. Check each report not just to learn your overall credit rating but to find and report any errors they may contain.
- **Maintain a good filing system.** Carefully file all important papers and keep them for at least three years. You may need them to dispute errors on a credit report or when reporting unauthorized activity to your credit card company or bank.
- **Check with your bank and credit card company.** Make sure you are protected against unauthorized charges (see Figure 13B.2). In most states, your liability is limited if someone else accesses your bank account or uses your credit card without your knowledge. But you may be required to report the incident quickly. Contact these agencies and ask what protections they offer against fraud and ID theft.

FIGURE 13B.2

This page, at the VISA Web site, explains the company's "zero liability" policy. Many credit cards carry similar protections, but you may be responsible for reporting unauthorized activity on your card.



Protecting Your Privacy

If you take precautions to guard against ID theft, you'll be going a long way toward protecting your privacy in general, but there are a few other steps you should take to keep your private information out of the wrong hands.

Keeping Marketers at Bay

One of the main reasons for guarding your personal information is to avoid the attention of marketers,

Urheberrechtlich geschütztes Material



FIGURE 13B.3

The privacy notice at Amazon.com.

who want to know as much about you as possible so they can target marketing campaigns to people of your demographic status or interests. The following tips can help you keep them off your back:

» **Be Wary about Filling Out Forms.** Whenever you fill out a form on a Web page, send in a subscription card for a magazine, or submit a warranty card for a product, you give out information about yourself. Some of these forms ask for much more than your name and address. As a general rule, don't submit such forms (either online or by mail) unless you have read the company's privacy policy (see Figure 13B.3). This policy will tell you how the company handles private information and what they will do with your information. Many companies provide an opt-out option on their registration or warranty forms. If you select this option, the company promises either not to share your information with anyone else or not to send you advertisements.

» **Guard Your Primary E-Mail Address.** As you will read later in this lesson, you can avoid spam by having two e-mail addresses. Give your primary address only to people you trust and use the second address for everything else. The secondary address will receive most of the spam, leaving your main inbox relatively clean.



Norton ONLINE

For more information on laws that protect your privacy and personal information, visit **http://www.mhhe.com/petemorton**

Knowing Your Rights

You can protect yourself further by knowing your legal rights (see Figure 13B.4). Consumers have the right to control access to their information. The control is based on a set of laws that have evolved over the past 40 years, including

» In 1966, the Freedom of Information Act (5 U.S.C. § 552) allowed each individual to view and amend personal information kept about them by any governmental entity.

» The Privacy Act of 1974 (5 U.S.C. § 552a) places universal restrictions on sharing of information about you by federal agencies without written consent.

» The Fair Credit Reporting Act (1970) mandates that personal information assembled by credit reporting agencies must be accurate, fair, and private. It allows you to review and update your credit record as well as dispute the entries.

» The Electronic Communications Privacy Act (1986) prevents unlawful access to voice communications by wire. It originally regulated electronic wiretaps and provided the basis for laws defining illegal access to electronic communications, including computer information. It is the basis for protection against unreasonable governmental intrusion into Internet usage, stored electronic communications, and e-mail.

» The Right to Financial Privacy Act of 1978 and the Financial Modernization Act of 1999 (Gramm-Leach-Bliley) require companies to give consumers notice of their privacy and information-sharing practices.

In response to terrorist attacks on September 11, 2001, the federal government took actions aimed at modifying these protections. Specifically, the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act was enacted. It is commonly known as the USA Patriot Act

Urheberrechtlich geschütztes Material

and extends the authority of law enforcement and intelligence agencies in monitoring private communications and access to your personal information.

Managing Cookies, Spyware, and Other "Bugs"

Unlike most of the countermeasures you have read about previously, high-tech methods are required to deal with threats such as cookies and spyware. Luckily, there are many options to choose from, including some that can find and eradicate just about any type of spyware that might find its way onto your system.

Dealing with Cookies

Most Web browsers feature built-in settings that give you some control over cookies (see Figure 13B.5). Internet Explorer, for example, gives you the option of refusing all cookies, accepting all cookies, or requiring notification before allowing a cookie onto your PC. If you actually use these tools, however, they can make browsing difficult. If you refuse all cookies, some Web sites simply won't function in your browser. If you set your browser to notify you before accepting a cookie, you can expect to see a notification (in the form of a pop-up message) every few seconds. This is because most Web sites use cookies in some manner.

Making things more difficult is the fact that there are multiple types of cookies, including the following:

- Session cookies are temporary cookies that are automatically deleted when you close your browser (ending your browsing session). Session cookies can be essential for viewing some Web pages, and they generally are not used to store any type of personal information. Session cookies are also known as transient cookies.
- Persistent cookies are stored on your computer's hard disk until they expire or you delete them. (Persistent cookies usually have expiration dates, at which time they are deleted.) Persistent cookies are used to store information about you or to remember settings you have made for a Web site you visit often. Persistent cookies are also called stored cookies.
- First-party cookies come from the Web site you are currently viewing. First-party cookies are persistent and usually store preferences you have set for viewing the site. Some first-party cookies store information that can personally identify you.
- Third-party cookies come from a different Web site than the one you are currently viewing. This is possible because some Web sites get content from other sites. Banner ads are an example. Third-party cookies are often used to track your browsing history for marketing purposes. These cookies are usually session cookies but can be persistent.

If you don't manage cookies, thousands can build up on your hard disk. Although persistent cookies are set to expire, their expiration date may be years away.

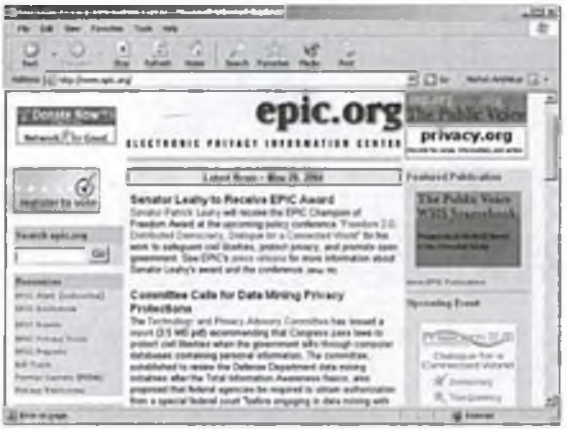


FIGURE 13B.4

You can learn more about the laws regarding public records by visiting Web sites such as the Electronic Privacy Information Center at http://www.epic.org

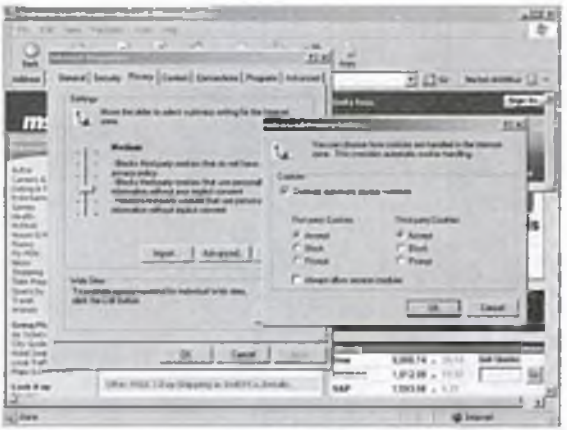


FIGURE 13B.5

Cookie-control settings in Microsoft Internet Explorer.

Norton ONLINE

For more information on cookie-management and anti-spyware utilities, visit **http://www.mhhe.com/peternorton**

Urheberrechtlich geschütztes Material

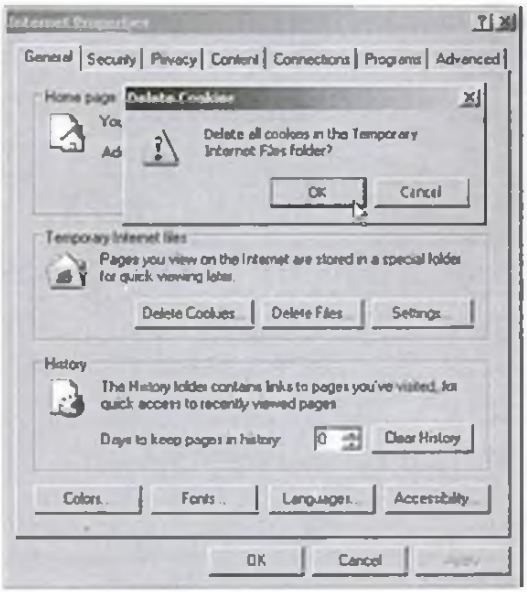


FIGURE 13B.6

Deleting cookies in Microsoft Internet Explorer.

Further, you may decide you just don't want all these cookies on your system gathering information about you. There are two ways to manage cookies:

» **Manually Delete Them.** Your Web browser should have a tool that lets you erase cookies. Figure 13B.6 shows cookies being manually deleted in Internet Explorer.

» **Use Cookie Management Software.** A cookie-management utility can locate and delete all the cookies on your PC, either automatically or when you tell it to. Some utilities will let you decide which cookies to remove and which ones to keep. This is a good idea, because it lets you keep cookies for Web sites you trust while getting rid of the rest. Some programs, such as Cookie Crusher, focus primarily on handling cookies. More feature-filled programs such as Windows Washer can remove cookies and other types of files from your system, making it difficult for anyone to track your surfing habits.

Removing Web Bugs and Spyware

Most software developers classify Web bugs and spyware together. For this reason, most anti-spyware utilities (or anti-adware utilities, as they may be called) can detect both types of programs. The key to successfully dealing with these nuisances is to find an anti-spyware program you like, run it frequently, and keep it up-to-date according to the developer's directions. Popular anti-spyware programs include SpyGuard, NoAdware, and XoftSpy, but there are many others (see Figure 13B.7). Many antivirus programs can find and remove Web bugs and spyware in addition to viruses, worms, and other malicious files.

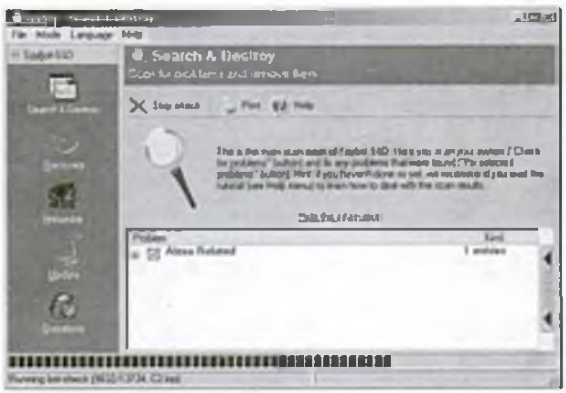


FIGURE 13B.7

Scanning for spyware with Spybot – Search & Destroy

Another key to avoiding spyware is to be careful about downloading files and programs from the Internet. Shareware and freeware programs are popular sources of spyware, because many spyware developers pay other software developers to include spyware code in their programs.

Also, be sure to install a pop-up blocker on your PC (see Figure 13B.8). These small utilities prevent secondary browser windows (called pop-up windows, because they "pop up" on your screen) from appearing when you are on the Web. The majority of pop-ups are advertisements, many of which carry spyware.

Evading Spam

You can take several countermeasures against spam, all of which are simple. First, if you receive a great deal of spam, contact your Internet service provider. Have a list of messages ready and be prepared to give your ISP information about the messages. Many ISPs have the ability to block messages from known spammers or messages that appear to be spam. Your ISP can tell you how to take advantage of these services, which are typically free.

Urheberrechtlich geschütztes Material

As mentioned earlier, you should never give your primary e-mail address to any person or business you don't know. (Your primary e-mail account is the one you set up with your ISP as part of your Internet access package.) Instead, give that address only to people and businesses you trust, and ask them not to give it to anyone else. Then, set up a secondary e-mail account using a free, Web-based e-mail service such as Hotmail or Yahoo (see Figure 13B.9). Use this address when you must provide an e-mail address when making a purchase or registering for a service. The secondary address can collect the spam, while your primary address stays out of the hands of spammers.



FIGURE 13B.8

Configuring the Google toolbar in Microsoft Internet Explorer. This toolbar, which you can download for free from the Google Web site (http://www.google.com), can block pop-up windows.

You also can protect yourself by setting up filters in your e-mail program. A filter is a rule you establish that the program must follow when receiving mail. (For this reason, e-mail filters are sometimes called rules.) For example, you can tell the program to ignore messages from a specific sender or to automatically store certain messages in a specific folder. In Microsoft Outlook, filters are configured from the Tools menu (see Figure 13B.10).

Protection that is more robust is provided by special programs called spam blockers. These programs monitor e-mail messages as you receive them, can block messages from known spammers, and can mark suspicious messages. Spam-blocking software is available from many reputable vendors, such as McAfee and Symantec.

Finally, never respond to a spam message, even if it includes a link that purports to "remove you" from the sender's address list. Most such "remove me" options are phony. If you respond, the spammer knows that your e-mail account is active and you are a good target.

To get onto the Internet equivalent of a "do not spam" list, you may choose to opt out of any kind of targeted advertising by going to http://www.networkadvertising.org (see Figure 13B.11). This site is operated by the Network Advertising Initiative (NAI) and it is that industry's voluntary response to the objections to secretive tracking and spamming of Internet users.



FIGURE 13B.9

Setting up a free e-mail account on the Mail.com Web site. There are dozens of free, Web-based e-mail services to choose from.

Keeping Your Data Secure

Threats to your data are numerous, but the most ominous threat comes from malware in its various forms: viruses, worms, Trojan horses, and others. Viruses, in fact, are such a significant problem that an entire Appendix C "Computer Viruses," is devoted to them following this chapter. Refer to that feature for detailed information on viruses of all types and the best methods for dealing with them.

Urheberrechtlich geschütztes Material

FIGURE 13B.10

Setting up an e-mail filter in Microsoft Outlook.

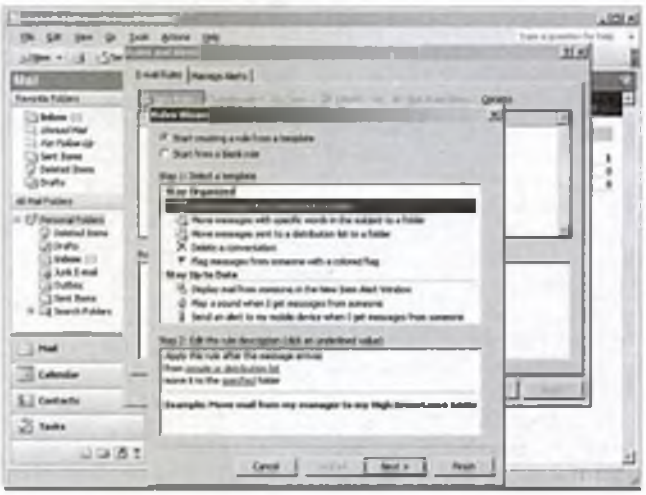
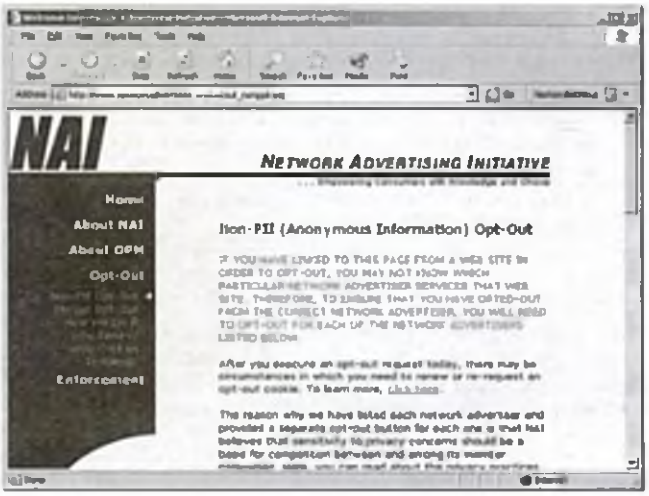


FIGURE 13B.11

The "opt out" page at the Network Advertising Initiative's Web site.





Norton ONLINE

For more information on avoiding spam, visit **http://www.mhhe.com/peternorton**

The following sections discuss two important countermeasures you can take to protect your data from a variety of threats.

Restricting Access to Your System

Aside from viruses, disk failures, and natural disasters, the worst thing that can happen to your data is when someone else gains access to it. And it doesn't take a professional hacker to ruin all the data on your PC. A member of your own family can do it just as well, if unintentionally. This is why it's critical to restrict access to your system, to keep other people away from your data.

Limiting Physical Access

If other users have physical access to your PC, you still may be able to limit their ability to find your data. Most newer operating systems, such as Windows XP, allow users to set up "accounts" on a shared PC. In his or her account, each user can set up a unique set of preferences, such as the desktop's appearance, passwords,

Urheberrechtlich geschütztes Material

Computers In Your Career

Computer Scientist

Dr. Michael Young is not the average computer scientist. Sure, he's well versed in the ways of technology and excellent at problem solving, but he knows a really good video game when he sees one. That's why this assistant professor of computer science at North Carolina State University in Raleigh allocates 40 percent of his time to Liquid Narrative Group, a group of computer science students who are creating software tools that will improve the artificial intelligence (AI) of games and educational software.

Specifically, Dr. Young and his team are investigating ways that the software allows users to both interact with the narrative, or storyline, and feel like an active participant in the way the story unfolds. "We want to open games up so players have more of a role in how games unfold," says Dr. Young. "We're trying to build general software tools that can understand both what's going on in a game and what makes for an interesting game or a good story."

When Dr. Young isn't exploring new ways to improve the gaming experience, you can find him teaching in the classroom or laboratory, or handling project management and administrative tasks like proposal writing. He holds a PhD from the University of Pittsburgh in Intelligence Systems, a Masters degree from Stanford University in Computer Science, and a Bachelors in Computer Science from California State University Sacramento.

Dr. Young says future opportunities for computer scientists are "quite strong" because of how deeply embedded information technology has become in our everyday lives. In fact, he says making people's lives easier and/or better is the biggest reward of his job. In addition to academia, computer scientists like Dr. Young work in government and private industry as theorists, researchers, or inventors.

The higher level of theoretical expertise and innovation they apply to complex problems and the creation or application of new technology distinguishes computer scientists' jobs. Dr. Young advises students interested in the field to focus not only on core computer science concepts, but to



FIGURE 13B.19

Special tools such as "canned air" and a small vacuum can keep your PC clean.

boards and the reliability of the power supplies. Dust worsens heating problems by blanketing components and clogging vents. You should maintain the fans and filters that ventilate the inside of your CPU cabinet (see Figure 13B.19). If you do not feel capable of changing filters and "dusting" the internal components, you should schedule regular visits to commercial computer maintenance services.

Urheberrechtlich geschütztes Material

Summary

- You can protect your privacy and avoid identity theft by handling important documents carefully—especially those that contain personal information such as your Social Security number or account numbers.
- Another important step to protecting your privacy is to be careful about giving out personal information. It is never a good idea, for example, to give out account numbers or passwords via e-mail. Do so over the phone only if you are sure you are dealing with a legitimate business.
- You should check your credit report once a year, to look for suspicious transactions and errors. The report can provide clues if someone else is making transactions in your name.
- A variety of laws exist to protect your personal information from being misused. By learning more about these laws, you can better safeguard your privacy.
- Your Web browser may provide tools for managing cookies, but a cookie-management utility will offer more options for identifying and removing unwanted cookies from your PC.
- Similarly, you can use special anti-spyware software to find and delete spyware from your system. Some antivirus programs also target spyware.
- To avoid receiving spam, avoid giving out your e-mail address. Otherwise, you can reduce spam by setting up a secondary e-mail account, using e-mail filters, and working with your ISP to block spam messages.
- To secure your data, you must keep other people away from it. This means limiting physical access to your computer so other people cannot get to your data. It also means using a firewall to prevent hackers from accessing your system via the Internet.
- Regular data backups are an effective countermeasure against threats to your data. Should any of your data become lost or damaged, you can restore it to you computer by using a backup copy.
- By protecting your hardware, you are also protecting your data and avoiding the expense of replacing your PC. Make sure others cannot get to your PC and damage or steal it.
- Take care when handling computer hardware and storage media, to avoid damaging them. If a disk becomes damaged, the data it stores may be lost.
- Another way to protect your PC hardware and data is by keeping the system clean and avoiding exposure to magnetism or extreme temperatures. Dust can also cause system components to fail, so it is important to keep your PC clean.

Urheberrechtlich geschütztes Material

Key Terms

always-on connection, 505
anti-adware utility, 502
anti-spyware utility, 502
cookie-management utility, 502
credit report, 499
degaussing, 509
Electronic Communications Privacy Act, 500
Event Viewer, 508
Fair Credit Reporting Act, 500
filter, 503
Financial Modernization Act of 1999, 500
first-party cookie, 501
Freedom of Information Act, 500
opt-out option, 500
persistent cookie, 501
pop-up blocker, 502
pop-up window, 502
primary e-mail account, 503
Privacy Act of 1974, 500
restore, 508
Right to Financial Privacy Act of 1978, 500
rule, 503
screen saver, 505
secondary e-mail account, 503
session cookie, 501
spam blocker, 503
stored cookie, 501
third-party cookie, 501
transient cookie, 501
USA Patriot Act, 500

Key Term Quiz

Complete each statement by writing one of the terms from the Key Terms list in each blank.

1. A(n) _____ is a document that lists all your financial accounts that can be a source of credit or that you can use to make purchases or other transactions.
2. If you select the _____ on a company's Web page or warranty form, the company promises either not to share your information or not to send you advertisements.
3. The _____ Act of 1970 mandates that personal information assembled by credit reporting agencies must be accurate, fair, and private.
4. A(n) _____ cookie is temporary; it is automatically deleted when you close your browser.
5. A(n) _____ cookie comes from a different Web site than the one you are viewing.
6. A(n) _____ window is a secondary browser window that may contain an advertisement and carry spyware.
7. Your _____ e-mail account is the one you set up with your ISP as part of your Internet access package.
8. By creating a(n) _____ in your e-mail program, you can tell the program to ignore messages from a specific sender.
9. A(n) _____ is a blank screen or a moving image that appears on the screen after the computer has gone unused for several minutes.
10. You can use a backup copy of your data to _____ lost files to your PC.

Urheberrechtlich geschütztes Material

Review Questions ::

In your own words, briefly answer the following questions.

1. Why should you tell your bank or credit card company about suspicious transactions or charges immediately?
2. List two methods you should not use to give out personal information such as an account number or a password.
3. How can you avoid spam by having two e-mail addresses?
4. Name two laws that require companies to give consumers notice of their privacy and information-sharing practices.
5. List four types of cookies that can be placed on your computer by a Web site.
6. What is the best way to deal with spyware and Web bugs?
7. What is a spam blocker?
8. How might your operating system help you protect the privacy of your files if you share your PC with other users?
9. When is it especially important to use a firewall?
10. Why is it important to protect storage media from dust, dirt, and fingerprints?

Lesson Labs ::

Complete the following exercise as directed by your instructor.

1. Check your cookie-management settings. To do this, launch your browser. If you use Internet Explorer, open the Tools menu, then click Internet Options. When the Internet Properties dialog box appears, click the Privacy tab, and then click the Advanced button. When the Advanced Privacy Settings dialog box appears, check the cookie-management settings. Close both dialog boxes by clicking Cancel.

   If you use Netscape Navigator, open the Edit menu, then click Preferences. When the Preferences dialog box appears, double-click the Privacy & Security category, then click Cookies. Check the settings that appear, and then close the dialog box by clicking Cancel.

   Do not change the settings unless your instructor directs you to do so.

Urheberrechtlich geschütztes Material

Chapter Labs

Complete the following exercises using a computer in your classroom, lab, or home.

1. Learn more about pop-up blockers. Pop-up windows can make Web surfing a maddening experience. A good pop-up blocker can save you a lot of time and aggravation by preventing pop-up windows from appearing on your screen, while letting you decide if you want specific pop-ups to open.

   To learn more about pop-up blockers, visit your favorite search engine and conduct a search on the key words "pop-up blocker". Visit several sites and compare at least three programs. (Do not download or install any software without your instructor's consent.) Summarize the comparison in a one-page report, and be prepared to present your findings to the class.

2. Back up a folder. Use your operating system's Help system to find out if your OS has a built-in backup utility. If so, launch the utility and learn how it works. With your instructor's permission, use the program to back up at least one file or folder. You may be able to back up the data to a floppy disk, Zip disk, network drive, or recordable CD. Next, use the program's Help system to learn how to restore the backed-up data, in case it were accidentally deleted from the hard disk.

3. Learn more about CAN-SPAM. Go online and research the CAN-SPAM law, which took effect at the beginning of 2004. What measures does the law take to limit the amount of spam messages that consumers receive? What penalties does it assess spammers who violate the law? What recourse does the law give to consumers who continue to receive a lot of spam? Your instructor may ask you to focus on one aspect of the law, or to work with a group. Compile your findings into a one-page report, and be prepared to share it with the class.

Discussion Questions

As directed by your instructor, discuss the following questions in class or in groups.

1. Laws such as CAN-SPAM hope to curb the amount of junk e-mail by imposing restrictions on spammers. Do you think these laws go far enough? Should unsolicited commercial e-mail messages be banned altogether? Why or why not? If the government attempted to ban spam completely, what hurdles would it face?

2. Before you read this chapter, what steps (if any) were you taking to protect your personal information? How will you change your approach to guarding your privacy? Compare your thoughts and ideas with those of your classmates.

Urheberrechtlich geschütztes Material

Research and Report

Using your own choice of resources (such as the Internet, books, magazines, and newspaper articles), research and write a short paper discussing one of the following topics:

- **The various methods firewalls use to protect a computer or network.**
- **The extent to which spyware is being used online, and the reasons for it.**
- **The effects the environment can have on a computer.**

When you are finished, proofread and print your paper, and give it to your instructor.

ETHICAL ISSUES

1. One of the primary reasons why it is easy to violate the rights of others is because of the relative anonymity that the Internet allows. Rather than having to go out and steal, or trespass, all you have to do is execute a programming routine in your own home. For instance, if you had to steal the software by going to the store and shoplifting a CD, you would get a sense that you were committing a crime. But if you download a file containing all of the same material, it is hard to get a sense that you are doing something wrong. Discuss the impact that the "virtuality" of the Internet has on our perception of ethical violations. In particular, what other areas of ethics might need a new set of definitions besides file sharing?
2. Many people who think about those sorts of things believe that the Internet will force us to define a new legal framework to embody the new powers it bestows. Specifically, where does the Internet blur the legal definitions? Consider issues of pornography, intellectual property, sabotage, government regulation, and taxation.

Urheberrechtlich geschütztes Material

Appendix A— Creating Your Own Web Page

If you have put off creating a Web page because you think it's a long or difficult process, think again. Web design can be very easy, especially if you just want to build a simple personal Web page or a basic noncommerce Web site. Creating and publishing Web content is straightforward and does not have to be any more difficult than creating any other kind of digital document. You just need to understand the process.



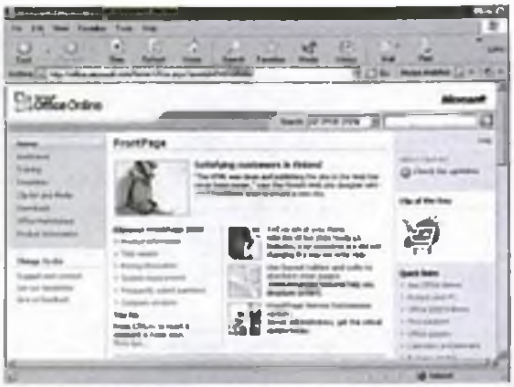
With the right tools, you can create simple Web pages—such as a list of your favorite links or a basic resume—in a snap.

Choosing Your Design Tools

When you set out to create a Web site, your first challenge is deciding which tools to use. Luckily, there are many Web design programs that let you create a site without mastering HTML or learning a scripting language. This means that you can design and lay out your pages as if you were using a word processing program; the software handles all the coding and formatting chores "behind the scenes," so you don't have to do it yourself. If you are enthusiastic about creating Web content but prefer to avoid a steep learning curve, these programs offer the easiest route to follow.

