

**Sixth Semester B. E. (Computer Science and Engineering)
Examination**

ARTIFICIAL INTELLIGENCE

Time : 2 Hours]

[Max. Marks : 40

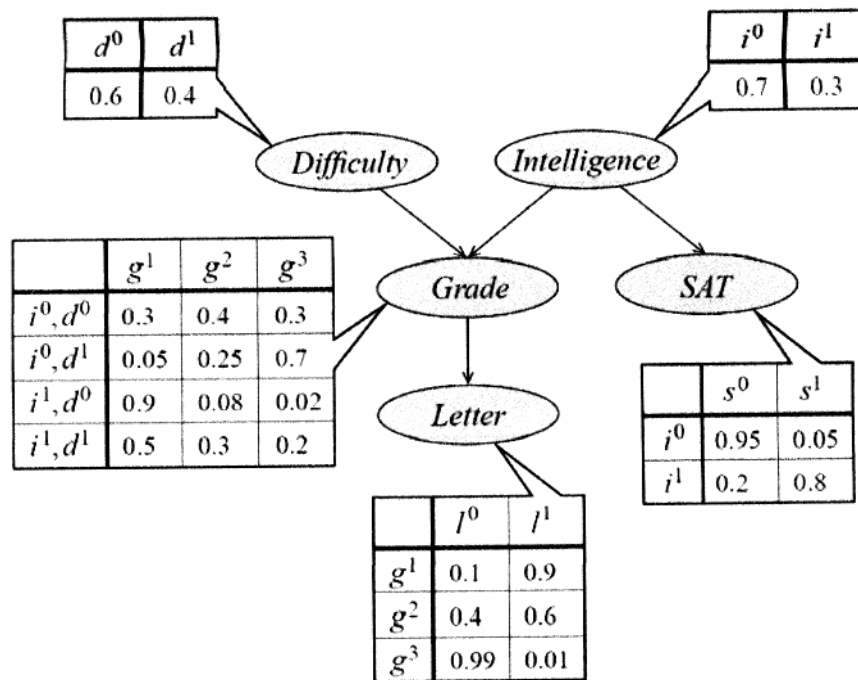
Instructions to Candidates :—

- (1) All questions are compulsory.
- (2) All questions carry marks as indicated.
- (3) Explain your answer with neat sketches, wherever applicable.

1. Consider the 3-water jug problem, which is stated as follows :
There are three jugs of capacity 12, 8 and 5 liters. There is no mark on any jug. Initially the 12-liter jug is filled with water and other two jugs are empty. You cannot get water from any external source and you cannot pour water on the ground. Determine state representation of 3-water-jug problem.
Determine operators (rules) for 3-water-jug problem.
Apply BFS (graph version) on 3-water jug problem up to 10 iterations Clearly show current node, frontier and explored lists at each iteration. 7(CO1)
2.
 - (a) Explain with examples, various problems due to which hill climbing may get stuck. 3(CO1)
 - (b) Determine heuristic function for 8-Queen problem. Apply A*(tree version) on 8-Queen problem for 4-iterations with empty chessboard as initial state. Show current node, frontier and explored (if needed) lists at each iteration. 4(CO1)
3. This problem exercises the basic concepts of game playing, using tic-tac-toe (noughts and crosses) as an example. We define X_n as the number of rows, columns, or diagonals with exactly n X's and no O's. Similarly, O_n is the number of rows, columns, or diagonals with just n O's. The utility function assigns +1 to any position with $X_3 = 1$ and -1 to any position with $O_3 = 1$. All other terminal positions have utility 0. For nonterminal positions, we use a linear evaluation function defined as
$$\text{Eval}(s) = 3X_2(s) + X_1(s) - (3O_2(s) + O_1(s)).$$
 - (a) Approximately how many possible games of tic-tac-toe are there ?

- (b) Show the whole game tree starting from an empty board down to depth 2 (i. e., one X and one O on the board), taking symmetry into account.
 - (c) Mark on your tree the evaluations of all the positions at depth 2.
 - (d) Using the minmax algorithm, mark on your tree the backed-up values for the positions at depths 1 and 0, and use those values to choose the best starting move.
 - (e) Circle the nodes at depth 2 that would not be evaluated if alpha-beta pruning were applied, assuming the nodes are generated in the optimal order for alpha-beta pruning. 7(CO2)
- 4.
- (1) It is a crime for an American to sell weapons to hostile nations.
 - (2) Nono has some missiles.
 - (3) All of its missiles were sold to it by Colonel West.
 - (4) All missiles are weapons.
 - (5) Enemy of America counts as hostile.
 - (6) Colonel West is American.
 - (7) Nono, an enemy of America. 7(CO3)
5. Solve the following :
- (a) Represent these facts using predicate logic.
 - (b) Convert all these facts into Prenex normal form.
 - (c) Convert all these facts into skolem normal form.

- (d) Answer the question "Is Colonel West Criminal ?"



What is the probability that a student will get a good recommendation letter (l^1), if student is intelligent (i^1) ? 5(CO4)

6. (a) Construct decision trees to represent the following Boolean functions :
- A OR [B AND C]
 - [A AND B] OR [C AND D] 3(CO5)
- (b) Apply perceptron learning algorithm on NOT classification up to 1 epochs (2 iterations) with initial weight $W_0 = [0.5, 0.3]^T$ and learning rate, $c = 0.5$. 4(CO5)

