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**Paper Code : MCA-303**

## INTELLIGENT SYSTEMS

*Time Allotted* : 3 Hours | *Full Marks* : 70

*The figures in the margin indicate full marks.*

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

### GROUP – A

### ( Multiple Choice Type Questions )

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Artificial intelligence is
      a) putting your intelligence into computer
      b) programming with your own intelligence
      c) making a machine intelligent
      d) adding more memory into computer.

   ii) There are no existential quantifiers in
      a) PCNF b) SSF
      c) WFF d) FOPL.

iii) Which search method takes less memory ?

a) Depth-First search b) Breadth-First search

c) Both (a) and (b) d) Linear search.

iv) What is the converse of the statement, "I'll go to movie if today is Sunday" ?

a) I'll not go to movie if today is not Sunday

b) If I go to a movie then today is Sunday

c) I'll go to movie if today is not Sunday

d) If today is Sunday then I'll go to movie.

v) Which is invalid ?

a) $(p \wedge q) \rightarrow p$

b) $(p \wedge q) \rightarrow (p \rightarrow q)$

c) $[p \wedge (p \vee q) \rightarrow \sim q$

d) $[(p \rightarrow q) \wedge (p \rightarrow r)] \rightarrow (p \rightarrow r)$.

vi) An algorithm *A* is admissible if

a) It is not guaranteed to return a solution when one exists

b) If is guaranteed to return an optimal solution when one exists

c) It returns all solutions

d) It guarantees to return all optimal solutions.

vii) $\alpha - \beta$ cut off is applicable in

a) MINIMAX search b) Semantic net

c) Blind search d) Hill climbing.

viii) Heuristic function is

a) a function that calculates the distance from root to leaf

b) a function which takes parameters of type string and returns an integer value

c) a function which determines the distance of the goal

d) a function that maps from problem state descriptions to measure of desirability.

ix) In Baye's theorem, what is meant by $P(\text{Hi} \mid E)$ ?

a) The probability that hypotheses Hi is true given evidence $E$

b) The probability that hypotheses Hi is false given evidence $E$

c) The probability that hypotheses Hi is true given unknown evidence $E$

d) The probability that hypotheses Hi is true given unexpected evidence $E$.

x) In Chomsky classification language generated by type 2 grammar is recognized by

a) Finite automata

b) Pushdown automata

c) Linear bounded automata

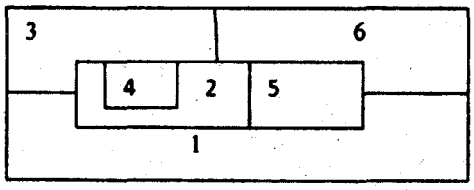
d) Turing machine.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. 3 × 5 = 15

2. Consider the following map. The task is to colour the map using the four colours red, blue, yellow and green, such that no two adjacent regions take the same colour.




Give a suitable representation (state representation, initial state, goal state and operators) of this map colouring problem. 1 + 1 + 1 + 2

3. a) For trade-off between time and space required by BFS and DFS we use Iterative Deepening Search. Explain with an example.

   b) "Iterative Deepening Search (IDS) uses Depth First Search (DFS) to do Breadth First Search (BFS) to reduce the space requirement compared to BFS." Compare the space requirement of IDS and BFS mathematically. 2 + 3

4. a) Differentiate between normal search and AI search with respect to search space.

   b) Suggest a heuristic function to solve an 8-puzzle problem and show how this function works to solve the problem.

   c) What is rational agent ? 1 + 3 + 1

5. Build a semantic net that represents the following knowledge :

   Man (Parantap)

   Married (Parantap, Madonna)

   Gave_To (Madonna, Parantap, Measles)

6. a) Write the following sentences or WFF to Causal form :

   i) $\forall x$ : man ( $x$ ) $\rightarrow$ mortal ( $x$ )

   ii) Every friend of Samir either studies with him or plays with him or he is Anjan's friend.

   b) What is Horn clause in predicate logic ? 4 + 1

## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following. 3 × 15 = 45

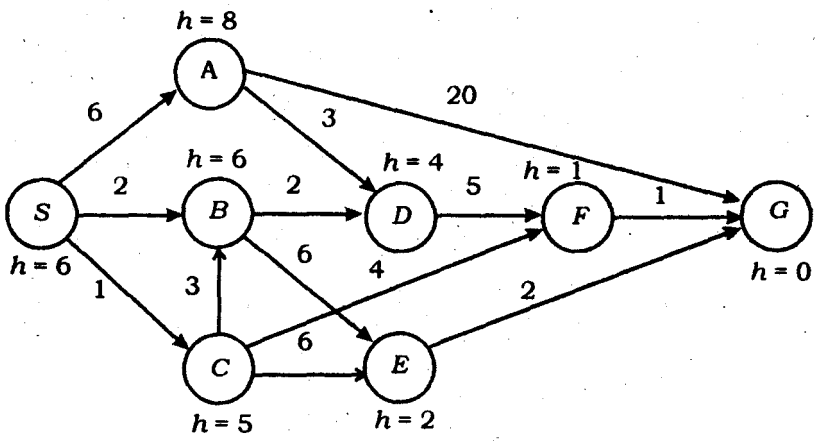
7. a) Consider a state space where the start state is number 1 and the successor function for state $n$ returns two states, numbers $2n$ and $2n + 1$.

   i) Draw the portion of the state space for states 1 to 15.