To that end, this *Computing Keynote* feature shows you how to create a Web page using Microsoft FrontPage—a popular Web page design program. Because FrontPage is intuitive and easy to use, it is a good choice for the first-time Web designer. What is more, it comes with templates that simplify the page-creation process. If you have Microsoft Office, then you may already have a copy of FrontPage installed on your PC. If not, you can get a trial copy of FrontPage by visiting Microsoft's Web site at http://www.microsoft.com/frontpage.

Of course, there are many other popular and easy-to-use Web design programs. The most popular programs for novice



Visit http://www.microsoft.com/frontpage/ for more information about FrontPage or to download a trial copy.

designers work in much the same manner as FrontPage, by doing the "grunt work" of HTML coding automatically. You work in a graphical user interface, which lets you create text, import graphics, and format pages by clicking icons and menus. All of these programs, like FrontPage, also let you view and edit the HTML codes yourself, if you want to, and some offer detailed tutorials on the basics of HTML and Web-page design.

Some other popular Web design programs are

- **NetObjects Fusion,** from Website Pros, Inc. For more information, visit http://www.netobjects.com.
- **Dreamweaver MX,** from Macromedia, Inc. For more information, visit http://www.macromedia.com.
- **GoLive CS,** from Adobe Systems, Inc. For more information, visit http://www.adobe.com.

If you want to add graphics to your Web page, you will need a graphics-editing program. A professional tool such as Adobe Photoshop can be used, or you can choose from a variety of affordable yet feature-rich graphics programs. Four low-cost favorites include the following:

- **Paint Shop Pro,** from Jasc, Inc. For more information, visit http://www.jasc.com.
- **Fireworks MX,** from Macromedia, Inc. For more information, visit http://www.macromedia.com.
- **LView Pro,** from MMedia Research Corp. For more information, visit http://www.lview.com.
- **The GIMP,** from The Free Software Foundation. For more information, visit http://www.gimp.org.

Urheberrechtlich geschütztes Material



Graphics products like Paint Shop Pro offer professional imaging tools that are simple enough for beginners to master quickly.

Planning Your Page or Site

Before you design anything, you need to determine what your Web page (or site, if you want to publish several pages) is going to be about. For example, you may want to publish information about yourself or your family. Or you might want to create a page or small site for an organization, such as a synagogue, club, neighborhood association, or community center.

It is important to know each page's main topic before you start. The topic will help you decide what kind of information to prepare, and it will also help you keep the contents focused. Otherwise, visitors will quickly lose interest and leave your site. You need to engage your visitors right away and let them know why they should stay on your site, reading your content and visiting any other pages within the site.

Organizing Text The next step in planning is to arrange your site's information into sensible categories. Whether you are designing a single page or a site with many pages, you should organize your thoughts in order to help the site's visitors understand what you are trying to do. Get out a piece of paper and start organizing your ideas.

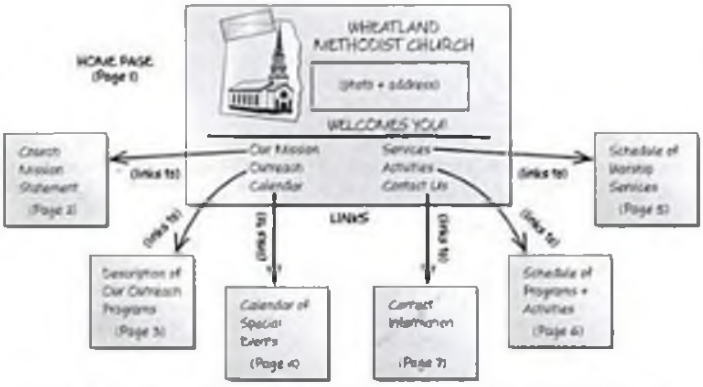
Some common topics for a personal page or site include the following:

- About You (or your organization)
- Photo Album
- Friends and Family
- Poems and Stories
- Favorite Links
- Resume

Be careful here, because many pages suffer from the "Too Much Stuff" syndrome. Clutter can turn visitors off. The best way to avoid this problem is to look carefully at the way you have organized the information you would like to have on your page. Keep written content short and to the point. If you have a lot of written content, such as information about your organization, break up the information by using headers and lists. This makes the information easier to read and more interesting.

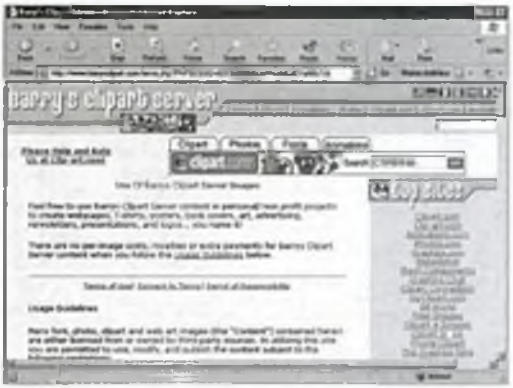
Planning for Graphical Appeal Of course, a Web page can have much more than just words on it! You will want to create your own graphics or find suitable graphics for your Web site from popular graphic repositories.

Importing Graphics Graphics—such as scanned drawings or digital photos—can add a touch of your own personality and talent to your pages. To import graphics, you will need a graphics program, as mentioned earlier, as well



If your site is small, you can draw a basic layout on paper, as shown here. At this stage of the process you do not need too much detail; you just need an idea of the major topic or topics you want to include. And remember—limit your site to one topic per page.

Urheberrechtlich geschütztes Material



Look for license or usage agreements before you download an image from a clip-art service. This agreement appears on Barry's Clipart Server.

rials, and services for designers of all types and ability levels. The site features links to many other sites, where you can find graphics resources for your Web site. Some are free, others require a membership.

Before you download any kind of image from a Web site (or any other online source), however, be sure to read the licensing or usage agreement that governs its use. Reputable online clip-art services post these agreements on their Web sites, so you cannot miss them. Even free images can have some usage restrictions; for example, the image's owner may require you to acknowledge the owner or artist on your site or get written permission before you use the graphic.

You will find more information about borrowing images, text, and HTML code from other Web sites in the section titled "Web Content and Intellectual Property Rights," at the end of this *Computing Keynote*.

Building Your Site

So you have gathered your tools, organized your ideas, and gotten up to speed with Web graphics. Now it is time to roll up your sleeves and start building your Web site.

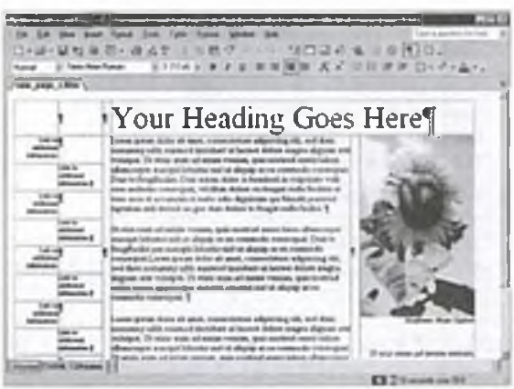
Start by launching FrontPage. To do this, open the Start menu, and then open the Programs menu (or the All Programs menu, if you use Windows XP). When you launch FrontPage, it creates a folder on your PC called My Webs. This folder contains a subfolder called Images. Before going any further, open Windows Explorer or My Computer and move all your images into the Images subfolder.

Now it is time to actually create a site, step by step.

Selecting a Template Since your goal is to create a site right away, you will work with a template and modify it to suit your needs. Follow these steps to select the template in FrontPage:

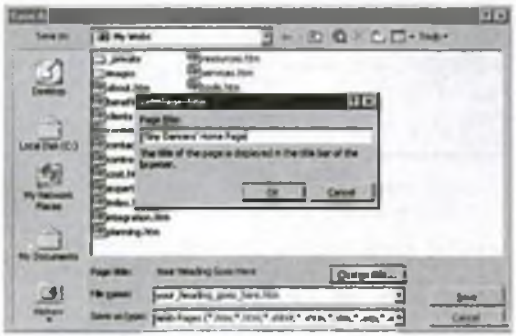
1. Open the File menu, click New | Page or Web. The New Page or Web task pane appears.
2. On the task pane, click Page Templates. The Page Templates dialog box opens.
3. In the dialog box, click the General tab, if necessary. Click the One-Column Body with Two Sidebars icon, and then click OK. The layout appears in FrontPage.
4. Open the File menu and click Save As. The Save As dialog box appears. Here, you need to do three things:
   a. Click the Change Title button next to the Page title. When the Set Page Title dialog box appears, give the page a suitable title, such as Tiny Dancers' Home Page. Click OK to return to the Save As dialog box.
   b. Give the file a name, and then click Save. (If this is the site's first page, name it INDEX or HOME. The word *Index* is often used for a site's opening page because this page usually contains a list—or index—of links to other pages in the site.) The dialog box closes and FrontPage saves the file in the My Webs folder.
   c. Because this layout includes a picture, FrontPage displays the Save Embedded Files dialog box. For now, click Ok. You'll replace the sample picture later.

Adding an Image Next, replace the placeholder image (on the right side of the page) with one of your own images:

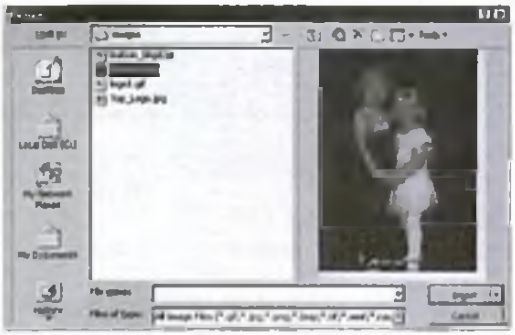


Using a FrontPage template to create an attractive home page.

Urheberrechtlich geschütztes Material



Saving your first Web page, with a file name and a title.



Adding an image to a Web page.

1. Click the existing image and then right-click it. When the shortcut menu opens, click Cut. The image disappears from the template. Leave the cursor where it is.
2. Open the Insert menu, click Picture, and then click From File. The Picture dialog box appears. Navigate to the Images subfolder, if necessary, and then open the subfolder by double-clicking it.
3. When the Images subfolder opens, click the image you want to use. Click INSERT. The picture is now inserted into your design.
4. To change the picture caption, select the old text (by dragging across it with the mouse pointer) and type your own caption in its place.

Modifying a Heading and Adding Content Now you are ready to fill in all the template's text areas with your custom information:

1. To modify the heading, select it and type your new heading.
2. To add content to the main section, find the text you would like to use, and then copy and paste it right over the placeholder text. Or you can delete the placeholder text and type your own text in its place.
3. Continue replacing the placeholder text until you're happy with the results. You can modify font styles and sizes by using FrontPage's tools. Be careful to use these features lightly because using too many fonts and sizes can make reading difficult.

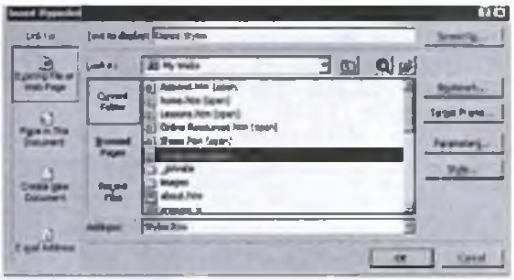
Adding Pages and Linking to Them Links are the most important part of a Web page. Luckily, the template you are using allows for a number of links. If you want to add other pages to your site—and the page you created earlier is the site's index page—then you will probably want to add lines of text to this page and format them as hyperlinks that lead to the other pages. Here's how to do that:

1. To add new pages, follow the same steps you used earlier for working with the template. Be sure to name your files (they will be empty until you wish to edit them later) and save them in the My Web folder.
2. In the index page, highlight the placeholder text where you would like to add the link and rename the link as is appropriate for your needs. Then select the text.
3. Open the Insert menu and then click Hyperlink. The Insert Hyperlink dialog appears.
4. Select the page to which you want to link by clicking its name. Click Ok.



The template with a new image, heading, and content in place. Here, notice that the text is formatted differently than in the template.

Urheberrechtlich geschütztes Material



Creating a hyperlink to another page on your site.

Continue adding links until you have added all the links you require. Save the page so your changes are updated. When you have finished (or whenever you want to see how your page will look online), you can click the Preview tab. Alternatively, if you prefer to see your page in an actual Web browser, open the File menu, and then click Preview in Browser.

Of course, there are many other modifications and additions you can make to this document, but you are off to a great start.

Web Design Tips

No matter what kind of content your Web page or site contains, you want it to look great. Just as important, you want your site's visitors to find your content easy to read and navigate. You can accomplish these goals and avoid common Web design pitfalls by following these tips:

- Use bold and italic sparingly. Bold and italic effects actually make text harder to read. Use bold and italic for emphasis only.
- Be sure to properly align body text. Centered body text (that is, paragraphs of body text centered between the margins, usually with "ragged" left and right edges) can be hard to read. It is better to adjust your margins than to center body text. You can center headers, footers, and accent text.
- Use a plain background that will not interfere with your text. Don't use complicated backgrounds (such as patterns or textures). Plain backgrounds are almost always best with any text.
- Use contrasting colors for backgrounds, text, and links. The higher the contrast, the better the readability. White text on a yellow background is just annoying.
- Keep body text at its default size.
- Look carefully at your page. Is there anything on it that is unnecessary? If so, get rid of it!
- Unless you update your pages regularly, do not post the date on which the page was last updated, and do not put time-sensitive information on it. If you are offering Christmas greetings to your visitors in July, for example, they will think your whole site is stale!
- Never put your home address or home phone number on a Web page, and always think carefully before putting very personal information on a page.

Finding a Host for Your Web Site

Once your page or site is ready to go, you will want to publish it online. This means finding a "host"—a person or company with a server computer that stores Web pages. A wide range of Web hosting options are available.

If you already have an account with an Internet service provider (ISP), you may have some free Web space available as part of your account. Check with your provider to see if this is true, and ask how to access your area on the ISP's Web server.

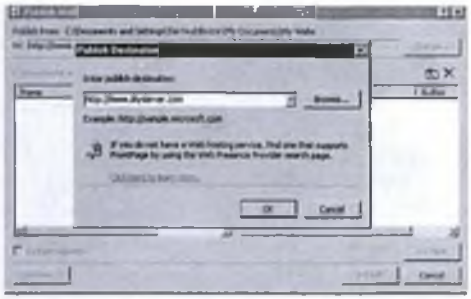
If your ISP does not provide Web space, there are plenty of other hosting options. The most popular options for enthusiasts are free hosting services and low-cost services.

Free Hosting Services Free services can be a terrific option if you are just starting out. The big problem with using a free service, however, is that you may have no control over the advertisements that the service uses. This means your site might display pop-up advertisements (which "pop



The final results: a simple but attractive home page, shown here in Microsoft Internet Explorer.

Urheberrechtlich geschütztes Material



Publishing Web content with FrontPage.

in order to effectively create the many layers of complexity that today's professional sites entail.

There are many technologies and standards emerging, and as a result, the way professionals are working today is much different than the way an enthusiast will work. Still, the idea is essentially the same: create content and publish it on the Web.

If the process of creating a Web page excites you, and if you would like to learn more about professional Web design and development, consider a visit to these sites to see what a variety of resources are available to you.

- **World Wide Web Consortium (W3C).** http://www.w3.org
- **HTML Writers Guild.** http://www.hwg.org
- **WebReference.com.** http://www.webreference.com
- **Webmonkey.com.** http://hotwired.lycos.com/webmonkey
- **List Apart.** http://www.alistapart.com
- **Digital Web Magazine.** http://www.digital-web.com
- **Web Developer's Virtual Library.** http://www.wdvl.com
- **Builder.com.** http://www.builder.com

Web Content and Intellectual Property Rights

A lot of information sharing happens on the Web, but it is not always OK to use an item you happen to find online; you could be breaking the law. If you are not sure whether you should use a graphic, text, or code you find on a Web site, check the following list of questions and answers:

1. **Can I swipe HTML code from a Web site I like?**

   While many people use their browser's View Source feature to look at the way code is written, it is not necessarily helpful to simply swipe it! Be inspired by it, use it as an example to learn from, but do not just take it. Even though HTML code itself cannot be copyrighted, you should either learn how to work with it or use software that generates it for you.

2. **Is it okay to "borrow" a graphic from someone else's page?**

   Without express permission from the image's owner, you should not put other people's work on your Web site. Learn to create your own graphics, or use graphics that are royalty-free, such as those available from the Web sites mentioned earlier in this article.

3. **Can I put quotes from articles, books, movies, and other sources on my page?**

   If you use one paragraph or less, place it in quotes, and clearly state the source, you are following the general rules of what is known as "fair use." Be cautious and fair, however. Anything more than a paragraph can be considered infringement of copyright, and if you use someone else's work without referencing the source, you are guilty of plagiarism! Stay safe and honest—always ask for permission before using materials that are likely to be copyrighted.

It is also a good idea to protect your own work. If you have original art, writing, and music on your pages, it is a good idea to copyright it. You can learn more about copyright with a visit to these sites:

- **United States Copyright Office.** http://www.copyright.gov
- **Canadian Intellectual Property Office.** http://cipo.gc.ca
- **Ten Big Myths About Copyright Explained.** http://www.templetons.com/brad/copymyths.html
- **Intellectual Property Law Primer for Multimedia and Web Developers.** http://www.eff.org/pub/CAF/law/ip-primer

Urheberrechtlich geschütztes Material

Appendix B— Buying Your First Computer

Buying your first computer can be just as challenging as buying your first car. Look at a few magazines or television advertisements and you will quickly see that there are hundreds of models and features to choose from. Sifting through all those options can be time-consuming and frustrating, and you may never feel certain that you are making the right choice or getting the best price.

With so many choices to make, what is the best way to buy a new PC? Very simply, the best thing you can do is plan ahead, understand your needs, and do your homework. This kind of preparation will help you find a PC that best meets your needs, at a price you can afford. That is what this *Computing Keynote* is all about: helping you decide what you need *before* you start shopping.



Many popular magazines feature dozens of advertisements for computers.

Think Before You Shop

If you have never bought a PC before, you are probably eager to get started. After all, you have a lot of shopping to do if you want to find the best deal! But before you hit the malls or go online, you need to make some decisions. That way, you will have a good idea of what you need, which may help you avoid looking at models or options that are not right for you.

So grab a pen and a piece of paper and answer some basic questions. The answers will help you decide what type of computer will best meet your needs, which options you must have, and which features you can live without.

1. **What will you use your computer for?** This is the most important question you can answer before buying a computer. Will you use a PC primarily for Internet surfing and word processing, or do you plan to develop programs? The more demanding your tasks are, the more powerful your computer should be. Be realistic: don't add "programming" or "database development" to your list unless you really plan to do those things. Use the following checklist to determine which activities you will use your computer for.

Task	Yes	No
Internet/e-mail/chatting	☐	☐
Word processing	☐	☐
Spreadsheet	☐	☐
Database management	☐	☐
Presentations	☐	☐
Recording or editing audio	☐	☐
Recording or editing video	☐	☐
Creating or editing graphics	☐	☐
Working with digital photos	☐	☐
Web design	☐	☐
Programming	☐	☐
Computer-aided design	☐	☐
Playing games	☐	☐

If your list includes a lot of tasks, or if you plan to work on a few demanding tasks, then you need a more powerful system. This means you will need the fastest processor, greatest amount of memory, and largest hard disk you can afford.

It's important to remember that some computing tasks are more processing-intensive than others. So, if you only plan to use your PC for word processing, e-mail, and Web surfing, you can easily get by with a lower-cost, lower-power processor, such as a Celeron. In this case, a PC with 128 MB of RAM will probably meet your needs. By choosing a system with a lower-power processor and minimal RAM, you can save hundreds of dollars.

Digital video editing and computer-aided design, however, require as much power and storage as your system can muster. Tasks such as these are very processing-intensive, requiring a system with the fastest processor and as much RAM as you can afford. Processing-intensive tasks also tend to be storage-intensive, too, so if you plan to use your new PC for chores like these, buy the fastest processor, the most RAM, and the biggest hard disk you can afford. If possible, make sure the PC has a built-in CD-RW or DVD-RW unit, so you can create high-volume backups of your work.

2. **What features or capabilities are most important to you?** If you want to use a PC mostly for game playing and listening to music, then good graphics and audio

Urheberrechtlich geschütztes Material

Use the following checklist to help you decide which options you need and don't need. When you are ready to shop, use the list to help you compare options in the systems you consider buying.

Option	Yes	No	Details
Processor	☑	☐	Type: _____ Speed: _____ GHz
RAM	☑	☐	Type: _____ Amount: _____
Hard disk	☑	☐	Type: _____ Capacity: _____ Spin Rate: _____ Avg. Access Time: _____
Optical drive	☑	☐	Type: _____ Read Speed: _____ Write Speed: _____
Monitor	☐	☐	Type: _____ Size: _____ Special Features: _____
High-capacity floppy disk drive	☐	☐	Type: _____ Capacity: _____
Modem	☐	☐	Type: _____ Speed: _____
Keyboard	☑	☐	Type: _____ Special Features: _____
Pointing device	☑	☐	Type: _____ Special Features: _____
Video card	☑	☐	Type: _____ Amount of VRAM: _____
Sound card	☑	☐	Type: _____
Speakers	☐	☐	Type: _____
Microphone	☐	☐	Type: _____
Video camera	☐	☐	Type: _____
USB ports	☐	☐	Number: _____
IEEE 1394 ports	☐	☐	Number: _____
Special ports (MIDI, TV In/Out, Audio In/Out, multimedia memory cards, etc.)	☐	☐	Number: _____ Type(s): _____
Operating system	☑	☐	Type: _____ Version: _____
Antivirus software	☐	☐	Type: _____ Version: _____
Warranty	☐	☐	Type: _____ Duration: _____

Urheberrechtlich geschütztes Material

capabilities may be more important to you than some other options. On the other hand, if you want to work with video, then a large hard disk and plenty of RAM may be most important to you.

3. **What features can you live without?** If you do not plan to watch DVD videos or record CDs on your system, then you probably shouldn't pay for a DVD player or CD-R/CD-RW drive. If you don't plan to install lots of software or hoard thousands of audio files, then you can save money by getting a smaller hard disk. If you do not plan to connect the computer to a network, then do not pay for a network interface card (although you do need one if you plan to connect to the Internet through a cable modem or DSL connection). By omitting features you do not need, the money you save can be applied toward the features you want.

4. **How much money can you afford to spend?** The answer to this question, of course, determines how much PC you can buy. But do not be disappointed if you cannot afford the biggest, fastest, most-power-packed PC in the store. Depending on your needs, you may be able to buy a system that is just right for you, for less than you imagined.

   Nearly every PC maker offers a line of home computers for $1,000 or less. Many of these machines feature processors with speeds of 1–2 GHz, 256 MB of RAM (or more), high-capacity hard drives, a fast system bus, and more. And remember: you don't have to buy everything at once. For example, if you already have a monitor, use it instead of buying a new one. The same applies to speakers, a printer, and other peripheral devices. If you already have a computer, you may get by just fine by buying a new system unit alone, saving hundreds of dollars in the process.



Don't worry if you don't have a lot of money to spend. You can easily find a fully equipped, powerful new PC for a few hundred dollars, if you do your homework

Do Some Homework

Once you figure out why you want to use a PC and what basic features are most important, it's time to start learning about the different options that are available from most PC makers.

Check Out Processors Today's PCs are based on processors from two manufacturers—Intel and AMD—and you can learn the differences between their products by visiting their Web sites at http://www.intel.com and http://www.amd.com.

You can find even more detailed information by visiting some of the many Web sites that regularly review processors, such as

- **CNET Shopper.** http://shopper.cnet.com
- **MSN Technology.** http://tech.msn.com
- **PC Magazine.** http://www.pcmag.com
- **PC World.** http://www.pcworld.com

Know Your RAM Needs The rule of thumb is: "the more RAM you have, the better." Of course, this is not an *absolute* truth because it is possible to have more RAM than your system will use. On average, though, it is a good idea to have a reasonably high level of memory in your computer to enable your computer to run more efficiently.

If you can afford it, make sure that your new PC has at least 256 MB of RAM (this amount is standard on many lower-cost PCs, but not always); that should give you enough memory to run Windows and several applications at the same time. If the manufacturer gives you the option of installing faster RDRAM or DDR-SDRAM, and if you can afford it, take the option. Your system will perform better.

To best determine how much RAM you will actually need, check the system requirements for the operating system and application programs you plan to use. You can find this information on the side of the program's package or on the manufacturer's Web site. The more programs you plan to run simultaneously, the more RAM you need.

Urheberrechtlich geschütztes Material

» **To Bundle or Not to Bundle?** Nearly all consumer-level PCs come with lots of software already installed. This can be a great feature if you plan to use the software, but it also can drive up the system's cost. Some vendors will give you a choice of software bundles; for example, you may be able to choose from productivity-oriented programs, entertainment programs, photo-editing tools, or something else. If you are tempted to skip the bundle and save your money, remember: bundled software may be far cheaper than buying off-the-shelf programs later. Compare the prices before deciding.

Some manufacturers like to bundle extra hardware with their PCs. These companies may offer special package prices for a PC and a printer, or a PC and a digital camera, or some other hardware combination. If you need the extra hardware anyway, then check the bundle's price against the cost of buying the devices separately. However, make sure the bundled hardware is comparable to the devices you would choose if you were to buy them separately.

» **To Extend or Not to Extend (the warranty)?** The majority of new PCs come with a one-year warranty that covers most problems you are likely to encounter. Some computers have a three-year manufacturer's warranty. The vendor will probably ask if you want to extend the warranty, and may give the option of stretching the warranty by one, two, or three years. You also may have the option of getting on-site service instead of shipping the computer off to be repaired. Extended warranties can cost anywhere from $50 to $250, depending on the options you choose. If you can't imagine opening a PC and trying to fix it yourself, then choose a vendor that offers a good basic warranty and extend it if you can afford to. If you aren't afraid to work on a PC yourself, then skip the extended warranty.

» **New or Used?** Granted, you can save big bucks by buying a used PC instead of a new one. However, you may be buying someone else's headaches. Has the system been damaged or upgraded? What kind of treatment has it received? Are all the components truly compatible? If you want to buy a used PC, stick with a brand-name system such as Compaq, IBM, Dell, or Gateway and try to find out as much as you can about the unit's history. Make sure the computer is not out of date; if it has a Pentium II processor, for example, you should consider it obsolete.

Instead of buying a used PC, consider buying a factory-refurbished one from a major PC vendor. These computers are systems that were previously sold and then returned to the manufacturer. Often, these machines were never taken out of the box, or they were only slightly used. Manufacturers typically refurbish these systems by updating any outdated components and thoroughly testing them. Most refurbished PCs come with the same warranty as a new PC, but at a fraction of the cost.

Talking Turkey

Now that you know what you need (and don't need), it is time to start shopping. You can buy a computer in at least three ways; the method you choose depends on your comfort level:

» **At a Store.** If you live in or near a large town, you probably have access to stores that carry PCs, software, and



Macintosh computers make up about 5 percent of the total personal computer market, so compatibility may be an issue if you need to share files with other people.



Bundled hardware or software may be a good value, depending on your needs.

Urheberrechtlich geschütztes Material

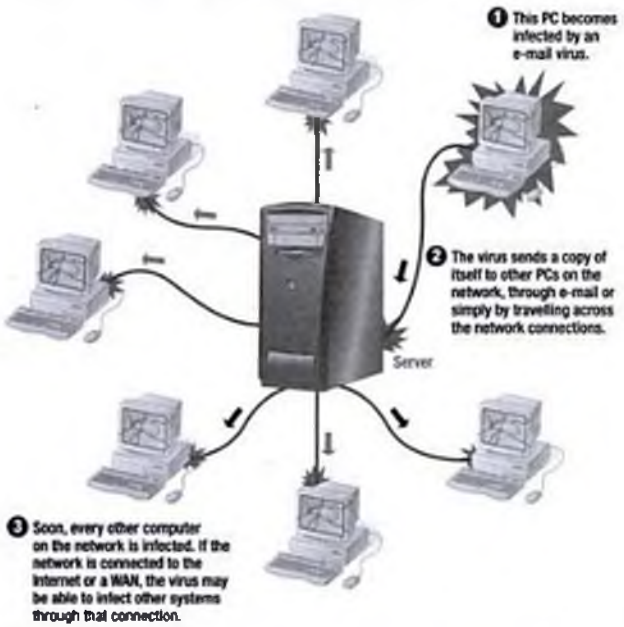
» Downloading an infected file to your computer across a network, an online service, or the Internet. Unless you have antivirus software that inspects each incoming file for viruses, you probably will not know if you have downloaded an infected file.

