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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third/Fourth Semester

Artificial Intelligence and Data Science

AL 3391 – ARTIFICIAL INTELLIGENCE

(Common to: Computer Science and Engineering (Artificial Intelligence and Machine Learning)

(Regulations 2021)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. There are well-known classes of problems that are intractably difficult for computers and other classes that are provably undecidable. Does this mean that AI is impossible?

2. Formulate PEAS for an automated Bill paying system.

3. What is admissible heuristics?

4. Give two examples of partially observable environments.

5. Given two jugs of capacities 5 litres and 3 litres with no measuring markers on them. Assume that there is endless supply of water. What is the minimum number of states to measure 4 litres of water?

6. What for Monte–Carlo tree search is used?

7. How do you represent "All dogs have tails" in First order logic?

8. What are knowledge –based agents? Name its parts.

9. Two students A and B have registered for a certain course. Student A attends the class 80% of the time. Student B attends the class 60% of the time. Assuming their absences are independent, what is the probability that both neither show up to class on any given day?

10. What are causal networks?

PART B — (5 × 13 = 65 marks)

11. (a) (i) List some environmental properties that are important for intelligent agents. (7)

(ii) Describe the properties of the environment for the Mars Rover. (6)

Or

(b) Consider the search graph shown below in Fig. 11(b). S is the start state and G is the goal state. All edges are bidirectional. For each of the following search strategies, give the path that would be returned and the pseudocode for the same.

(i) Depth-first graph search (4)

(ii) Breadth–first graph search (4)

(iii) Uniform cost graph search (5)

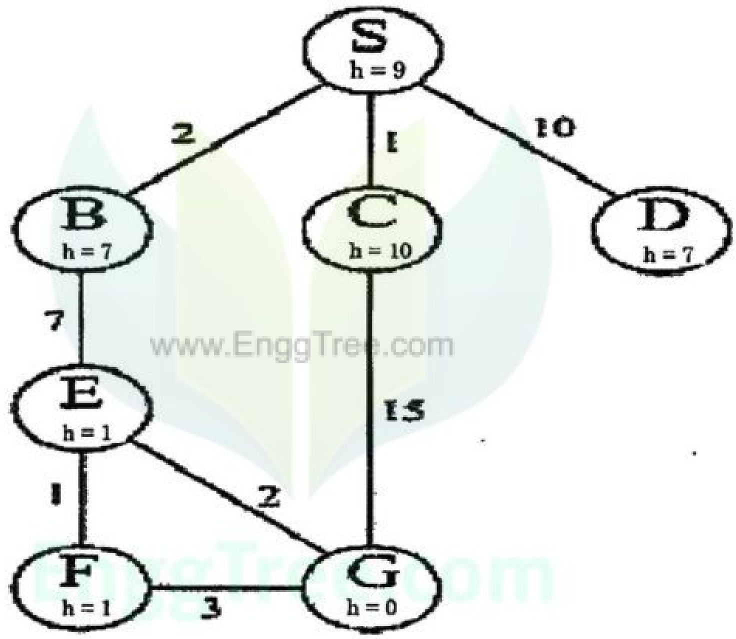

Fig. 11(b).

12. (a) Discuss on any two Local Search algorithms with examples.

Or

(b) Discuss on online search agents with example.

13. (a) Describe how the minimax and alpha—beta algorithms change for two-player, non–zero–sum games in which each player has a distinct utility function and both utility functions are known to both players. If there are no constraints on the two terminal utilities, is it possible for any node to be pruned by alpha–beta? What if the player's utility functions on any state differ by at most a constant k, making the game almost cooperative?

Or

(b) Consider the so-called Crypt-arithmetic problem shown below.

SAVE+

MORE

———

MONEY

The problem is to figure out the digits (0 to 9) that should be assigned to these letters so that the indicated arithmetic operation is valid. Your job is to formulate this as a search problem. Clearly indicate a definition of state, initial state, goal state, operators and define a suitable path cost. Estimate the size of the search tree and draw a small segment of the search tree.

14. (a) Discuss on Knowledge representation and engineering.

Or

(b) Differentiate backward and forward chaining with example.

15. (a) We have a bag of three biased coins a, b, and c with probabilities of coming up heads of 30%, 60%, and 75%, respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins), and then the coin is flipped three times to generate the outcomes X1, X2, and X3.

(i) Draw the Bayesian network corresponding to this setup and define the necessary Conditional Probability Tables. (7)

(ii) Calculate which coin was most likely to have been drawn from the bag if the observed flips come out heads twice and tails once. (6)

Or

(b) How does Exact interface differ from approximate Inference? Give example.

PART C — (1 × 15 = 15 marks)

16. (a) The traveling salesperson problem (TSP) can be solved with the minimum–spanning-tree (MST) heuristic, which estimates the cost of completing a tour, given that a partial tour has already been constructed. The MST cost of a set of cities is the smallest sum of the link costs of any tree that connects all the cities.

(i) Show how this heuristic can be derived from a relaxed version of the TSP. (3)

(ii) Show that the MST heuristic dominates straight-line distance. (3)

(iii) Write a problem generator for instances of the TSP where cities are represented by random points in the unit square. (4)

(iv) Find an efficient algorithm for constructing the MST and use it with a graph search to solve instances of the TSP. (5)

Or

(b) CSP: Air Traffic Control

We have five planes: A, B, C, D, and E and two runways: international and domestic. We would like to schedule a time slot and runway for each aircraft to either land or take off. We have four time slots: {1, 2, 3, 4} for each runway, during which we can schedule a landing or take off of a plane. We must find an assignment that meets the following constraints:

- Plane B has lost an engine and must land in time slot 1.
- Plane D can only arrive at the airport to land during or after time slot 3.
- Plane A is running low on fuel but can last until at most time slot 2.
- Plane D must land before plane C takes off, because some passengers must transfer from D to C.
- No two aircrafts can reserve the same time slot for the same runway.

Brief on CSP and complete the formulation of this problem as a CSP in terms of variables, domains and constraints (both unary and binary). Constraints should be expressed implicitly using mathematical or logical notation rather than with words.
