VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

Fall Semester 2024-25

CAT I **SLOT: E2+TE2**

Programme Name & Branch: B. Tech. (BCB, BCE, BCI, BCT, BDS & BKT)

Course Name & Code: Artificial Intelligence BCSE306L

Class Number (s): VL2024250101495, 5795, 1424, 1468, 1472, 1453, 1428, 1484, 1487, 1433, 1480, 1458, 1478, 1503, 1482, 1437, 1476, 1492, 3566

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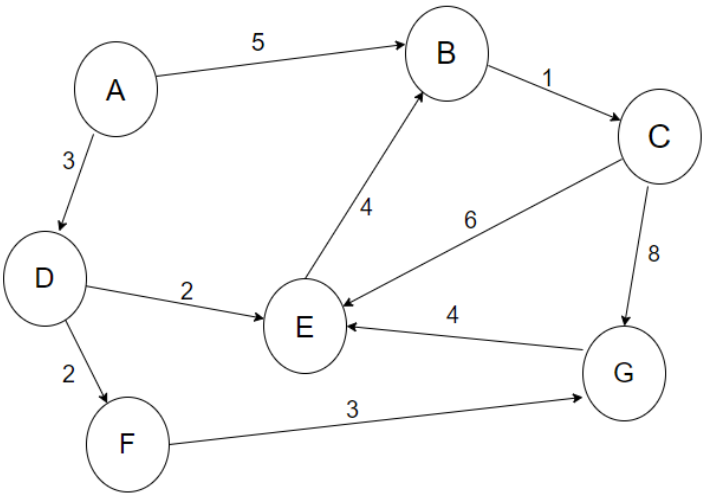
Exam Duration: 90 Min. **Maximum Marks: 50**

General instruction(s):

Answer all the Questions

Q.No.	Question	Max Marks
1.	You are given with five different tasks like (i) Crossword puzzle (ii) N Queens Problem (iii) Tower of Hanoi (iv) Ludo List the **PEAS** description and the properties for the given tasks to their environment characteristics with suitable justification.	10
2.	A taxi company wants to optimize its drivers' routes to reduce fuel consumption, minimize travel time, and enhance customer satisfaction. List the **challenges and plans** in developing an AI system for a real-time route optimization system that assists drivers in selecting the most efficient routes while considering dynamic factors like traffic, road conditions, toll plazas and weather conditions? Discuss with diagram the **most suitable type of agent** that can be used for this type of system.	10
3.	a) Given two unmarked jugs, one which holds 7 litres, and another which holds 11 litres, an unlimited supply of water, how do you measure exactly 4 litres in 7 litres jug? Represent the solution using state space search method and explain the steps. (5 Marks)	10

b) Consider the following graph. The starting node is A and the goal node is **G**. Find the actual and traversed paths from A to G using uniform cost search along with the algorithm's performance measures. (5 Marks)



4. Using A* algorithm solve the given the 15 puzzle problem consisting of 1-15 numbered tiles on a square box (one tile space is blank). The objective of this problem is to change the arrangement of tile from initial state to goal state by using series of legal moves (one tile at a time). The initial and goal states arrangement is shown below, consider g(n) = Depth of node and h(n) = Number of misplaced tiles. 10

	1	3	4
5	2	6	7
8	9	10	11
12	13	14	15

Initial State

1	2	3	4
5	6	7	
8	9	10	11
12	13	14	15

Goal State

5. Show that hill-climbing approach suffers from local optima in solving a problem. Use a global heuristic function to solve the same problem to reach the goal state. 10

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Programme Name & Branch: B. Tech. (BCB, BCE, BCI, BCT, BDS & BKT)

Course Name & Code: Artificial Intelligence BCSE306L

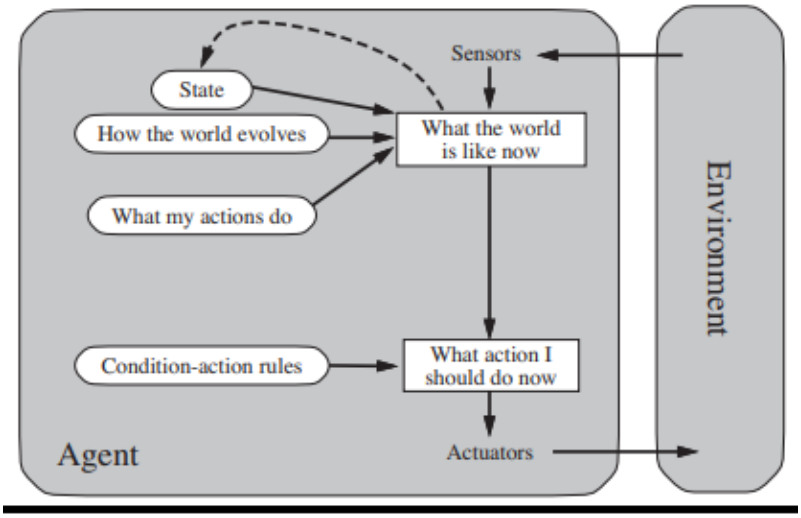
Q.No.	Question
1.	You are given with five different tasks like (i) Crossword puzzle (ii) N Queens Problem (iii) Tower of Hanoi (iv) Ludo List the **PEAS** description and the properties for the given tasks to their environment characteristics with suitable justification. **Answer: Each task 2.5 marks**

