Qn. Set Code-7

Semester: 5th
Programme: B.Tech
Branch: IT, CSSE

AUTUMN END SEMESTER EXAMINATION-2024

5th Semester B.Tech

ARTIFICIAL INTELLIGENCE

CS30002

(For 2023 (L.E), 2022 & Previous Admitted Batches)

Time: 2 Hours 30 Minutes Full Marks: 50

Answer any FIVE questions.
Question paper consists of two SECTIONS i.e. A and B.
Section A is compulsory.
Attempt any Four question from Sections B.
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) When do we choose stochastic hill climbing over steepest ascent hill climbing approach?

(b) Prove that if the heuristic function "h" obeys the triangle inequality, then the f-cost along any path in the search tree is non-decreasing order.

(c) Mention six capabilities that a computer should posses to qualify for Total Turing Test.

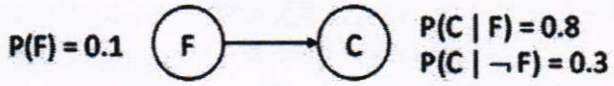
(d) Suppose that we run a greedy search algorithm with h(n) = –g(n). What sort of search will the greedy search emulate?

(e) How to formally define a problem as state space search? Discuss it with the help of an example.

(f) Illustrate the use of predicate logic to represent the knowledge with suitable example.

(g) Explain in detail the connectives used in propositional logic.

(h) Consider the following Bayesian network, where F = having the flu and C = coughing:



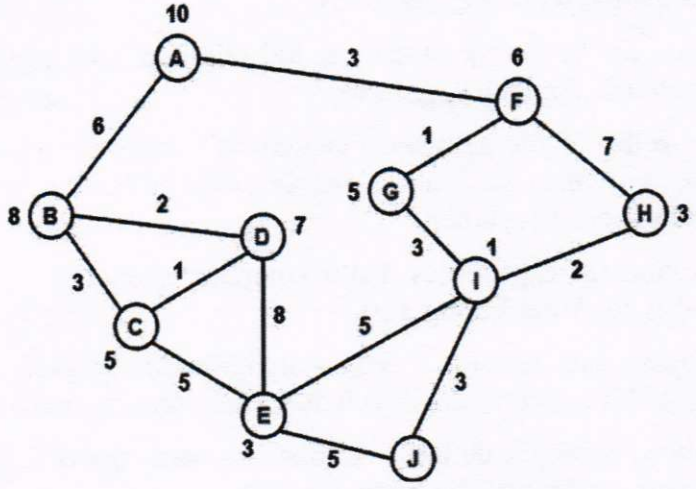
Write down the joint probability table specified by the Bayesian network.

(i) Give precise formulations for the following as constraint satisfaction problems: For rectilinear floor-planning find non overlapping places in a large rectangle for a number of smaller rectangles.

(j) Name the four approaches of AI. Why is Rational agent approach is superior to other three approaches?

SECTION-B

2. (a) Consider the following graph- [5]

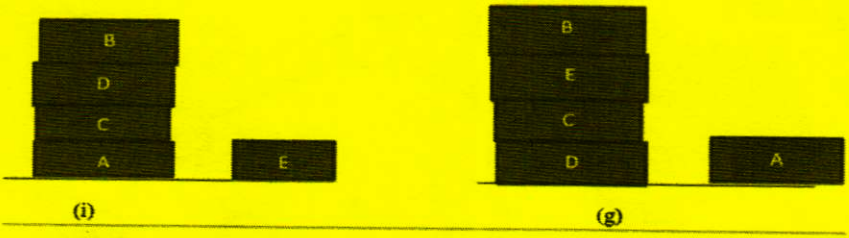


Find the most cost-effective path to reach from start state A to final state J using A* Algorithm. Assume that the numbers written on edges represent the distance between the nodes and the numbers written on nodes represent the heuristic value.

(b) Why is Table driven approach to agent construction is a failure? Explain a learning agent with suitable diagram. Describe its four conceptual components with an example for each of these components. [5]

3. (a) Explain planning problem in AI. What are different types of planning? Consider problem of changing a flat tire. The goal is to have a good spare tire properly mounted on the car's axle, where the initial state has a flat tire on the axle and a good spare tire in the trunk. Give the ADL description for the problem. [5]

(b) In the figure below, (i) is the initial state and (j) is the final state. Apply hill climbing algorithm and/or its versions to achieve the goal. (Note: You can remove/ put only one tile from one place to another at a time.) [5]



Take the following heuristics:

- h(x) = +1, if the tile x is at the correct position
- h(x) = –1, otherwise.

