INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

LOGIC PROGRAMMING FOR ARTIFICIAL INTELLIGENCE LABORATORY								
III Semester: CSE (AI&ML)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD02	Core	0	0	2	1	40	60	100
Contact Classes: NIL	**Tutorial Classes: NIL**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Python Programming								

I. COURSE OVERVIEW:

Logic programming is a type of AI that is based on formal logic. This means that it is based on a set of rules that are used to infer new information. This course covers fundamental concepts and underlying assumptions about intelligence. The goal is to produce programs to do intelligent things as people do. It also explains different kinds of techniques useful for solving AI problems. Different Heuristic approaches are explored to measure how far a node in a search tree seems to be from a goal. Defining the problem accurately and segregating the background knowledge needed in the solution are clearly stated and implemented.

II. COURSES OBJECTIVES:

The students will try to learn:

I The designing of Prolog/Python programs to represent the knowledge with respective to propositional and predicate logic.

II The identification and applying of uninformed and informed techniques and algorithms to solve real world search problems.

III The designing of Prolog/Python programs to represent the knowledge with reasoning under uncertainty.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Outline the fundamentals of AI concepts for production systems to represent the production rules/knowledge base.
CO2	Choose knowledge reasoning with predicate logic and inference rules to solve problems to new situations
CO3	Make use of Heuristic algorithms and implement the selected strategy to address a search problem
CO4	Experiment with uncertainty issues by using statistical and symbolic reasoning approaches to generate inferences.
CO5	Select the expressiveness and efficiency of different knowledge representation methods to assess their suitability for specific AI applications.
CO6	Utilize knowledge representation for reasoning under uncertainty to solve complex problems and provide decision-making ability.

IV. COURSE SYLLABUS:

Week – 1: PRODUCTION SYSTEMS – WATER JUG PROBLEM

1. Given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can we get exactly 2 gallons of water into a 4- gallon jug?

a. Describe the state space as a set of ordered pairs of integers.
b. Generate production rules and perform basic operations to achieve the goal.
c. Initialize the start state and apply the rules iteratively until the goal state is reached.

d. Generate a search tree (Depth-First Search / Breadth-First Search)

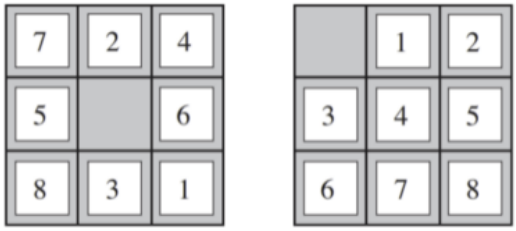
Week – 2: PRODUCTION SYSTEMS – TOWERS OF HANOI

2. There are three pegs, 1, 2, and 3, and three disks, a, b, and c (a being the smallest and c being the biggest). Initially, all the disks are stacked on peg 1. The problem is to transfer them all on to peg 3. Only one disk can be moved at a time, and no disk can ever be placed on top of a smaller disk.

Input:

Week – 3: STATE SPACE SEARCH – EIGHT PUZZLE PROBLEM

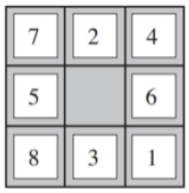
3. The 8-puzzle consists of a 3×3 board with eight numbered tiles and a blank space. A tile adjacent to the blank space can slide into the space. The task is to reach a specified goal state, such as the one shown on the right of the figure.



Start State Goal State

The objective is to place the numbers on tiles to match the final configuration using the empty space. You can slide four adjacent (left, right, above, and below) tiles into the empty space.

Input:



Start State

Week – 4: STATE SPACE SEARCH – BLOCKS REARRANGEMENT PROBLEM

4. The problem is to find a plan for rearranging a stack of blocks as shown below. We are allowed to move one block at a time. A block can be grasped only when its top is clear. A block can be put on the table or on some other blocks. To find a required plan, we must find a sequence of moves that accomplish the given transformation. Think the problem as a problem of exploring among possible alternatives.

Input:

Week – 5: STATE SPACE SEARCH – MONKEY BANANA PROBLEM

5. Imagine a room containing a monkey, chair and some bananas that have been hung from the center of ceiling. If the monkey is clever enough, he can reach the bananas by placing the box directly below the bananas and climbing on the chair. The problem is to prove whether the monkey can reach the bananas. The monkey wants it but cannot jump high enough from the floor. At the window of the room there is a box that the monkey can use.

Input: The monkey can perform the following actions: - 1) Walk on the floor. 2) Climb the box. 3) Push the box around (if it is beside the box). 4) Grasp the banana if it is standing on the box directly under the banana.

Week – 6: STATE SPACE SEARCH – FARMER CROSSING A RIVER

6. A farmer wants to get a lion, a fox, a goose, and some corn across a river. There is a boat, but the farmer can only take one passenger in addition to himself on each trip, or else both the goose and the corn, or both the fox and the corn. The corn cannot be left with the goose because the goose will eat the corn; the fox cannot be left with the goose because the fox will eat the goose; and the lion cannot be left with the fox because the lion will eat the fox. How does everything get across the river? Assume animals do not wander off when left alone.

