

3 Hours

Total Marks = 80

**Note:**

- (i) Each question carries 20 marks
- (ii) Question 1 is compulsory
- (iii) Attempt **any three (3)** from the remaining questions
- (iv) Assume suitable data wherever required

Q1 Attempt **any four (4)** questions from the following [20]

- (a) Give PEAS description for a **Self Driving Car** agent. Characterize its environment.
- (b) Give the initial state, goal test, successor function, and cost function for the **Travelling salesman problem**
- (c) What will be the job of each of the components (Performance element, Learning element, Critic and problem generator) of learning agent?
- (d) Consider an 8 puzzle problem with the following initial state and goal state.

|               |   |   |
|---------------|---|---|
| 7             | 2 | 4 |
| 5             |   | 6 |
| 8             | 3 | 1 |
| Initial State |   |   |

|            |   |   |
|------------|---|---|
|            | 1 | 2 |
| 3          | 4 | 5 |
| 6          | 7 | 8 |
| Goal State |   |   |

- Generate successors at next two levels. Apply number of misplaced tiles as the heuristic function. Which successor nodes will be selected at each level if we apply Hill climbing algorithm?
- (e) Convert the following English sentence into predicate logic and then into CNF  
**“The culprit was tall and dark”**

Q2 (a) Explain decision tree learning with an example. What are decision rules? How to use it for classifying new samples? [10]

- (b) Write first order logic equivalent of the following statements: [10]
  - (i) Anand likes only comedy films.
  - (ii) The culprit has to be one from Tinker, Tailor and Butler.
  - (iii) Whoever can read is literate.
  - (iv) Every child loves Santa.
  - (v) Some birds cannot fly.

Q3 (a) Design a classical planner for air cargo transportation problem using STRIPS. The problem involves loading, unloading cargo and flying it from place to place. Define three actions: Load, Unload and Fly. The actions affect two predicates: In(c, p) means that cargo c inside plane p, and At(x, a) means that object x (either plane or cargo) is at airport a. [10]

- (b) Give a formal definition of a Bayesian Belief Network (BBN). Illustrate the process of constructing a BBN with a suitable scenario. What type of inferences can be drawn from BBN network? [10]

Q4 (a) Compare **Breadth first search (BFS)**, **Depth first search (DFS)**, **Depth limited search (DLS)** and **Iterative Deepening search** algorithms based on performance measure with justification: Complete, Optimal, Time and Space complexity. PTO [10]

- (b) Write a pseudo code for alpha-beta algorithm. Apply alpha-beta pruning on example [10]

given in Figure 1 considering first node as max.

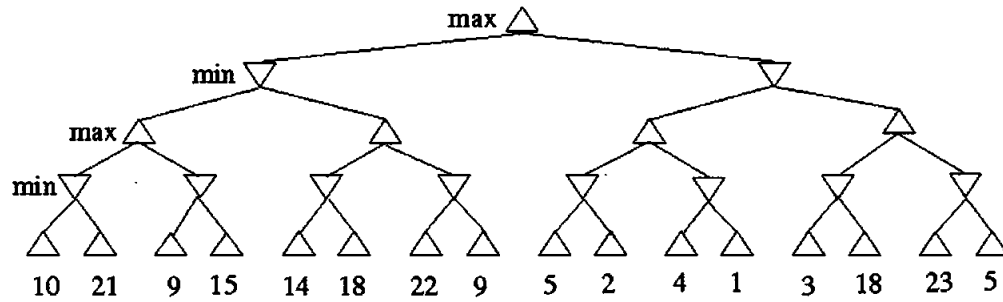


Figure 1

- Q5 (a) How will you convert the propositional logic statement into CNF? Give a suitable example at each step? [10]
- (b) Consider the graph given in Figure 2 below. Assume that the initial state is **S** and the goal state is **G**. Show how **A\* Search** would create a search tree to find a path from the initial state to the goal state: [10]

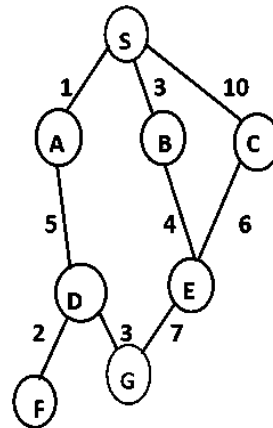


Figure 2

At each step of the search algorithm, show which node is being expanded, and the content of fringe (OPEN). Also report the eventual solution found by the algorithm, and the solution cost. Assuming the straight-line distance as the heuristics function:  $h(S)=13$ ,  $h(A)=7$ ,  $h(B)=9$ ,  $h(C)=11$ ,  $h(D)=2$ ,  $h(E)=4$ ,  $h(F)=1$ , and  $h(G)=0$ .

- Q6 Answer any two (2) of the following [20]
- (a) What are the steps involved in natural language processing (NLP) of an English sentence? Explain with an example sentence.
- (b) Draw and describe each component in the Architecture of Expert System with a suitable example
- (c) Explain how Genetic algorithms work. Define the terms chromosome, fitness function, crossover and mutation as used in Genetic algorithms

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