

**ARTIFICIAL INTELLIGENCE
(CSEN 3281)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following:

10 × 1 = 10

- (i) Inheritable knowledge is best represented by
 (a) Semantic net (b) database
 (c) FOPL (d) none of these.
- (ii) Which is not a property of representation of knowledge?
 (a) Representational Verification (b) Representational Adequacy
 (c) Inferential Adequacy (d) Inferential Efficiency.
- (iii) An 'agent' is anything that
 (a) Perceives its environment through sensors and acting upon that environment through actuators
 (b) Takes input from the surroundings and uses its intelligence and performs the desired operations
 (c) A embedded program controlling line following robot
 (d) All of the mentioned.
- (iv) A perceptron is
 (a) a single layer feed-forward neural network with pre-processing
 (b) an auto-associative neural network
 (c) a double layer auto-associative neural network
 (d) a neural network that contains feedback.
- (v) When is breadth-first-search optimal?
 (a) When there is less number of nodes (b) When all step costs are equal
 (c) When all step costs are unequal (d) Both (a) & (c).
- (vi) Consider the following PROLOG clauses:
 p(1). p(2):-!. p(3).
 Which of the following is correct if the goal p(X), !, p(Y) is placed?
 (a) X=1, Y=1 (b) X=1, Y=1; X=1, Y=2
 (c) X=2, Y=1 (d) All of the above.
- (vii) Which is true?
 (a) Not all formal languages are context-free
 (b) All formal languages are context free
 (c) All formal languages are like natural language
 (d) Natural languages are context-oriented free.
- (viii) The initial state and the legal moves for each side define the _____ for the game.
 (a) search tree (b) game tree
 (c) state space search (d) forest
- (ix) Which value is assigned to alpha and beta in the alpha-beta pruning?
 (a) Alpha = max (b) Beta = min
 (c) Beta = max (d) Both Alpha = max & Beta = min.
- (x) A Perceptron is a _____
 (a) feed-forward neural network (b) back-propagation algorithm
 (c) back-tracking algorithm (d) feed forward-backward algorithm.

Group – B

2. (a) We have 3 jugs of capacities 3, 5, and 8 litres respectively. There is no scale on the jugs, so it's only their capacities that we certainly know. Initially, the 8-litre jug is full of water, the other two are empty. Now answer the following questions:

- (i) Formulate this problem as state-space search problem by clearly representing the initial state, set of goal states and possible operators.
 - (ii) Draw the state-space graph for the problem.
 - (iii) Show any one solution to the problem by specifying the sequence of operators.
- (b) "Chaining is a special case of resolution" - Justify the statement for propositions with suitable example.

(3 + 4 + 3) + 2 = 12

3. (a) Suppose you have the following search space:

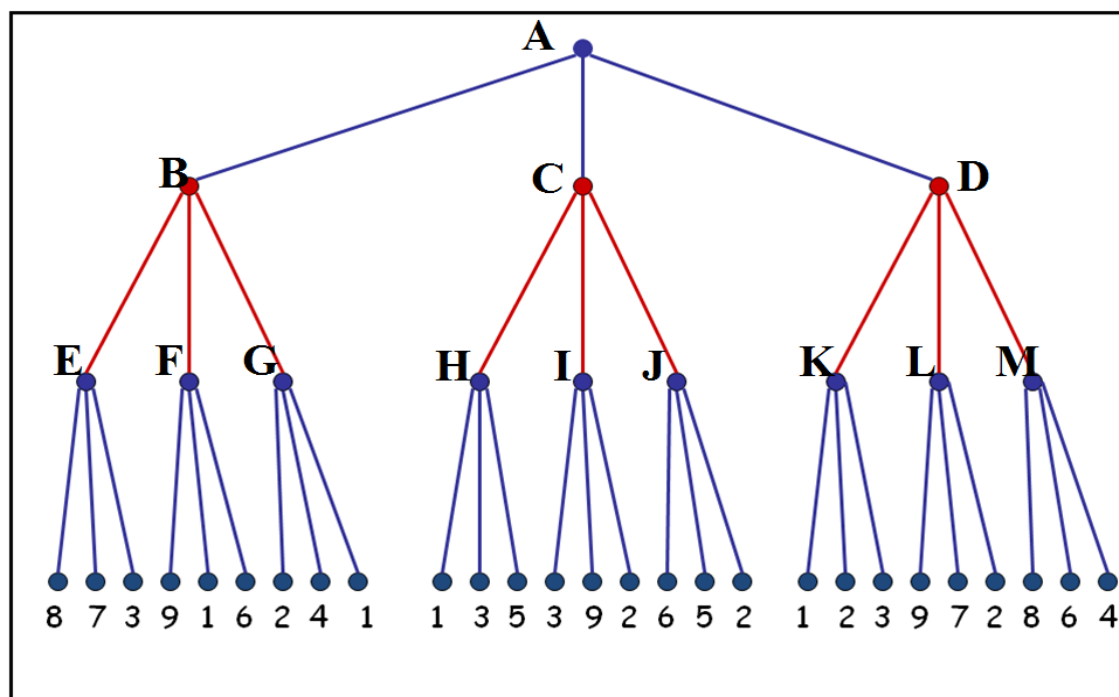
State	next	cost
A	B	4
A	C	1
B	D	3
B	E	8
C	C	0
C	D	2
C	F	6
D	C	2
D	E	4
E	G	2
F	G	8

