ARTIFICIAL INTELLIGENCE: KNOWLEDGE REPRESENTATION AND REASONING

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TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 12 weeks (18 Jan’ 21 - 9 Apr’ 21)
EXAM DATE : 24 Apr 2021

PRE-REQUISITES : Some exposure to formal languages, logic and programming
INTENDED AUDIENCE : BE/ME/MS/MSc/PhD students
INDUSTRIES APPLICABLE TO : Software companies dealing with knowledge and reasoning, including the semantic web and semantic search

COURSE OUTLINE :
An intelligent agent needs to be able to solve problems in its world. The ability to create representations of the domain of interest and reason with these representations is a key to intelligence. In this course we explore a variety of representation formalisms and the associated algorithms for reasoning. We start with a simple language of propositions, and move on to first order logic, and then to representations for reasoning about action, change, situations, and about other agents in incomplete information situations. This course is a companion to the course Artificial Intelligence: Search Methods for Problem Solving that was offered recently and the lectures for which are available online.

ABOUT INSTRUCTOR :
Deepak Khemani is Professor at Department of Computer Science and Engineering, IIT Madras. He completed his B.Tech. (1980) in Mechanical Engineering, and M.Tech. (1983) and PhD. (1989) in Computer Science from IIT Bombay, and has been with IIT Madras since then. In between he spent a year at Tata Research Development and Design Centre, Pune and another at IIT, Mandi. He has had shorter stays at several Computing departments in Europe. Prof Khemani's long-term goals are to build articulate problem solving systems using AI that can interact with human beings. His research interests include Memory Based Reasoning, Knowledge Representation and Reasoning, Planning and Constraint Satisfaction, Qualitative Reasoning and Natural Language Processing.

COURSE PLAN :
Week 1: Introduction, Propositional Logic, Syntax and Semantics
Week 2: Proof Systems, Natural Deduction, Tableau Method, Resolution Method
Week 3: First Order Logic (FOL), Syntax and Semantics, Unification, Forward Chaining
Week 4: The Rete Algorithm, Rete example, Programming Rule Based Systems
Week 5: Representation in FOL, Categories and Properties, Reification, Event Calculus
Week 6: Deductive Retrieval, Backward Chaining, Logic Programming with Prolog
Week 7: Resolution Refutation in FOL, FOL with Equality, Complexity of Theorem Proving
Week 8: Description Logic (DL), Structure Matching, Classification
Week 9: Extensions of DL, The ALC Language, Inheritance in Taxonomies
Week 10: Default Reasoning, Circumscription, The Event Calculus Revisited
Week 11: Default Logic, Autoepistemic Logic, Epistemic Logic, Multi Agent Scenarios
Week 12:
Optional Topics A: Conceptual Dependency (CD) Theory, Understanding Natural Language
Optional Topics B: Semantic Nets, Frames, Scripts, Goals and Plans