» Receiving an infected disk (a diskette, a CD created by someone with a CD-R drive, a high-capacity floppy disk, and so on) from another user. In this case, the virus could be stored in the boot sector of the disk or in an executable file (a program) on the disk.

» Copying to your disk a document file that is infected with a macro virus. An infected document might be copied from another disk or received as an attachment to an e-mail message.

What Can a Virus Do?

The majority of computer viruses are relatively harmless; their purpose is to annoy their victims rather than to cause specific damage. Such viruses are described as benign. Other viruses are indeed malicious, and they can do great damage to a computer system if permitted to run.



Viruses also can spread through a network connection, as shown here. In this simple example, one PC has been infected by a virus, which quickly spreads to other computers on the network.

Viruses can be programmed to do many kinds of harm, including the following:

» Copy themselves to other programs or areas of a disk.

» Replicate as rapidly and frequently as possible, filling up the infected system's disks and memory, rendering the system useless.

» Display information on the screen.

» Modify, corrupt, or destroy selected files.

» Erase the contents of entire disks.

» Lie dormant for a specified time or until a given condition is met, and then become active.

» Open a "back door" to the infected system that allows someone else to access and even take control of the system through a network or Internet connection. This type of virus may actually be a type of program called a Trojan Horse, and can be used to turn an infected system into a "zombie," which the virus's author can use to attack other systems. For example, by using viruses to create a large number of zombie systems, the author can use the zombies to send thousands of requests to a specific Web server, effectively shutting it down. Such an attack is sometimes called a "denial of service (DOS) attack" or a "distributed denial of service (DDOS) attack," because it prevents the server from providing services to users.

This list is by no means comprehensive. Virus programmers can be extremely creative, and many create viruses to perform a specific type of task, sometimes with a specific victim in mind. Regardless, you need to protect your system against all kinds of viruses, because nearly any one can strike at any time, given the right circumstances.

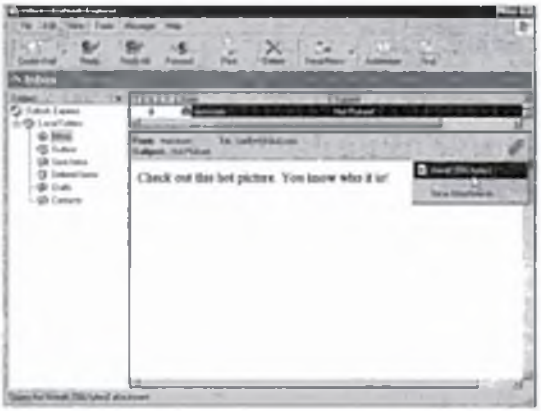
Viruses may seem like major problems for individual computer users. For corporations, however, viruses can be devastating in terms of lost data and productivity. U.S. companies lose billions of dollars every year to damage caused by viruses. Most of the expenses come from the time and effort required to locate and remove viruses, restore systems, rebuild lost or corrupted data, and ensure against future attacks. But companies also lose valuable work time—millions of person-hours each year—as workers sit idle, unable to use their computers.

Urheberrechtlich geschütztes Material

Categories of Viruses

Depending on your source of information, different types of viruses may be described in slightly different ways. Some specific categories of viruses include the following:

- **Bimodal, Bipartite, or Multipartite Viruses.** This type of virus can infect both files and the boot sector of a disk.
- **Bombs.** The two most prevalent types of bombs are time bombs and logic bombs. A time bomb hides on the victim's disk and waits until a specific date (or date and time) before running. A logic bomb may be activated by a date, a change to a file, or a particular action taken by a user or a program. Many experts do not classify bombs as viruses, but some do. Regardless, bombs are treated as viruses because they can cause damage or disruption to a system.
- **Boot Sector Viruses.** Regarded as one of the most hostile types of virus, a boot sector virus infects the boot sector of a hard or floppy disk. This area of the disk stores essential files the computer accesses during start-up. The virus moves the boot sector's data to a different part of the disk. When the computer is started, the virus copies itself into memory where it can hide and infect other disks. The virus allows the actual boot sector data to be read as though a normal start-up were occurring.
- **Cluster Viruses.** This type of virus makes changes to a disk's file system. If any program is run from the infected disk, the program causes the virus to run as well. This technique creates the illusion that the virus has infected every program on the disk.
- **E-mail Viruses.** E-mail viruses can be transmitted via e-mail messages sent across private networks or the Internet. Some e-mail viruses are transmitted as an infected attachment—a document file or program that is attached to the message. This type of virus is run when the victim opens the file that is attached to the message. Other types of e-mail viruses reside within the body of the message itself. To store a virus, the message must be encoded in HTML format. Once launched, many e-mail viruses attempt to spread by sending messages to everyone in the victim's address book; each of those messages contains a copy of the virus.
- **File-Infecting Viruses.** This type of virus infects program files on a disk (such as .exe or .com files). When an infected program is launched, the virus's code is also executed.
- **Joke Programs.** Joke programs are not viruses and do not inflict any damage. Their purpose is to frighten their victims into thinking that a virus has infected and damaged their system. For example, a joke program may display a message warning the user not to touch any keys or the computer's hard disk will be formatted.
- **Macro Viruses.** A macro virus is designed to infect a specific type of document file, such as Microsoft Word or Excel files. These documents can include macros, which are small programs that execute commands. (Macros are typically used to issue program-specific commands, but they also can issue certain operating-system commands.) A macro virus, disguised as a macro, is embedded in a document file and can do various levels of damage to data, from corrupting documents to deleting data.
- **Polymorphic, Self-Garbling, Self-Encrypting, or Self-Changing Viruses.** This type of virus can change itself each time it is copied, making it difficult to isolate.
- **Stealth Viruses.** These viruses take up residence in the computer's memory, making them hard to detect. They also can conceal changes they make to other files, hiding the damage from the user and the operating system.
- **Trojan Horses.** A Trojan Horse is a malicious program that appears to be friendly. For example, some Trojan Horses appear to be games. Because Trojan Horses do not make duplicates of themselves on the victim's disk (or copy themselves to other disks), they are not technically viruses. But, because they can do harm, many experts consider them to be a type of virus. Trojan Horses are often used by hackers to create a "back door" to an infected system as described earlier.
- **Worms.** A worm is a program whose purpose is to duplicate itself. An effective worm will fill entire disks with



An e-mail attachment may look harmless, but opening it could unleash a virus onto your PC.

Urheberrechtlich geschütztes Material

Appendix D— History of Microcomputers

1965

Honeywell corporation introduces the H316 "Kitchen Computer." This is the first home computer and is offered in the Neiman Marcus catalog for $10,600.



1970

Ken Thompson and Denis Ritchie create the UNIX operating system at Bell Labs. UNIX will become the dominant operating system for critical applications on servers, workstations, and high-end microcomputers.



1971

In 1971, Dr. Ted Hoff puts together all the elements of a computer processor on a single silicon chip slightly larger than one square inch. The result of his efforts is the Intel 4004, the world's first commercially available microprocessor. The chip is a four-bit computer containing 2,300 transistors (invented in 1948) that can perform 60,000 instructions per second. Designed for use in a calculator, it sells for $200. Intel sells more than 100,000 calculators based on the 4004 chip. Almost overnight, the chip finds thousands of applications, paving the way for today's computer-oriented world, and for the mass production of computer chips now containing millions of transistors.

Steve Wozniak and Bill Fernandez create a computer from chips rejected by local semiconductor companies. The computer is called the Cream Soda Computer because its creators drank Cragmont cream soda during its construction.



Urheberrechtlich geschütztes Material

1972

Dennis Ritchie and Brian Kernighan create the C programming language at Bell Labs. The UNIX operating system is re-written in C. C becomes one of the most popular programming languages for software development.

5.25-inch floppy diskettes are introduced, providing a portable way to store and move data from machine to machine.



1973

IBM introduces new mass storage devices: the eight-inch, two-sided floppy disk that can hold 400 KB of data and the Winchester eight-inch, four-platter hard drive that can hold an amazing 70 MB of data.

Bob Metcalfe, working at Xerox PARC, creates a methodology to connect computers called Ethernet.



1974

Intel announces the 8080 chip. This is a 2-MHz, eight-bit microprocessor that can access 64 KB of memory using a two-byte addressing structure. It has over 6000 transistors on one chip. It can perform 640,000 instructions per second.

Motorola introduces the 6800 microprocessor. It is also an eight-bit processor and is used primarily in industrial and automotive devices. It will become the chip of choice for Apple computers sparking a long-running battle between fans of Intel and Motorola chips.



Urheberrechtlich geschütztes Material

1975

The first commercially available microcomputer, the Altair 880, is the first machine to be called a "personal computer." It has 64 KB of memory and an open 100-line bus structure. It sells for $397 in kit form or $439 assembled. The name "Altair" was suggested by the 12-year-old daughter of the publisher of *Popular Electronics* because Altair was the destination that evening for the *Enterprise*, the *Star Trek* space ship.

Two young college students, Paul Allen and Bill Gates, unveil the BASIC language interpreter for the Altair computer. During summer vacation, the pair formed a company called Microsoft, which eventually grows into one of the largest software companies in the world.



1976

Steve Wozniak and Steve Jobs build the Apple I computer. It is less powerful than the Altair, but also less expensive and less complicated. Users must connect their own keyboard and video display, and have the option of mounting the computer's motherboard in any container they



choose—whether a metal case, a wooden box, or a briefcase. Jobs and Wozniak form the Apple Computer Company together on April Fool's Day, naming the company after their favorite snack food.

1977



The Apple II computer is unveiled. It comes already assembled in a case, with a built-in keyboard. Users must plug in their own TVs for monitors. Fully assembled microcomputers hit the general market, with Radio Shack, Commodore, and Apple all selling models. Sales are slow because neither businesses nor the general public know exactly what to do with these new machines.

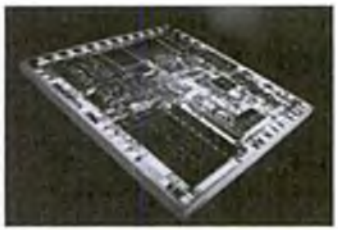
Datapoint Corporation announces Attached Resource Computing Network (ARCnet), the first commercial LAN technology intended for use with microcomputer applications.

Urheberrechtlich geschütztes Material

1978

Intel releases the 8086 microprocessor, a 16-bit chip that sets a new standard for power, capacity, and speed in microprocessors.

Epson announces the MX-80 dot-matrix printer, coupling high performance with a relatively low price. (Epson from Japan set up operations in the United States in 1975 as Epson America, Inc., becoming one of the first of many foreign companies to contribute to the growth of the PC industry. Up until this point, it has been U.S. companies only. According to Epson, the company gained 60 percent of the dot-matrix printer market with the MX-80.)



1979



Intel introduces the 8088 microprocessor, featuring 16-bit internal architecture and an eight-bit external bus.

Motorola introduces the 68000 chip; it contains 68,000 transistors, hence the name. It will be used in early Macintosh computers.

Software Arts, Inc., releases VisiCalc, the first commercial spreadsheet program for personal computers. VisiCalc is generally credited as being the program that paved the way for the personal computer in the business world.

Bob Metcalf, the developer of Ethernet, forms 3Com Corp. to develop Ethernet-based networking products. Ethernet eventually evolves into the world's most widely used network system.

MicroPro International introduces WordStar, the first commercially successful word-processing program for IBM-compatible microcomputers.

1980



IBM chooses Microsoft (co-founded by Bill Gates and Paul Allen) to provide the operating system for its upcoming PC. Microsoft purchases a program developed by Seattle Computer Products called Q-DOS (for Quick and Dirty Operating System), and modifies it to run on IBM hardware.

Bell Laboratories invents the Bellmac-32, the first single-chip microprocessor with 32-bit internal architecture and a 32-bit data bus.

Lotus Development Corporation unveils the Lotus 1-2-3 integrated spreadsheet program, combining spreadsheet, graphics, and database features in one package.



Urheberrechtlich geschütztes Material

1983

Time magazine features the computer as the 1982 "Machine of the Year," acknowledging the computer's new role in society.

Apple introduces the Lisa, a computer with a purely graphical operating system and a mouse. The industry is excited, but Lisa's $10,000 price tag discourages buyers.

IBM unveils the IBM-PC XT, essentially a PC with a hard disk and more memory. The XT can store programs and data on its built-in 10MB hard disk.



The first version of the C++ programming language is developed, allowing programs to be written in reusable independent pieces, called objects.

The Compaq Portable computer is released, the first successful 100 percent PC-compatible clone. (The term *clone* refers to any PC based on the same architecture as the one used in IBM's personal computers.) Despite its hefty 28 pounds, it becomes one of the first computers to be lugged through airports.

1984

Adobe Systems releases its PostScript system, allowing printers to produce crisp print in a number of typefaces, as well as elaborate graphic images.

Richard Stallman leaves MIT to start the GNU (GNU's not Unix) free software project. This project will grow adding thousands of programs to the library of free (open-source, available under a special license), software. This movement is supported by the Free Software Foundation, an alternative to expensive, closed-source software.

Apple introduces the "user-friendly" Macintosh microcomputer, which features a graphical interface.

IBM ships the IBM-PC AT, a 6 MHz computer using the Intel 80286 processor, which sets the standard for personal computers running DOS.

IBM introduces its Token Ring networking system. Reliable and redundant, it can send packets at 4 Mbps; several years later it speeds up to16 Mbps.

Satellite Software International introduces the WordPerfect word processing program.



Urheberrechtlich geschütztes Material

1985

Intel releases the 80386 processor (also called the 386), a 32-bit processor that can address more than four billion bytes of memory and performs 10 times faster than the 80286.

Aldus releases PageMaker for the Macintosh, the first desktop publishing software for microcomputers. Coupled with Apple's LaserWriter printer and Adobe's PostScript system, PageMaker ushers in the era of desktop publishing.



Microsoft announces the Windows 1.0 operating environment, featuring the first graphical user interface for PCs mirroring the interface found the previous year on the Macintosh.

Hewlett-Packard introduces the LaserJet laser printer, featuring 300 dpi resolution.



1986

IBM delivers the PC convertible, IBM's first laptop computer and the first Intel-based computer with a 3.5-inch floppy disk drive.

Microsoft sells its first public stock for $21 per share, raising $61 million in the initial public offering.

The First International Conference on CD-ROM technology is held in Seattle, hosted by Microsoft. Compact discs are seen as the storage medium of the future for computer users.



Urheberrechtlich geschütztes Material

1987



IBM unveils the new PS/2 line of computers, featuring a 20-MHz 80386 processor at its top end. This product line includes the MicroChannel bus, but is not a great success because consumers do not want to replace industry standard peripherals. To compete with IBM's MicroChannel architecture, a group of other computer makers introduces the EISA (Extended Industry Standard Architecture) bus.

IBM introduces its Video Graphics Array (VGA) monitor offering 256 colors at 320 × 200 resolution, and 16 colors at 640 × 480.

The Macintosh II computer, aimed at the desktop publishing market, is introduced by Apple Computer. It features an SVGA monitor. Apple Computer introduces HyperCard, a programming language for the Macintosh, which uses the metaphor of a stack of index cards to represent a program—a kind of visual programming language. HyperCard allows linking across different parts of a program or across different programs; this concept will lead to the development of HTML (hypertext markup language).



Motorola unveils its 68030 microprocessor.

Novell introduces its network operating system, called NetWare.

1988

IBM and Microsoft ship OS/2 1.0, the first multitasking desktop operating system. Its high price, a steep learning curve, and incompatibility with existing PCs contribute to its lack of market share.

Apple Computer files the single biggest lawsuit in the computer industry against Microsoft and Hewlett-Packard, claiming copyright infringement of its operating system and graphical user interface.

Hewlett-Packard introduces the first popular ink jet printer, the HP Deskjet.



Steve Jobs' new company, NeXT, Inc., unveils the NeXT computer, featuring a 25-MHz Motorola 68030 processor. The NeXT is the first computer to use object-oriented programming in its operating system and an optical drive rather than a floppy drive.

Apple introduces the Apple CD SC, a CD-ROM storage device allowing access to up to 650 MB of data.

A virus called the "Internet Worm" is released on the Internet, disabling about 10 percent of all Internet host computers.

Urheberrechtlich geschütztes Material

1993

Mosaic, a point-and-click graphical Web browser, is developed at the National Center for Supercomputing Applications (NCSA), making the Internet accessible to those outside the scientific community.



Intel, mixing elements of its 486 design with new processes, features, and technology, delivers the long-awaited Pentium processor. It offers a 64-bit data path and more than 3.1 million transistors.

Apple Computer expands its entire product line, adding the Macintosh Color Classic, Macintosh LC III, Macintosh Centris 610 and 650, Macintosh Quadra 800, and the Powerbooks 165c and 180c.

Apple introduces the Newton MessagePad at the Macworld convention, selling 50,000 units in the first 10 weeks.

Microsoft ships the Windows NT operating system.

IBM ships its first RISC-based RS/6000 workstation, featuring the PowerPC 601 chip developed jointly by Motorola, Apple, and IBM.



1994

Apple introduces the Power Macintosh line of microcomputers based on the PowerPC chip. This line introduces RISC to the desktop market. RISC was previously available only on high-end workstations.

Netscape Communications releases the Netscape Navigator program, a World Wide Web browser based on the Mosaic standard, but with more advanced features.

Online service providers CompuServe, America Online, and Prodigy add Internet access to their services.

After two million Pentium-based PCs have hit the market, a flaw in the chip's floating-point unit is found by Dr. Thomas Nicely. His report is made public on CompuServe.

Red Hat Linux is introduced and quickly becomes the most commonly used version of Linux.





Urheberrechtlich geschütztes Material

1995

Intel releases the Pentium Pro microprocessor.

Motorola releases the PowerPC 604 chip, developed jointly with Apple and IBM.

Microsoft releases its Windows 95 operating system with a massive marketing campaign, including prime-time TV commercials. Seven million copies are sold the first month, with sales reaching 26 million by year's end.

Netscape Communications captures more than 80 percent of the World Wide Web browser market, going from a start-up company to a $2.9 billion company in one year.



A group of developers at Sun Microsystems create the Java development language. Because it enables programmers to develop applications that will run on any platform, Java is seen as the future language of operating systems, applications, and the World Wide Web.

Power Computing ships the first-ever Macintosh clones, the Power 100 series with a PowerPC 601 processor.

eBay, the premier online auction house, is formed.

1996

Intel announces the 200 MHz Pentium processor.

U.S. Robotics releases the PalmPilot, a personal digital assistant that quickly gains enormous popularity because of its rich features and ease of use.



Microsoft adds Internet connection capability to its Windows 95 operating system.

Several vendors introduce Virtual Reality Modeling Language (VRML) authoring tools that provide simple interfaces and drag-and-drop editing features to create three-dimensional worlds with color, texture, video, and sound on the Web.

The U.S. Congress enacts the Communications Decency Act as part of the Telecommunications Act of 1996. The act mandates fines of up to $100,000 and prison terms for transmission of any "comment, request, suggestion, proposal, image or other communication which is obscene, lewd, lascivious, filthy, or indecent" over the Internet. The day the law is passed, millions of Web page backgrounds turn black in protest. The law is immediately challenged on constitutional grounds, ultimately deemed unconstitutional, and repealed.

Sun Microsystems introduces the Sun Ultra workstation that includes a 64-bit processor.



Urheberrechtlich geschütztes Material

1999

Intel unveils the Pentium III processor, which features 9.5 million transistors. Although the Pentium III's performance is not vastly superior to the Pentium II, it features enhancements that take greater advantage of graphically rich applications and Web sites. A more powerful version of the chip (named Xeon) is also released, for use in higher-end workstations and network server systems.

With its Athlon microprocessor, Advanced Micro Devices finally releases a Pentium-class chip that outperforms the Pentium III processor. The advance is seen as a boon for the lower-price computer market, which relies heavily on chips from Intel's competitors.

Sun Microsystems acquires Star Division Corporation and begins free distribution of StarOffice, a fully featured alternative to Microsoft Office and other proprietary office productivity products.

Apple Computer introduces updated versions of its popular iMac computer, including a laptop version, as well as the new G4 system, with performance rated at one gigaflop, meaning the system can perform more than one billion floating point operations per second.

The world braces for January 1, 2000, as fears of the "Millennium Bug" come to a head. As airlines, government agencies, financial institutions, utilities, and PC owners scramble to make their systems "Y2K-compliant," some people panic, afraid that basic services will cease operation when the year changes from 1999 to 2000.

Peter Merholz coins the term *blog*, a contraction of Web-log. In early 1999, there are already 50 recognized blog sites on the Web. By 2005 the sites will number in the hundreds of thousands.

The Internet Assigned Number Agency begins assigning Internet Protocol addresses using the new IPv6 addressing structure.



Urheberrechtlich geschütztes Material

2001

Microsoft releases the Windows XP operating system, with versions for home computers and business desktops. The XP version of Microsoft Office also is unveiled.

After blaming digital music pirates for lost revenue, the Recording Industry Association of America (RIAA) files lawsuits against purveyors of MP3 technology—most notably Napster, an online service that enables users to share MP3-format files freely across the Internet. The suits effectively shut down Napster, but do not stop individuals and other file-sharing services from exchanging music, text, and other files.

Apple introduces OS X, a new operating system for Macintosh computers that is based on BSD (Berkley Software Distribution) Unix with a beautiful graphical interface. It is an immediate success.

Several versions of recordable DVD discs and drives hit the market. Users instantly adopt the devices to store digitized home movies, data, and software; even though movie pirates soon begin copying and distributing movies on DVD, most users find the large capacity discs a wonderful storage and backup medium.

After several years of explosive growth, the "dot-com" revolution goes in to sudden reverse. As thousands of Web-based companies go out of business (giving rise to the phrase "dot-bomb"), tens of thousands of workers lose their jobs, shareholders suffer billions of dollars in losses, and the world's financial markets learn a valuable lesson.

Apple introduces the iPod, the premier music player with a 5 GB internal hard disk that will store 1,000 CD-quality songs.

Technology takes an important new role in society after the United States is attacked by terrorists on September 11, 2001. Government agencies, the military, and airlines place a new emphasis on security, recruiting new high-tech methods to monitor travelers and inspect people and baggage for dangerous items. Almost immediately, billions of dollars are invested in the development of new bomb-detection technologies and the creation of a huge, multinational database that can allow airlines to track the movements of passengers through the flight system.

Europe and Asia adopt the new Internet Protocol standard IPv6, the United States has not yet moved to adopt the new standard.







Urheberrechtlich geschütztes Material

2002



Because of to the high cost of flying and concerns about security, many American businesses drastically reduce business travel. Increasingly, companies rely on technologies such as video-conferencing, teleconferencing, and online document sharing to work with partners and customers.

After a year of devastating shakeouts, the dot-com world begins to pick itself up again. The new breed of online entrepreneur bases companies on sound business practices, rather than the glamour of simply being "new economy." Investments in new online ventures slow to a trickle, enabling only those companies with the best ideas and real promise of profits to flourish.

The wireless networking boom continues with an emphasis on enabling handheld computers and telephones to access the Internet via wireless connections. Products such as digital two-way pagers, wireless phones, and combination telephone/PDAs sell at unprecedented levels.

Michael Robertson releases Lindows, a Linux-based operating system that has a full graphical user interface and comes with Open Office software. Wal-Mart and Fry's, two large retail chains, market Lindows-based computer systems for as little as $199. Microsoft immediately sues Robertson to try to prevent the product from reaching the market but loses.

XML (eXtensible Markup Language) and Web-based applications take center stage in many businesses.

Microsoft releases Windows XP Server Edition and the .NET Framework.

OpenOffice.org announces the release of OpenOffice.org 1.0, a free, full-featured suite of productivity applications compatible with the file formats used by Microsoft Office and many other office suites. An open-source alternative to expensive application suites, OpenOffice.org runs under Windows, Solaris, Linux, the Mac OS, and other operating systems.







Urheberrechtlich geschütztes Material

2003

The National Center for Supercomputing Applications announces that Mike Showerman and Craig Steffen created a supercomputer based on 70 Sony PlayStation 2 gaming systems. The supercomputer cost about $50,000 to build, uses the Linux operating system and a Hewlett-Packard high-speed switch, and can perform 6.5 billion mathematical operations per second.

The Slammer worm does over $1 billion in damage and demonstrates that no network is truly secure.

Lindows explodes across the globe with several countries opting for this powerful and inexpensive alternative to high-priced proprietary software.

Microsoft releases Office 2003, the latest in the Office suite series.

Intel and AMD release 64-bit processors targeted for the home computer market.

Apple introduces the Power Macintosh G5, a 64-bit processor.

In a continuing attempt to control file sharing, the Recording Industry Association of America begins suing individuals who share files.

Apple opens an online music store, iTunes, offering more than 200,000 titles at $0.99 each.

Wi-Fi (Wireless Fidelity) or 802.11b/g comes to the consumer market with hot spots springing up both in home networking and in some commercial locations such as Starbucks. With this new technology comes the new technique called "war driving," where individuals drive around in automobiles with laptop computers looking for wireless networks that will allow them access.





Urheberrechtlich geschütztes Material

Appendix E—Self-Check Answers

Chapter 1, Lesson A, page 10
1. C
2. A
3. B

Chapter 1, Lesson B, page 36
1. B
2. A
3. C

Chapter 2, Lesson A, page 113
1. B
2. A
3. B

Chapter 2, Lesson B, page 73
1. B
2. A
3. B

Chapter 3, Lesson A, page 99
1. C
2. A
3. B

Chapter 3, Lesson B, page 113
1. B
2. A
3. B

Chapter 4, Lesson A, page 134
1. B
2. A
3. C

Chapter 4, Lesson B, page 151
1. C
2. B
3. B

Chapter 5, Lesson A, page 175
1. C
2. A
3. B

Chapter 5, Lesson B, page 192
1. C
2. A
3. B

Chapter 6, Lesson A, page 212
1. B
2. A
3. B

Chapter 6, Lesson B, page 231
1. B
2. A
3. B

Chapter 7, Lesson A, page 252
1. B
2. A
3. C

Chapter 7, Lesson B, page 270
1. A
2. A
3. C

Chapter 8, Lesson A, page 393
1. B
2. A
3. C

Chapter 8, Lesson B, page 315
1. B
2. A
3. C

Chapter 9, Lesson A, page 335
1. C
2. A
3. B

Chapter 9, Lesson B, page 350
1. C
2. A
3. B

Chapter 10, Lesson A, page 370
1. B
2. A
3. C

Chapter 10, Lesson B, page 391
1. B
2. A
3. B

Chapter 11, Lesson A, page 406
1. C
2. B
3. A

Chapter 11, Lesson B, page 428
1. A
2. C
3. B

Chapter 12, Lesson A, page 448
1. C
2. A
3. B

Chapter 12, Lesson B, page 465
1. B
2. A
3. C

Chapter 13, Lesson A, page 488
1. B
2. C
3. A

Chapter 13, Lesson B, page 508
1. C
2. A
3. B

Urheberrechtlich geschütztes Material

Glossary

Numerals

10Base-T See *Ethernet*.

100Base-T See *Fast Ethernet*.

3-D modeling software Graphics software used to create electronic models of three-dimensional objects.

3GL See *third-generation language*.

4GL See *fourth-generation language*.

5GL See *fifth-generation language*.

802.11b A wireless networking standard that describes specifications for data transmission speeds up to 11 Mbps.

802.11g A wireless networking standard that describes specifications for data transmission speeds of 20 Mbps and higher.

A

Accelerated Graphics Port (AGP) bus A bus standard that incorporates a special architecture that allows the video card to access the system's RAM directly, greatly speeding up graphics performance. Most new computers feature AGP graphics capabilities in addition to a PCI system bus and an expansion bus.

acceptance testing Testing performed during the development phase of the systems development life cycle. In acceptance testing, end users work with the installed system to ensure that it meets their criteria.