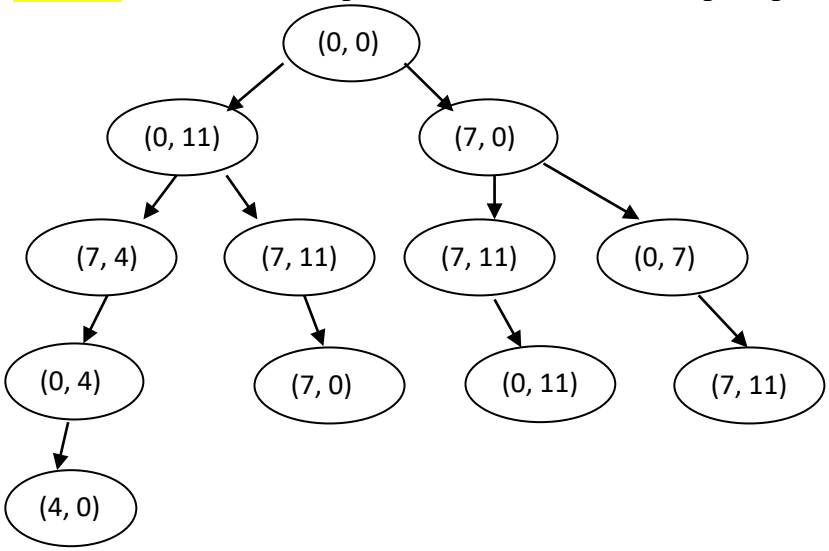
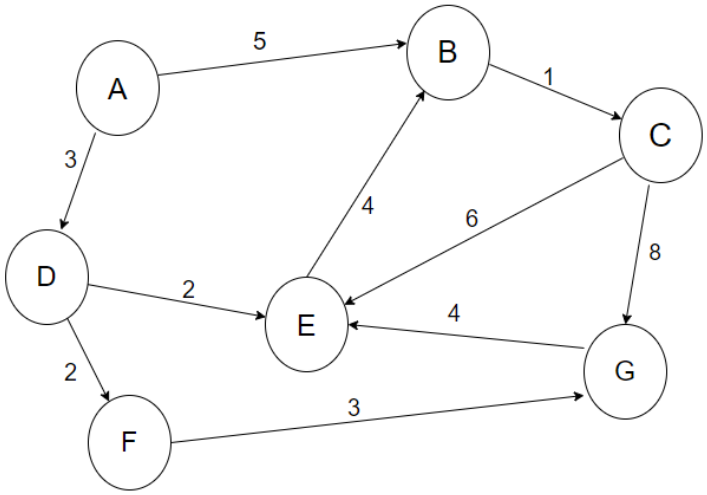
Tasks/ Environment	Performance Measure	Environment	Actuators	Sensors
Cross word puzzle	• Correctness of the filled crossword (all words must be valid and fit the given clues). • Completeness (filling all the cells). • Time taken to solve the puzzle.	entire puzzle grid is visible and does not change	Placement of letters in the grid	• Reading the current state of the grid. • Accessing the list of clues and word definitions.
N Queens Problem	• Correct placement of all N queens such that no two queens threaten each other. • Efficiency (finding a solution in minimal time)	• a chessboard of size NxN. • finite number of positions on the board.	• Placing a queen on the board at a specific position. • Removing or moving a queen to a different position.	• Checking the current state of the board to determine if any queens threaten each other. • Detecting the number of queens already placed on

				the board.
Tower of Hanoi	• Number of moves required to solve the puzzle (fewer moves are better). • Correctness (all disks are moved from the source to the destination peg in the correct order).	• three pegs and a set of disks. • finite number of disks and positions on the pegs.	Moving a disk from one peg to another.	• Sensing the current configuration of disks on the pegs. • Determining the position of each disk (which peg and order).
Ludo	• Winning the game by getting all pieces to the home area before the opponents. • Number of moves taken to reach the home area. • Defensive and offensive strategies (capturing opponent pieces).	• involves dice rolls and opponent strategies. •board with a finite number of positions.	• Rolling the dice. • Moving a piece according to the dice roll. • Deciding which piece to move when multiple options are available.	• Detecting the outcome of a dice roll. • Sensing the current positions of all pieces on the board. • Monitoring opponent piece movements.

