(vii) Truth value of any propositional sentence can be computed by using which of the following:
(a) Syntax of propositional logic (b) Semantics of propositional logic
(c) both (a) and (b) (d) none of these.

(viii) Which of the following methods is effective for escaping from local minima?
(a) Hill-climbing search algorithm (b) Simulated annealing
(c) Eliminating heuristic estimate (d) none of these.

(ix) Decision tree reaches its decision by using
(a) single test (b) two tests (c) sequence of tests (d) no test.

(x) 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 and c.

Group – B

2. (a) There are three discs with different diameters. We can slide these discs onto three perpendicular rods. It's important that if there is a disc under another one then it must be bigger in diameter. We denote the rods with P, Q and R, respectively. The discs are denoted by 1, 2 and 3, respectively, in ascending order of diameter. We can slide a disc onto another rod if the disc is on the top of its current rod, and the discs on the goal rod will be in ascending order by size after the replacing. Our goal is to move all the discs to rod R.

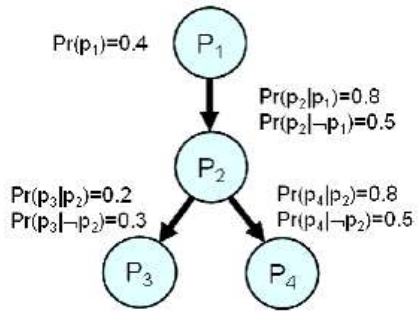
Now answer the following questions:
i) Formulate this problem as a state-space search problem by specifying state descriptions.
ii) What is your representation of the initial state?
iii) Give your representation of the set of goal states.
iv) Consider an operator, move $_{\text{which, where}}$, that says which disc to be moved to which rod, is used as a valid operator then specify the possible pre-conditions of the operator.
v) What will be the effect of applying this operator on a given state?
vi) Show at least one solution path of the given problem.

(b) Justify the following statements for propositions:
i) "Chaining is a special case of resolution"
ii) "Modus ponens is also a special case of resolution"

(1+1+1+2+2+2) + (1.5+1.5) = 12

3. (a) Consider the search space below, where S is the start state and G1, G2 are the goal states. Arcs are labeled with the cost of traversing them and the estimated cost to a goal is reported inside nodes. A data structure, OPEN, holds nodes generated in the explicit graph, but not yet expanded. Now, apply DFS and BFS algorithms and indicate which goal state is reached (if any) for each case and list, in order, all the states popped off of the OPEN list. When all else is equal, nodes should be removed from OPEN in alphabetical order.

7. (a) Consider the following Bayesian network:



Calculate marginal and conditional probabilities,
pr($\neg p_3$), pr($p_2|\neg p_3$), pr($p_1|p_2, \neg p_3$) and pr($p_1|\neg p_3, p_4$)

(b) Define a fuzzy set.
Consider two fuzzy subsets of the universal set X = {a, b, c, d, e}, referred to as A and B, where A = {1/a, 0.3/b, 0.2/c 0.8/d, 0/e}, B = {0.6/a, 0.9/b, 0.1/c, 0.3/d, 0.2/e}
Now find the result of the following operations done on two fuzzy sets A and B:
i) AUB, ii) A∩B, iii) A⊆B, iv) support (A), v) core (A), vi) height (A)

8 + (1 + 6 × 0.5) = 12

Group – E

8. (a) Discuss the significance of crossover operation in the implementation of genetic algorithm and its convergence.

(b) "Artificial Neural Network can be used as a classifier" – Give proper explanation against this statement.

6 + 6 = 12

9. (a) Calculate the information gain corresponding to the attributes Weather, Parents and Financial Condition in selecting an attribute to construct (induct) a decision tree in from the data provided in the following table. Also mention the attribute you will select based on the calculated information gain in each and every step. Consider the attribute 'Decision' as the class label.

Weekend	Weather	Parents	Financial Condition	Decision
W1	Sunny	Yes	Rich	Cinema
W2	Sunny	No	Rich	Play Tennis
W3	Windy	Yes	Rich	Cinema
W4	Rainy	Yes	Poor	Cinema
W5	Rainy	No	Poor	Stay in
W6	Rainy	Yes	Poor	Cinema
W7	Windy	No	Poor	Cinema
W8	Windy	No	Rich	Shopping
W9	Windy	Yes	Rich	Cinema
W10	Sunny	No	Rich	Play Tennis

(b) Explain in brief the working principle of Goal Stack Planning.

9 + 3 = 12

B.TECH/CSE/6TH SEM/CSEN 3281/2019

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) In genetic algorithm, probability of mutation μ_m is generally kept in which of the following ranges:
(a) [0.001, 0.01] (b) [0.01, 0.1] (c) [0.1, 1.0] (d) [0, 1].

