

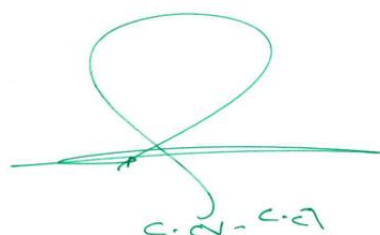


MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Knowledge Representation		Module Delivery
Module Type	C		☒ Theory ☒ Lecture ☐ Lab ☐ Tutorial ☒ Practical ☒ Seminar
Module Code	AI2101		
ECTS Credits	6		
SWL (hr/sem)	150		
Module Level	2	Semester of Delivery	1
Administering Department	AI	College	Computer Science and Information Technology
Module Leader	Ali Mahmoud Ali	e-mail	ali.mahmoud@uowa.edu.iq
Module Leader's Acad. Title	Assist lecturer	Module Leader's Qualification	MSc
Module Tutor	Ali Mahmoud Ali	e-mail	ali.mahmoud@uowa.edu.iq
Peer Reviewer Name	Mahmood Jasim	e-mail	mahmood.jasim@uowa.edu.iq
Scientific Committee Approval Date	01/09/2026	Version Number	1.0

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	---	Semester	--
Co-requisites module		Semester	


01/09/2026




01/09/2026

Module Aims, Learning Outcomes and Indicative Contents	
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	<ul style="list-style-type: none"> Foundational Logic & Methods: Introduce students to basic concepts, paradigms, and different types of Knowledge Representation (KR) techniques essential to Artificial Intelligence. Formal Reasoning Systems: Equip students with core logic formalisms—including Propositional Logic and First-Order Logic—and the inference mechanisms used to automate reasoning. Structured & Conceptual Models: Train students in organizing complex domain knowledge using Semantic Networks (taxonomic/part-whole relations), Frame-Based Representations (inheritance, slots, and default values), and Ontologies (OWL). Production Systems & Rules: Enable students to design rule-based systems and master forward/backward chaining inference alongside conflict resolution strategies. Uncertainty & Graph Architectures: Provide practical understanding of modeling uncertainty via Bayesian Networks and constructing, querying, and applying modern Knowledge Graphs.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	<p>Upon successful completion of this module, students will be able to:</p> <ol style="list-style-type: none"> LO1 (Knowledge): Define key KR paradigms—including Logic, Frames, Semantic Networks, Rule Systems, Ontologies, and Knowledge Graphs—and explain their role in AI. LO2 (Formulation): Translate natural language domain information into formal logical statements, frame hierarchies, and ontological structures. LO3 (Inference): Apply algorithmic reasoning techniques, such as resolution, forward/backward chaining, and Bayesian inference, to derive logical conclusions. LO4 (Graph & Ontology Engineering): Construct, query, and manipulate modern Knowledge Graphs and OWL-based ontologies for effective knowledge sharing. LO5 (Synthesis & Defense): Design a domain-specific KR solution and successfully demonstrate and present the project deliverables.
Indicative Contents المحتويات الإرشادية	<p>Unit 1: Introduction to Knowledge Representation</p> <ul style="list-style-type: none"> Definitions of Data, Information, Knowledge, and Intelligence. The KR Trade-off: Expressiveness vs. Computational Tractability. <p>Unit 2: Logic-Based Formalisms</p> <ul style="list-style-type: none"> Propositional Logic: Syntax, Semantics, Truth Tables, and Equivalence.