Access A database management program.

activate (1) To initiate a command or load a program into memory and begin using it. (2) To *choose*; for example, you can activate a resource by choosing its icon, toolbar button, or filename.

active matrix LCD A liquid crystal display (LCD) technology that assigns a transistor to each pixel in a flat-panel monitor, improving display quality and eliminating the "submarining" effect produced by some types of flat-panel monitors. Also called a *thin-film transistor (TFT)* display.

Active Server Pages (ASP) A specialized Web-scripting language that enables a Web page to access and draw data from databases.

active window On the computer screen, the window in which the user's next action will occur. The active window's title bar is highlighted, while the title bars of inactive windows appear dimmed.

adapter See *expansion board*.

address book A database that stores information about people, such as their names, addresses, phone numbers, e-mail addresses, and other details. Commonly part of a personal information management or e-mail program.

address bus A set of wires connecting the computer's CPU and RAM, across which memory addresses are transmitted.

Address Resolution Protocol (ARP) A specialized protocol that resolves logical IP addresses into physical addresses.

ADSL See *Asynchronous DSL*.

Advanced Micro Devices (AMD) A chip manufacturer that makes processors for PC-compatible computers.

adware See *spyware*.

AGP See *Accelerated Graphics Port*.

algorithm A set of ordered steps or procedures necessary to solve a problem.

all-in-one peripheral A device that combines the functions of printing, scanning, copying, and faxing. All-in-one peripherals can be based on either laser or ink jet printing technology and may operate in black and white, color, or both.

alphanumeric field See *text field*.

alphanumeric keys On a computer keyboard, the keys that include the letters of the alphabet, numerals, and commonly used symbols.

ALU See *arithmetic logic unit*.

always-on connection An Internet connection that is always active, as long as the computer is running. Cable modem and DSL connections are examples of always-on connections.

AMD See *Advanced Micro Devices*.

American Standard Code for Information Interchange An eight-bit binary code developed by the American National Standards Institute (ANSI) to represent symbolic, numeric, and alphanumeric characters. The ASCII character set is the most commonly used character set in PCs.

anonymous FTP archive An FTP site with files available to the general public. The user types the word "anonymous" as the account name in order to access the files.

anti-adware utility See *anti-spyware utility*.

antiglare screen A device that fits over a computer monitor and reduces glare from light reflecting off the screen.

anti-spyware utility A program that can locate and remove spyware programs from a user's computer. Some anti-spyware utilities can "immunize" a computer against known types of spyware, to prevent them from infecting the system.

antivirus utility A program that scans a computer's disks and memory for viruses; when it detects viruses, it removes them. Some antivirus programs can help the user recover data and program files that have been damaged by a virus and can actively scan files as they are being copied from a disk or downloaded from the Internet.

Apache HTTP Server A Web server product developed by the Apache Group. A robust and commercial-grade Web server that is maintained and improved upon as free, open-source software. Apache is the most popular Web server and runs on UNIX, Linux, and Windows servers.

APIPA See *automatic private IP address*.

applet A small program that can be run from within a Web page. Many Web-based applets are written in the Java programming language.

Urheberrechtlich geschütztes Material

basic rate ISDN See *basic rate integrated services digital network*.

batch (.bat) file An executable file that can be used to automate common or repetitive tasks. A batch file is a simple program that consists of an unformatted text file containing one or more commands. If you type a batch file's name in at a command prompt, your operating system will execute the commands in the file. A batch file can have a .com extensions instead of a .bat extension.

billions of instructions per second (BIPS) A common unit of measure when gauging the performance of a computer's processor.

binary field A database field that stores binary objects (such as clip art, photographs, screen images, formatted text, sound objects, and video clips) or OLE objects (such as charts or worksheets created with a spreadsheet or word processor).

binary large object (BLOB) (1) A graphic image file such as clip art, a photograph, a screen image, formatted text, a sound object, or a video clip. (2) An OLE object such as a chart or worksheet created with a spreadsheet or word processor; frequently used with object-oriented databases.

binary number system A system for representing the two possible states of electrical switches, which are on and off. (The binary number system is also known as *base 2*.) The binary number system gets its name from the fact that it includes only two numbers: 0 and 1. In computer storage and memory systems, the numeral 0 represents off and a 1 represents on.

BIOS See *basic input output system*.

BIPS See *billions of instructions per second*.

bit The smallest unit of data that can be used by a computer, represented by a 1 or a 0.

bitmap A binary representation of an image in which each part of the image, such as a pixel, is represented by one or more bits in a coordinate system. Also called a *raster*.

bits per second (bps) A measure of data transmission speed. This unit may be used to measure the data transmission rate of a specific device—such as a modem or disk drive—or for the components of a network. May be modified as kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps).

BLOB See *binary large object*.

block A contiguous series of characters, words, sentences, or paragraphs in a word processing document. This term is also sometimes used to describe a range of cells in a spreadsheet. Once a block of text or cells has been selected, the user can perform many different actions on it, such as moving, formatting, or deleting.

BMP Abbreviation for *bitmap*. BMP is a graphic-file format native to Windows and OS/2. BMP is widely used on PCs for icons and wallpaper.

board See *expansion board*.

Boolean field See *logical field*.

Boolean operator Special words—such as AND, OR, and NOT—that can be used to modify a keyword search in a Web-based search engine. These operators are commonly used in standard database queries.

boot To start a computer. The term comes from the expression "pulling oneself up by one's own bootstraps."

boot sector The portion of a disk that contains the master boot record—a program that runs when the computer is first started and determines whether the disk has the basic operating system components required to run successfully.

bottom-up design A design method in which system details are developed first, followed by major functions or processes.

bps See *bits per second*.

branch One of several directions that flows from a condition statement or function call within a sequence structure.

BRI See *basic rate integrated services digital network*.

brick-and-mortar store A business, such as a retail store, that has a physical location but does not have an online presence such as a Web site.

bridge A device that connects two LANs and controls data flow between them.

broadband Describes a high-speed network connection or data connection to the Internet. To qualify as broadband, a connection must transmit data faster than is possible with a dial-up connection through a standard modem and telephone line. Cable modems and DSL are common examples of broadband Internet connections.

browser See *Web browser*.

buddy list A list of people who can participate in chats, using instant messaging software.

buffer A dedicated space in memory or on a disk that temporarily stores data until it is needed by a program. Once the data has been used, it is deleted from the buffer.

bug An error in a computer program.

bus The path between components of a computer. The bus's width determines the speed at which data is transmitted. When used alone, the term commonly refers to a computer's data bus.

bus topology A network topology in which all network nodes and peripheral devices are attached to a single conduit.

business logic The process executed by one computer in a three-tier distributed application. This process can include determining what data is needed from a database, the best way to connect to the database, and other tasks.

business-to-business (B2B) transaction A transaction (such as the placing of an order or the paying of an invoice) conducted by two businesses. A B2B transaction can be conducted in many ways, with or without the use of computers, but the term *B2B* is commonly used to describe transactions that occur online or through a private corporate network such as an extranet.

business-to-consumer (B2C) transaction A transaction (such as the ordering of a product or the paying of a bill) conducted between an individual consumer and a business. A B2C transaction can be conducted in many ways, with or without the use of computers, but the term *B2C* is commonly used to describe transactions that occur via the Internet.

Urheberrechtlich geschütztes Material

clip art Predrawn or photographed graphic images that are available for use by anyone. Some clip art is available through licensing, some through purchase, and some for free.

Clipboard A holding area maintained by the operating system in memory. The Clipboard is used for storing text, graphics, sound, video, or other data that has been copied or cut from a document. After data has been placed in the Clipboard, it can be inserted from the Clipboard into other documents, in the same application, or in a different application.

clock cycle In a processor, the amount of time required to turn a transistor off and back on again. Also called a *tick*. A processor can execute an instruction in a given number of clock cycles, so as a computer's clock speed (the number of clock cycles it generates per second) increases, so does the number of instructions it can carry out each second.

clock speed A measure of a processor's operating speed, currently measured in megahertz (MHz, or millions of cycles per second) or gigahertz (GHz, or billions of cycles per second). A computer's operating speed is based on the number of clock cycles, or ticks, it generates per second. For example, if a computer's clock speed is 800 MHz, it "ticks" 800 million times per second.

cluster On a magnetic disk (such as a hard disk), a group of sectors that are treated as a single data-storage unit. The number of sectors per disk can vary, depending on the type of disk and the manner in which it is formatted.

coaxial cable (coax) A cable composed of a single conductive wire wrapped in a conductive wire mesh shield with an insulator in between.

code The instructions or statements that are the basis of a computer program.

color monitor A computer monitor whose screen can display data in color. A color monitor's capabilities are based on a variety of factors. Current high-resolution color monitors can display more than 16 million colors, but they also can be set to display as few as 16 colors or varying shades of gray.

command An instruction issued to the computer. The user can issue commands, usually by choosing from a menu, clicking an on-screen tool or icon, or pressing a combination of keys. Application programs and the operating system also issue commands to the computer.

command-line interface A user interface that enables the user to interact with the software by typing strings of characters at a prompt.

command prompt See *prompt*.

commercial software Software that a manufacturer makes available for purchase. The consumer usually pays for a license to use the software, instead of purchasing the software itself.

communications device An input/output device used to connect one computer to another to share hardware and information. This family of devices includes modems and network interface cards.

compact disc (CD) A type of optical storage medium, identical to audio CDs. The type of CD used in computers is called *compact disc read-only memory (CD-ROM)*. As the device's name implies, you cannot change the information on the disc, just as you cannot record over an audio CD. Standard compact discs can store either 650 MB or 700 MB of computer data, or 70 minutes or 80 minutes of audio data.

compact disc read-only memory (CD-ROM) The most common type of optical storage medium. In CD-ROM, data is written in a series of lands and pits on the surface of a compact disc (CD), which can be read by a laser in a CD-ROM drive.

compatible Describes the capability of one type of hardware, software, or data file to work with another. See also *incompatible*.

compiler A program that translates a file of program source code into machine language.

Complex Instruction Set Computing (CISC) Describes a type of processor designed to handle large and comprehensive instruction sets. CISC processors are commonly used in IBM-compatible PCs.

computer An electronic device used to process data, converting the data into information that is useful to people.

computer-aided design (CAD) Software used to create complex two- or three-dimensional models of buildings and products, including architectural, engineering, and mechanical designs.

computer-aided software engineering (CASE) Software used to develop information systems. CASE automates the analysis, design, programming, and documentation tasks.

computer-generated imaging (CGI) The process of using powerful computers and special graphics, animation, and compositing software to create digital special effects or unique images. CGI is frequently used in filmmaking, game design, animation, and multimedia design.

computer system A four-part system that consists of hardware, software, data, and a user.

conditional statement A feature of selection structure programming that directs program flow by branching to one part of the program or another depending on the results of a comparison.

configure To adapt a computer to a specific need by selecting from a range of hardware or software options. Configuration may include installing new or replacement hardware or software or changing settings in existing hardware or software.

contact information Data that can help communicate with individuals or businesses, such as names, mailing addresses, phone numbers, e-mail addresses, and other details. This kind of information is often stored and managed in special software, such as contact-management software, personal information managers, or e-mail programs.

contact-management software See *personal information manager*.

contact manager See *personal information manager*.

context menu In Windows 95 and later operating systems, a brief menu that appears when the user right-clicks certain items.

Urheberrechtlich geschütztes Material

database A collection of related data organized with a specific structure.

database management system (DBMS) A computer program used to manage the storage, organization, processing, and retrieval of data in a database.

datagram The term for data packets when traversing the Internet. A datagram (or packet) is a piece of a larger message that has been broken up for transmission over the Internet.

date field A database field that stores a date.

DB2 An enterprise-level database management system, developed and sold by IBM Corp.

DBMS See *database management system*.

DDOS attack See *distributed denial of service attack*.

debugging The process of tracking down and correcting errors (called *bugs*) in a software program.

decimal number system The system that uses 10 digits to represent numbers; also called *base 10*.

decision support system (DSS) A specialized application used to collect and report certain types of business data, which can be used to aid managers in the decision-making process.

decision tree A graphical representation of the events and actions that can occur in a program or information system under different conditions.

decoding (1) In a machine cycle, the step in which the control unit breaks down a command into instructions that correspond to the CPU's instruction set. (2) During file compression, the process of reinserting bits stripped away during encoding.

dedicated media Media (such as cables or wireless links) that are specifically set up for use in a network.

defragmentation The process of locating file fragments (parts of a file that are stored in noncontiguous sectors) on the surface of a magnetic disk, then storing them in contiguous sectors. This process can help optimize a disk's performance by allowing it to locate and load files in less time.

degaussing The process of disrupting a magnetic field. If a floppy disk become degaussed, for example, the data stored on it can be corrupted or destroyed.

density A measure of the quality of a magnetic disk's surface. The higher a disk's density, the more data the disk can store.

description field See *memo field*.

deselect The opposite of *select*. In many applications, the user can select, or highlight, blocks of text or objects for editing. By clicking the mouse in a different location or pressing a cursor-movement key, the user removes the highlighting and the text or objects are no longer selected.

desktop In a computer operating system, a graphical workspace in which all of the computer's available resources (such as files, programs, printers, Internet tools, and utilities) can be easily accessed by the user. In such systems, the desktop is a colored background on which the user sees small pictures, called *icons*. The user accesses various resources by choosing icons on the desktop.

desktop computer A full-size personal computer whose system unit is designed to sit on top of a desk or table; such computers are not considered to be portable. One variation of the desktop model is the *tower model*, whose system unit can stand upright on the floor.

development phase Phase 3 of the systems development life cycle, in which programmers create or customize software to fit the needs of an organization, technical documentation is prepared, and software testing is begun.

device Any electronic component attached to or part of a computer; hardware.

DHCP See *Dynamic Host Control Protocol*.

dial-up connection An Internet connection between a client computer and an Internet service provider's (ISP's) server computer, which takes place over a standard telephone line, using a standard modem. Such connections are called "dial-up" because the client computer's modem must dial a telephone number in order to connect to the ISP's server computer.

dialog box A special-purpose window that appears when the user issues certain commands in a program or graphical operating system. A dialog box gets its name from the "dialog" it conducts with the user as the program seeks the information it needs to perform a task.

digital The use of the numerals 1 and 0 (digits) to express data in a computer. The computer recognizes the numeral 1 as an "on" state of a transistor, whereas a 0 represents an "off" state.

digital camera A camera that converts light intensities into digital data. Digital cameras are used to record images that can be viewed and edited on a computer.

digital light processing (DLP) A technology used in some types of digital projectors to project bright, crisp images. DLP devices use a special microchip, called a *digital micromirror device*, that uses mirrors to control the image display. DLP projectors can display clear images in normal lighting conditions.

digital pen See *pen*.

Digital Subscriber Line (DSL) A form of digital telephone service used to transmit voice and data signals. There are several varieties of DSL technology, which include Asymmetrical DSL, High bit-rate DSL, and others.

Digital Video Disc (DVD) A high-density optical medium capable of storing a full-length movie on a single disc the size of a standard compact disc (CD). Unlike a standard CD, which stores data on only one side, a DVD-format disc stores data on both sides. Using compression technologies and very fine data areas on the disc's surface, newer-generation DVDs can store several gigabytes of data.

Digital Video Disc-RAM (DVD-RAM) A type of optical device that allows users to record, erase, and re-record data on a special disc. Using video editing software, you can record your own digitized videos onto a DVD-RAM disc, then play them back in any DVD player. (However, special encoding makes it impossible to copy movies from commercial DVD onto a DVD-RAM disc.) DVD-RAM drives can read DVDs, DVD-R discs, CD-R discs, CD-RW discs, and standard CDs.

Urheberrechtlich geschütztes Material

digitize To convert an image or a sound into a series of binary numbers (1s and 0s) that can be stored in a computer.

DIMM See *Dual In-Line Memory Module*.

direct attached storage (DAS) A storage device that is attached directly to a computer and that depends on the computer's processor.

Director A multimedia authoring program, developed by Macromedia, Inc.

directory See *folder*.

disconnected datasets Information that is temporarily copied from a central database to a user's computer and resides on the user's system only for as long as the user needs it. During that time, the connection with the database is broken.

disk A storage medium commonly used in computers. Two types of disks are used: magnetic disks, which store data as charged particles on the disk's surface; and optical discs, which use lasers to read data embossed on the disc in a series of lands and pits.

disk controller A device that connects a disk drive to the computer's bus, enabling the drive to exchange data with other devices.

disk defragmenter A utility program that locates the pieces of fragmented files saved in noncontiguous sectors on a magnetic disk and rearranges them so they are stored in contiguous sectors. Defragmenting a disk can improve its performance because the operating system can locate data more efficiently.

disk drive A storage device that holds, spins, reads data from, and writes data to a disk.

disk optimization One or more disk-management procedures that can improve a disk's performance. Disk optimization procedures include defragmentation, deletion of unneeded files, compression, and others.

diskette A removable magnetic disk encased in a plastic sleeve. Also called *floppy disk* or *floppy*.

diskette drive A device that holds a removable floppy disk when in use; read/write heads read and write data to the diskette.

display adapter See *video card*.

distributed application A program that is divided into parts, each of which executes on a different computer. In essence, the program's execution is distributed across multiple systems.

distributed computing A system configuration in which two or more computers in a network share applications, storage, and processing power. Also called *distributed processing*.

distributed denial of service (DDOS) attack A type of hacking attack in which a hacker hides malicious code on the PCs of many victims. This code may enable the hacker to take over the infected PCs, or simply use them to send requests to a Web server. If the hacker controls enough PCs, and can get them to send enough requests to the targeted Web server, the server essentially becomes jammed with requests and stops working.

distributed processing See *distributed computing*.

DLL See *dynamic link library file*.

DLP See *digital light processing*.

DNS See *domain name system*.

docking station A base into which a portable computer can be inserted, essentially converting the portable computer into a desktop system. A docking station may provide connections to a full-size monitor, keyboard, and mouse, as well as additional devices such as speakers or a digital video camera.

document A computer file consisting of a compilation of one or more kinds of data. There are many types, including text documents, spreadsheets, graphics files, and so on. A document, which a user can open and use, is different from a program file, which is required by a software program to operate.

document area In many software applications, the portion of the program's interface in which the active document appears. In this part of the interface, the user can work directly with the document and its contents. Also called *document window*.

document format In productivity applications, a setting that affects the appearance of the entire document, such as page size, page orientation, and the presence of headers or footers.

document window See *document area*.

domain name A name given to a computer and its peripherals connected to the Internet that identifies the type of organization using the computer. Examples of domain names are .com for commercial enterprises and .edu for schools. Also called *top-level domain*.

domain name system (DNS) A naming system used for computers on the Internet. This system provides an individual name (representing the organization using the computer) and a domain name, which classifies the type of organization.

dot matrix printer A type of impact printer that creates characters on a page by using small pins to strike an inked ribbon, pressing ink onto the paper. The arrangement of pins in the print head creates a matrix of dots—hence the device's name.

dot pitch The distance between phosphor dots on a monitor. The highest-resolution monitors have the smallest dot pitch.

dots per inch (dpi) A measure of resolution commonly applied to printers, scanners, and other devices that input or output text or images. The more dots per inch, the higher the resolution. For example, if a printer has a resolution of 600 dpi, it can print 600 dots across and 600 down in a one-inch square, for a total of 360,000 dots in one square inch.

double-click To select an object or activate a command on the screen by pointing to an object (such as an icon) and pressing and releasing the mouse button twice in quick succession.

download To retrieve a file from a remote computer. The opposite of *upload*.

dpi See *dots per inch*.

drag To move an object on the screen by pointing to the object, pressing the primary mouse button, and holding down the button while dragging the object to a new location.

drag and drop To move text or graphics from one part of the document to another by selecting the desired information.

Urheberrechtlich geschütztes Material

encryption The process of encoding and decoding data, making it useless to any system that cannot decode (decrypt) it.

Enhanced Integrated Drive Electronics (EIDE) An enhanced version of the IDE interface.

enterprise directory A collection of data about the users of a network and the computer resources of the network. This database typically is managed by the network operating system, which resides on a network server.

enterprise software Software that is used by hundreds or thousands of people at the same time, or that handles millions of records, or both.

enterprise storage A large-scale system of data storage, connected to the computer system of a large organization.

enterprise system A very large-scale computer system, such as one used by a large organization.

ergonomics The study of the physical relationship between people and their tools. In the world of computing, ergonomics seeks to help people use computers correctly to avoid physical problems such as fatigue, eyestrain, and repetitive stress injuries.

error-correction protocol A standard for correcting errors that occur when static interferes with data transmitted via modems over telephone lines.

Ethernet The most common network protocol. Also called *10Base-T*.

Event Viewer In later versions of Windows, a program that records certain conditions, such as errors, and creates a log that is usable by the system's user or administrator.

executable (.exe, .com) file The core program file responsible for launching software.

execute To load and carry out a program or a specific set of instructions. Executing is also called *running*.

execution cycle The second portion of the machine cycle, which is the series of steps a CPU takes when executing an instruction. During the execution cycle, the CPU actually carries out the instruction by converting it into microcode. In some cases, the CPU may be required to store the results of an instruction in memory; if so, this occurs during the execution cycle.

exit condition In programming, a condition that must be met in order for a loop to stop repeating.

expansion board A device that enables the user to configure or customize a computer to perform specific tasks or to enhance performance. An expansion board—also called a *card*, *adapter*, or *board*—contains a special set of chips and circuitry that add functionality to the computer. An expansion board may be installed to add fax/modem capabilities to the computer, for example, or to provide sound or video-editing capabilities.

expansion slot The area of the motherboard into which expansion boards are inserted, connecting them to the PC's bus.

expert system An information system in which decision-making processes are automated. A highly detailed database is accessed by an inference engine, which is capable of forming an intelligent response to a query.

Extended ASCII An extension of the ASCII character set, which specifies the characters for values from 128 to 255. These characters include punctuation marks, pronunciation symbols, and graphical symbols.

Extended Binary Coded Decimal Interchange Code (EBCDIC) An eight-bit code that defines 256 symbols. It is still used in IBM mainframe and midrange systems, but it is rarely encountered in personal computers.

Extensible Hypertext Markup Language (XHTML) An outgrowth of HTML, XHTML is a superset of the HTML commands, including the capabilities of HTML and adding to them. XHTML allows for the execution of programs written in Extensible Markup Language (XML) and it is itself extensible, meaning that it allows for new commands and features to be added.

Extensible Markup Language (XML) An outgrowth of HTML, it is a markup language that allows data to be stored in a human-readable format. The language also allows users to create unique tags or other elements.

Extensible Markup Language Mobile Profile (XHTML MP) A new development environment formerly known as Wireless Markup Language (WML) used to create documents that can be viewed by handheld devices such as Web-enabled cell phones, PDAs, and even digital pagers.

Extensible Stylesheet Language (XSL) An XML technology that allows XML documents to be formatted for display in HTML-based browsers.

extension point A device that allows a greater number of users to access a wireless network.

external cache See *Level-2 cache*.

external modem A communications device used to modulate data signals. This type of device is described as "external" because it is housed outside the computer and connected to the computer through a serial port and to the telephone system with a standard telephone jack.

extract To uncompress one or more compressed files that have been stored together in an archive file.

extranet A network connection that enables external users to access a portion of an organization's internal network, usually via an Internet connection. External users have access to specific parts of the internal network but are forbidden to access other areas, which are protected by firewalls.

eyestrain Fatigue of the eyes, caused by staring at a fixed object for too long. Extended computer use can lead to eyestrain.

F

Fair Credit Reporting Act A federal law (enacted in 1970) that mandates that personal information assembled by credit reporting agencies must be accurate, fair, and private. It allows individuals to review and update their credit record as well as dispute the entries.

FAQ See *frequently asked questions*.

Fast Ethernet A networking technology, also called *100Base-T*, that uses the same network cabling scheme as Ethernet but uses

Urheberrechtlich geschütztes Material

different network interface cards to achieve data transfer speeds of up to 100 Mbps.

FAT See *file allocation table*.

fault tolerance The ability of a computer system to continue functioning, even after a major component has failed.

fax modem A modem that can emulate a fax machine.

fetching The first step of the CPU's instruction cycle, during which the control unit retrieves (or fetches) a command or data from the computer's memory.

fiber-optic cable A thin strand of glass wrapped in a protective coating. Fiber-optic cable transfers data by means of pulsating beams of light.

field The smallest unit of data in a database; used to group each piece or item of data into a specific category. Fields are arranged in a column and titled by the user.

fifth-generation language (5GL) A high-level programming language that theoretically would use artificial intelligence techniques to create software, based on the programmer's description of the program.

file A set of related computer data (used by a person) or program instructions (used by an application or operating system) that has been given a name.

file allocation table (FAT) In a diskette or hard disk, a log created during the logical formatting process that records the location of each file and the status of each sector on the disk.

file compression See *data compression*.

file compression utility See *data compression utility*.

file format A standardized method of encoding data for storage.

file server The central computer of a network; used for shared storage. A server may store software applications, databases, and data files for the network's users. Depending on the way a server is used, it also may be called a *network server*, *application server*, or *server*.

file server network A hierarchical network strategy in which the server is used to store and forward files to the nodes. Each node runs its own applications.

file system In an operating system, a logical method for managing the storage of data on a disk's surface.

file transfer The process of sending a file from one computer to another by modem or across a network. See also *download* and *upload*.

file transfer protocol (FTP) A set of rules that dictate the format in which data is sent from one computer to another.

filter (1) A DBMS tool that enables the user to establish conditions for selecting and displaying a subset of records that meet those criteria. (2) In an e-mail program, a tool that allows the user to decide how messages are handled. For example, you can create a filter that automatically deletes messages from a certain sender or that stores certain messages in a specific folder. In e-mail programs, a filter also may be called a *rule*.

Financial Modernization Act of 1999 A federal law that requires companies to give consumers notice of their privacy and information-sharing practices.

firewall An antipiracy method for protecting networks. A firewall permits access to public sections of the network while protecting proprietary areas.

FireWire See *IEEE 1394*.

first-generation language A term applied to machine languages, which were the earliest and crudest programming languages used with personal computers.

first-party cookie A cookie placed on a user's computer by the Web site he or she is currently viewing. First-party cookies are persistent and usually store preferences the user has set for viewing the site. Some first-party cookies store information that can personally identify the user.

Flash A development tool for creating very sophisticated Web pages; it can include moving graphics, animation, sound, and interactivity.

flash memory A special type of memory chip that combines the best features of RAM and ROM. Like RAM, flash memory lets a user or program access data randomly. Also like RAM, flash memory lets the user overwrite any or all of its contents at any time. Like ROM, flash memory is nonvolatile, so it retains data even when power is off.

flash memory drive A small-format storage device that uses flash memory to hold data. This highly portable storage device is small enough to be carried on a keychain.

flat-file database A database file consisting of a single data table that is not linked to any other tables.

flat-panel display A thin, lightweight monitor used in laptop and notebook computers. Most flat-panel displays use LCD technology.

floppy See *diskette*.

floppy disk See *diskette*.

flowchart A diagram of the program control flow.

folder A tool for organizing data stored on a disk. A folder contains a list of files and other folders stored on the disk. A disk can hold many folders, which can in turn store many files and other folders. Also called a *directory*.

font A family of alphanumeric characters, symbols, and punctuation marks that share the same design. Modern applications provide many different fonts and enable users to use different fonts in the same document. Also called a *typeface*.

form A custom screen created in a database management system (DBMS) for displaying and entering data related to a single database record.

format (1) As relating to magnetic storage devices, the layout of tracks and sectors in which data is stored. (2) In productivity applications, a setting that affects the appearance of a document or part of a document.

formatting (1) The process of magnetically mapping a disk with a series of tracks and sectors where data will be stored. Also

Urheberrechtlich geschütztes Material

IDE See *integrated development environment*.

identity (ID) theft A type of crime in which a thief uses someone else's identity to obtain money or conduct business transactions. This crime usually involves the theft of the victim's personal information, such as a Social Security number, credit card number, or bank account information.

IEEE 1394 An expansion bus technology that supports data-transfer rates of up to 400 Mbps. Also called *FireWire*.

IETF See *Internet Engineering Task Force*.

IGES See *Initial Graphics Exchange Specifications*.

IIS See *Internet Information Server*.

IM See *instant messaging*.

image scanner An input device that digitizes printed images. Sensors determine the intensity of light reflected from the page, and the light intensities are converted to digital data that can be viewed and manipulated by the computer. Sometimes called simply a *scanner*.

