CSEN2031 ARTIFICIAL INTELLIGENCE L T P S J C 3 0 2 0 0 4

Pre-requisite: Data Structures, DAA, Programming languages Co-requisite

Preferable: Discrete Maths, Statistics and Probability

Course Description:

This course enables the students to think critically about what makes humans intelligent, and how computer scientists are designing computers to act more like us. Artificial Intelligence (AI) is the study of how to make computers make things that can 'think' and act the right way, given the circumstances. AI plays an important role in the design and development of systems with intelligent behaviour. The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence.

Course Educational Objectives:

● To understand the fundamentals of Artificial Intelligence

● To solve problems by using search algorithms

● To gain insight into competitive environments using adversarial search algorithms

● To learn knowledge representation and knowledge representation techniques

● To address the uncertainty and to learn the ways of learning

UNIT 1 Basics of Artificial Intelligence 9 hours,

Introduction: Introduction to AI – concept of Intelligence, Artificial Intelligence, Foundational Areas of AI, Approaches to AI- Rationalist, Empiricist Approaches, Applications of AI and Limitations of AI

Intelligent Agents: Agents and Environments, Examples, The Concept of Rationality, Nature of Environments, The Structure of Agents.

UNIT 2

Solving Problems by Searching 9 hours,

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies: Breadth-first Search, Depth-first Search and DFS variations, Lowest cost-first Search, Informed (Heuristic) Search Strategies: Greedy Best-first Search, A* search, Recursive Best First Search, Heuristic Functions.

Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hill-climbing Search and variations to resolve problems with steepest ascent, Genetic Algorithms.

UNIT 3

Adversarial Search and Logical Agents 9 hours,

Adversarial Search: 2-Player Games, Optimal Decisions in Games: AND-OR graph, Minimax algorithm, Alpha-Beta Pruning. Chance based games.

CSP, Constraint Networks, Solving CSP by Search Logical Agents: Knowledge-based Agents, Propositional Logic, Propositional Theorem Proving: Inference.

UNIT 4

First-Order Logic 9 hours,

Propositional Logic – Proof by Resolution, Forward Chaining, Backward Chaining,

First-Order Logic: Syntax and Semantics of First-Order Logic, Models for First-Order Logic, Quantifiers, Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution in First-Order Logic.

UNIT 5

Uncertainty and Learning 9 hours

Uncertainty: Acting under Uncertainty, Conditional Probabilities, Full Joint Distributions, Bayes Rule and its Applications: Bayesian Networks.

Basics of Learning: Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Unsupervised Learning.

Lab Exercises suggested:

1. Revisit/Refresh the Study of Python and PROLOG (can use any other programming Language also)

2. Write a program to control the VACUUM Cleaner moves (Intelligent systems design process)

3. Write a program to solve Monkey & Banana Problem.

4. Write a program to solve Water-Jug problem (PROLOG)

5. Write a program to solve 8-tiles puzzle problem (Using heuristics).

6. Write a program to solve Shortest path problem: (i) Using BFS (ii) Using Lowest-cost-first search

7. Write a program to implement TIC – TAC - TOE game (Understanding Minimax Algorithm and Alpha – Beta pruning)

8. Write a program to implement Hangman game (Or Wordle).

9. Write a program to understand Propositional logic using KANREN, SYMPY, pyDatalog packages in Python.

10. Write a program to understand Inferential logic using KANREN, SYMPY, pyDatalog packages in Python.

11. Write a program to implement a binary classification using Decision Trees (Understanding Decision Trees)

Lab Infrastructure:

1. Python, PROLOG on Windows or Linux

2. Python packages KANREN, Sympy, pyDataLog

Textbooks:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach,3 rd Edition, Pearson, 2015

2. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, 2nd Edition, Cambridge University Press, 2017

References:

1. George F Lugar, Artificial Intelligence, Pearson, 6th edition(2017)

2. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, TMH Education Pvt. Ltd., 2008.

3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson.

4. David Poole Book Reference site: https://artint.info/2e/html/ArtInt2e.html

5. Russel lecture reference site: https://inst.eecs.berkeley.edu/~cs188/sp19/

6. Microsoft AI project s Site: https://www.microsoft.com/en-us/ai/ai-lab-projects

7. https://nptel.ac.in/courses/106/105/106105079/ (Nptel course on artificial Intelligence by Prof. Dasgupta maps to the syllabus and beyond and can be used as listening material for the relevant topics)

Course Outcomes:

After successful completion of the course the student will be able to:

1. Relate to the concept of artificial intelligence, the role of intelligent agents, uninformed and informed search techniques

2. Analyse and solve problems using various Search mechanisms

3. interpret real-world problems in competitive environments

4. create knowledge representation at features level and apply inference for finding solutions

5. infer the ways of acting on uncertainty