   ii) Suppose the goal state is 11. List the order in which nodes will be visited for breadth first search, depth first search and iterative deepening search.

iii) Describe how one could apply bidirectional search to this problem. Why is it appropriate ?

b) Consider the search problem below with start state *S* and goal state *G*. The transition costs are next to the edges, and the heuristic values are next to the states :

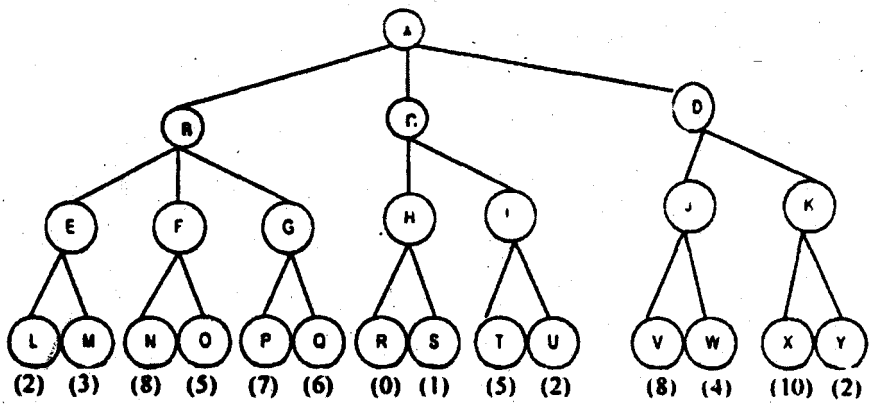



What are the final paths and its path-cost for the following search techniques to reach the goal ?

i) Uniform-cost search

ii) A* search. 2 + 6 + 1 + 6

8. a) Consider the following game tree in which the static scores (in parentheses at the tip nodes) are all from the first player's point of view. Assume that the first player is the maximizing player.




i) Using MINIMAX procedure, determine what moves should be chosen by the max-player in his first turn.

ii) What nodes would not need to be examined using the Alpha-Beta pruning, assuming that nodes are examined in left-to-right order using DFS ? For each cut-off specify whether it is an Alpha-cut or Beta-cut.

b) Write a PROLAG or LISP program to find the *n*!.

5 + 6 + 4

9. a) We have 3 jugs of capacities 3, 5 and 8 litres, respectively. There is no scale on the jugs, so its only their capacities that we certainly know. Initially, the 8-litre jug is full of water, the other two are empty. We can pour water from one jug to another and the goal is to have exactly 4 litres of water in any of the feasible jugs. The amount of water in the other two jugs at the end is irrelevant. Give suitable representation such as state representation, initial state, goal state and operators of the above water jug problem. Also generate the search tree to provide one of the solutions.

b) What are the different problems associated with Hill climbing search ? Explain with diagram.

c) How do you overcome the hill-climbing search problems using Simulated Annealing search ?

d) Is simulated annealing guaranteed to find the optimum solution of an optimization problem like Travelling Salesman problem ? 7 + 3 + 3 + 2

10. a) Certain medications and traumas can both cause blood clots. A blood clot can lead to a stroke, heart attack or it could simply dissolve on its own and have no health implications.

i) Create a diagram that represents this situation.

ii) The following probability information is given where $M$ = medication, $T$ = trauma, $BC$ = blood clot, $HA$ = heart attack, $N$ = nothing and $S$ = stroke. $T$ stands for true, or this event did occur. $F$ stands for false, or this event did not occur.

| |
|---|
| $P(M = T)$ 0·2 |
| $P(M = F)$ 0·8 |
| $P(T = T)$ 0·05 |
| $P(T = F)$ 0·95 |

| $M$ | $T$ | $P(BC = T)$ | $P(BC = F)$ |
|---|---|---|---|
| $T$ | $T$ | 0·95 | 0·05 |
| $T$ | $F$ | 0·3 | 0·7 |
| $F$ | $T$ | 0·6 | 0·4 |
| $F$ | $F$ | 0·9 | 0·1 |

| $BC$ | $P(HA=T)$ | $P(HA=F)$ | $P(S = T)$ | $P(S = F)$ | $P(N = T)$ | $P(N = F)$ |
|---|---|---|---|---|---|---|
| $T$ | 0·4 | 0·6 | 0·35 | 0·65 | 0·25 | 0·75 |
| $F$ | 0·15 | 0·85 | 0·1 | 0·9 | 0·75 | 0·25 |

What is the probability that a person will develop a blood clot as a result of both medication and trauma and then have no medical implications *i.e.* $P(N, BC, M, T)$ ?

b) What are the different forms of learning ? Discuss the explanation-based learning.

c) State different application areas of AI. 2 + 6 + 4 + 3

11. a) Consider the following knowledge bases :

i) If a triangle is equilateral then it is isosceles.

ii) If a triangle is isosceles then two sides *AB* and *AC* are equal.

iii) If *AB* and *AC* are equal then angle *B* and angle *C* are equal

iv) *ABC* is an equilateral triangle.

Goal : Angle *B* is equal to angle *C* of this triangle.

Prove by resolution theorem that the goal is derivable from the above knowledge bases.

b) What is 'Skolemization' in Predicate Logic ?

c) Let $p_1$ = the-sky-is-cloudy, $p_2$ = it-will-rain and $p_3 \equiv p_1 \rightarrow p_2$ to be three propositions. Check whether forward and backward chaining holds good for $p_1, p_3 \Rightarrow p_2$. 7 + 3 + 5