IMAP4 See *Internet Mail Access Protocol Version 4*.

impact printer A type of printer that creates images by striking an inked ribbon, pressing ink from the ribbon onto a piece of paper. Examples of impact printers are dot-matrix printers and line printers.

implementation phase Phase 4 of the systems development life cycle. In this phase, new software and hardware are installed in the user environment, training is offered, and system testing is completed.

incompatible The opposite of *compatible*. Describes the inability of one type of hardware, software, or data file to work with another.

Industry Standard Architecture (ISA) bus A PC bus standard developed by IBM, extending the bus to 16 bits. An ISA bus can access 8-bit and 16-bit devices.

inference engine Software used with an expert system to examine data with respect to the knowledge base and to select an appropriate response.

information processing cycle The set of steps a computer follows to receive data, process the data according to instructions from a program, display the resulting information to the user, and store the results.

information system A mechanism that helps people collect, store, organize, and use information. An information system does not necessarily include computers; however, a computer is an important part of an information system.

Information Systems department The people in an organization responsible for designing, developing, implementing, and maintaining the systems necessary to manage information for all levels of the organization.

INI file See *initialization file*.

Initial Graphics Exchange Specifications (IGES) One of a few universal file formats for vector graphics.

initialization (.ini) file A file containing configuration information, such as the size and starting point of a window, the color of the background, the user's name, and so on. Initialization files help programs start running or they contain information that programs can use as they run.

initializing See *formatting*.

ink jet printer A type of nonimpact printer that produces images by spraying ink onto the page.

input device Computer hardware that accepts data and instructions from the user. Examples of input devices include the keyboard, mouse, joystick, pen, trackball, scanner, bar code reader, microphone, and touch screen.

input/output (I/O) Communications between the user and the computer or between hardware components that result in the transfer of data.

input/output (I/O) device A device that performs both input and output functions. Modems and network interface cards are examples of input/output devices.

input–processing–output (IPO) chart A programming tool used in the planning of a software development project, an IPO chart contains three columns that list the program's required inputs, processes, and outputs.

insertion point See *cursor*.

installation testing During the development phase of the systems development life cycle (SDLC), the installation of a new system in a test environment where it is tested by the business.

instant messaging (IM) Chat software that enables users to set up buddy lists and open a window to "chat" when anyone on the list is online.

instruction A command that the computer must execute so that a specific action can be carried out.

instruction cycle The first portion of the machine cycle, which is the series of steps a CPU takes when executing an instruction. During the instruction cycle, the CPU's control unit fetches a command or data from the computer's memory, enabling the CPU to execute an instruction. The control unit then decodes the command so it can be executed.

instruction set Machine language instructions that define all the operations a CPU can perform.

integrated development environment (IDE) A programming tool that provides the programmer with all of the tools needed to develop applications in one program; most commonly used with 3GLs and 4GLs.

integrated pointing device A pointing device built into the computer's keyboard; consists of a small joystick positioned near the middle of the keyboard, typically between the *g* and *h* keys. The joystick is controlled with either forefinger. Two buttons that perform the same function as mouse buttons are just beneath the spacebar and are pressed with the thumb. One type of integrated pointing device, developed by IBM, is called *TrackPoint*.

integrated services digital network (ISDN) A digital telecommunications standard that replaces analog transmissions and transmits voice, video, and data.

Intel A leading manufacturer of microprocessors. Intel invented the first microprocessor, which was used in electronic calculators.

Urheberrechtlich geschütztes Material

joint requirements planning (JRP) A process—often used during the requirements planning phase of the rapid application development (RAD) systems development cycle—to identify high-level, strategic management requirements. At the heart of JRP are highly structured workshops in which senior managers participate in defining the goals and strategy of the organization and defining the goals and priorities of the new system.

joystick An input device used to control the movement of on-screen components; typically used in video games.

JPEG See *Joint Photographic Experts Group format*.

JRP See *joint requirements planning*.

K

KB See *kilobyte*.

keyboard The most common input device, used to enter letters, numbers, symbols, punctuation, and commands into the computer. Computer keyboards typically include numeric, alphanumeric, cursor-movement, modifier, and function keys, as well as other special keys.

keyboard buffer A part of memory that receives and stores the scan codes from the keyboard controller until the program can accept them.

keyboard controller A chip within the keyboard or the computer that receives the keystroke and generates the scan code.

keyboarding Touch typing using a computer keyboard.

keyword A term or phrase used as the basis for a search when looking for information on the World Wide Web.

kilobyte (KB) Equivalent to 1,024 bytes; a common measure of data storage.

knowledge base A highly specialized database used with an expert system to intelligently produce solutions.

knowledge discovery Describes a type of database utility designed to analyze data and report useful information.

L

L1 cache See *Level-1 cache*.

L2 cache See *Level-2 cache*.

L3 cache See *Level-3 cache*.

label Descriptive text used in a spreadsheet cell to describe the data in a column or row.

LAN See *local area network*.

land A flat area on the metal surface of a optical disc that reflects the laser light into the sensor of an optical disc drive. See also *pit*.

laptop computer See *notebook computer*.

laser printer A quiet, fast printer that produces high-quality output. A laser beam focused on an electrostatic drum creates an image to which powdered toner adheres, and that image is transferred to paper.

LCD monitor See *liquid crystal display monitor*.

LDAP See *Lightweight Directory Access Protocol*.

Level-1 (L1) cache A type of cache memory built directly into the microprocessor. Also called *on-board cache*.

Level-2 (L2) cache A type of cache memory that is external to the microprocessor but is positioned between the CPU and RAM. Also called *external cache*.

Level-3 (L3) cache A type of cache memory that is built into the computer's motherboard.

Lightweight Directory Access Protocol (LDAP) A set of protocols used for accessing information directories such as e-mail names and addresses stored on a mail server. The advantages of LDAP are that it is very fast, it is simpler, and it is constructed to work with TCP/IP. LDAP eventually should make it possible for almost any application running on virtually any computer platform to obtain directory information such as e-mail addresses.

line conditioner A device that protects hardware from electrical surges and line noise.

line noise Power disturbances that can be caused by high-demand electrical equipment such as air conditioners.

line printer A type of impact printer that uses a special, wide print head to print an entire line of characters at one time.

link See *hypertext link*.

Linux A freely available version of the UNIX operating system. Developed by a worldwide cooperative of programmers in the 1990s, Linux is a feature-rich, 32-bit, multiuser, multiprocessor operating system that runs on virtually any hardware platform.

liquid crystal display (LCD) monitor A flat-panel monitor on which an image is created when the liquid crystal becomes charged; used primarily in notebook computers.

listserv An e-mail server that contains a list of names and enables users to communicate with others on the list in an ongoing discussion.

local area network (LAN) A system of PCs located relatively near to one another and connected by wire or a wireless link. A LAN permits simultaneous access to data and resources, enhances personal communication, and simplifies backup procedures.

local bus An internal system bus that runs between components on the motherboard.

logic error A bug in which the code directs the computer to perform a task incorrectly.

logical field A database field that stores only one of two values: yes or no, true or false, on or off, and so on. Also called a *Boolean field*.

logical formatting An operating system function in which tracks and sectors are mapped on the surface of a disk. This mapping creates the master boot record, FAT, root folder (also called the *root directory*), and the data area. Also called *soft formatting* and *low-level formatting*.

logical operation One of the two types of operations a computer can perform. Logical operations usually involve making a comparison, such as determining whether two values are equal. See also *arithmetic operation*.

Urheberrechtlich geschütztes Material

.NET A development environment that combines several programming languages, including Visual Basic, C++, C#, and J#. Using .NET, developers can write programs for Windows, the World Wide Web, and PocketPC.

.NET Framework A set of technologies that support Web-based applications, large databases, e-commerce servers, and distributed applications.

Netscape Fast Track A popular Web server program, developed by Netscape Communications.

network (1) A system of interconnected computers that communicate with one another and share applications, data, and hardware components. (2) The act of connecting computers together in order to permit the transfer of data and programs between users.

network attached storage (NAS) A large, dedicated storage device that is attached directly to a network rather than being part of a server.

network interface card (NIC) A circuit board that controls the exchange of data over a network.

network news transfer protocol (NNTP) A set of rules that enable news servers to exchange articles with other news servers.

network operating system (NOS) A group of programs that manage the resources on a network.

network operations center (NOC) A professionally managed facility that houses high-volume Web servers.

network protocol A set of standards used for network communications.

network server See *file server*.

network storage Refers to one or more shared storage devices attached to a network.

network version An application program especially designed to work within a network environment. Users access the software from a shared storage device.

news A public bulletin board service on the Internet; organized into discussion groups representing specific topics of interest.

news server A host computer that exchanges articles with other Internet servers.

newsgroup An electronic storage space where users can post messages to other users, carry on extended conversations, and trade information.

newsreader A software program that enables the user to post and read articles in an Internet newsgroup.

NIC See *network interface card*.

NNTP See *network news transfer protocol*.

NNTP server Another name for news servers using the network news transfer protocol.

NOC See *network operations center*.

node An individual computer that is connected to a network.

nonimpact printer A type of printer that creates images on paper without striking the page in any way. Two common examples are ink jet printers, which spray tiny droplets of ink onto the page, and laser printers, which use heat to adhere particles of toner to specific points on the page.

nonvolatile The tendency for memory to retain data even when the computer is turned off (as is the case with ROM).

NOS See *network operating system*.

notebook computer A small, portable computer with an attached flat screen; typically powered by battery or AC and weighing less than 10 pounds. Notebook computers commonly provide most of the same features found in full-size desktop computers, including a color monitor, a fast processor, a modem, and adequate RAM and storage for business-class software applications. Also called *laptop computer*.

ns See *nanosecond*.

NSFnet Acronym for *National Science Foundation Network*. A network developed by the National Science Foundation (NSF) to accommodate the many users attempting to access the five academic research centers created by the NSF.

***n*-tier application** A distributed database application that is divided among more than three computers.

numeric field A database field that stores numeric characters.

numeric keypad The part of a keyboard that looks and works like a calculator keypad; it has 10 digits and mathematical operators.

O

object In object-oriented programming, a data item and its associated characteristics, attributes, and procedures. An object's characteristics define the type of object—for example, whether it is text, a sound, a graphic, or video. Attributes might be color, size, style, and so on. A procedure refers to the processing or handling associated with the object.

object code The executable file in machine language that is the output of a compiler.

object embedding The process of integrating a copy of data from one application into another, as from a spreadsheet to a word processor. The data retains the formatting applied to it in the original application, but its relationship with the original file is destroyed.

object linking The process of integrating a copy of data from one application into another so that the data retains a link to the original document. Thereafter, a change in the original document also appears in the linked data in the second application.

Object Linking and Embedding (OLE) A Windows feature that combines object embedding and linking functions. OLE allows the user to construct a document containing data from a single point in time or one in which the data is constantly updated.

object-oriented programming (OOP) A programming technology that makes use of reusable, modular components, called *objects*.

object-oriented systems analysis (OOSA) A systems development methodology.

OCR See *optical character recognition*.

Urheberrechtlich geschütztes Material

parallel processing The use of multiple processors to run a program. By harnessing multiple processors, which share the processing workload, the system can handle a much greater flow of data, complete more tasks in a shorter period of time, and deal with the demands of many input and output devices. Also called *multiprocessing (MP)* or *symmetric multiprocessing (SMP)*.

passive matrix LCD Liquid crystal display technology used for flat-panel monitors; it relies on a grid of transistors arranged by rows and columns. In a passive matrix LCD, the color displayed by each pixel is determined by the electricity coming from the transistors at the end of the row and the top of the column.

password A word or code used as a security checkpoint by an individual computer system or a network to verify the user's identity.

password capture A technique used by hackers and identity thieves to learn passwords or other personal information from a victim. In password capture, the thief listens to or records telephone conversations or intercepts network transmissions in hopes of gathering the right information.

password guessing A technique used by hackers and identity thieves to learn passwords or other personal information from a victim. In password guessing, the thief attempts to log into a network or Web site by guessing the victim's password.

password sharing A technique used by hackers and identity thieves to learn passwords or other personal information from a victim. In password sharing, the victim unwittingly gives his or her password to the thief by writing it down in a conspicuous place or telling it to someone else.

Paste command An application command that copies data from the Clipboard and places it in the document at the position of the insertion point. Data in the Clipboard can be pasted into multiple places in one document, multiple documents, and documents in different applications.

payload In a packet, the actual data being transmitted across a network or over telephone lines. Also refers to the executable portion of a computer virus or the output produced by a virus.

PC See *personal computer*.

PC Card A specialized expansion card the size of a credit card; it fits into a computer and is used to connect new components.

PC DOS A version of the disk operating system marketed by IBM Corp.

PC-to-TV converter A hardware device that converts a computer's digital video signals into analog signals for display on a standard television screen.

PC video camera A small video camera that connects to a special video card on a PC. When used with videoconferencing software, a PC video camera enables users to capture full-motion video images, save them to disk, edit them, and transmit them to other users across a network or the Internet.

PCI See *Peripheral Component Interconnect bus*.

PDA See *personal digital assistant*.

peer-to-peer (P2P) network A network environment in which all nodes on the network have equal access to at least some of the resources on all other nodes.

peer-to-peer (P2P) service A special type of connection provided via the Internet, which allows connected client computers to communicate and exchange data directly instead of using server computers.

pen An input device that allows the user to write directly on or point at a special pad or the screen of a pen-based computer, such as a PDA. Also called a *stylus*.

Peripheral Component Interconnect (PCI) bus A PC bus standard developed by Intel; it supplies a high-speed data path between the CPU and peripheral devices.

Perl A scripting language commonly used in the development of Web-based applications.

persistent cookie A cookie that remains on the user's hard disk after the current browsing session is ended. Persistent cookies are usually set to "expire" on a certain date; until then, they remain active.

personal computer (PC) The most common type of computer found in an office, classroom, or home. The PC is designed to fit on a desk and be used by one person at a time; also called a *microcomputer*.

personal digital assistant (PDA) A very small portable computer designed to be held in one hand; used to perform specific tasks, such as creating limited spreadsheets or storing phone numbers.

personal information manager (PIM) A software program used for collecting and refining information about people, schedules, and tasks. PIMs are also called *contact-management software* or *contact managers*, because these programs are used primarily for managing information about people the user commonly contacts.

phishing A technique used by hackers and identity thieves to learn passwords and other important information from victims. In phishing, the thief contacts victims via phone or e-mail, pretending to be a legitimate business such as a bank, then asks the victim for private information.

photo-editing program A multimedia software tool used to make modifications, including adjusting contrast and sharpness, to digital photographic images.

photo printer A special color printer used for outputting photo-quality images. These printers are typically used to print images captured with a digital camera or an image scanner.

PhotoCD A special optical disc technology, developed by Kodak, for digitizing and storing standard film-based photographs.

photorealistic Describes computer-generated images that are lifelike in appearance and not obviously models.

PICT Abbreviation for *picture*. A graphics file format developed for and commonly used on the Macintosh platform, but seldom used on the PC platform.

PIM See *personal information manager*.

Urheberrechtlich geschütztes Material

print head In impact printers, a device that strikes an inked ribbon, pressing ink onto the paper to create characters or graphics.

print server A special network server that is devoted to managing printing tasks for multiple users. A print server makes it easy for many users to share a single printer.

printer An output device that produces a hard copy on paper. Two types are impact and nonimpact.

Privacy Act of 1974 A federal law that restricts federal agencies from sharing information about individuals without their written consent.

private IP address An IP address that is reserved for use by a specific organization's computer.

processing A complex procedure by which a computer transforms raw data into useful information.

processor See *central processing unit (CPU)*.

program (1) A set of instructions or code to be executed by the CPU; designed to help users solve problems or perform tasks. Also called *software*. (2) To create a computer program. The process of computer programming is also called *software development*.

program control flow The order in which a program's statements are executed when the program is run.

programmable read-only memory (PROM) A type of computer chip whose contents cannot be changed. PROM chips are often found on hard drives and printers. They contain the instructions that power the devices. These instructions, once set, never need to be changed.

programmer The person responsible for creating a computer program, including writing new code and analyzing and modifying existing code.

programming language A higher-level language than machine code for writing programs. Programming languages use variations of basic English.

PROM See *programmable read-only memory*.

prompt In a command-line interface, the on-screen location where the user types commands. A prompt usually provides a blinking cursor to indicate where commands can be typed. Also called a *command prompt*.

protocol A set of rules and procedures that determine how a computer system receives and transmits data.

prototype A working system model used to clarify and refine system requirements.

pseudocode "Fake" code; a text version of the program control flow; similar to the program code but lacking the exact syntax and details.

public domain software Software that is freely available to anyone, free of charge. Generally, users can modify the source code of public domain software.

public IP address An IP address that is available for use by any computer on the Internet.

public record A legal document, such as driving records or marriage licenses, that is available for viewing by anyone.

publish See *post*.

Q

QBE See *query by example*.

query In a database management system (DBMS), a search question that instructs the program to locate records that meet specific criteria.

query by example (QBE) In a database management system (DBMS), a tool that accepts a query from a user and then creates the SQL code to locate data requested by the query. QBE enables the user to query a database without understanding SQL.

Quick Launch bar A customizable area of the Windows taskbar that lets you launch programs with a single click.

R

RAD See *rapid application development*.

RAID 0 A data storage technology (also called *striping*) that provides the user with rapid access by spreading data across several disks in a disk array. Striping alone, however, does not provide redundancy. If one of the disks in a striped array fails, the data is lost.

RAID 1 A data storage technology (also called *mirroring*) in which data is written to two or more disks simultaneously, providing a complete copy of all the information on multiple drives in the event one drive should fail. This improves reliability and availability, and if one disk fails, the mirrored disk continues to function, thus maintaining reliability and availability.

RAID 4 A data storage technology (also called *striping-with-parity*) in which data from each file is spread over multiple disks. It provides the speed of striping with the safety of redundancy because the system stores parity information that can be used to reconstruct data if a disk drive fails. Such arrays also provide error-checking.

RAM See *random access memory*.

random access memory (RAM) A computer's volatile or temporary memory, which exists as chips on the motherboard near the CPU. RAM stores data and programs while they are being used and requires a power source to maintain its integrity.

random access storage device A storage device that can locate data at any point on the storage medium without going through all the data up to that point. Floppy disks, hard disks, and optical discs are examples of random access storage devices.

rapid application development (RAD) A method used in systems development that allows for fast creation of computer systems and applications in an organization.

raster See *bitmap*.

read/write head The magnetic device within the disk drive that reads, records, and erases data on the disk's surface. A read/write head contains an electromagnet that alters the polarity of magnetic particles on the storage medium. Most disk drives have one read/write head for each side of each disk in the drive.

Urheberrechtlich geschütztes Material

read-only memory (ROM) A permanent, or nonvolatile, memory chip used to store instructions and data, including the computer's startup instructions.

real-time application An application that responds to certain inputs extremely quickly—thousandths or millionths of a second (milliseconds or microseconds, respectively). Real-time applications are needed to run medical diagnostics equipment, life-support systems, machinery, scientific instruments, and industrial systems.

real-time operating system An operating system designed to support real-time applications.

record A database row composed of related fields; a collection of records makes up the database.

Reduced Instruction Set Computing (RISC) Refers to a type of microprocessor design that uses a simplified instruction set; it uses fewer instructions of constant size, each of which can be executed quickly.

redundant array of independent disks (RAID) a storage system that links any number of disk drives (a disk array) so that they act as a single disk. This is done for better performance and/or redundancy.

refresh rate The number of times per second that each pixel on the computer screen is scanned; measured in hertz (Hz).

register High-speed memory locations built directly into the ALU and used to hold instructions and data currently being processed.

relational database A database structure capable of linking tables; a collection of tables that share at least one common field.

Remote Access VPN Special networking software that allows a user to create a secure connection to a private network via the Internet.

repeat rate A keyboard setting that determines how rapidly the character is typed and how long an alphanumeric key must be held down before the character will be repeated.

repetition structure A control structure in which a condition is checked and a loop is executed based on the result of the condition. Also called *looping structure*.

repetitive stress injury (RSI) An injury to some part of the body caused by continuous movement. Computer-related injuries include strain to the wrist, neck, and back.

report A database product that displays data to satisfy a specific set of search criteria presented in a predefined layout, which is designed by the user.

resolution The degree of sharpness of an image, determined by the number of pixels on a screen; expressed as a matrix.

resolver A network device that converts logical IP addresses into physical addresses.

restore To replace a damaged or missing file on a hard disk with a copy from a backup.

right-click To use the right mouse button of a two-button mouse to select an object or command on the screen.

Right to Financial Privacy Act of 1978 A federal law that requires companies to give consumers notice of their privacy and information-sharing practices.

ring topology A network topology in which network nodes are connected in a circular configuration. Each node examines the data sent through the ring and passes on data not addressed to it.

RISC See *Reduced Instruction Set Computing*.

ROM See *read-only memory*.

root folder The top-level folder on a disk. This primary folder contains all other folders and subfolders stored on the disk. Also called the *root directory*, or sometimes just the *root*.

router A computer device that stores the addressing information of each computer on each LAN or WAN; it uses this information to transfer data along the most efficient path between nodes of a LAN or WAN.

RSI See *repetitive stress injury*.

rule See *filter*.

ruler An on-screen tool in a word processor's document window. The ruler shows the position of lines, tab stops, margins, and other parts of the document.

run See *execute*.

S

SAN See *storage area network*.

scalability A program's capability to adjust to changes in scale—the number of users it must support or the numbers of tasks it must perform.

scanner See *image scanner*.

screen saver A utility program that displays moving images on the screen if no input is received for several minutes; originally developed to prevent an image from being burned into the screen.

scroll To move through an entire document in relation to the document window in order to see parts of the document not currently visible on screen.

scroll bar A vertical or horizontal bar displayed along the side or bottom of a document window that enables the user to scroll horizontally or vertically through a document by clicking an arrow or dragging a box within the scroll bar.

SCSI See *Small Computer System Interface*.

SDLC See *systems development life cycle*.

SDSL See *Synchronous DSL*.

search engine A Web site that uses powerful data-searching techniques to help the user locate Web sites containing specific types of content or information.

second-generation language Refers to assembly language, which is slightly more advanced and English-like than machine languages (which are considered first-generation languages).

Urheberrechtlich geschütztes Material

second-level domain (SLD) A domain name given to an organization. In the URL *www.government.org*, for example, *government* is the second-level domain.

secondary e-mail account A backup e-mail account that can be used as a collection place for spam and other unwanted e-mail messages.

sector A segment or division of a track on a disk.

Secure Hypertext Transfer Protocol (HTTPS) An Internet protocol used to encrypt individual pieces of data transmitted between a user's computer and a Web server, making the data unusable to anyone who does not have a key to the encryption method.

secure sockets layer (SSL) An Internet protocol that can be used to encrypt any amount of data sent over the Internet between a client computer and a host computer.

secure Web page A Web page that uses one or more encryption technologies to encode data received from and sent to the user.

seek time See *average access time*.

select (1) To highlight a block of text (in a word processor) or range (in a spreadsheet), so the user can perform one or more editing operations on it. (2) To click once on an icon.

selection structure A control structure built around a conditional statement.

sequence structure A type of control structure in which a computer executes lines of code in the order in which they are written.

sequential access device A storage device that must search a storage medium from beginning to end in order to find the data that is needed. Such devices cannot access data randomly. A tape drive is an example of a sequential access device.

serial interface A channel through which data bits flow one at a time. Serial interfaces are used primarily to connect a mouse or a communications device to the computer. Also called a *serial port*.

serial port See *serial interface*.

server See *file server*.

session cookie A cookie that remains on the user's hard disk only during a Web-browsing session. The cookie is deleted when the session ends. Also called a *transient cookie*.

shadow mask In a cathode ray tube (CRT) monitor, a fine mesh made of metal fitted to the shape and size of the screen. The holes in the shadow mask's mesh are used to align the electron beams to ensure that they strike the correct phosphor dot. In most shadow masks, these holes are arranged in triangles.

shareware Software that can be used without paying a fee or registering for a specified time period. After that time, the user is obligated to purchase and/or register the product.

shell Refers to a GUI environment that can run on top of a command-line operating system, such as Linux or UNIX.

shopping cart At many e-commerce Web sites, a feature that lets the shopper store, review, and edit items to be purchased before checking out.

shortcut Any means that enables the user to quickly execute an action or issue a command. On the Windows desktop, for example, icons serve as shortcuts by allowing you to quickly launch programs. Within programs, you may be able to click buttons or press specific keys to quickly perform tasks; these buttons and keystrokes are also shortcuts.

shortcut menu See *context menu*.

shoulder surfing A method used by hackers and identity thieves to learn passwords and other personal information from their victims. In shoulder surfing, the thief watches as the victim enters a password or other information at a computer, ATM, phone, or other device.

S-HTTP See *Secure Hypertext Transfer Protocol*.

SIMM See *Single In-Line Memory Module*.

Simple Mail Transfer Protocol (SMTP) A common protocol for sending e-mail between servers on the Internet. It also often is used for sending e-mail from an e-mail client to a server.

Single In-Line Memory Module (SIMM) One type of circuit board containing memory chips.

single-user/multitasking operating system An operating system that supports only one user at a time, but allows the user to perform multiple tasks simultaneously, such as running several programs at the same time. Examples include Windows and the Macintosh operating system.

single-user/single-tasking operating system An operating system that supports only one user at a time and allows the user to perform only one task at a time. Examples include MS-DOS and some operating systems designed for use on handheld computers.

site license An agreement in which an organization purchases the right to use a program on a limited number of machines. The total cost is less than would be required if individual copies of the software were purchased for all users.

site-to-site VPN A special type of networking software that can be used to connect two networks together in a secure manner. Both networks may be part of the same private intranet or they may be networks of partner companies participating in an extranet.

SLD See *second-level domain*.

slide An individual graphic that is part of a presentation. Slides are created and edited in presentation programs.

Small Computer System Interface (SCSI) A high-speed interface that extends the bus outside the computer, permitting the addition of more peripheral devices than normally could be connected using the available expansion slots.

small outline DIMM (SO-DIMM) A small-format memory chip found in portable computers.

smart card A plastic card—about the same size as a standard credit card—that contains a small chip that stores data. Using a special device, called a smart card reader, the user can read data from the card, add new data, or revise existing data.

smart card reader A device that can read data from or write data to a smart card.

Urheberrechtlich geschütztes Material

USA Patriot Act A federal law (enacted in 2001) that extends the authority of law enforcement and intelligence agencies in monitoring private communications and access to your personal information.

USB See *Universal Serial Bus*.

user The person who inputs and analyzes data using a computer; the computer's operator.

User Datagram Protocol (UDP) A transport protocol that is sometimes used instead of the more common TCP (Transport Control Protocol) for sending messages across a network.

user ID See *user name*.

user interface The on-screen elements that enable the user to interact with the software.

user name A code that identifies the user to the system; often the user's full name, a shortened version of the user's name, or the user's e-mail name. Also called a *user ID*.

user session The period during which a user interacts with a terminal server, using a shared program on a network.

utility A software program that may be used to enhance the functionality of an operating system. Examples of utility software are disk defragmenters and screen savers.

V

value A numerical entry in a spreadsheet—representing currency, a percentage, a date, a time, a fraction, and so on—that can be used in calculations.

vector A mathematical equation that describes the position of a line.

very small aperture terminal (VSAT) An earth-based communications station that allows an individual or organization to connect to the Internet via satellite.

VGA See *Video Graphics Array*.

video capture card A specialized expansion board that enables the user to connect video devices—such as VCRs and camcorders—to the PC. This enables the user to transfer images from the video equipment to the PC, and vice versa. Many video cards enable the user to edit digitized video and to record the edited images on videotape.

video card A circuit board attached to the motherboard that contains the memory and other circuitry necessary to send information to the monitor for display on screen. This controller determines the refresh rate, resolution, and number of colors that can be displayed. Also called the *display adapter*.

