CSE3221: Multiagent Systems

Programme: B.Tech CSE Year: III Semester: V

Course: Program Elective Credits: 3 Hours: 40

Course Context and Overview:

The course aims to provide a broad introduction to the fields of artificial intelligent agents with an emphasis on the Multiagent systems. The topics include agent architectures, inter-agent communication, teamwork, distributed rational decision making, agent modelling, and Multiagent learning. The course will help the students in formulating the solutions of different categories of problems in artificial intelligence with the use of the theory of multiple agents. The students will have the opportunity to apply the problem formulation techniques through the practical project assignments using selected tools and development environments (such as JADE, Cougaar, MASON, NetLogo, Repast, etc.).

Prerequisites Courses: Discrete Mathematical Structures, Probability and Statistics, Design and Analysis of Algorithms

Course Outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Understand the importance of multiagent systems and their significance in different areas.
CO2: Recognize the ways to formulate the problems for different agent-based paradigms.
CO3: Analyze the different multiagent interaction techniques and their architectures.
CO4: Implement the concepts of cooperation, collaboration, coordination, and competitive learning.
CO5: Plan and produce the solution methodologies and logic using agent-based paradigm.

Course Topics:

Contents	Hours	
UNIT 1 **Fundamentals of Multiagent Systems**		5
1.1 Intelligent agents: environments, agents and objects, types of agents, agents and expert systems	2	
1.2 Agents as intentional systems, abstract architectures for intelligent agents, synthesizing agents	1	

1.3 Multiagent interactions and problem formulation: utilities and preferences, multiagent Markov Decision Process (MDP), planning	2	
UNIT 2 **Reasoning Agents**		6
2.1 Deductive reasoning agents: agents as theorem provers, agent-oriented programming; Practical reasoning agents: means-ends reasoning, procedural reasoning system	2	
2.2 Proactive and Reactive agents: Brooks and Subsumption architecture, limitations of reactive agents	2	
2.3 Hybrid agents: evolution and role in current technological trends, TouringMachines, InteRRap	2	
UNIT 3 **Multiagent Interaction**		15
3.1 Distributed constraints: filtering algorithm, hyper-resolution-based consistency algorithm, asynchronous backtracking, asynchronous weak commitment search, distributed breakout, distributed constraint optimization	8	
3.2 Standard and extended form games: games in normal form, games in extended form, characteristic form games and coalition formation	7	
UNIT 4 **Learning in Multiagent Systems**		10
4.1 The machine learning problem, cooperative learning, repeated games, stochastic games, general theories for learning agents, collective intelligence	5	
4.2 Cooperation, collaboration and coordination: problem solving, Multiagent planning and synchronization, negotiation, auction, voting, coordination using goal and plan hierarchies	5	
UNIT 5 **Methodologies, Applications and Logics for Multiagent systems**		4
5.1 When is an agent-based solution appropriate?, agent-oriented analysis and design techniques, pitfalls of agent development, mobile agents, agents for workflow and business process management, agents for distributed sensing, agents for information retrieval and management, agents for electronic commerce, agents for human-computer interfaces, agents for virtual environments, agents for social simulation	2	
5.2 Nature-inspired approaches: ants and termites, immune system, swarm of mobile agents	2	

Evaluation Methods:

Item	Weightage
Quiz/Assignment	20
Midterm	30
Final Examination	50

Textbook references (IEEE format):
Text Books:

1. Michael Wooldridge, "*An Introduction to Multiagent Systems"* (2nd ed.), John Wiley & Sons, 2009.
2. Gerhard Weiss, "*Multiagent systems: a modern approach to distributed artificial intelligence"* (1st ed.), The MIT Press, 2000.

References:

1. José M. Vidal, "*Fundamentals of Multiagent Systems with NetLogo Examples"*, Citeseer, 2007.
2. Gerhard Weiss, "*Multiagent Systems" (Intelligent Robotics and Autonomous Agents series)* (2nd ed.), The MIT Press, 2013.
3. Yue Wang, Eloy Garcia, David Casbeer, and Fumin Zhang," *Cooperative Control of Multi-Agent Systems: Theory and Applications"* (1st ed.), John Wiley & Sons, 2017.

Prepared By: Saurabh Kumar
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