Tasks/ Environment	Observable	Agents	Deterministic	Episodic	Static	Discrete
Crossword puzzle	Fully	Single	Deterministic	Sequential	Static	Discrete
N Queens Problem	Fully	Single	Deterministic	Sequential	Static	Discrete
Tower of Hanoi	Fully	Single	Deterministic	Sequential	Static	Discrete
Ludo	partially	Multi	stochastic	Sequential	Dynamic	Discrete

2. A taxi company wants to optimize its drivers' routes to reduce fuel consumption, minimize travel time, and enhance customer satisfaction. List the **challenges and plans** in developing an AI system for a real-time route optimization system that assists drivers in selecting the most efficient routes while considering dynamic

	factors like traffic, road conditions, toll plazas and weather conditions? Discuss with diagram the **most suitable type of agent** that can be used for this type of system. Answer: **3marks challenges + 3marks plans + 4 marks agent type and diagram** Challenges: • Traffic conditions can change rapidly, affecting travel times. • Weather conditions may impact driving routes and times. • Customers may have specific preferences or constraints, such as avoiding toll roads or choosing scenic routes. Plans: • Collect historical trip data, including routes, travel times, and customer feedback. • Integrate real-time data sources such as GPS, traffic sensors, weather updates, and road closures. • Segment the data based on time of day, location, and trip type to identify patterns. • Implement graph-based algorithms such as Dijkstra's or A* for initial route calculations. • Display optimized routes and real-time updates for drivers. • Include features for voice navigation, alternative route suggestions, and customer-specific instructions.  **11** A model-based reflex agent. Here it is given dynamic factors like traffic, road conditions, toll plazas and weather conditions, so most suitable model is model based agent. Whereas for learning-based agent it can learn from past experiences, for continuous improvement, which is not that in this case as the given scenario is dynamic in nature.
3.	a) Given two unmarked jugs, one which holds 7 litres, and another which holds 11 litres, an unlimited supply of water, how do you measure exactly 4 litres in 7 litres jug? Represent the solution using state space search method and explain the steps.

	(5 Marks) Answer: **3marks state representation + 2 marks steps explanation**  A-7 Ltrs Jug B- 11 Ltrs Jug Fill B and transfer 7 litres to A. You will be left with 4 litres in B. Throw away entire water of A and transfer 4 litres of B to A. b) Consider the following graph. The starting node is A and the goal node is **G**. Find the actual and traversed paths from A to G using uniform cost search along with the algorithm's performance measures. (5 Marks)  Actual path => A -- D -- F -- G, with Path Cost = 8. Traversed path => A -- D -- B -- E -- F -- C – G Answer: **3marks traversed path + 2 marks actual path**
4.	Using A* algorithm solve the given the 15 puzzle problem consisting of 1-15 numbered tiles on a square box (one tile space is blank). The objective of this

problem is to change the arrangement of tile from initial state to goal state by using series of legal moves (one tile at a time). The initial and goal states arrangement is shown below