Video Graphics Array (VGA) An IBM video display standard capable of displaying resolutions of 640 × 480, with 16 colors.

video RAM (VRAM) Memory on the video controller (sometimes called *dual-ported memory*) that can send a screen of data to the monitor while receiving the next data set.

videoconference A live, real-time video communications session involving two or more people using computers, video cameras, telecommunications and videoconferencing software.

viewing angle The widest angle from which a display monitor's image can be seen clearly. Generally speaking, cathode ray tube (CRT) monitors provide a wider viewing angle than liquid crystal display (LCD) monitors do.

viewing area The actual portion of a computer monitor that displays an image.

virtual memory Space on a computer's hard drive that acts as a backup to system RAM. Programs can store instructions or data in virtual memory that is not needed immediately; when an instruction or data is needed, it can quickly be moved into RAM, where the processor can access it.

virtual private network Technologies that allow data to be exchanged securely and privately over a public network, such as the Internet.

virus A parasitic program that infects another legitimate program, sometimes called the *host*. To infect the host program, the virus modifies the host so that it contains a copy of the virus.

virus definition A database of information about specific viruses that enables an antivirus program to detect and eradicate viruses. Also called a *virus pattern*.

virus pattern See *virus definition*.

Voice over Internet Protocol (VoIP) A protocol that allows voice data to travel over the Internet.

voice recognition See *speech recognition*.

VoIP See *Voice over Internet Protocol*.

volatile The tendency for memory to lose data when the computer is turned off, as is the case with RAM.

VPC Acronym for *virtual private connection*. See *virtual private network*.

VPN See *virtual private network*.

VRAM See *video RAM*.

VSAT See *very small aperture terminal*.

vulnerability Any aspect of a system that is open to harm. For example, if a computer does not have antivirus software, this is a vulnerability because the system can easily become infected by a virus.

W

WAN See *wide area network*.

WAP See *wireless access point*.

war driving The act of searching an area covered by a Wi-Fi network to locate spots where wireless Internet access is available.

Web browser A program that enables the user to view Web pages, navigate Web sites, and move from one Web site to another. Also called a *browser*.

Web bug A GIF-format graphic file, placed in a Web page or HTML-format e-mail message, that can be used to track a person's online activities. Web bugs are commonly considered to be a form of spyware.

Urheberrechtlich geschütztes Material

Chapter 6

p. 231 both Photo courtesy of Neural Signals, Inc.; **6B.10** palmOne, Zire, Tungsten, Treo, logos, stylizations, and design marks associated with all the preceding, and trade dress associated with palmOne, Inc.'s products, are among the trademarks or registered trademarks owned by or exclusively licensed to palmOne, Inc.; **p. 235 top** Photographers Choice/Getty Images; **p. 235 bottom** Jose Luis Pelaez/Corbis.

Chapter 7

7A.1 Christian Hoehn/Getty Images; **7A.17, 7A.18, 7A.19, 7A.21** Aaron Haupt; **7A.22, 7A.23** Photo courtesy of Linksys; **7A.26** Courtesy TrippLite; **p.261** Courtesy Symantec; **7B.1** Javier Pierini/Corbis; **7B.3** Courtesy U.S. Robotics; **7B.4** Courtesy Zoom Technologies; **7B.5** Courtesy IBM; **7B.9** Photo courtesy of Linksys; **7B.10** D-Link Systems, Inc.; **p. 271** Epson America, Inc.; **p. 277** Jim Craigmyle/Corbis.

Chapter 8

8A.1 Bettmann/Corbis; **8A.2** Salus, CASTING THE NET: FROM ARPANET TO INTERNET AND BEYOND, p. 300, © 1995 Addison-Wesley Publishing Company Inc. Reprinted by permission of Pearson Education, Inc. Publishing as Pearson Addison Wesley.; **p. 305 top** Dennis Degnan/Corbis; **8B.1** Courtesy Research in Motion.

Chapter 9

9A.1 Michael Newman/Photoedit; **9A.3** Courtesy 3Com; **9B.2** DiMaggio/Kalish/Corbis; **9B.3** David Young Wolff/Photoedit; **9B.12** Walter Hodges/Corbis; **9B.14** John Henley/Corbis.

Chapter 10

10A.24, p. 393 top Mark Burnett; **10B.5** Amanita Pictures; **10B.11** RF/Corbis; **10B.14** Kobal collection; **10B.15** Aaron Haupt; **p.520** Doug Martin.

Chapter 11

p. 431 Charles Gupton/Corbis.

Chapter 13

13A.1 VCL/Getty Images; **13A.2** Michael S. Yamashita/Corbis; **13A.4** Kevin R. Morris/Corbis; **13A.5** Chuck Savage/Corbis; **13A.7** Rf/Corbis; **13A.12** Courtesy American Power Conversion; **13A.13** Courtesy Computer Products, Inc.; **13A.15** Rf/Comstock/Getty Images; **13B.1** Spencer Grant/Photoedit; **13B.13** Photo courtesy of Linksys; **13B.17** Property of Fellowes; **13B.18, 13B.19** David Young Wolff/Photoedit; **p. 507** Photodisc Red/Getty Images; **p. 511** Paul Sakuma/AP Wide World.

TIMELINE

p. 544-1965 Computer History Museum; **p. 544-1970** Lucent Technologies Inc./Bell Labs; **p. 544-1971** Photo courtesy of Intel Corporation; **p. 545-1972** W. Cody/Corbis; **p. 545-1973** Courtesy IBM; **p. 545-1974** Photo courtesy of Intel Corporation; **p. 546-1975, 1976** Computer History Museum; **p. 546-1977** Courtesy Apple Inc.; **p.547-1978** Photo courtesy of Intel Corporation; **p. 547-1980 left** Courtesy Microsoft; **P. 547-1980 right** Box shot of Lotus 1-2-3 (copyright 1980) IBM Corporation. Used with permission of IBM Corporation. Lotus and 1-2-3 are trademarks of IBM Corporation.; **p. 548-1981 top** Computer History Museum; **p. 548-1981 bottom** Courtesy of IBM Corporate Archives; **p. 548-1982** Photo courtesy Hewlett-Packard; **p. 549-1983** Photo courtesy Hewlett-Packard; **1984** Paul Sakuma/AP Wide World; **1985 left** Courtesy Microsoft; **1985 right** Photo courtesy Hewlett-Packard; **1986, 1987 left** Courtesy of IBM Corporate Archives; **1987 right** Courtesy Apple Inc.; **1988** Shahn Kermani/Getty Images; **1989 left** Photo courtesy of Intel Corporation; **1989 right** Donna Coveny/MIT News; **1990 left** Courtesy Microsoft; **1990 right** Courtesy IBM; **1991 left** Paul Sakuma/AP Wide World; **1991 right** Courtesy of Apple Inc.; **1992** Courtesy IBM; **1993 left** Courtesy National Center for Supercomuting Applications and the Board of Trustees of the University of Illinois.; **1993 right** Reproduced with Permission of Motorola, Inc.; **1994 bottom** RED HAT is a registered trademark of Red Hat, Inc.; **1995 left** Courtesy Microsoft; **1995 right** eBay™ is a trademark of eBay Inc.; **1996 left** Amanita Pictures; **1996 right** Paul Sakuma/AP Wide World; **1997 left** Photo courtesy of Intel Corporation; **1997 right, 1998 left** Amanita Pictures; **1998 right, 1999** Aaron Haupt; **2000 left** Amanita Pictures; **2000 center** Photo courtesy AMD 2004; **2000 right** Photo courtesy of Intel Corporation; **2001 left** Courtesy Microsoft; **2001 center** Courtesy Apple, Inc; **2001 right** AP Wide World; **2002 top** Steve Chenn/Corbis; **2002 bottom left** Courtesy Handspring. palmOne, Zire, Tungsten, Treo, logos, stylizations, and design marks associated with all the preceding, and trade dress associated with palmOne, Inc.'s products, are among the trademarks or registered trademarks owned by or exclusively licensed to palmOne, Inc.; **2002 center** Denis Poroy/AP Wide World; **2002 bottom right** Open Office.org; **2003 left** © Robin Scholtz; **2003 right** Courtesy Apple, Inc.; **2005** Photo courtesy of Nokia.

Urheberrechtlich geschütztes Material

Index

Symbols and Numbers

.NET Framework, function of, 232
.NET programming language, 460–461
10Base-T, Ethernets and, 259
100Base-T, Ethernets and, 259
3-D animation software, 389–390
3-D modeling programs, 389
802.11b, wireless networks, 275
802.11g, wireless networks, 275

A

A_Backup utility, 217
Aberdeen Group, spam statistics and, 316
Accelerated Graphics Port (AGP) bus, 137
accounting programs, QuickBooks, 16
active matrix LCD technology, 92
Active Server Pages (ASP), 465
active windows, 209
ActiveX programming language, 460
adapters, expansion boards, 155
address books, 378
address bus, 137
Advanced Micro Devices (AMD) processors, 148, 554
Advanced Research Projects Agency (ARPA), 286
adware, security and, 482
airbrush tools, repairing a scratched image with, 388
algorithms, 445, 448–449
  complexity of, 448
  intractable problems and, 449
  tractable and, 448–449
all-in-one peripherals, 112–113
Allen, Paul, 540–541
alphanumeric keys, keyboards and, 50
ALT key, keyboard shortcuts, 60
Altair 880, 540
AltiGen, 156
always-on connections, 505
AMD processors, 149
American National Standards Institute (ANSI), 193
American Standard Code for Information Interchange (ASCII), 128
analog systems, 4
AngelFire, web sites, 524
Animators, careers in multimedia, 393
anonymous FTP archives, 319
anti-adware utilities, 502
anti-spam laws, web sites, 484
anti-spyware utilities, 502
antiglare screens, 98
antivirus programs, 447
antivirus utility, 217
Apple I computer, 540
Apple II computer, 540
applets, 460
application servers, 245
application software, review questions and, 379–382
applications
  distributed applications, 232
  real-time applications, 206
Archie, web searches and, 320
architecture, processors and, 147
archive files, 191
arithmetic logic units, 130
articles, newsgroups and, 318
Artificial Intelligence, 466–467
  ethical issues and, 475
ASCII Codes, 129
assemblers, 458
assembly languages, 458–459
Asynchronous DSL (ADSL), 333
asynchronous transfer mode (ATM), 274
Athlon processors, 149
audio
  headphones, 102
  headsets, 103
  overview and, 87
  sound cards, 100–101
  sound systems, 100–103
  streaming audio, 293
audio input, other types of, 76
Audio-conferencing, 246
audiovisual input devices, 74–76
  review questions and, 80–85
authoring environments, 461
AutoCAD, 3-D projects, 542
automatic vehicle location (AVL) software, 337
automobiles, on-board computer system, 39
Automotive mechanics, computer systems and, 41
autonomous acoustic recording devices, 102
average access time, drive performance, 188

B

backbones, networking and, 287
backing up your data, 174–175
backup utility, 217
band printers, 109
Bank of America, web sites, 350
banking
  online banking and finance, 349–350
  online services and, 15
bar code readers, 71
Barry, Mark, 234
Barry's Clipart Server, web sites, 520
basic input output system (BIOS), 132
basic rate integrated services digital network, 272
batch (.bat) files, 441
Bellmac-32, 541
Berners-Lee, Tim, 294, 546
Best Buy, web sites, 349
billions of instructions per second (BIPS), 131
Bimodal viruses, 534
binary fields, 408
binary large objects (BLOBs), 408
binary number systems, 127
Bioacoustics Research Program (BRP), 102–103
Bipartite viruses, 534
(BitMaP) format, 385
bitmapped images, 384
bitmaps, Standard Formats for Bitmap Graphics, 385–386
bits, 127
bits per second (bps), 268
blocks, definition of, 367
blogs, 552
Bloodhound Heuristics, 447
Blu-Ray laser drives, 181
blueprints, construction ocuments, 388
boards, expansion boards, 155
Bombs, 534
bookmarks, 297–298
Boolean operators, 302–303
  Google, 304
boot sector viruses, 534
boot sectors, 170
booting, 170
Brain Communicator, 230
branching structures. See selection structures
brick-and-mortar stores, 347
bridges, definition of, 257
broadband connections, 272, 332–333
  sharing and, 340
browsers, 290–291
  closing and, 298
  getting help with browsers, 299
  launch your browser, 296
  using browsers in World Wide Web, 295–299
  using navigation tools, 298
  using site-specific search tools, 307
buddy list, instant messaging and, 321
buffers, keyboard buffer, 54
Bundled hardware, 530
Bureau of Labor Statistics
  computer support specialists, 235

Urheberrechtlich geschütztes Material

Bureau of Labor Statistics—cont.
income of computer scientists and, 511
Internet careers and, 354–355
multimedia employment, 393
networking statistics and, 277
sales earnings and, 157
technical writers and, 323
bus, definition of, 136
bus standards, 137
bus topology network, 264
Bush, Vannevar, 4
business, e-commerce and, 350–354
business logic, 421
business programmers, 469
business-to-business (B2B) transactions, 350–351
business-to-consumer (B2C) transactions, online shopping and, 346
bytes
data abd, 127
definition of, 29

C

C programming language, 459
C++ programming language, 459
cable modem services, 273–274, 334
cabling equipment, 258–260
cache memory, 138
caches
Level-1 (L1) caches, 139
Level-2 (L2) caches, 139
Level-3 (L3) caches, 139
CAD programs, construction documents, 388
cameras, digital, 77–78
campus area networks (CAN), 269
CAN-SPAM Act of 2003, 484
Canvas Systems, 78
cards
expansion boards, 155
PC Cards, 156
careers in outsourcing, 194–195
carpal tunnel syndrome, 61–62
Case, Jennifer, 430–431
cathode ray tube (CRT), 88
CD-Recordable (CD-R) drive, 32, 178
CD-ReWritable (CD-RW) discs, 32
CD-ReWritable (CD-RW) drives, 178
CD-ROM drives, 32
CD-ROMs, 176–177
Cedant Web Hosting, web sites, 524
cell addresses, 369–370
cell pointers, 369
cells, 369
graphics and, 370
central processing unit (CPU), 28
CERT Coordination Center, viruses and, 536
Changing Your PC's Operating System, 218–219
channels, discussions groups and, 321
character formatting, 367
characters per second (cps), printers and, 109
chat, Internet relay chat (IRC), 320
chat rooms, 321
chips
making of, 150
universal asynchronous receiver-transmitter (UART), 152
circuit boards, processing devices, 28
click-and-mortar stores, 347
client/server networks, 250–251
clip art, 386
Clipboards, 215
definition of, 213
clock cycles, 136
clock speeds, 136
clocks, internal, 136
Cluster Viruses, 534
clusters, 8, 170
CMYK color process, 110
CNet, web sites, 397
CNET Shopper, web sites, 528
CNN, web sites, 293, 307
Coalition of Essential Schools (CES), student portfolios, 192
coaxial cables, 255
codes
ASCII Codes, 129
Extended Binary Coded Decimal Interchange Code, 127
text codes, 127–128
color monitors, 89–90
dot pitch and, 96
columns, in databases, 404
command-line interfaces, 211–212
commercial software, 364
common buses, performance specifications of, 138
Common User Access (CUA), 60
Communications Decency Act, 549
communications devices, 31
Compact Disc Read-Only Memory (CD-ROM), 32
compact discs (CDs), 32
Compaq Portable computer, 543
compilers, 443
complex instruction set computing (CISC) processor, 150
CompTIA, 430–431
computer data, 34–35
Computer Emergency Response Team (CERT), web sites, 492
computer programs. See also software
algorithms, 445
antivirus programs, 447
batch (.bat) files, 441
code, 441–442
code branches, 449
compilers, 443
definition of, 440–441
development life cycles, 465–468
dynamic link library (.dll) files, 440
executable (.exe) files, 440
exit conditions, 450
flowchart algorithms, 445–446
help (.hlp, .chm) files, 440
heuristics, 446–447
initialization (.ini) files, 440
input-processing-output (IPO) charts, 444
interpreters, 443–444
interrupts, 441
loops, 450
machine codes, 442
object-oriented programming (OOP), 449–451
overview of, 439
planning and, 444
program control flow, 445
programming, 442
programming languages, 442–443
pseudocode, 444
repetition structures, 450
review questions and, 452–455
selection structures, 449–450
sequence structures, 449
source codes, 442
structured programming, 448–449
computer scientists, 510–511
computer skills, ethical issues and, 47
computer systems
computerized disease management, 36
data and, 25–26
dissecting the ultimate machine, 24
information processing cycle, 26–27
Input and Output Devices, 30–31
memory devices, 29
parts of, 25–26
review of, 42–45
software and, 25
users and, 26
computer training specialists, 116–117
computer users, 38–39
installing software, 38
maintaining the system, 39
managing files, 39
running programs, 39
setting up the system, 38

Urheberrechtlich geschütztes Material

Computer-aided design (CAD) programs, 388–389
computer-generated animation, 390
computer-generated imaging (CGI), 389
computer-related ailments, 484
computer viruses
categories of, 534
definition of, 532–533
effects of, 533–534
computerized disease management, 36
computerized voting, 62–63
computers
accepting input from the keyboard, 53–54
career uses and, 322–323
careers in multimedia, 392
careers in outsourcing, 194–195
complex hardware configurations, 13
computer-based phone systems, 156
computer training specialists, 116–117
computerized voting, 62–63
Controlling Computers with the Mind, 230–231
cost of, 528
customer service support, 219
definition of, 4
designing multimedia products, 13
desktop computers, 5–6
Desktop or Portable?, 529
Desktop Publishing application, 13
drive-interface standards, 192–194
education and, 15
factors affecting processing speed, 133
getting images into your computer, 386
government use and, 12
Graphics-Intensive applications, 13
Handheld personal computers, 7
Health Care and, 18–19
Help Desk and Technical Support Specialists, 234–235
history of microcomputers, 538–557
home use and, 14–15
impact of other inventions and, 11
importance of, 12–14
individual users and, 5–8
industry and, 16
internal clocks, 136
keeping your computer clean, 509–510
Keeping Your PC Up to Date, 486–487
laptop computers, 6–7
Mainframe computers, 9–10
memory and computing power, 134–135
midrange computers, 10
minicomputers, 10
mobile computers, 7
monitors and, 88–96
computers—*cont.*
network servers, 8–9
Notebook computers, 6–7
Online shopping for, 531
online spying tools, 481
organizations and, 8–10
overview of, 2
PC or Macintosh?, 529
personal digital assistant (PDA), 7
productivity tips and, 12
representation of data and, 126–128
resource for study and, 15
review questions and, 20–23
shopping for, 526–528
small business and, 15–16
society and, 11–19
speech recognition and, 74–75
standard computer ports, 152
storage needs and, 529
storing computer equipment, 509–510
Supercomputers, 10–11
tablet PCs, 7
To Bundle or Not to Bundle?, 530
trust issues and spam, 316
useless computers, 39
using outside of the IT industry, 40–41
warranty and, 530
Why Own When You Can Rent?, 390–391
workstations and, 6
Computing Keynotes, 518–525, 526–531, 532–584
Additional Resources on Web Design, 524–525
building your web page, 521–522
finding graphics online, 520–521
hosting services, 523–524
Intellectual Property Rights, 525
linking sites to web pages, 522–523
publishing your web site, 524–525
selecting a template, 521
CondéNet, 451
conditional statements, 449
Confucian Etext Project, web sites, 294
construction documents, blueprints, 388
Construction managers, 41
contact information, 376
contact-management software, 377
contact managers, 376
context menu, 209
control units, 130
cookies, 348, 481–482, 501–502
cookie-management utility, 502
manually deleting and, 502
Copy commands, 214
corporate networks, servers and, 9
counter fields, 408–409
countermeasures, security and, 478
Courier services, 41
CPU
billions of instructions per second (BIPS), 131
bus speed vs. CPU speed, 136
cache memory and, 138
decoding and, 131
definition of, 130
executing and, 131
factors affecting processing speed, 133
fetching and, 131
overview of, 146
performance specifications and, 150
storing and, 131
creating
charts in PowerPoint, 375
macros and, 376
presentation programs and, 374–375
creativePOST Inc., 392
credit reports, 499
Critical Infrastructure Protection Board (CIPB), 492
CRT monitors, 89–90
shadow masks, 90
cursor-movement keys, 52
cursors, 52
customer relationship management (CRM) software, 234
customer service resources, e-commerce, 349
customer service support, 219
networking and, 276
Cut commands, 214
cybercrime, 488
cost of, 489
cyberslacking
catching "cyberslackers" on the job, 252–253
Packet sniffers, 253
proxy servers, 253
surveillance software, 253
web filters and, 253
cyberterrorism, 492
Cyborgs Among Us: Wearable Technology, 134–135

D

data, 13
AMD processors, 149
ASCII Codes, 129
backing up, 174–175, 504–505
binary number systems, 122
bits, 122
bytes, 122
categorizing storage devices, 166
computer data, 34–35
computer processing and, 128–133

Urheberrechtlich geschütztes Material

data—*cont.*
computer representation of, 126–128
current Intel processors, 148–149
data compression, 190–191
decimal number systems, 126
definition of, 25
easier data backup, 247
entering data in worksheets, 369
execution cycles, 131
extracting compressed files, 191
input device overview, 68
instruction cycles, 131
limiting physical access t o, 504–505
machine cycles, 130–131
magnetic storage devices, 166–173
microcomputer processors, 147–148
millions of instructions per second (MIPS), 131
number systems and, 126–127
optical storage devices, 175–179
optimizing disk performance, 189–191
overview of, 125
processors and, 147–150
random access memory (RAM), 29
review questions and, 142–145
Serial and Parallel Ports, 153–154
solid-state storage devices, 179–182
text codes, 127–128
uninstalling programs, 190
universal asynchronous receiver-transmitter (UART), 152
data areas, 170
data bus, 136
Accelerated Graphics Port (AGP) bus, 137
Industry Standard Architecture (ISA) bus, 137
local bus, 137
PC Card bus, 138
performance specifications of, 138
Peripheral Component Interconnect (PCI) bus, 137
Universal Serial Bus (USB), 132
data communications
modems and telephone lines, 268–270
overview and, 267
review questions and, 278–281
using digital data connections, 271–274
data communications managers, 277
data compression, 190–191
data-conferencing, 246–247
data diddling, 489
data mining, 424–425
data processing, 401
data projectors, 100, 375
data transfer rates, 138, 188–189
data warehouses, 406–407
database management system (DBMS), 350, 353–354
overview of, 401
review questions and, 417–419, 433–437
databases, 402–404
in baseball, 414–415
binary fields, 408
binary large objects (BLOBs), 408
in businesses, 423–425
careers and, 430–431
columns and, 404
counter fields and, 408–409
data entry, 409
data mining, 424–425
date fields, 408
DB2, 429
definition of, 402
description fields, 409
disconnected datasets, 422–423
field types, 407–409
fields, 403, 404
filters, 410
flat-file structure, 405
forms, 403, 409–410
interfaces, 406
Internet, 425
knowledge discovery, 424–425
logical fields, 408
macros, 426–427
memo fields, 409
MySQL, 429
numeric fields, 408
Oracle, 428
personal, 425–426, 428
query by example (QBE), 413
querying, 412–413
record sorting, 410–411
records, 403–404
relational structure, 405
report generation, 413
reports, 403
rows, 404
scalability, 429
sorting records, 410–411
SQL Servers, 429
table creation, 407
table view, 409–410
tables, 403
text fields, 408
time fields, 408
traffic, 422
viewing tables, 409–410
datagrams, definition of, 254
datasheets, 375
date fields, 408
dates, spreadsheets and, 370
DB2 database system, 429
dBASE database system, 428
decimal number systems, 126
Decision Trees, 466–467
decoding, 131
dedicated media, 268
defragmentation utility, 190
degaussing, magnetic media and, 509
density, disks and, 172
Department of Defense Advanced Research Projects Agency (ARPA), 286
deselecting text, 367
designing multimedia products, 13
desktop computers, 5–6
system unit and, 6
desktop context menu, Windows XP, 209
Desktop Publishing application, 13
device drivers, 216
dial-up connections, 332
sharing and, 341
Dialog boxes, definition of, 211
Diebold Election Systems, 62
digital cameras, 30, 77–78
digital light processing (DLP) technology, 100
digital pens, tablet PCs and, 7
digital student portfolios, 192–193
digital subscriber line (DSL), 272–273, 333–334
Digital systems, 4
digital telephone lines, 271–274
asynchronous transfer mode (ATM), 274
cable modem services, 273–274
using digital data connections, 271–274
digital video cameras, 386
Digital Video Disc (DVD), 32
Digital Video/Versatile Disc (DVD) technology, 550
digitizing, sound cards and, 75
Director, 463–464
directories
definition of, 116
enterprise directory, 232
search tools, 299
using and, 301
disconnected datasets, 422–423
disk controllers, 192
Disk Defragmenter, 190–191
disk drives, 31
disk optimization, 189–191
disk optimization tools, 189
disk storage, 166–167
diskette drives, 31
maximum access time, 172
diskettes, 171–172
magnetic storage devices, 171–172

Urheberrechtlich geschütztes Material

disks
defragmentation utility, 190
density and, 172
file allocation table (FAT), 170
hard disks, 173
hot-swappable hard disks, 173
removable high-capacity disks, 173–174
scanning disks for errors, 190
solid-state disks (SSD), 182
distributed applications, 232, 421
distributed computing, 262–263
distributed denial of service (DDOS) attack, 489
Do-It-Yourself Tech Support, 214–215
docking stations, Notebook computers, 7
document areas, 268
document formatting, 368
document windows, 366
documents
definition of, 37
entering and editing text, 366–367
managing your papers, 438
Dogpile
metasearch engines and, 306
web sites, 306
DOS (disk operating system), 225
dot matrix printers, 108–109
dot pitch, color monitors and, 96
dots per inch (dpi), printing and, 112
downloading files, 270
draw programs, vector-based graphics programs, 387
Dreamweaver, 463
Dreamweaver MX, web sites, 518
drive-interface standards, 192–194
drive performance
average access time, 188
cleaning up unneeded files, 189–190
data transfer rate, 188–189
optimizing disk performance, 189–191
overview and, 187
drivers
device drivers, 216
maintaining your drivers, 115
drives
Blu-Ray laser drives, 181
CD-Recordable (CD-R) drives, 178
CD-ReWritable (CD-RW) drives, 178
disk optimization, 189–191
DVD-RAM drives, 179
DVD-Recordable (DVD-R) drives, 178
Enhanced integrated drive electronics (EIDE), 193
flash memory drives, 179
integrated drive electronics (IDE), 193
SCSI drive interfaces, 194
drives—*cont.*
sequential access devices, 175
small computer system interface (SCSI), 193–194
Tape drives, 174–175
dual in-line memory module (DIMM) chips, 132
dual-scan LCD technology, matrix screens and, 92
dumb terminals, 9
dumpster diving, security and, 479
Duron processors, 149
DVD-RAM drives, 179
DVD-Recordable (DVD-R) drives, 178
DVD-ROMs, 177–178
DXF (Data Exchange Format), 385
dye-sublimation (dye-sub) printers, 115
dynamic addressing, 258
Dynamic Host Control Protocol (DHCP), 258
dynamic link library (.dll) files, 440

E

e-commerce
business level and, 350–354
business-to-business (B2B) transactions, 350–351
career opportunities and the Internet, 354–355
consumer levels and, 346–350
customer service resources, 349
online banking and finance, 349–350
Online shopping, 343–350
paying for purchases, 348
review questions and, 356–361
shopping carts, 348
using online catalogs, 347–348
e-mail
address books, 378
creating a new e-mail message, 314–315
definition of, 313
e-mail programs, 313–316
networks and, 246
productivity tips and, 12
receiving and reading a message, 315–316
software and Internet connections, 14
spam and, 316, 556
viruses, 534
Web-based e-mail services, 317
e-mail addresses, 313–314
Listserv systems, 314
post office protocol (POP), 314
protecting and, 500
e-mail clients, 313
e-mail Help, 215
e-mail programs, 313–316
eBay, online shopping and, 248
Edison, Thomas, 18
editing
drag-and-drop editing and, 57
entering and editing text, 366–367
education, computers and, 15
EISA (Extended Industry Standard Architecture), 545
Electroluminescent displays (ELDs), 92
electromagnetic fields (EMFs), 98–99
electron guns
refresh rate and, 95
scanning pattern of, 90
electronic commerce (e-commerce), overview, 345
Electronic Communications Privacy Act (1986), 500
electronic document management (EDM), 421–422
embedded operating systems, 233–234
encryption, security and, 355
Enhanced integrated drive electronics (EIDE), 193
enhancing an OS with utility software, 216–217
Enkeboll Designs, 40
Enriquez, Richard, 40
enterprise directory, 232
Enterprise Hardware Sales, 157
enterprise software, 420–423
enterprise systems, 421
entertainment programmers, 469
Epson, MX-80 dot-matrix printer, 541
ergonomics
definition of, 60
electromagnetic fields (EMFs), 98–99
eyestrain and, 97–98
keyboards and, 63
monitors and, 97–99
padded wrist support, 63
error-correction protocols, 269
errors
customer service support, 219
scanning disks for errors, 190
essential computer hardware, 22–32
Ethernets
definition of, 259
Fast Ethernets, 259
Gigabit Ethernets, 259
Ethical Issues
artificial intelligence, 163
artificial intelligence systems, 475
computer piracy and, 475
computer skills and, 47
computer storage devices, 262
direct-marketing lists, 437
government databases and, 437
hacking and, 283

