[Nov-23]

GITAM (Deemed to be University)

[CSEN2031]

GST/GSS/GSB/GSHS Degree Examination

V SEMESTER

ARTIFICIAL INTELLIGENCE

(Effective for the admitted batch 2021-22)

Time: 2 Hours **Max. Marks: 30**

Instructions: All parts of the unit must be answered in one place only.

Section-A

1. Answer all Questions: **(5×1=5)**

a) Imagine you are a product manager for a company that sells smartphones. You need to decide which features to prioritize for the next product release for maximizing customer satisfaction and profits. Choose an agent to solve this problem.
i) Utility based agent ii) Goal based agent iii) Simple reflex agent iv) Model based reflex agent

b) Identify the name of the search algorithm which equals depth limited search having infinite depth limit (i.e. $l = \infty$).

c) You are a detective investigating a crime scene. You find a note at the scene with the following message: TO + GO = OUT. You know that this message is a crypt arithmetic puzzle, and you need to solve it in order to crack the case. What is the value of O in the equation TO + GO = OUT?

d) There is at least one student who has attended every class of the AI course. Formulate (1) Universal quantifier and (2) Existential Quantifier for the above sentence.

e) For the following statement, either prove it is true or give a counter example.
If P(a | b, c) = P(b | a, c), then P(a | c) = P(b | c).

Section-B

Answer the following: **(5×5=25)**

UNIT-I

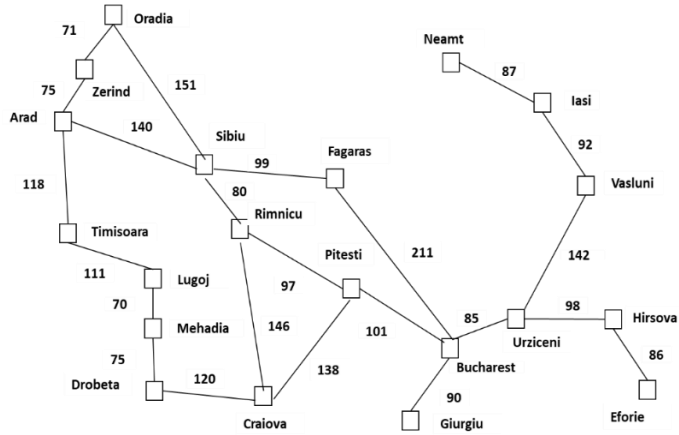
2. For each of the following assertions, say whether it is true or false and support your answer with examples or counterexamples where appropriate.
   a) An agent that senses only partial information about the state cannot be perfectly rational.
   b) There exist task environments in which no pure reflex agent can behave rationally.
   c) There exists a task environment in which every agent is rational.
   d) The input to an agent program is the same as the input to the agent function
   e) Every agent function is implementable by some program/machine combination.

OR

3. In the context of a factory employing a robotic agent to sort bolts, analyze the task environment of the agent. Explain how does the agent receive perceptual inputs, perform actions, and measure its performance. By considering the dynamic nature of the task environment, explain the operation of the agent within it.

UNIT-II

4. Describe how does the Recursive Best-First Search (RBFS) algorithm explore the given Romania map network to find an optimal path from 'Arad' to 'Bucharest'. Also, analyze the advantages and limitations of RBFS compared to any other search algorithm when applied to this problem.



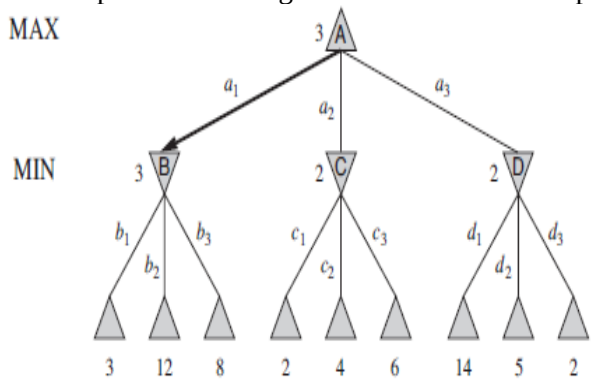
city	hsld to Bucharest	city	hsld to Bucharest
Arad	366	Mehadia	241
Bucharest	0	Neamt	234
Craiova	160	Oradea	380
Droheta	242	Pitesti	100
Eforie	161	Rimnicu	193
Fagaras	176	Sibiu	253
Giurgiu	77	Timisoara	329
Lasi	226	Urziceni	80
Lugoj	244	Vaslui	199
		Zerind	374

OR

5. Use the Romania map given in the above 4th question to employ Uniform Cost Search (UCS) algorithm for determining the solution path (sequence of states) when searching for a route from the starting point as Sibiu to the destination as Bucharest. Please meticulously outline each step of the search process including the nodes visited along the way. Additionally, draw the search tree to illustrate the exploration process.

UNIT-III

6. How does the Alpha-Beta Pruning contribute to the efficiency of the Minimax algorithm in game-playing scenarios? Explain a situation for the following graph where Alpha-Beta Pruning would have a significant impact on reducing the number of nodes explored.



OR

7. Analyze the 'SEND + MORE = MONEY' cryptarithmetic puzzle. Describe the key steps and strategies you would use to systematically solve this problem, ensuring that each letter represents a unique digit (0-9). How would you apply logical reasoning to arrive at a valid solution and provide a step-by-step information of your thought process.

UNIT-IV

8. Prove each of the following assertions:
   a. α is valid if and only if True $\models \alpha$.
   b. For any α, False $\models \alpha$.
   c. $\alpha \models \beta$ if and only if the sentence $(\alpha \Rightarrow \beta)$ is valid.
   d. $\alpha \equiv \beta$ if and only if the sentence $(\alpha \Leftrightarrow \beta)$ is valid.
   e. $\alpha \models \beta$ if and only if the sentence $(\alpha \wedge \neg\beta)$ is unsatisfiable.

OR

9. Consider the following sentence: $[(\text{Food} \Rightarrow \text{Party}) \vee (\text{Drinks} \Rightarrow \text{Party})] \Rightarrow [(\text{Food} \wedge \text{Drinks}) \Rightarrow \text{Party}]$
   a) Using enumeration, determine whether this sentence is valid, satisfiable (but not valid), or unsatisfiable.
   b) Convert the left-hand and right-hand sides of the main implication into CNF, showing each step, and explain how the results confirm your answer to (a).

UNIT-V

10. Illustrate the representation and functioning of Decision Tree Algorithm with an example.

OR

11. Given the full joint distribution given in the figure. Calculate the following
    a) P(toothache).
    b) P(Cavity).
    c) P(Toothache | cavity).
    d) P(Cavity | toothache ∨ catch)

	Toothache		**¬ toothache**	
	Catch	¬ *catch*	*Catch*	¬ *catch*
cavity	0.108	0.012	0.072	0.008
¬ *cavity*	0.016	0.064	0.144	0.576