Input: Domain specific knowledge including objects and relationship among them.

Week – 7: UNINFORMED SEARCH TECHNIQUE – DEPTH FIRST SEARCH

7. Depth First Search – Develop the code to demonstrate the implementation of depth-first search algorithm. The concept of depth-first search is like that of a state-space problem. It aims to find a solution path from one node to another in the state space. The algorithm is called depth-first because of the order in which it searches for the alternatives. Whenever it is given a choice between continuing the search from multiple nodes or going deep, it always chooses the deepest one.

Week – 8: INFORMED SEARCH TECHNIQUE – BEST FIRST SEARCH

8. Best First Search Algorithm - The Best First Search algorithm is a set of rules that work together to perform a search. It considers the various characteristics of a prioritized queue and heuristic search. The goal of this algorithm is to reach the state of final or goal in the shortest possible time.

Week – 9: HEURISTIC SEARCH TECHNIQUE – A* ALGORITHM

9. A square grid is composed of many obstacles that are scattered randomly. The goal is to find the final cell of the grid in the shortest possible time. Implement A* algorithm to search for the shortest path among the given initial and the final state.

Week – 10: AND-OR GRAPH GENERATOR

10. Implement the algorithm to generate AND-OR graph or tree to represent the solution by dividing the problem into sub problems and solve them separately to obtain the result by combining all the sub solutions.

Week – 11: KNOWLEDGE PRESENTATION USING PREDICATE LOGIC

11. Develop the code to implement the predicate logic in artificial intelligence to derive inferences based on the existing knowledge:

Input: Let's start with a Harry Potter example. Consider the following sentences:

1. If it didn't rain, Harry visited Hagrid today.
2. Harry visited Hagrid or Dumbledore today, but not both.
3. Harry visited Dumbledore today.

Week – 12: KNOWLEDGE REPRESENTATION USING PROPOSITIONAL LOGIC

12. Use the propositional logic and develop a knowledgeable AI agent that can analyze like humans. In this lesson, we will develop a game engine that will detect a murder based on its knowledge base. Implement propositional logic to make our game engine knowledgeable, and then we will make able the engine to detect the murderer.

    Input: Doctor Black has just been found dead in his mansion yesterday. Yesterday, there were only Three People in Doctor Black's mansion.

    They are the prime suspects:

    1. Col. Mustard
    2. Prof. Plum
    3. Ms. Scarlet

    Police found Three Weapons in the mansion:

    1. Knife
    2. Revolver
    3. Wrench

    The murder has happened in one of the Three Rooms of the mansion:

    1. Ballroom
    2. Kitchen
    3. Library

Week – 13: THE MONTY HALL PROBLEM

13. In this problem, a participant can choose one out of three doors. Behind one door is a valuable prize, while the other two doors hide goats. After the participant chooses a door, the host (Monty), who knows what's behind each door, opens one of the remaining doors to disclose a goat. The participant is then given the option to either stick with their original choice or switch to the other unopened door. Develop the code to Implement the best strategy for the participant to maximize their chances of winning the prize?

    Input: Model the Monty Hall problem using a Bayesian network with three nodes representing the participant's initial choice (C), the location of the prize (P), and the door opened by the host (H).

Week – 14: BAYESIAN NETWORKS

14. Develop the code to know the use cases and practical applications of the Bayesian Networks by considering the usage of the network, particularly digit generalization and visualization.

    Input: Digits dataset

V. TEXT BOOKS:

1. Stuart Russel, Peter Norvig, "AI – A Modern Approach", Pearson Education, 2nd edition 2007.
2. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill, 2008.
3. lvan Bratko E. Kardelj University, J. Stefan Institute Yugosla, "Prolog Programming for Artificial Intelligence", Addison-Wesley publishing company, 1986.

VI. REFERENCE BOOKS:

1. Prateek Joshi, "Artificial Intelligence with Python", Packt Publication, UK, 2017.
2. Vinod Chandra SS, Anand Hareendran S, "Artificial and Machine Learning", PHI Learning, 1st edition 2014.
3. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

4. G. Luger, W. A. Sttubblefield, “Artificial Intelligence”, Addison-Wesley Longman, 3rd edition,1998.
5. N. J. Nilson, “Principles of Artificial Intelligence”, Narosa Publishing House, 1980.
6. Tom Mitchell, “Machine Learning”, Tata McGraw Hill India, 1st edition 2017.

VII. ELECTRONICS RESOURCES:

1. http://www.youtube.com/playlist?list=PLD52D2B739E4D1C5F
2. NPTEL: Artificial Intelligence, https://nptel.ac.in/courses/106105077/
3. http://www.udacity.com/
4. http://www.library.thinkquest.org/2705/
5. http://www.ai.eecs.umich.edu/

VIII. MATERIALS ONLINE

1. Syllabus
2. Lab Manual