Qn. Set Code-1

Semester: 5th
Programme: B.Tech
Branch: CSE, CSCE, CSSE

AUTUMN END SEMESTER EXAMINATION-2023

5th Semester B.Tech (DE-I)

ARTIFICIAL INTELLIGENCE

CS 3011

(For 2022 (L.E), 2021 & Previous Admitted Batches)

Time: 3 Hours | Full Marks: 50

Answer any SIX questions.
Question paper consists of four SECTIONS i.e. A, B, C and D.
Section A is compulsory.
Attempt minimum one question each from Sections B, C, D.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

(a) Explain the basic difference between the heuristic function, h(n) and the path cost function, g(n) where n is the current node in the search tree.

(b) State the difference between an omniscient agent and a rational agent.

(c) How would you formulate an 8-queen problem as a Constraint Satisfaction Problem?

(d) Draw the one dimensional state-space landscape diagram for Hill climbing search indicating various key features in this landscape.

(e) Write down the PEAS to specify the task environment for a cooking agent.

(f) For Total Turing test, indicate the six capabilities required for a AI system.

(g) Differentiate among three uninformed search strategies: DFS, DLS, and IDS.

(h) Briefly explain the TELL and ASK operations in a KB-based agent program.

(i) What is the basic difference between entailment and inference with respect to a logical agent?

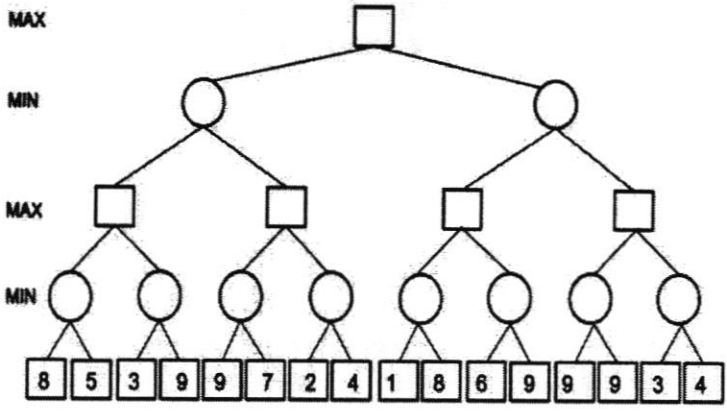
(j) "Pruning achieves better time complexity than Min-Max Algorithm". Justify this statement.

SECTION-B

2. (a) Differentiate between BFS (Breadth first search) and UCS (Uniform cost search). Under what condition, these two search strategies become similar? Derive the time and space complexities of BFS and DFS. [4]

(b) Three Water Jugs' Problem: Suppose, there are 3 jugs of capacities 12, 7.5 and 4.5 litre respectively. There is no measuring scale in any of these jugs. So it is only their capacities that are known. Initially the 12 litre jug is filled up with water and the other two jugs remain empty. The water can be poured from one jug to another. The goal is to have exactly 6 litre of water in any of these jugs. The amount of the water in other two jugs at the end is irrelevant. No water should be wasted. Draw the path with successive states from Initial state to Goal state. [4]

3. (a) How does alpha-beta pruning work? Define the terms alpha and beta. Solve the following example and show how alpha-beta pruning helps in pruning the search tree. [4]



(b) Solve the following Cryptarithmetic Problem: [4]

S E N D + M O R E = M O N E Y

Also find the value of Y + E + M + E + N

SECTION-C

4. (a) Define Sudoku problem as a Constraint Satisfaction Problem (CSP). Explain various types of constraints in CSP. Explain different types of local consistencies with examples. [4]

(b) In the following 8-puzzle problem, initial and final states are given: [4]

Initial State

	1	3
4	2	5
7	8	6

Final State

1	2	3
4	5	6
7	8	

Find the path to reach the final state from the initial state using A* Algorithm and corresponding path cost.

(Consider, path cost of node n, g(n) = Depth of node n, and heuristic value of node n, h(n) = Manhattan distance)

5. (a) Differentiate between Propositional Logic (PL) and First Order Logic (FOL). Explain the Universal quantification and Existential quantification through some examples. [4]

By applying De Morgan rules, express the following sentence using proper FOL syntax 1) using Universal quantifier and 2) using Existential quantifier, without losing the meaning of the sentence:

"Everyone likes chocolate"

(b) By considering the example of Wumpus World in the textbook, verify that its Knowledge Base (KB) entails the sentence, "There is no pit in Cell [1, 2]" by using any one of the following approaches: [4]

1) Model Checking

2) Theorem Proving

6. (a) Suppose following is the initial state of a tic-tac-toe game: [4]

O	O	X
	X	
O	X	

'X' symbol belongs to MAX player and 'O' symbol belongs to MIN player. Develop the game tree till all the terminal states are generated. Obtain the minimax values of each node of the game tree if the utility values are assumed to be 1 for a Win, -1 for a Loss and 0 for a Draw.

What will be the utility value for each of the following scenarios?:

1. Both MAX and MIN play optimally.

2. MAX plays optimally and MIN plays sub-optimally.

3. MAX plays sub-optimally and MIN plays optimally.

4. Both MAX and MIN play sub-optimally.

(b) Give a complete problem formulation for each of the following. Choose a formulation that is precise enough to be implemented. [4]

1. Using only four colors, you have to color a planar map in such a way that no two adjacent regions have the same color.

2. A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-footceiling. He would like to get the bananas. The room contains two stackable, movable, climbable 3-foot-high crates.

SECTION-D

7. (a) Write the basic Hill Climbing search algorithm. Analyze the performance of the algorithm based upon appropriate performance evaluators. Explain three reasons for which Hill Climbing often gets stuck and also brief solution measures in each case. [4]

(b) Suppose a genetic algorithm uses chromosomes of the form x = abcdefgh with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$, and let the initial population consist of four individuals with the following chromosomes: x1 = 5 4 3 1 6 7 8 2; x2 = 7 9 1 3 6 7 0 2; x3 = 4 7 8 5 9 2 3 1; x4 = 8 2 4 3 5 0 4 9 [4]

I. Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.

II. Cross the fittest two individuals using one–point crossover at the middle point. Evaluate the fitness values of the generated two off-springs.

8. (a) What is Logical Agent? What do you understand by soundness and completeness in inference mechanism? Give the PEAS representation and characteristics features for Wumpus World problem. Consider a particular scenario of this problem and explain how the logical agent can solve this problem. [4]

(b) What is PDDL in classical planning? Give PDDL description for any one of the following examples: [4]

i) Air cargo transport.

ii) The spare tire problem.

iii) The blocks world.

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