	<ul style="list-style-type: none"> • First-Order Logic (FOL): Quantifiers, Predicates, Functions, and Clausal Form. • Inference Systems: Unification, Modus Ponens, and Resolution Theorem Proving. <p>Unit 3: Structured Representation Schemes</p> <ul style="list-style-type: none"> • Semantic Networks: Nodes, Links, Inheritance, and Spreading Activation. • Frames and Scripts: Slots, Fillers, Default Values, and Procedural Attachments. • Conceptual Dependency Theory and Conceptual Graphs. <p>Unit 4: Production Rules & Expert Systems</p> <ul style="list-style-type: none"> • Rule-Based Systems Architecture: Working Memory, Rule Base, and Inference Engine. • Conflict Resolution Strategies and Inference Modes (Forward vs. Backward Chaining). <p>Unit 5: Ontologies and the Semantic Web</p> <ul style="list-style-type: none"> • Introduction to Description Logics (DL). • Web Ontology Language (OWL) and Resource Description Framework (RDF). • Designing Ontologies using Protégé. <p>Unit 6: Reasoning Under Uncertainty</p> <ul style="list-style-type: none"> • Non-Monotonic Reasoning and Default Logic. • Bayesian Networks and Probabilistic Reasoning. • Introduction to Fuzzy Sets and Fuzzy Logic.
--	---

Learning and Teaching Strategies	
	استراتيجيات التعلم والتعليم
Strategies	<p>Theoretical Lectures (☒ Theory): Interactive lectures to establish foundational concepts, mathematical logic, and theoretical paradigms.</p> <p>Practical Sessions (☒ Practical): Guided computer lab activities focused on writing declarative code (e.g., Prolog, Python logic packages) and building ontologies.</p> <p>Tutorials (☒ Tutorial): Small-group problem-solving workshops focused on manual logic derivations, resolution proofs, and model conversions.</p> <p>Seminars (☒ Seminar): Student-led group presentations and discussions analyzing real-world applications of Knowledge Representation in AI.</p>

Student Workload (SWL)			
الحمل الدراسي للطلاب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطلاب خلال الفصل	48	Structured SWL (h/w) الحمل الدراسي المنتظم للطلاب أسبوعيا	3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطلاب خلال الفصل	102	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطلاب أسبوعيا	7
Total SWL (h/sem) الحمل الدراسي الكلي للطلاب خلال الفصل	150		

Module Evaluation					
تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	5	15% (10)	2,3,5,8,12	LO #1, #2 and #5
	Assignments	5	10% (10)	3,4,6,9,11	LO #3, #4 and #5
	Assignments in college	5	10% (10)	2,3,5,8,12	All
	Report	1	5% (5)	13	LO #5
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #5
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)	
المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction to Knowledge Representation - Overview of knowledge representation and its importance in AI
Week 2	- Different types of knowledge representation methods
Week 3	Logical Representations - Propositional logic - First-order logic
Week 4	- Inference and reasoning with logical representations
Week 5	Semantic Networks - Basic concepts of semantic networks - Types of semantic networks (taxonomic, part-whole relations, etc.) - Inference in semantic networks

Week 6	Frame-Based Representation - Basic concepts of frames as a knowledge representation tool - Frame attributes, default values, and slots - Inheritance hierarchies and reasoning with frames
Week 7	Ontologies - Definition and components of ontologies - Ontology languages like OWL - Developing and using ontologies for knowledge sharing
Week 8	Midterm Term
Week 9	Rules and Production Systems - Basic concepts of rules and rule-based systems
Week 10	- Forward chaining and backward chaining inference - Conflict resolution strategies
Week 11	Uncertainty in Knowledge Representation - Representing uncertainty using Bayesian networks
Week 12	- Reasoning with uncertain knowledge - Applications involving uncertainty
Week 13	Knowledge Graphs - Structure and construction of knowledge graphs - Querying knowledge graphs
Week 14	- Knowledge graph applications
Week 15	Projects Presentation

Learning and Teaching Resources		
مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Van Harmelen, F., Lifschitz, V., Porter, B. (ed.). Handbook of knowledge representation. – Elsevier, 2008. – Vol. 1. – 1034 pp.	No
Recommended Texts	Boolos, G. S., Burgess, J. P., Jeffrey, R. C. Computability and logic. – Cambridge university press, 2002. – 364 pp. Nipkow, T., Grumberg, O., Hauptmann, B. (ed.). Software Safety and Security: Tools for Analysis and Verification. – IOS Press, 2012. – 400 pp.	No
Websites	https://protege.stanford.edu/	

Grading Scheme				
مخطط الدرجات				
Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	A - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
<p>Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.</p>				