	1	3	4
5	2	6	7
8	9	10	11
12	13	14	15

Initial State

1	2	3	4
5	6	7	
8	9	10	11
12	13	14	15

Goal State

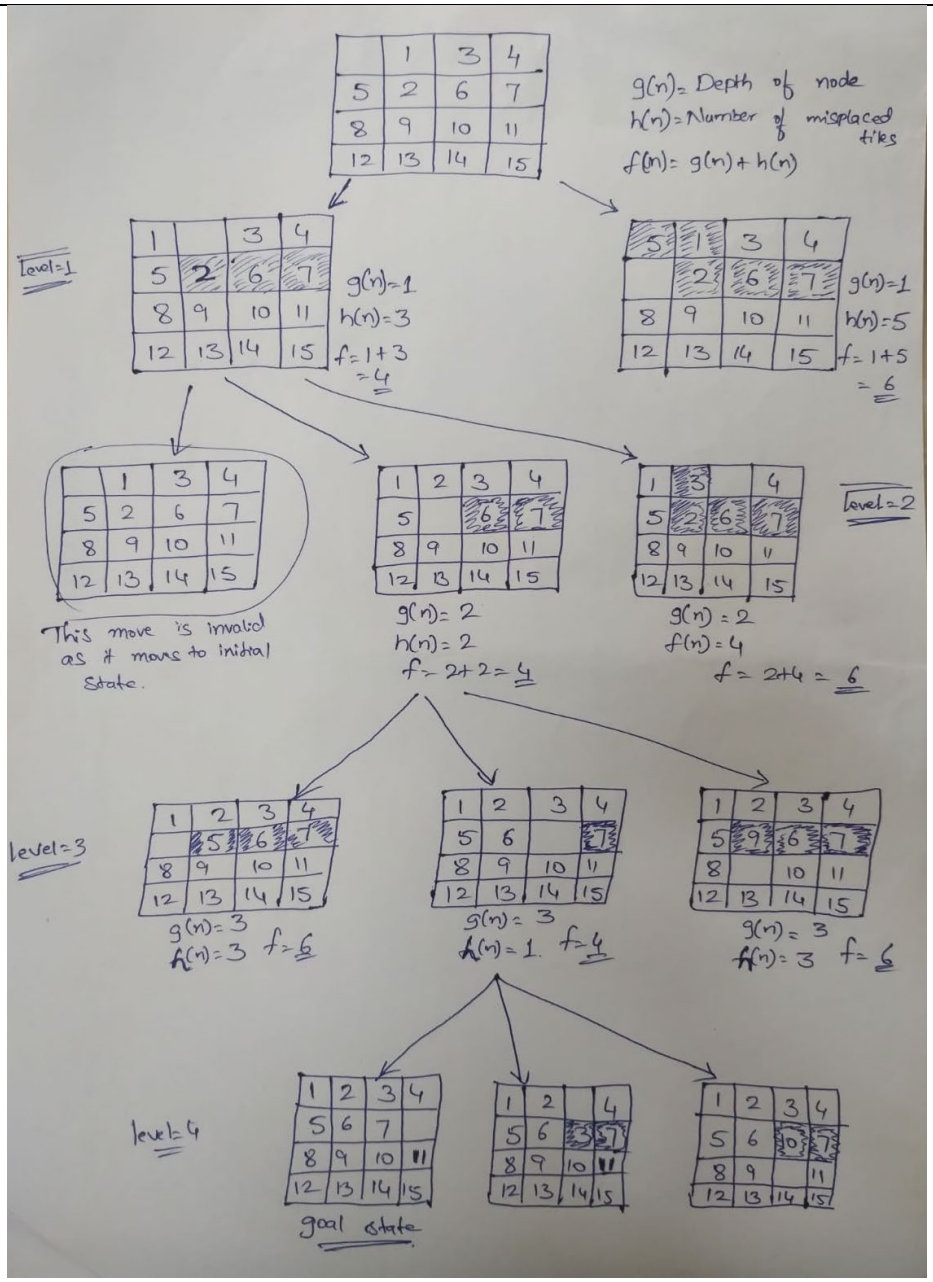
Find the most cost-effective path to reach the goal state from initial state using A* Algorithm.

Consider g(n) = Depth of node and h(n) = Number of misplaced tiles.

Answer:

Each level 2marks * 4 levels = 8marks

Correct calculation of g(n), h(n), f = 2marks



5. Show that hill-climbing approach suffers from local optima in solving a problem. Use a global heuristic function to solve the same problem to reach the goal state.

Answer:

Steps representing local optima problem = 5marks
Further solving the same problem using global heuristic function and solving the problem with steps = 5marks

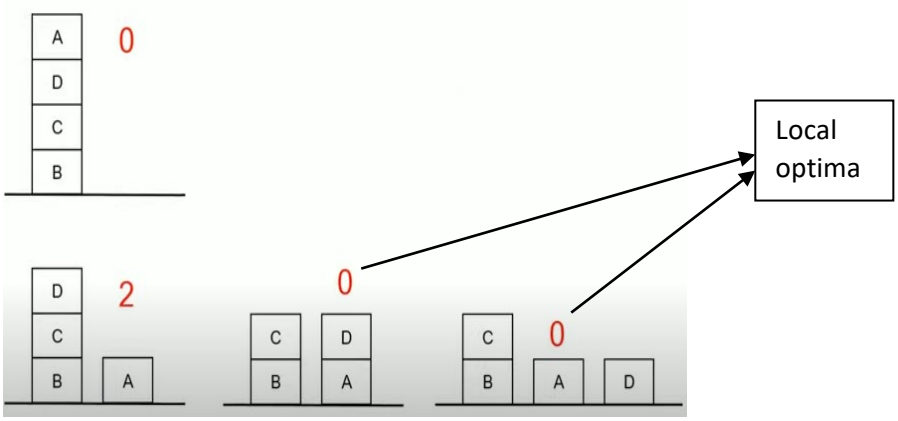
Students can use any problem to solve the hill-climbing approach.
Given below is a sample problem.

Considering the Block World problem with its initial and goal states as.

A D

Initial State Goal State

local heuristic function
h(x)= +1 for all block that is resting on the block correctly
h(x)= -1 for all block that is resting on the wrong block



global heuristic function
h(x) = +1 for each block in the support structure correctly positioned h(x)= -1 for each block in the support structure incorrectly positioned.