IT 228: Artificial Intelligence

(BIM 5th Sem)

Credits: 3
Lecture Hours: 48

Course Description: This course is designed to provide an in-depth exploration of recent advances and emerging trends in Artificial Intelligence (AI). Students will delve into cutting-edge topics, applications, and research areas within the field of AI, gaining a comprehensive understanding of the latest developments.

Course Objectives:
Upon successful completion of this course, students will be able to:

- Understand Recent Advances: Comprehend the recent breakthroughs and advancements in AI technology.
- Apply Advanced AI Techniques: Apply advanced AI techniques to solve real-world problems and challenges.
- Evaluate Emerging Technologies: Evaluate the impact and potential applications of emerging AI technologies.
- Stay Updated: Develop skills to stay updated on the fast-evolving landscape of AI research and development.
- Critical Thinking: Develop critical thinking skills in analyzing and synthesizing recent AI research papers and articles.

Course Details

Unit 1: Introduction **3 LHs**

Intelligence, Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally, History of AI, Foundations of AI: Philosophy, Economics, Psychology, Sociology, Linguistics, Neuroscience, Mathematics, Computer Science, Control Theory, AI Ethics and Responsible AI: Bias and Fairness in AI, Transparency and Accountability, AI Regulations and Policies, Applications of AI.

Unit 2: Intelligent Agents **4 LHs**

Introduction of agents, Structure of Intelligent agent, Properties of Intelligent Agents, Configuration of Agents, PEAS description of Agents, PAGE, Types of Agents: Simple Reflexive, Model Based, Goal Based, Utility Based, Learning Agent, Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent

Unit 3: Problem Solving by Searching **9LHs**

Definition, Problem as a state space search, Problem formulation, Well-defined problems, Solving Problems by Searching, Search Strategies, Performance evaluation of search techniques, Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Bidirectional Search, Informed Search: Greedy Best first search, A* search, Hill Climbing, Simulated Annealing, Game playing, Adversarial search techniques, Mini-max Search, Alpha-Beta Pruning, Constraint Satisfaction Problems.

Unit 4. Knowledge Representation **14 LHs.**

Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems, Types of Knowledge Representation Systems: Semantic Nets, Frames, Conceptual Dependencies, Scripts, Rule Based Systems(Production System), Propositional Logic, Predicate Logic, Propositional Logic(PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Inference using Resolution, Backward Chaining and Forward Chaining, Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference with FOPL: By converting into PL (existential and universal instantiation), Unification and lifting, Inference using resolution, Handling Uncertain Knowledge, Radom Variables, Prior and Posterior Probability, Inference using Full Joint Distribution, Bayes' Rule and its use, Bayesian Networks, Reasoning in Belief Networks, Fuzzy Logic: Fuzzy Sets, Membership in Fuzzy Set, Fuzzy Rule base Systems.

Unit 5. Machine Learning **12 LHs**

Introduction to Machine Learning , Concepts of Learning, Supervised, Unsupervised and Reinforcement Learning, Statistical-based Learning: Naive Bayes Model, Learning by Genetic Algorithms: Operators in Genetic Algorithm: Selection, Mutation, Crossover, Fitness Function, Genetic Algorithm, Learning with Neural Networks: Introduction, Biological Neural Networks Vs. Artificial Neural Networks (ANN), Mathematical Model of ANN, Activation Functions: Linear, Step Sigmoid, Types of ANN: Feed-forward, Recurrent, Single Layered, Multi-Layered, Application of Artificial Neural Networks, Learning by Training ANN, Hebbian Learning, Perceptron Learning, Back-propagation Learning, Overview of Deep Learning Architectures : Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs).

Unit 6. Applications of AI **6 LHs**

Expert Systems, Components of Expert System: Knowledge base, inference engine, user interface, working memory, Development of Expert Systems, Natural Language Processing: Natural Language Understanding and Natural Language Generation, Steps of Natural Language Processing: Lexical Analysis(Segmentation, Morphological Analysis), Syntactic Analysis, Semantic Analysis, Pragmatic Analysis, Machine Translation, Machine Vision Concepts: Machine vision and its applications, Components of Machine Vision System, Object Detection and Recognition, Image Segmentation, Explainable AI in Computer Vision, AI in Healthcare and Bioinformatics, Applications of AI in Medicine, Predictive Modeling in Healthcare.

Laboratory Works:

Student should write programs and prepare lab sheet for most of the units in the syllabus. Majorly, students should practice design and implementation of intelligent agents, knowledge representation systems and machine learning techniques. Students are also advised to implement Neural Networks for solving practical problems of AI. Students are advised to use LISP, PROLOG, and any other high-level language like C, C++, Java, python etc.

Suggested Readings:

Stuart Russel and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition 2020, Pearson.
George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Benjamin/Cummings Publication.
E. Rich, K. Knight, Shivashankar B. Nair, Artificial Intelligence, Tata McGraw Hill.
D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
P. H. Winston, Artificial Intelligence, Addison Wesley.