Urheberrechtlich geschütztes Material

Ethical Issues—*cont.*
input devices and, 85
Internet addiction and, 123
Internet and, 329
Online masquerading and, 360
operating systems (OS), 261
piracy and, 517
processors, 163
security and, 517
software programs, 398
telecommuters and, 283
unneeded printouts, 123
war riding and, 360
Event Viewer, 448
executable (.exe) files, 440
executing, CPU and, 131
execution cycles, 131
expansion boards, 155–156
expansion slots, 155–156
Extended ASCII, 128
Extended Binary Coded Decimal Interchange Code, 127
Extensible HTML (XHTML), 462
Extensible Markup Language (XML), 462
Extensible Markup Language Mobile Profile (XHTML MP), 462–463
Extensible Style Sheet Language (XSL), 462
extension points, 275
external modems, 269
extracting, compressed files, 191
Extranets, 351–352,
networks and, 249
eyestrain, ergonomics and, 97–98

F

Fair Credit Reporting Act (1970), 500
Fast Ethernets, 259
FAT32, Windows 95 and, 171
fax modems, 269
faxes, productivity tips and, 12
faxing alternatives, 271
Federal Trade Commission (FTC), spam issues and, 317
feedback systems, 467
Fernandez, Bill, 538
fetching, 131
Fiber-optic cables, 255–256
fields, in databases, 403–404, 407–409
Fifth-generation languages (5GLs), 461
File Allocation Table (FAT), 170, 171
file compression, 190–191
file formats, compatibility issues and, 384–385
File-Infecting Viruses, 534
file server networks, 250
file servers, 244
file systems, 170
File transfer protocol (FTP), 319–320
files
archive files, 191
cleaning up unneeded files, 189–190
definition of, 37
downloading files, 270
extracting compressed files, 191
file compression, 190–191
temporary (temp) files, 189
uploading files, 270
filters
in databases, 410
definition of, 503
finance, online banking and finance, 349–350
Financial Modernization Act of 1999, 500
firewall switch routers, 275
firewall utility, 217
firewalls, 505
security and, 261
FireWire, 192, 194
Fireworks MX, web sites, 518
first-generation languages, 459
First-party cookies, 501
Flash, 463
flash memory, 132
flash memory drives, 179
flat-file database structure, 405
flat-panel display monitors, 88
flat-panel monitors, 90–91
flatbed scanners, 73
floppy disks, 31
magnetic storage devices, 171–172
magnetism and, 508–509
flowchart algorithms, 445–446
folders, root folders, 170
fonts, definition of, 367
formatting
character formatting, 367
document formatting, 368
logical formatting, 170
paragraph formatting, 368
formatting disks, 168
formatting text, 367–368
forms, 409
in databases, 403, 410
opt-out options, 500
formula bars, 369
formulas, spreadsheets and, 370
FortuneCity, web sites, 524
fourth-generation languages (4GLs), 460
fragmentation, data and, 190
frames, 374, 389
Free Servers, web sites, 524
Freedom of Information Act, 500
Freescale processors, 149
Freescale Semiconductor, Inc., 149
freeware, 364
frequently asked questions (FAQs), 215
newsgroups and, 318
FrontPage, web sites, 518
FTP client software, 319
FTP servers, 319
function keys, 51–52, 60

G

game controllers, 70
game pads, 71
Gates, Bill, 540–541
gateways, definition of, 257
GetDataBack, shareware programs, 365
Gigabit Ethernets, 259
gigabytes (GB), 29
Gigahertz (GHz), 136, 138
The GIMP, web sites, 518
global information technology, health care, 36
GoLive CS, web sites, 518
Google
Boolean operators, 304
Help links at, 304
search tools, 300
governments, use of computers and, 17
(Graphic Interchange Format) GIF format, 385
graphical user interface (GUI), 208–211
graphics
cells and, 370
clip art, 386
computer-generated animation, 390
computer-generated imaging (CGI), 389
finding graphics online, 520–521
getting images into your computer, 386
importing graphics and, 519–520
overview of, 383
photo-editing programs, 387–388
photo manipulation programs, 388
review questions and, 394–398
selecting a graphic to insert into a slide, 375
Standard Formats for Bitmap Graphics, 385–386
using hyperlinked graphics on a Web page, 298
vector graphics, 384
graphics file formats, 384–385
graphics software, 386–390
history of, 383
Graphics-Intensive applications, 13
Grayscale monitors, 88
Gutenberg Project, web sites, 294

Urheberrechtlich geschütztes Material

H

hackers
  fighting hackers and, 260-261
  firewalls and, 261
  Internet Service Providers (ISP), 261
  passwords and, 261
  Plug Windows' Security Holes, 261
hacking
  cost of, 489
  cyberterrorism, 492
  distributed denial of service (DDOS) attack, 489
  Ethical Issues and, 283
  IP spoofing, 490
  phishing and, 490
  security, 489
  social engineering and, 490
Handheld personal computers, 7
handheld scanners, 72
hard disks, 31, 173
  backing up and, 219
  handling storage media, 508-509
  parts of, 173
  reformatting and, 219
hardware
  antivirus utility, 217
  backup utility, 217
  Bundled hardware, 530
  device drivers, 216
  enhancing an OS with utility software, 216-217
  essential computer hardware, 27-32
  interrupt requests (IRQs), 216
  Managing Hardware, 215-216
  microprocessors, 28
  network hardware, 256-262
  processing devices and, 28
  safeguarding your hardware, 508-510
  threats to hardware, 484-487
hardware technicians, 78-79
  careers and, 195
headers, definition of, 253
headphones, 102
headsets, 103
Health Care, 18-19
  global information technology, 36
Help
  E-Mail Help, 215
  Help Desk and Technical Support Specialists, 234-235
  Technical support specialists, 235
help (.hlp, .chm) files, 440
Help Desk and Technical Support Specialists, 234-235
Help page, Target's Web site, 349
Help systems, getting help with browsers, 299
Help window, Internet Explorer and, 299
Hertz (Hz), 136
  refresh rate and, 95
heuristics, 446-447, 467
high-capacity floppy disk drives, 173
high-level languages, 458
High-Performance File System (HPFS), 171
high-quality printers, 113-116
high-speed memory locations, registers and, 130
Hitachi wearable PC unit, 135
Hoff, Ted, 537
home area networks (HAN), 249
host, definition of, 286
hosting services, 523-524
Hosting.Com, web sites, 524
hosts, finding a host for web sites, 523
hot-swappable hard disks, 173
Hotmail, composing a message in, 318
HTML (hypertext markup language), 289
HTML browsers, using in World Wide Web, 295-299
HTML tags, 290-291
HTTP (hypertext transfer protocol), 289
hubs, definition of, 257
Hybrid Networks, 248-249
HyperCard, 545
hyperlinks, 297-298
  as part of web pages, 297
  linking sites to web pages, 522-523
hypertext links, 289
HyperText Markup Language (HTML), 461-462
  dynamic, 464
  static, 464
Hypertext Preprocessor (PHP), 465
Hypertext systems, 289

I

IBM enhanced keyboard, 50
IBM-PC AT, 543
IBM-PC XT, 543
IBM processors, 149
IBM's ThinkPad computers, TrackPoint pointing device, 60
icons, 208
Identity (ID) theft, 479-480, 498
  guarding personal information, 499
  managing your papers, 498
IEEE 1394, 192, 194
IEEE 1394 (FireWire), 155
IEEE 1394 (FireWire) ports, 138
IGES (Initial Graphics Exchange Specification), 385
iMac, release of, 551
image quality, printing and, 112
image scanners, 72
images, getting images into your computer, 386
impact printers, 108
industry, computers and, 16
Industry Association of America (RIAA), 554
Industry Standard Architecture (ISA) bus, 137
information processing cycle, 26-27
  parts of, 26
Information Security Management Act of 2002, 492
Information Systems (IS) Managers, 277
initial public offerings of stock (IPOs), 352
initialization (.ini) files, 440
initializing disks, 168
ink jet printers, 110
Input and Output Devices, 30-31
input devices
  audiovisual input devices, 74-76
  game controllers, 70
  overview of, 68
  Pen-based systems, 69
  stylus, 69
  touch screens, 70
input/output (I/O) device, 9
input-processing-output (IPO) charts, 444
instant messaging (IM), 321
instruction cycles, 131
instruction sets, 130
Instructional Designers, careers in multimedia, 393
integrated development environment (IDE), 460
integrated drive electronics (IDE), 193
integrated pointing device, 58-59
integrated services digital network (ISDN), 272, 333
Intel
  80386 processor and, 544
  80486 chip, 546
  8080 chip and, 539
  current Intel processors, 148-149
  MMX technology, 550
  Pentium III process or, 552
  Pentium Pro microprocessor, 549
Intel Corporation, 147
Intel processors, 148
Intellectual Property Rights, 525
Intelligent smart cards, 180
intelligent terminals, 9
Interactive Scriptwriters, careers in multimedia, 393
Interactivity, definition of, 392
Interface Designers, careers in multimedia, 393

Urheberrechtlich geschütztes Material

internal modems, 269
Internal Revenue Service, computer technology and, 17
Internet
Advanced Research Projects Agency (ARPA), 286
always-on connections, 505
Asynchronous DSL (ADSL), 333
broadband connections, 332–333
cable modem services, 334
career opportunities and the Internet, 354–355
chat rooms and, 321
communicating through the, 312
crawlers, 425
databases on, 425
dial-up connections, 332
Digital Subscriber Line (DSL), 333–334
e-mail software and Internet connections, 14
features of, 317–323
File transfer protocol (FTP), 319–320
growth of, 287, 547
instant messaging (IM), 321
Internet addiction and, 123
Internet newsgroups, 317–318
Internet relay chat (IRC), 320
major services and, 288
modems and telephone lines, 268–270
network news transfer protocol (NNTP), 318
newsreader programs and, 318
Norton online web sites, 4
online services, 321–322
online services for banks, 15
Online shopping, 343–350
overview of, 285, 331
PC Applications accessing the Internet, 334–335
Peer-to-peer (P2P) services, 322–323
reliability of search results, 304
resource for study and, 15
review questions and, 308–311, 324–329, 342–344
satellite services, 336–337
search engines, 425
Sharing an Internet Connection, 340–341
Synchronous DSL (SDSL), 333
trust issues and spam, 316
using advanced search options, 303–306
using site-specific search tools, 307
Web-based e-mail services, 317
web sites for, 286
wireless local area network (WLAN), 338
wireless wide area networks (WWANs), 335–336
Internet Archive, web sites, 295
Internet monitoring, 481
Internet relay chat (IRC), 320
Internet security, 217–218
screen savers, 217–218
Internet service provider (ISP), 288
security and, 261
internetworking, process of, 287
interpreters, 443–444
interrupt requests (IRQs), 216
Intranets, 249, 351–352,
interface of, 353
intrusion detection software, 217
IP spoofing, 490
iPod, release of, 554
IPX/SPX protocol, 262

J

Jackson, Thomas Penfield, 553
Java programming language, 459–460
JavaScript, 464–465
Jenny Craig Inc., 354
Jensen, Mark, 322
jet printers, using a search engine, 301
Jobs, Steve, 540, 545
(Joint Photographic Experts Group) JPEG format, 385
Joke programs, 534
joysticks, 30, 70
Jupiterimages, web sites, 520

K

Kennedy, Phillip, 230
Kerio Winroute Pro, 217
Kernighan, Brian, 539
keyboard buffer, 54
keyboard controller, 53
keyboard-related injuries, 62–63
keyboard shortcuts, 60
keyboarding, typing and, 50
keyboards, 30
alphanumeric keys and, 50
cursor-movement keys, 52
cursors and, 52
Ergonomics and, 63
function keys, 51–52
modifier keys, 50–51
numeric keypad, 51
overview and, 49
repeat rates and, 54
review questions and, 65–67
special-purpose keys, 52–53
standard keyboard layout, 50
keyword search, 300
kilo-bytes (KB), 29
knowledge-based systems, 467
knowledge bases, 215,
knowledge discovery, 424
Koenig, Karen, 116
Kosoff, Jon, 354

L

L.L.Bean, web sites, 148
labels, 369
worksheets and, 371
LAN technology, 540
lands, data storage, 176
laptop computers, 6–7
Large-Format monitors, 375
laser printers, 111
text output quality, 109
LaserJet laser printers, 544
Launch, web sites, 293
Level-1 (L1) caches, 139
Level-2 (L2) caches, 139
Level-3 (L3) caches, 139
license agreements, modifications and, 373
LifeMasters Online, 37
LifeMasters program, disease management, 16
line conditioners, security, 485
line noise, security, 485
line printers, 109
links, linking sites to web pages, 522–523
Linux
network operating systems (NOS), 233
with an optional GUI desktop, 230
Linux for the Desktop, 229
The Linux Gazette, web sites, 240
Linux Online, web sites, 240
Linux Planet, web sites, 300
liquid crystal display (LCD) monitors, 91
Listserv systems, 314
local area networks (LAN), 248
local bus, 137
logic errors, 467
logical fields, 408
logical formatting, 170
logical operations, data and, 130
LookSmart home page, 300
looping structures. See repetition structures
loops, 450
Lotus Approach, 404
Lotus Development Corporation, 541
LView Pro, web sites, 518
Lycos home page, 302

M

machine code, 442
machine cycles, 130–131

Urheberrechtlich geschütztes Material

machine languages, 458–459
Macintosh computers, compatability and, 530
Macintosh operating systems (Mac OS), 228–229
macros
  Automating Your Work with Macros, 376–377
  creating and, 376
  definition of, 376
  shortcuts and, 61
  viruses, 534–535
magnetic disks
  data storage and, 168–169
  storage and, 31
magnetic storage devices, 166–174
  CD-ROMs, 176–177
  disk storage and, 166–167
  diskettes, 171–172
  DVD-ROMs, 177–178
  file allocation table (FAT), 170
  high-capacity floppy disk drives, 173
  hot-swappable hard disks, 173
  operating system finding data on disks, 170
magnetic storage disks, removable high-capacity disks, 173–174
Magnetic yoke, 89
magnetism, floppy disks and, 508–509
mail servers, 314
Mainframe computers, 9–10
  input/output (I/O) device, 9
malware, security and, 488
Mamma, web sites, 306
massively parallel processing (MPP), 406
McAfee VirusScan, web sites, 486, 536
McDowell, Douglas, 468–469
McGill University, ftp sites and, 320
mechanical mouse, 55
megabytes (MB), 29
Megahertz (MHz), 136–138
memo fields, 409
memory, 131–133
  basic input output system (BIOS), 132
  cache memory, 138
  dual in-line memory module (DIMM) chips, 132
  factors affecting processing speed, 133
  Flash memory, 132
  memory and computing power, 134–135
  nonvolatile memory, 29, 131–132
  power on self test (POST), 132
  programmable read only memory (PROM), 132
  read-only memory (ROM), 132
memory—*cont.*
  small outline DIMM (SO-DIMM) chips, 132
  virtual memory, 135, 141
  volatile memory, 132
memory chips, 133
memory devices, computer systems and, 29
menu bars, 269, 306
menus, definition of, 210
Merholz, Peter, 552
Merriam-Webster, web sites, 424
mesh topology, 254
metasearch engines, 306
Metcalfe, Bob, 539, 541
metropolitan area networks (MAN), 249
microcodes, 130
microcomputer processors, 147–148
microcomputers, 5
  history of, 538–557
microphones, 30, 74–75, 100
microprocessors, 28
Microsoft, releases Windows 3.0, 545
Microsoft Access, 422, 426–427
Microsoft Corporation, web sites, 307, 240
Microsoft Excel
  interface of, 369
  protecting a document in, 505
Microsoft Internet Explorer, 523
  configuring the Google toolbar in, 503
  Cookie-control settings in, 501
Microsoft Messenger, 382
Microsoft Office User Specialist (MOUS), 116
Microsoft Outlook, 219
  contact information and, 378
  e-mail filters and, 504
Microsoft PowerPoint, 372
Microsoft Typography, web sites, 397
Microsoft Visio, 210
Microsoft Word
  character-formatting tools in, 368
  interface of, 367
  shortcut keys and, 61
Microsoft Word 2003, clip art collection, 386
midrange computers, 10
military, computer technology and, 12
Millennium Bug, 552
millions of instructions per second (MIPS), 131
milliseconds (ms), storage time, 188
minicomputers, 10
MIT, web sites, 295
MMX technology, 550
mobile computers, 7
modems
  cable modem services, 273–274
modems—*cont.*
  data communications and, 268–270
  digital subscriber line (DSL), 272–273
  error-correction protocols, 269
  external modems, 269
  fax modems, 269
  faxing alternatives, 271
  internal modems, 269
  service accounts, 271
  uses for, 270
  using digital data connections, 271–274
  wireless communications, 271
modifier keys, 50–51
monitors, 30, 88
  antiglare screens and, 98
  color monitors, 89, 90
  comparing and, 93–96
  CRT monitors, 89–90
  electromagnetic fields (EMFs), 98–99
  ergonomics and, 97–99
  flat-panel display monitors, 88
  flat-panel monitors, 90–91
  Grayscale monitors, 88
  Large-Format monitors, 375
  liquid crystal display (LCD) monitors, 91
  other types of, 92
  plasma monitors, 375
  resolution and, 94
  review questions and, 104–106
  size and, 94
Monochrome monitors, 88
Mosaic, 290
  creation of, 548
motherboards, processing devices, 28
mouse
  double-clicking and, 57
  drag-and-drop editing and, 57
  integrated pointing device, 59–60
  mechanical mouse, 55
  mouse pointer, 54
  optical mouse, 55
  output devices, 30
  overview and, 49
  pointing and, 56
  review questions and, 65–67
  right-clicking and, 293
  single-clicking and, 293
  trackballs, 294–295
  trackpads and, 295
  using, 56
  variants of, 58
  wheel mouse and, 57
mouse button configurations, 58
mouse pointer, 54
MSN Technology, web sites, 528
multi-user/multitasking operating systems, 207

Urheberrechtlich geschütztes Material

multimedia
basics of, 390–392
careers in multimedia, 392
computer-generated animation, 390
computer-generated imaging (CGI), 389
getting images into your computer, 386
graphics file formats, 384–385
overview of, 383
photo-editing programs, 387–388
photo manipulation programs, 388
review questions and, 394–398
Standard Formats for Bitmap Graphics, 385–386
vector graphics, 384
multimedia developers, Internet careers and, 355
Multipartite viruses, 534
multiprocessing (MP) systems, 150
multitasking, 131
multitasking features, operating systems (OS), 206
Muri, Scott, 193
Musical Instrument Digital Interface (MIDI), 16
Musical Instrument Digital Interface (MIDI) port, 155
MX-80 dot-matrix printer, 541
MySQL database system, 429

N

n-tier applications, 421
nanoseconds (ns), storage time, 188
Napster, 554
National Center for Supercomputing Applications (NCSA), 290, 548
National Football League (NFL), web sites, 297
National Information Assurance Training and Education, web sites, 492
National Science Foundation (NSF), creation of Internet, 286
National Science Foundation Network (NSFNET), 546
Natural, Site, and Civil Disasters, security, 547
natural and man-made disasters, security, 486–487
navigating the Web, 296–298
Navigator 5.0 Web browser, 551
NetBIOS/NetBEUI protocol, 262
NetObjects Fusion, web sites, 518
Netscape Communications, 548–549
web sites, 307
network access servers. See VPN servers
network administrators, 277
careers and, 195
network hardware, 256–262
cabling equipment, 258–260
network linking devices, 256–258
network interface cards (NICs), 31, 256
network linking devices, 256–258
network news transfer protocol (NNTP), 318
network operating systems (NOS), 230–233
Linux, 233
Novell NetWare, 232–233
UNIX for Servers, 233
Windows 2000 Server, 232
Windows NT Server, 231
Windows Server 2003, 232
network servers, 8–9, 244
network versions, 245
networking, 5
careers in, 276–277
customer service support, 276
data communications managers, 277
Information Systems (IS) Managers, 277
internetworking and, 287
overview of, 243
networks
application servers, 245
Audio-conferencing, 246
backbone of, 287
basic rate integrated services digital network, 272
beginnings of, 286
bus topology network, 254
campus area networks (CAN), 249
client/server networks, 250–251
common types of, 248
corporate networks, 9
data-conferencing, 246–247
distributed computing, 252–253
Dynamic Host Control Protocol (DHCP), 258
easier data backup, 247
Extranets and, 249
file server networks, 250
home area networks (HAN), 249
hybrid networks, 248–249
integrated services digital network (ISDN), 272
Intranets and, 249
local area networks (LAN), 248
media and, 255
metropolitan area networks (MAN), 249
network interface cards (NIC), 256
peer-to-peer networks, 251
Peer-to-peer (P2P) services, 322
print servers and, 246
protocols and, 261–262
review questions and, 263–266, 278–283
server-based networks, 250
shared peripheral devices, 245–246
simultaneous access and, 244–245
site licenses, 245
structure of, 250–251
teleconferences, 246
Token Rings, 260–261
topologies and protocols, 253–262
twisted-pair cables, 255
uses of, 244–248
Videoconferencing, 246
Voice over Internet Protocol (VoIP), 247
wide area networks (WAN), 248
wire-based media, 255–266
wireless networks, 266, 274–276
wireless NIC, 256
Neural interface devices (NIDs), 230
Neural Signals, Inc., 230
New Connection Wizard, Windows XP, 332
New Technology File System (NTFS), 171
news servers, definition of, 318
Newsgroups, 155
frequently asked questions (FAQ), 318
Internet newsgroups, 317–318
subscribing to, 319
threads and, 319
newsreader programs, 318
Newton MessagePad, 548
Nicely, Thomas, 548
Nodes, 250
nonimpact printers, 108
nonvolatile memory, 131, 132
Northrop Grumman Mission Systems (NGMS), 337
Norton AntiVirus, 447
setting options in, 536
Norton Notebook
Artificial Intelligence, 466–467
Business, the Internet, and Everything, 351–352
Changing Your PC's Operating System, 218–219
Data Warehouses, 406–407
fighting hackers and, 260–261
flat screens and, 98–99
Internet Time Travel, 294–295
Looking Back, Moving Forward, 180–181

Urheberrechtlich geschütztes Material

Norton Notebook—*cont.*
Merging of Media and Meaning, 18
Nexus: converging technologies, 507-508
speech recognition, 74-75
What Is a Computer Chip?, 150-151
Why Own When You Can Rent?, 390
Norton online web sites, 4
Notebook computers, 6-7
docking stations, 7
Novell NetWare, 232-233
NSFnet, 287
NTFS 5, Windows 2000 and XP, 171
number systems, 126-127
numeric fields, 408
numeric keypad, 51

O

Object Linking and Embedding (OLE), 214-215
object-oriented programming (OOP), 449-451
attributes, 451
encapsulation, 451
objects, 450
Odom, Barbara, 194
Office 2003, release of, 556
Online Help System Designer, 322-323
online services, 321-322
exchanging e-mail messages and, 323
Online shopping, 343-350
online stores, vs. physical locations, 347
open-source software, 365
OpenOffice.org, web sites, 365
operating system programmers, 469
operating systems (OS)
changing your PC's operating system, 218-219
command-line interfaces, 211-212
embedded operating systems, 233-234
enhancing an OS with utility software, 216-217
ethical issues, 241
finding data on disks, 170
graphical user interface (GUI), 208-211
Macintosh operating systems OS), 228-229
Managing Hardware, 215-216
multi-user/multitasking operating systems, 207
multitasking features, 206
network operating system (NOS), 230-233
Object Linking and Embedding (OLE), 214-215
overview of, 205, 224
operating systems (OS)—*cont.*
PC Operating Systems, 225-229
real-time operating systems, 206
review questions and, 220-223, 236-241
running programs, 212-213
sharing information, 213-214
single-user/multitasking operating systems, 206-207
single-user single-tasking operating systems, 206
types of, 206-208
user interfaces, 208-212
opt-out options, 500
optical character precognition (OCR) software, 72
optical input devices, 71-74
optical mouse, 55
optical storage devices, 32, 166, 175-179
DVD-Recordable (DVD-R) drives, 178
PhotoCD systems, 178
recordable optical technologies, 178-179
optimizing disk performance, 189-191
Oracle database system, 428
OS X, release of, 554
Osborne, Adam, 542
Outlook Express, create a new e-mail message in, 314-315
output devices, 30-31
outsourcing, careers in, 194-195

P

Packet sniffers, cyberstalking, 253
packets, definition of, 351
padded wrist support, ergonomics and, 117
page-white displays, 146
PageMaker program, 544
pages per minute (ppm), printing, 165
paint programs, bitmap-based graphics programs, 327
Paint Shop Pro, 304, 324
web sites, 94
Palm OS, 294
PalmPilot, 549
paper jams, 169
paper-white displays, 146
paragraph formatting, 308
parallel ports, 213-214
parallel processing, 151-152
passive matrix LCD, monitors and, 92
password capture, 490
password guessing, 489
Password sharing, 489
passwords, security and, 261
Paste commands, 214
payloads, definition of, 254
PC Applications, accessing the Internet, 334-335
PC Card bus, 138
PC Cards, 156
PC convertible, laptop computers, 544
PC hardware sales, 156
PC Magazine, web sites, 528, 240
PC operating systems, 225-229
DOS (disk operating system), 225
Macintosh operating systems (Mac OS), 229
network operating system (NOS), 230-233
Windows 9x, 226-227
Windows NT Workstation, 225-226
Windows 2000 Professional, 228
Windows XP, 228
PC-to-TV converters, 375
PC video camera, 72
PC World, web sites, 528
peer-to-peer networks, 251
distributed computing, 252-253
Peer-to-peer (P2P) services, 322-323
Pen-based systems, input devices, 69
Pentium III processor, 552
Peripheral Component Interconnect (PCI) bus, 137
Persistent cookies, 503
personal databases, 425-426, 428
personal digital assistant (PDA), 7, 233
personal information managers (PIMs), 376-377, 402
phishing, hacking and, 490
phonemes, speech-recognition software, 76
Phosphor dots, 89
photo-editing programs, 387-388
photo manipulation programs, 388
photo printers, 113
PhotoCD systems, 178
photorealistic scenes, graphics and, 389
(PICTure) format, 385
PIMs (personal information managers), 402
pipelining, 131
piracy
ethical issues and, 475
software piracy, 372, 490-491
pits, data storage, 176
pixels, 89-92, 95, 384
plain old telephone systems (POTS), 268
plasma displays, monitors and, 92, 375
plasma monitors, 92, 375
platform independence, 428
plotters, roller plotters, 116
Plug and Play technology, 157-158
Plumer, Mike, 156