Which problem do you face, with this heuristic? Solve this problem with any other heuristic.

4. (a) Consider the graph with 8 nodes A_1, A_2, A_3, A_4, H, T, F_1, F_2. A_i is connected to A_{i+1} for all i, each A_i is connected to H, H is connected to T, and T is connected to each F_i. Find a 3-coloring of this graph by hand using the following strategy: backtracking with conflict-directed back jumping, the variable order A_1, H, A_4, F_1, A_2, F_2, A_3, T, and the value order R, G, B. [5]

(b) Solve the following Crypt arithmetic problem using constraints satisfaction search procedure. [5]

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  CROSS
+ ROADS
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 DANGER
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5. (a) I. What is the value of the root node after MiniMax search over the given tree? The root node fig h (labelled "a') is a max node. [5]

II. How many nodes (including leaves and internal nodes) will an alpha-beta pruning based MiniMax search visit in the given tree, assuming each successor is ordered left to right? The root node fig h (labelled "a")is a max node.

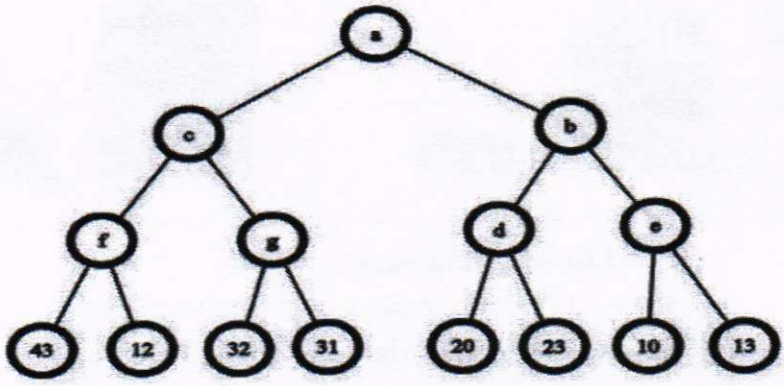


Fig h

(b) Represent the following sentences in first-order logic using a consistent vocabulary (which you must define): [5]

- Not all students take both History and Biology.
- Only one student failed both History and Biology.
- Every person who dislikes all vegetarians is smart.
- The best score in History was better than the best score in Biology.

6. (a) 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: [5]

$$f(x) = (a + b) - (c + d) + (e + f) - (g + h),$$

and let the initial population consist of four individuals with the following chromosomes:

x1 = 6 5 4 1 3 5 3 2

x2 = 8 7 1 2 6 6 0 1

x3 = 2 3 9 2 1 2 8 5

x4 = 4 1 8 5 2 0 9 4

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

b) Perform the following crossover operations:

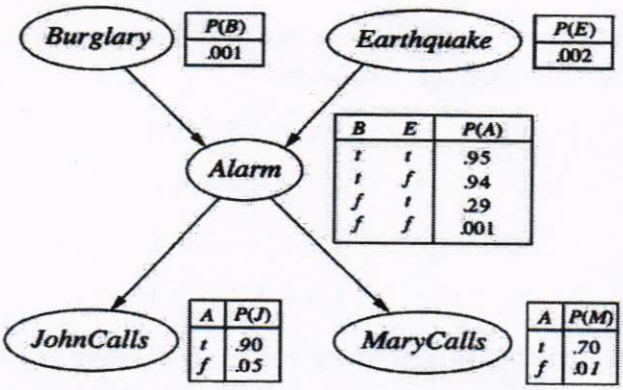
I. Cross the fittest two individuals using one–point crossover at the middle point.

II. Cross the second and third fittest individuals using a two–point crossover (points b and f).

c) Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?

(b) Harry installed a new burglar alarm at his home to detect burglary. The alarm reliably responds at detecting a burglary but also responds for minor earthquakes. Harry has two neighbors David and Sophia, who have taken a responsibility to inform Harry at work when they hear the alarm. David always calls Harry when he hears the alarm, but sometimes he got confused with the phone ringing and calls at that [5]

time too. On the other hand, Sophia likes to listen to high music, so sometimes she misses to hear the alarm. Here we would like to compute the probability of Burglary Alarm and the Bayesian network is given below.



I. Calculate the probability that alarm has sounded, but there is neither a burglary, nor an earthquake occurred, and David and Sophia both called the Harry.

II. What is the probability that David call?

7. (a) Suppose, there are 3 jugs of capacities 12,7.5 and4.5 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. [5]

(b) Explain wumpus world game with diagram and agent program of it. Explain how Propositional Logic is used to solve wumpus world problem. [5]

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