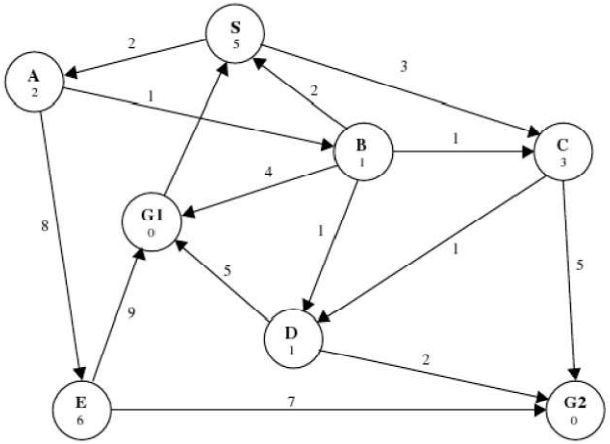
(ii) Which value is assigned to alpha and beta in the alpha-beta pruning?
(a) alpha=max and beta=min (b) alpha = min and beta=min
(c) beta = max and alpha=min (d) alpha = beta = 0.

(iii) Which of the following describes a perceptron best?
(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.

(iv) Semantic network is primarily used to represent which of the following types of knowledge:
(a) Procedural (b) Inheritable (c) Inferential (d) none of these.

(v) If b is the maximum branching factor of the search space, dl is the depth limit and d is the depth of the solution, then worst-case time complexity of depth-limited search is:
(a) O (b*dl) (b)O (b^{dl}) (c) O (b^{dl-d}) (d)none of these.

(vi) In A* algorithm, f(n) = g(n) + h(n). Now, if h(n) = 0 then the algorithm
(a) becomes purely informed search
(b) becomes purely BFS
(c) cannot give any solution
(d) will stop to a wrong solution



(b) Consider that in a problem, there is a provision for bidirectional search and you know the configuration of the goal node beforehand, then what small trick you can follow to reduce the space complexity by a factor of 2?

(5 + 5) + 2 = 12

Group – C

4. (a) Consider the following game:

There are three piles of sticks with 1, 1 and 2 sticks in each pile respectively. There are THREE players A, B and C who play in turn in that order. Each player can take one/ more sticks from one and only one pile. The player who takes the last stick wins one treat from each of the other two players (i.e. two treats total). Now answer the following questions:

i) How would you represent the game value of the leaf nodes in the game tree?

ii) Draw the complete game tree
(Hint: the piles (1, 2, 1) are equivalent to (1, 1, 2). You may always want to sort the numbers from small to large)

iii) What should A's initial move be? Give justifications against your answer

(b) Define Constraint Satisfaction Problem (CSP).

Consider the following classroom scheduling problem: There are four classes, C1, C2, C3, C4, and three class rooms, R1, R2, and R3. The following table shows the class schedule:

Class	Time
C1	8 am – 10:30am
C2	9 am – 11:30am
C3	10 am –12:30am
C4	11 am –1:30pm

In addition, there are the following restrictions:

(i) Each class must use one of the three rooms, R1, R2, R3.

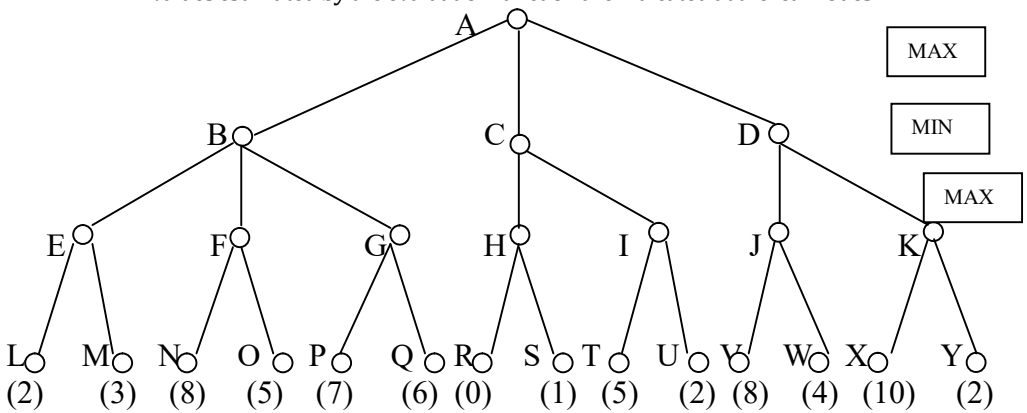
(ii) R3 is too small for C3.

(iii) R2 and R3 are too small for C4.

Now, formulate the above problem as CSP. Provide the constraint graph.

(4+2+2) + (1+3) = 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) Given the following facts and rules as a knowledge base:

A1. If X is on top of Y, Y supports X

A2. If X is above Y and they are touching each other, X is on top of Y.

A3. A cup is on a book

A4. A cup is touching a book

i) Translate these sentences into CNF form

ii) Show by using resolution that the predicate 'supports (book, cup)' is true

iii) Write a PROLOG Program to show that SUPPORTS (book, cup) is true using A1 to A4.

(b) State Baye's Theorem. Explain the significance of conditional independence using suitable example and how it is different from conditional probability.

(3+ 3 + 3) + 3 = 12