- (i) Draw the state space of this problem
 - (ii) If the initial state is A and the goal state is G, show how DFS & Iterative deepening DFS search strategies would create a search tree to find a path from the initial state to the goal state. At each step of the search algorithm, show which node is being expanded, and also report the eventual solution found by each algorithm, and the solution cost.
- (b) Justify each of the following statements:
- (i) BFS is a special case of Uniform-Cost search
 - (ii) DFS can be viewed as a special case of Depth-limited search.

(1 + 6) + (2.5 + 2.5) = 12

Group - C

4. (a) Consider the following 2 player game tree in which static scores are given from the first player's point of view:



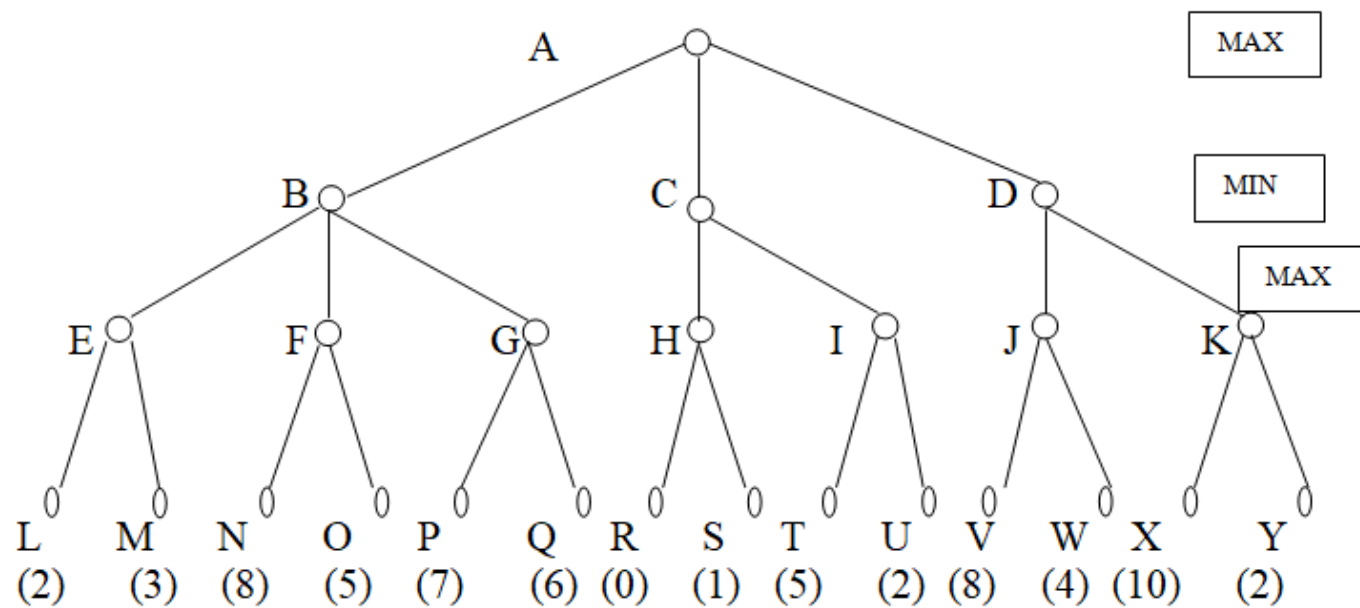
Suppose the first player is the maximizing player. What move should be chosen? Why? Use Mini-Max search to solve. Also explain limitations of Mini-Max search. How to overcome them?

