جامعــة الزيتونـــة الأردنيـة
Al-Zaytoonah University of Jordan
كلية العلوم وتكنولوجيا المعلومات
Faculty of Science and Information Technology

" عراقة وجودة"
"Tradition and Quality"

Detailed Course Description - Course Plan Development and Updating Procedures/ Basic Sciences Department	QF01/0408-3.0E

Faculty	Science and Information Technology	Department	Artificial intelligence
Course number	0142374	Course title	Cognitive and Knowledge-based Systems
Number of credit hours	3	Pre-requisite/co-requisite	Database

Brief course description:

This course covers all the concepts of building knowledge-based systems and structured knowledge representations. In addition, it covers all the knowledge-based methods of knowledge representations, reasoning, problem solving, planning, decision-making, and learning. This is a core course in artificial intelligence (AI), where students learn how to design knowledge-based AI agents and a knowledge structure integrated with production.

	Course goals and learning outcomes
Goal 1	Understanding the main concepts of knowledge-based systems
Learning outcomes	1.1 Understanding the key concepts of knowledge, representation, and reasoning. 1.2 To know what is a knowledge-based system and its categories and applications
Goal 2	Understanding the language of First-Order Logic
Learning outcomes	2.1 Understanding the syntax and semantic of First-Order Logic. 2.2 Understanding the basic elements of First-Order Logic syntax. 2.3 Understanding how to map atomic sentences into First-Order Logic.
Goal 3	Understanding the concept of expressing knowledge
Learning outcomes	3.1 Understanding the concept of knowledge engineering. 3.2 Understanding vocabulary, basic facts, and complex facts. 3.3 Understanding terminological facts, entailments, and abstract individuals.
Goal 4	Understanding the concept of resolution
Learning outcomes	4.1 Understanding propositional case, resolution derivations, and entailment procedure. 4.2 Understanding who to handle variables and quantifiers. 4.3 Understanding the First-Order resolution.
Goal 5	Understanding the concept of reasoning with horn clauses
Learning outcomes	5.1 Understanding the concept of horn clauses. 5.2 Understanding the concept of resolution derivations with horn clauses. 5.3 Understanding the concept of backward chaining and forward chaining.
Goal 6	Understanding the Prolog language
Learning outcomes	6.1 Understanding the syntax and semantic of Prolog programs. 6.2 Understanding how Prolog answers questions.
Textbook 1	Knowledge Representation and Reasoning / Ronald J. Brachman, Hector J. Levesque, and Maurice Pagnucco 1st edition, 2015.
Supplementary references	1. Knowledge-based Systems/ Rajendra Akerkar and Priti Sajja, 2010. 2. Prolog Programming for Artificial Intelligence/ Ivan Bratko, 4th edition, 2011 3. Expert Systems: Principles and Programming/ Joseph C. Giarratano and Gary Riley, 4th edition, 2005.

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Course timeline				
Week	Number of hours	Course topics	Pages (textbook)	Notes
01	3	**1. Introduction to Knowledge-based Systems** 1.1 The Key Concepts: Knowledge, Representation, and Reasoning…2 1.2 Why Knowledge Representation and Reasoning?.. . 5 1.2.1 Knowledge-Based Systems . . . . 6 1.2.2 Why Knowledge Representation? . . . . 7 1.2.3 Why Reasoning? . . . . 9 1.3 The Role of Logic 11	Textbook1 Pages: 1 - 14	
02	3	**2. The Language of First-Order Logic** 2.1 Introduction . .. . 15 2.2 The Syntax . . . . 16 2.3 The Semantics . . .. .18 2.3.1 Interpretations . . . . .20 2.3.2 Denotation . . . . 21 2.3.3 Satisfaction and Models 22	Textbook1 Pages: 15-22	
03	3	**2. The Language of First-Order Logic (Continued)** 2.4 The Pragmatics . . . . 22 2.4.1 Logical Consequence . . . . 23 2.4.2 Why We Care . . . . 23 2.5 Explicit and Implicit Belief . . . . 25 2.5.1 An Example . . . . 25 2.5.2 Knowledge-Based Systems 27	Textbook1 Pages: 22-28	
04	3	**3. Expressing Knowledge** 3.1 Knowledge Engineering . . . . 31 3.2 Vocabulary . . . . 32 3.3 Basic Facts . . . . 33 3.4 Complex Facts 34	Textbook1 Pages: 31 - 34	
05	3	**3. Expressing Knowledge (Continued)** 3.5 Terminological Facts . . . . 36 3.6 Entailments . . . . 37 3.7 Abstract Individuals . . . . 41 3.8 Other Sorts of Facts 43	Textbook1 Pages: 34 - 45	
06	3	**4. Resolution** 4.1 The Propositional Case . . . . 50 4.1.1 Resolution Derivations . . . . 52 4.1.2 An Entailment Procedure . . . . 53 4.2 Handling Variables and Quantifiers . . .. 55 4.2.1 First-Order Resolution . . . . 58 4.2.2 Answer Extraction . . . . 61 **First Exam**	Textbook1 Pages: 50-63	
07	3	**5. Reasoning with Horn Clauses** 5.1 Horn Clauses . . . . 85 5.1.1 Resolution Derivations with Horn Clauses . 86 5.2 SLD Resolution . . .. 87 5.2.1 Goal Trees 89	Textbook1 Pages: 85 - 90	
08	3	**5 Reasoning with Horn Clauses (Continued)** 5.3 Computing SLD Derivations . . . . 91 5.3.1 Backward Chaining. 91	Textbook1 Pages: 91 - 95	

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		5.3.2 Forward Chaining . . . . 93 5.3.3 The First-Order Case 94		
09	3	**1. The PROLOG Language** 1.1 An example program: defining family relations ….. 3 1.2 Extending the example program by rules…..8 1.3 A recursive rule definition…..14	Supplementary reference 2 Pages: 3 - 19	
10	3	1.4 How Prolog answers questions…..19 1.5 Declarative and procedural meaning of programs.24	Supplementary reference 2 Pages: 19 - 25	
11	3	Selected review questions and exercises **Second Exam**	Supplementary reference 2 Pages: 14, 19, 24	
12	3	**2. Syntax and Meaning of Prolog Programs** 2.1 Data objects …. 27 2.2 Matching……. 35 2.3 Declarative meaning of Prolog programs….. 40	Supplementary reference 2 Pages: 27 - 42	
13	3	**2. Syntax and Meaning of Prolog Programs (Continued)** 2.4 Procedural meaning….43 2.5 Example: monkey and banana….49 2.6 Order of clauses and goals…… 53	Supplementary reference 2 Pages: 43 - 59	
14	3	2.7 Remarks on the relation between Prolog and logic. 60 Exercises	Supplementary reference 2 Pages: 60-62	
15		Revision, Examples and Assignments Homework discussion		
16		**Final Exam**		

Theoretical course evaluation methods and weight	Participation = 10% First exam 20% Second exam 20% Final exam 50%	Practical (clinical) course evaluation methods	Semester students' work = 50% (Reports, research, quizzes, etc.) Final exam = 50%

Approved by head of department	Dr. Adnan Hunif	Date of approval	

Extra information (to be updated every semester by corresponding faculty member)

Name of teacher	Dr. Dara Aqel	Office Number	
Phone number (extension)		Email	d.aqel@zuj.edu.jo
Office hours			