Urheberrechtlich geschütztes Material

Pocket PC OS, 235
pointers, 208
pointing device, mouse and, 54
points, 367
polarized, storage disks and, 167
police, computer technology and, 17
Polymorphic viruses, 534
POP servers, 316
pop-up blockers, 502
pop-up windows, 502
porting, 459
ports
  IEEE 1394 (FireWire), 155
  IEEE 1394 (FireWire) ports, 138
  Musical Instrument Digital Interface (MIDI) port, 155
  Serial and Parallel Ports, 153–154
  specialized expansion ports, 154–155
  standard computer ports, 152
  Universal Serial Bus (USB) ports, 154–155
post office protocol (POP), 314
PostScript systems, 193–194, 544
Power Macintosh, 548
Power Macintosh G5, release of, 556
power on self test (POST), 132
power-related threats, security, 485
PowerBooks, 547
PowerPoint, 374
  creating a chart in, 375
Practical Extraction and Reporting Language (Perl), 465
presentation programs, 371–375
  creating a presentation, 374–375
  interface and, 372–373
Presentation software, 35
primary e-mail accounts, security and, 503
print heads, 108
print servers, 246
printers, 30
  all-in-one peripherals, 112–113
  band printers, 109
  Care and Feeding of Printers, 114–115
  characters per second (cps), 109
  commonly used printers, 108–112
  comparing and, 112–113
  cost and, 112
  cost of operation, 113
  dot matrix printers, 108–109
  dye-sublimation (dye-sub) printers, 115
  high-quality printers, 113–116
  impact printers, 108
  ink jet printers, 110
  laser printers, 111
  LaserJet laser printers, 544
  line printers, 109
  maintaining your drivers, 115
  printers—*cont.*
  MX-80 dot-matrix printer, 541
  nonimpact printers, 108
  paper jams and, 115
  photo printers, 113
  print heads, 108
  review questions and, 118–123
  roller plotters, 116
  thermal-wax printers, 114–115
  toner and, 111
  using a search engine, 301
printing
  dots per inch (dpi), 112
  image quality and, 112
  overview of, 107
  pages per minute (ppm), 112
privacy
  keeping marketers at bay, 499–500
  knowing your legal rights, 500–501
  opt-out options, 500
  protecting your privacy, 499–501
Privacy Act of 1974, 500
processing devices, 28
  central processing unit (CPU), 28
  circuit boards, 28
  motherboards, 28
processing speed, factors affecting, 133
processors
  Advanced Micro Devices (AMD) processors, 148
  Athlon processors, 149
  comparing and, 150–151
  complex instruction set computing (CISC) processor, 150
  current Intel processors, 148
  Duron processors, 149
  extending power to other devices, 152–155
  Freescale processors, 149
  IBM processors, 149
  Intel processors, 148
  looking inside and, 147–150
  massively parallel processing (MPP) computers, 152
  microcomputer processors, 147–148
  multiprocessing (MP) systems, 150
  overview of, 528
  parallel processing, 151–152
  reduced instruction set computing (RISC) processor, 150
  review questions and, 158–163
  RISC processors, 150
  symmetric multiprocessing (SMP), 152
  web sites, 528
productivity software
  overview of, 363
  review questions and, 379–382
Productivity Tip
  Automating Your Work with Macros, 376–377
  backing up your data, 174–175
  Care and Feeding of Printers, 114–115
  database macros, 426–427
  Do You Need More RAM?, 140
  Do-It-Yourself Tech Support, 214–215
  Finding Faster Algorithms, 448–449
  Keeping Your PC Up to Date, 486–487
  reliability of search results, 304
  Sharing an Internet Connection, 340–341
  Telecommuter's Checklist, 270–271
  Using Remote Online Help, 214
profiling, security, 481
program, definition of, 25
program control flow, 445
programmable read only memory (PROM), 132
Programmer/Software Designer, 393
programmers, careers and, 195, 355
programming
  bugs, 467
  debugging, 467
  development phase, 466–467
  implementation, 468
  logic errors, 467
  maintenance, 468
  needs anaylsis, 465
  program design, 465
  syntax errors, 467
programming languages, 442
  Active Server Pages (ASP), 465
  ActiveX, 460
  assemblers, 458
  assembly languages, 458–459
  authoring environments, 461
  C, 459
  C++, 459
  categories of, 457–458
  Director, 463–464
  Dreamweaver, 463
  Extensible HTML (XHTML), 462
  Extensible Markup Language (XML), 462
  Extensible Markup Language Mobile Profile (XHTML MP), 462–463
  Extensible Style Sheet Language (XSL), 462
  fifth-generation languages (5GLs), 461
  first-generation languages, 459
  Flash, 463
  fourth-generation languages (4GLs), 460
  high-level languages, 458
  HyperText Markup Language (HTML), 461–462

Urheberrechtlich geschütztes Material

programming languages—*cont.*
Hypertext Preprocessor (PHP), 465
integrated development environment (IDE), 460
Java, 459–460
JavaScript, 464–465
logic errors, 467
machine languages, 458–459
.NET, 460–461
portability, 459
Practical Extraction and Reporting Language (Perl), 465
review questions and, 473–475
scripting languages, 464–465
second-generation languages, 459
Sun Studio One, 461
syntax, 457
syntax errors, 467
third-generation languages (3GL), 459
World Wide Web development languages, 461–465
programs
3-D modeling programs, 389
Computer-aided design (CAD) programs, 388–389
firewall programs, 505
Joke programs, 534
photo-editing programs, 387–388
photo manipulation programs, 388
presentation programs, 371–375
Red Hat Certified Engineer (RHCE) program, 230
running programs, 212–213
shareware programs, 364
spreadsheet programs, 369
stand-alone programs, 364
uninstalling programs, 190
word processing programs, 365–368
prompts, 211
protective measures, security overview and, 497
protocols, 261–262
error-correction protocols, 269
IPX/SPX protocol, 262
NetBIOS/NetBEUI protocol, 262
TCP/IP protocol, 262
topologies and protocols, 253–262
proxy servers, cyberslacking, 253
Prudential Financial, web sites, 151
pseudocode, 444
public domain software, 364–365
public records, security and, 480
Public Records on the Internet, 480–481
publishing, self-publishing, 19

Q

Q-DOS, 541
query by example (QBE), 413
Quick Launch bars, 209
QuickBooks, accounting programs, 16
QuickTime, web sites, 293
QuickTime player, 397

R

RAID 0
RAID 1
RAID 4
RAM
cache memory and, 138
choosing computers and, 526
Do You Need More RAM?, 140
memory and computing power, 134–135
synchronous dynamic RAM (SDRAM), 182
random access memory (RAM), 29
random access storage devices, 168
raster, bitmap images, 384
RAVEN, software applications and, 103
read-only memory (ROM), 29, 132
read/write heads, magnetic storage and, 31
Real Networks, Inc., 176, 397
real-time applications, 206
real-time operating systems, 206
RealOne Player, 176
recordable optical technologies, 178–179
records, in databases, 403–404
Records Management System Aided Dispatch (CAD), 336
Red Hat Certified Engineer (RHCE) program, 230
Red Hat Linux, 548
reduced instruction set computing (RISC) processor, 96
redundant array of independent disks (RAID), 354
refresh rate, electron guns and, 95
registers, 133–134
high-speed memory locations, 130
relational database structure, 405
removable high-capacity disks, 173–174
repeat rates, keyboards and, 54
repetition structures, 450
repetitive stress injuries (RSIs), 61–62
reports, in databases, 403
RFID (Radio Frequency Identification) tags, 557
Right to Financial Privacy Act of 1978, 500
ring topology, 254
RISC processors, 150
Ritchie, Dennis, 538–539
Robertson, Michael, 555
robotic surgical devices, 18
roller plotters, 116
root folders, 170
routers, definition of, 257
rows, in databases, 404
rulers, 366
rules-based systems, 467
running programs, 212–213

S

sales, computer sales, 156–157
satellite servers, very small aperture terminal (VSAT), 338
satellite services, 336–337
scalability, 429
scanners, 30, 386
flatbed scanners, 73
handheld scanners, 72
image scanners, 72
scanning disks for errors, 190
scientific programmers, 468
screen savers, 217–218
definition of, 505
scripting languages, 464–465
scroll bars, 209, 366
SCSI drive interfaces, 194
Seagate Technology, Inc., 188
search engines, 299–300, 425
Boolean operators, 302–303
jet printers and, 301
metasearch engines, 306
reliability of search results, 304
using advanced search options, 303–306
search tools
Directories, 299
Google, 300
keyword search, 300
search engines, 299–300
using site-specific search tools, 307
second-generation languages, 459
secondary e-mail accounts, security, 503
sectors, 168–169
CD ROMs and, 177
magnetic disks and, 177
Secure HTTP (S-HTTP), 480
Secure Sockets Layer (SSL), 355, 480
security
adware, 482
backing up data, 504–505
computer-related ailments, 484
cookies, 481–482, 501–502
countermeasures and, 478
credit reports, 499
cybercrime, 483
cyberterrorism, 492
data diddling, 489
degrees of harm and, 478

Urheberrechtlich geschütztes Material

security—*cont.*
distributed denial of service (DDOS) attack, 489
firewalls and, 261, 505
hacking, 489
handling storage media, 508–509
Identity (ID) theft, 479–480, 498
Internet monitoring, 481
Internet security, 217–218
Internet Service Providers (ISP), 261
keeping your computer clean, 509–510
keeping your data secure, 503–506
knowing your legal rights, 500–501
line conditioners, 485
line noise, 485
Loss of Privacy, 480–481
malware and, 488
Natural, Site, and Civil Disasters, 487
natural and man-made disasters, 486–487
online spying tools, 481
overview and, 477
password capture, 490
password guessing, 489
password sharing, 489
passwords and, 261
Plug Windows' Security Holes, 261
power-related threats, 485
profiling, 481
protecting your privacy, 499–501
Public Records on the Internet, 480–481
restricting access to your system, 504–505
review questions and, 493–496, 512–517
safeguarding your hardware, 508–510
screen savers, 217–218
secure sockets layer (SSL) technology, 355
software piracy, 490–491
spam, 483–484
spam blockers, 503
Spoof, 484
spying, 481
spyware, 482, 501–502
storing computer equipment, 509–510
surge suppressors, 485
theft and vandalism, 485–486
threats to hardware, 484–487
using automated warnings, 508
war driving, 339
Web bugs, 482
Web pages and, 354–355
Wire Equivalent Privacy (WEP), 339
Selecky, Christobel, 37
selection structures, 449
Self-Encrypting viruses, 534
Self-Garbling viruses, 534
self-publishing, 19
sequence structure, 449
sequential access devices, 175
serial ports, 153–154
server-based networks, 250
server farms, 8
servers
application servers, 245
corporate networks and, 9
file servers, 246
FTP servers, 319
mail servers, 316
network news transfer protocol (NNTP), 318
network servers, 8–9, 246
news servers, 318
POP servers, 316
print servers and, 246
proxy servers, 253
terminal servers, 207
UNIX for servers, 233
service accounts, 271
Session cookies, 501
shadow masks, CRT monitors, 90
shared peripheral devices, 245–246
shareware programs, 364
shells, definition of, 229
shielded twisted-pair (STP) wires, 255
shopping carts, 348
SHORTCUT key, 51–53
shortcut keys, Microsoft Word and, 61
shortcut menu, 209
shortcuts, 208
Function keys, 60
keyboard shortcuts, 60
macros and, 61
Start menu, 209
shoulder surfing, security and, 479
Showerman, Mike, 556
Simpson, Corby, 392
Single Edge Contact (SEC) cartridge, 550
Single in-line memory modules (SIMMs), 132
single-user/multitasking operating systems, 206–207
single-user single-tasking operating systems, 206
site licenses, 245
Slammer worm, 556
slide shows
presentation of, 375
presentation software, 35
slides
adding text to a slide, 374
choosing a layout for a new slide, 374
selecting a graphic to insert into a slide, 375
slides —*cont.*
single-screen images, 372
small business, computers and, 15–16
Small Computer System Interface (SCSI), 154, 193–194
small outline DIMM (SO-DIMM) chips, 132
smart cards, 180
intelligent smart cards, 180
solid-state storage devices, 180
smart phones, 8
snagging, security and, 479
snail mail, 376
sniffing, hacking methods, 489
social engineering
hacking and, 490
security and, 480
sockets, 334
software, 32–35, 439. See also computer programs
3-D animation software, 389–390
commercial software, 364
contact-management software, 377
customer relationship management (CRM) software, 234
definition of, 25
freeware, 364
FTP client software, 319
graphics software, 386–390
intrusion detection software, 217
online spying tools, 481
open-source software, 365
optical character precognition (OCR) software, 72
Presentation software, 35
public domain software, 364–365
software suites, 364
surveillance software, 351
vector-based software, 384
Who Really Owns the Software on Your PC?, 372–373
Word processing software, 34
software applications, acquiring and, 364–365
software license, 372
software piracy, 372, 490–491
software programs
overview of, 439
review questions and, 452–455
software sales, 157
software suites, 364
solid-state disks (SSD), 182
solid-state storage, 166
solid-state storage devices, 179–182
flash memory drives, 179
smart cards, 180
solid-state disks (SSD), 182

Urheberrechtlich geschütztes Material

sound, overview and, 87
sound cards, 74–75, 100–101
sound producers, 393
sound systems, 100–101
source codes, 442
  compilers, 443
  interpreters, 443–444
spam, 556
  e-mail and, 316
  evading spam and, 502–503
  security, 483–484
  statistics and, 316
spam blockers, 503
spawn, 294
special-purpose keys, 52–53
specialized expansion ports, 154–155
Specialty Hardware Sales, 157
speech recognition, 74–75
sponsored links, 306–307
spoofing
  IP spoofing, 490
  security, 484
spreadsheet formulas, 371
spreadsheet programs, 369
spreadsheets
  dates and, 370
  formulas and, 370
  values and, 370
spying, security, 481
Spyware, 501–502
  anti-spyware utilities, 502
  security, 482
SQL Server database system, 429
Stallman, Richard, 543
stand-alone programs, 364
Standard Formats for Bitmap Graphics, 385–386
star topology, 254
START button, 209
START key, 51–53
Start menu, 209
  shortcuts, 209
start page, web pages, 296
status bars, 366
Stealth Viruses, 534
Steffen, Craig, 556
storage
  handling storage media, 508–509
  magnetic disks, 31
  optical storage, 32
  Units of Measure for Computer Memory, 29
storage devices, 31–32
  categorizing and, 166–174
  disk storage and, 166–167
  drive-interface standards, 192–196
  ethical issues and, 202
  flash memory drives, 179
storage devices—*cont.*
  formatting disks, 168
  initializing disks, 168
  magnetic storage, 166
  magnetic storage devices, 166–174
  operating system finding data on disks, 170
  optical storage, 166
  optical storage devices, 175–179
  overview of, 165
  review questions and, 183–186, 196–201
  solid-state storage, 166
  solid-state storage devices, 179–182
storage media, 166
stored cookies, 501
storing, CPU and, 131
streaming audio, 293
streaming media, web sites, 293
streaming video, 293
Structured English QUEry Language (SEQUEL), 412
structured programming, 448–449
Structured Query Language (SQL), 412
stylus
  input devices, 69
  tablet PCs, 7
submarining, monitors and, 92
subscribe, newsgroups and, 318
Sun Studio One, 461
Sun Ultra workstation, 549
Super VGA (SVGA) standard, monitor resolution and, 95
Supercomputers, 10–11
surge suppressors, security, 485
surveillance software, cyberstalking and, 253
swap ins, 135
swap outs, 135
switches, definition of, 257
Symantec, web sites, 486
Symbian, operating systems, 235
symmetrical multiprocessing (SMP), 152, 406
Synchronous DSL (SDSL), 333
synchronous dynamic RAM (SDRAM), 182
syntax errors, 467
system calls, 212
system clocks, 136
system operators, discussion groups and, 322
system units, desktop computers and, 6
systems development life cycle, 465
  data flow diagrams, 483
  decision tree, 483

T

T3 lines, 222
tables, in databases, 403, 407
tablet PCs, 7
  digital pens and, 7
  stylus and, 7
(Tagged Image File Format) TIFF format, 385
Tape drives, 174–175
task switching, 210
taskbars, 209
TCP/IP protocol, 262
technical support, frequently asked questions (FAQs), 215
technical support specialists, 235
technical writers, Bureau of Labor Statistics and, 323
Techno-Cops, computer-aided dispatch, 336
Telecommunications Sales, 157
telecommuters, 352–353
Telecommuter's Checklist, 270–271
teleconferences, 246
templates, 374
  selecting a template, 521
temporary (temp) files, 189
Tendu, 414–415
terabytes (TB), 29
terminal clients, 207
terminal servers, 207
terminals
  dumb terminals, 9
  intelligent terminals, 9
terminators, network devices and, 254
text
  adding text to a slide, 374
  deselecting text, 367
  entering and editing text, 366–367
  formatting text, 367–368
text boxes, 374
text codes, 121–128
text fields, 408
TFT displays, monitors and, 92
theft and vandalism, security, 485–486
thermal-wax printers, 114–115
third-generation languages (3GL), 459
third-party cookies, 501
Thompson, Ken, 538
threads, 131
  linked articles and, 318
  newsgroups and, 319
threats, security and, 478
threats to hardware, 484–487
three-tier applications, 421
throughput, data transfer rate, 188
tiers, 421
time fields, 408
title bars, 209
Token Rings, 260–261, 543
tokens, definition of, 256
toner, printers and, 111

Urheberrechtlich geschütztes Material

toolbars, 209, 366
tools
  airbrush tool, 388
  disk optimization tools, 189
  Event Viewer, 508
TopHosts.com, web sites, 524
topologies and protocols, 253–262
  bus topology network, 256
  mesh topology, 256
  ring topology, 256
  star topology, 256
touch screens, 31, 70
touchpads, 30
tower designs, desktop computers and, 6
trackballs, 30, 58–59
trackpads, 59
TrackPoints, 60
tracks, 168–169
transient cookies, 501
transistors, 125, 147, 150
Trojan horse attacks, security and, 488, 536
trust, issues of spam, 316
twisted-pair cables, 255
two-tier applications, 421
Type styles, 367

U

Unicode Worldwide Character Standard, 128
uninstalling programs, 190
universal asynchronous receiver-transmitter (UART), 152
Universal Serial Bus (USB) ports, 137, 154–155, 192, 194
UNIX for Servers, 233
UNIX for the Desktop, 229
UNIX operating system, 538
unsolicited commercial e-mail (UCE), 483
unsponsored links, 306–307
uploading files, 270
URLs (uniform resource locators), 291–292
  World Wide Web and, 296–298
U.S. Census Bureau, computer technology and, 17
USA PATRIOT ACT, 500–501
Usenet Domains, 318
user interfaces, 208–212
  graphical user interface (GUI), 208–211
user names, e-mail addresses, 313–314
user sessions, 207
userless computers, 39
users, computer systems and, 26
utilities
  A_Backup utility, 217
  antivirus utility, 217
utilities—*cont.*
  backup utility, 217
  enhancing an OS with utility software, 216–217
  firewall utility, 217

V

values, spreadsheets and, 310
vandalism, security, 546–547
vector-based graphics programs, draw programs, 327
vector graphics, 324
vectors, definition of, 324
Versadex Computer Aided Dispatch (CAD), 388
very small aperture terminal (VSAT), 390
video
  digital student portfolios, 262–263
  overview and, 141
  PC video camera, 131
  streaming video, 57
  video capture cards, 131
  Webcam systems, 131
video capture cards, 131
video cards, 150–151, 193
video controllers, 151
Video Graphics Array (VGA), monitor resolution and, 149, 591
video input capabilities, 131
Videoconferencing, 344
videographer, 333
viewing angle, monitors and, 165
virtual memory, 195, 201
virtual private networks (VPNs), 466–467
Virtual Reality Modeling Language (VRML), 597
viruses
  Bimodal viruses, 581
  Bipartite viruses, 581
  Boot Sector Viruses, 581
  categories of, 581
  Cluster Viruses, 581
  definition of, 579–580, 579
  E-mail viruses, 581
  effects of, 580–581, 580
  File-Infecting Viruses, 581
  Macro viruses, 581, 582
  Millennium Bug, 552
  Multipartite viruses, 581
  Polymorphic viruses, 581
  Preventing Infection, 581–582
  security and, 549
  Self-Encrypting viruses, 581
  Self-Garbling viruses, 581
  Stealth Viruses, 581
  Y2K bug, 553
VisiCalc, spreadsheet programs, 541
vision, eyestrain and, 151–152
Vista Development, 86
Visual Designers, careers in multimedia, 333
Voice over Internet Protocol (VoIP), 345
voice recognition, 129
volatile memory, 192
voting
  computerized voting, 116–117
  Diebold Election Systems, 116
VPN servers, 467
vulnerability, security and, 539

W

war driving, security, 339
watercolors, paint programs, 387
wearable computers, 134
Weather Channel, web sites, 293
WeatherLabs, Inc., 450–451
Web-based chat, 320–321
Web-based e-mail services, 317
Web browsers, 290–291
Web bugs
  anti-spyware utilities, 502
  security, 482
Web Design, tips for, 523
Web designers, Internet careers and, 355
web filters, cyberslacking and, 253
Web Masters, Internet careers and, 355
Web pages
  building your site, 521–522
  hyperlinks and, 297–298
  hypertext links and, 289
  importing graphics and, 519–520
  linking sites to web pages, 522–523
  planning your site or page, 519
  publishing the page, 290
  security and, 354–355
  start page, 296
  using hyperlinked graphics on a Web page, 298
Web programmers, 469
web sites
  Additional Resources on Web Design, 524–525
  AngelFire, 524
  anti-spam laws, 484
  Bank of America, 350
  Barry's Clipart Server, 520
  Best Buy, 349
  Cedant Web Hosting, 524
  CNet, 397
  CNET Shopper, 528
  CNN, 293, 307
  Confucian Etext Project, 294
  creating web sites and, 525

Urheberrechtlich geschütztes Material

web sites—*cont.*
definition of, 289
Dogpile, 306
Dreamweaver MX, 518
examples of, 290, 292
finding a host for, 523
Fireworks MX, 518
FortuneCity, 524
Free Servers, 524
Freescale Semiconductor, Inc., 149
FrontPage, 518
FTP support for, 320
The GIMP, 518
GoLive CS, 518
Gutenberg Project, 294
history of Internet and, 286
Hosting.Com, 524
Intellectual Property Rights, 525
Internet Archive, 295
Jupiterimages, 520
L.L.Bean, 348
Launch, 293
The Linux Gazette, 240
Linux Online, 240
Linux Planet, 240
LView Pro, 518
Mamma, 306
McAfee VirusScan, 486, 536
Microsoft Corporation, 307, 240
Microsoft Typography, 397
MIT, 295
MSN Technology, 528
web sites—cont.
National Football League (NFL), 292
National Information Assurance Training and, 492
NetObjects Fusion, 518
Netscape Communications, 307
Norton online, 4
OpenOffice.org, 365
Paint Shop Pro, 518
PC Magazine, 528, 240
PC World, 528
processors, 528
Prudential Financial, 351
publishing your web site, 524–525
QuickTime, 293
streaming media, 293
Symantec, 486
TopHosts.com, 524
viruses and, 536
Weather Channel, 293
Windows Update service, 115
ZDNet, 307, 397
Webster's Dictionary, web sites, 423
Westinghouse, George, 18
Wi-Fi (Wireless Fidelity), 556
Wi-Fi Protected Access (WPA), 339
wide area networks (WAN), 248
Wide Ultra 2 SCSI interface, 194
windows, 209
active windows, 209
document windows, 366
Windows, operating systems and, 33
Windows 9x, 226–227
Windows 95
32-bit applications, 227
release of, 226
Windows 98, 227
Windows 98 Active Desktop, 227
Windows 98 operating system, 551
Windows 2000, release of, 553
Windows 2000 Professional, 228
Windows 2000 Server, 232
Windows CE .NET, 234
(Windows Enhanced Metafile) EMF format, 385
Windows Me (Millennium Edition), 227
Windows Media Player 9, 228, 397
Windows NT Server, 231
Windows NT Workstation, 225–226
Windows Paint, 387
Windows Server 2003, 232
Windows Update service, web sites, 115
Windows XP, 228
activating the firewall in, 506
Add or Remove Programs utility, 190
advanced mobile computing, 228
advanced networking and communications, 228
desktop context menu, 209
Disk Defragmenter, 191
Event Viewer, 508
folder listing in, 120
New Connection Wizard, 332
release of, 553
using the backup utility in, 507
Windows XP Command Prompt, 212
Windows XP Embedded, 233–234
Windows XP GUI, taskbars and, 208
Windows XP Media Center Edition, 228
Windows XP Professional, 296
Winsock, 334
interface applications, 335
WinZip file compression utility, 191
wire-based media, 255–256
Wire Equivalent Privacy (WEP), 339
Wireless:802.11, 275
wireless access points (WAP), 275
wireless adapter cards, 275
wireless local area network (WLAN), 338
Wireless Markup Language (WML). See Extensible Markup Language Mobile Profile (XHTML MP)
wireless networks, 266, 274–276
wireless NIC, 256
wireless wide area network (WWAN), 335–336
word processing programs, 365–368
Word processing software, 34
word processors, interface of, 366
word size, 134
workbooks, 369
worksheets, 369
entering data in, 369
labels and, 371
workstations, 6
World Wide Web
creation of, 546
development languages, 461–465
launch your browser, 296
navigating the Web, 296–298
programmers, 469
reliability of search results, 304
review questions, 308–311
searching the Web, 299
sponsored links, 306–307
trust issues and spam, 316
understanding of, 288–295
URLs and, 296–298
using advanced search options, 303–306
using browsers and, 295–299
using site-specific search tools, 307
Web-based e-mail services, 317
worms, 534–535
security and, 488
Slammer worm, 556
viruses and, 545
Wozniak, Steve, 538, 540

X

X-Cleaner, cleaning spyware, 483
Xbase, 412–413
Xerox Star computer, 542
XML (eXtensible Markup Language), 555

Y

Y2K bug, 553
Yahoo!, advanced search form, 305
Yother, Andy, 78
Young, Michael, 510

Z

ZDNet, web sites, 307, 397

Urheberrechtlich geschütztes Material

IT Tools and Applications by Taxali **0-07-053509-4** **Rs. 250***

- Systematic and step-by-step exposure to DOS, Windows 2000. Word 2000, Excel 2000 and PowerPoint 2000.
- Excellent learning aids with Learning objectives, Tips, Notes, Caution, More Information boxes.
- Designed for the course on IT Tools and Applications offered to students taking the DOEACC 'O' and 'A' level certificate examinations.

Using Information Technology, 5th Ed. (Complete Version) by Williams 0-07-049545-9 Rs. 295*

- Covers the fundamental computing concepts that are part of the digital age.
- Includes concepts of software, hardware, data, people, and procedures.
- The text centers on educating today's technology consumer, using themes of ethics, the Internet, and communications.
- Demonstrates how the changing world of technology influences our lives and the decisions we make.

Office XP: The Complete Reference (With CD) by Nelson **0-07-044723-3** **Rs. 595***

- Work and communicate more effectively with help from this trusted reference.
- Execute word processing, spreadsheets, multimedia presentations, Internet and e-mail functions, publishing to the Web, small business programs and more.
- Comprehensive coverage helps new users pick up the basics.
- Existing users can find upgrade specifics all neatly organized so that everyone can quickly locate exactly the information they need.

*Prices as on June 24, 2005. Prices are subject to change without notice.

Unrechtmäßig gescannte Material

The McGraw-Hill Companies

Sixth Edition

INTRODUCTION TO COMPUTERS

NORTON

START YOUR CAREER WITH NORTON

A trusted name in Information Technology, Peter Norton has been synonymous with computers for nearly two decades. The unparalleled success of this series has led to the Indian Adaptation of the 6th Edition of this book - part of the trilogy that also includes Computing Fundamentals and Essential Concepts. It has brought together what can only be described as some of the leading educating resources for faculty and students alike.

Updated With:

- New chapter on Information Security - critical to today's systems and the Internet.
- New coverage of database management systems including overviews of Oracle, IBM DB2, mySQL and Microsoft SQL Server.
- Expanded coverage of Networking and Internet technologies.

Key Features:

- Web integrated text and a new design with enhanced illustrations
- Self-check questions with answers
- Norton Online Notes
- Norton Notebooks, Productivity Tips, Computers In Your Career and At Issue articles
- End-of-Chapter material including Lesson Quizzes, Internet Labs, Ethical Questions and Research and Report Activities

- ***Self assessments to reinforce main concepts***
- ***Dedicated web site: http://highered.mcgraw-hill.com/sites/0070593744***

Visit us at | www.tatamcgrawhill.com

ISBN-13: 978-0-07-059374-9
ISBN-10: 0-07-059374-4

9 780070 593749

Tata McGraw-Hill

Urheberrechtlich geschütztes Material