- (b) Solve the following Crypt-arithmetic problem with the following constraints. Give solution steps.
 Constraints: (i) Use decimal arithmetic and
 (ii) No two letters possess same digit.

$$\begin{array}{r}
 \text{CROSS} \\
 + \text{ROADS} \\
 \hline
 \text{DANGER}
 \end{array}$$

7 + 5 = 12

5. (a) Consider the following game tree, where it is maximizer's turn to start the game. The values estimated by the evaluation function are indicated at the leaf nodes.



Now answer the following questions:

- (i) Apply MINIMAX algorithm on the above game tree to get the estimated values of the intermediate nodes. Write those values beside every node and also indicate the proper move of the maximizer by circling one of the root's outgoing edges.
 - (ii) In the tree above, cross out the nodes that would not be evaluated if alpha-beta pruning were applied.
 - (iii) Reorder the nodes of the game tree given above such that alpha-beta will prune more nodes than were pruned in your previous answer. In reordering the nodes, A should remain the root, and B, C, and D should still be its children. More generally, all parent, child, and sibling relationships should be maintained. Draw the new game tree, and cross out the nodes that will be pruned.
- (b) "The most-constrained variable heuristic provides a way to select the next variable to assign in a backtracking search for solving a CSP" – Justify the statement.

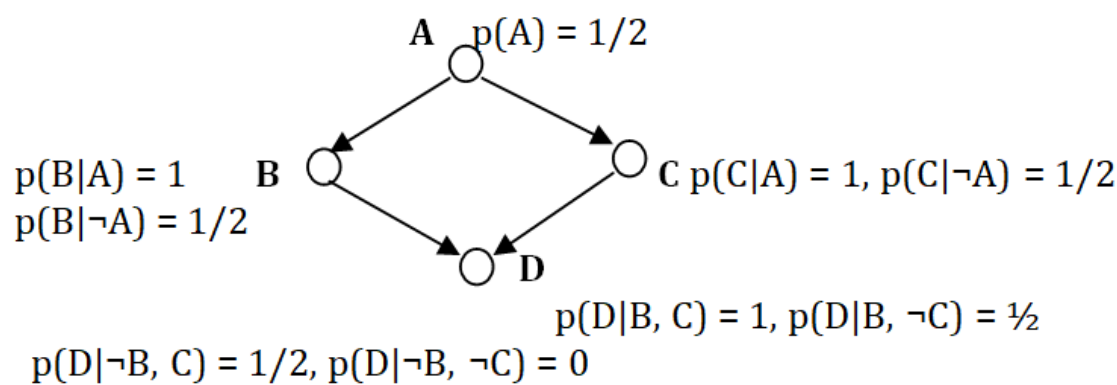
(2 + 3 + 4) + 3 = 12

Group - D

6. (a) Consider the following FOPL sentences:
- (i) $\forall X: \text{Barks}(X) \rightarrow \text{Dog}(X)$.
 - (ii) $\forall X \forall Y \exists Z: \text{Has-master}(X, Y) \wedge \text{Likes}(X, Y) \wedge \text{Unprecedented_situation}(Z) \rightarrow \text{Barks}(X)$
 - (iii) Unprecedented-situation (noise).
 - (iv) Likes (fido, jim).
 - (v) Has-master (fido, jim).
- Now using resolution method prove that Dog (fido) can be inferred from the above sentences.
- (b) Write a program in PROLOG to reverse a list using accumulator.

7 + 5 = 12

7. (a) An admission committee for a college is trying to determine the probability that an admitted candidate is really qualified. The relevant probabilities are given in the following Bayesian network. Find $p(A|D)$.



- (b) State the difference between Inheritable knowledge and inferential knowledge. Construct the semantic net for "Sam gave the flower buckeyes to Manu on her birthday".

7 + (2 + 3) = 12

Group - E

- 8. (a) Discuss the importance of mutation operation in the implementation of genetic algorithm and its convergence.
- (b) Explain how Artificial Neural Network can be used as a classifier.

5 + 7 = 12

9. (a) Create a decision tree by using the given dataset that describes which day is suitable for playing Tennis. Here, the days are described by the attributes like outlook, temperature, humidity & wind. Use entropy as the impurity measure while creating the Decision Tree.

Day	Outlook	Temperature	Humidity	Wind	PlayTennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

(b) Identify the drawbacks of Roulette Wheel selection method used in Genetic Algorithm.

10 + 2 = 12