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VI SEMESTER

B.Tech. (MCE)

END TERM EXAMINATION May-2023

MC312 Artificial Intelligence

Time: 03 Hours Max. Marks: 40

Note : Attempt any five questions. All the questions are of 8 mark each. Assume suitable missing data, if any.

Q.1. (a). Write a program in Prolog to find the sum of first N natural numbers. [3 marks][CO5]

(b). Explain, with Prolog programs, how the following operations are performed on the List data structure: [3+2 = 5 marks] [CO5]

(i) Finding the sum of all elements of a given list.

(ii) Divide the list in two lists of approximately same length.

Q.2. (a) Given the information below for two attributes and a class label: [4 marks] [CO6]

Attribute 1	Attribute 2	Class Label
T	F	+
T	T	+
T	T	+
T	F	-
T	T	+
F	F	-
F	F	-
F	F	-
T	T	-
T	F	-

Evaluate the information gain for both the attributes. Hence, determine which attribute is better for building the decision tree classifier.

(b). Consider the data given below: [4 marks] [CO6]

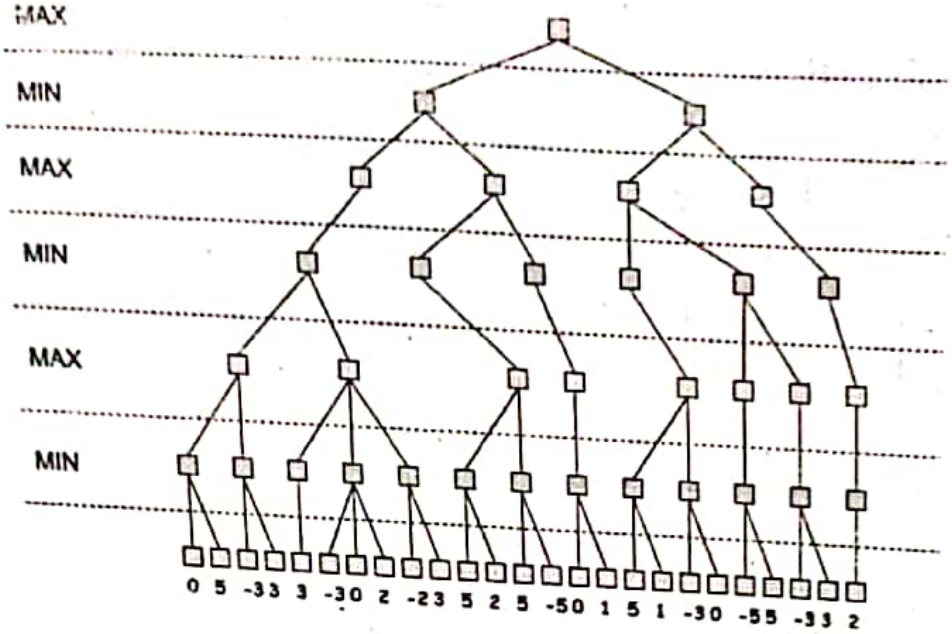
A	B	C	Class Label
0	0	0	+
0	0	1	-
0	1	1	-
0	1	1	-
0	0	1	+
1	0	1	+
1	0	1	-
1	0	1	-
1	1	1	+
1	0	1	+

Given a test sample [A=0 B=1 C=0]. How can you predict the class label for this given test sample with Naïve Bayes classifier ?

Q.3. (a). Explain Sussman's Anomaly in Goal Stack Planning with the help of an example. [3 marks][CO3]

(b). Given an initial state: {ON (B, A) ∧ ONTABLE (A) ∧ ONTABLE(C) ∧ ONTABLE(D) ∧ ARMEMPTY}, and the goal state as: {ON(C, A) ∧ ON(B,D) ∧ ONTABLE(A) ∧ ONTABLE(D)}. How can the goal state be achieved with Goal Stack Planning ? Explain all the steps involved. [5 marks] [CO3]

Q.4. (a) Consider a game tree given below that consists of alternate levels for MAX and MIN players. The evaluation function for each of the leaf nodes is written in the last level. The evaluation function values for the leaf nodes starting from the leftmost leaf to the rightmost leaf node is {0, 5, -3, 3, 3, -3, 0, 2, -2, 3, 5, 2, 5, -5, 0, 1, 5, 1, -3, 0, -5, 5, -3, 3, 2}. Evaluate the number of alpha cutoffs and beta cutoffs on the game tree if we apply the Alpha-Beta pruning technique on this given tree. Also, describe which leaf nodes will be evaluated and which leaf nodes will be pruned with Alpha-Beta pruning. [5 marks][CO2, CO3]



(b). How do you define the term "*Strategy*" in game playing algorithms with respect to MAX player ? Given a 4-ply game tree with MAX at the root, how many strategies exist for the MAX player ?

[3 marks][CO2, CO3]

Q.5. Given a set of locations and distances between them, the goal of the Traveling Salesperson Problem (TSP) is to find a shortest tour that visits each location exactly once. Assume that you do not return to the start location after visiting the last location in a tour. We would like to solve the TSP problem using a hill-climbing algorithm. Each state corresponds to a permutation of all the locations (called a tour). The function "*neighbours(s)*" generates all neighbouring states of any state "s" by swapping two locations. For example, if s =<A-B-C> is a tour, then, <B-A-C>, <C-B-A> and <A-C-B> are the three neighbours generated by "*neighbours(s)*" function. We can set the evaluation/heuristic function for a state to be the total distance of the tour where each pairwise distance is looked up from a distance matrix. For example, if s =<A-B-C> is a tour, then total distance of this tour is d(A, B) + d(B,C), where d(A, B) is the distance between A and B, and d(B, C) is the distance between B and C. Suppose the table below represents the distance matrix between four locations: M, W, E and S.

	M	W	E	S
M	0	1.1	1.4	0.9
W	1.1	0	0.6	0.7
E	1.4	0.6	0	0.5
S	0.9	0.7	0.5	0

Now, we need to apply hill climbing algorithm from the initial state: <W-M-E-S>.

(a). Compute the total distance of the initial state. [1 mark][CO1]

(b). What are the possible neighbouring states of the given initial state that can be generated by the "*neighbours*" function ? [1 mark][CO1]

(c). From the initial state, what is the next state reached with the hill climbing algorithm. [2 marks][CO1]

(d). Explain when the hill climbing algorithm will terminate from the initial state. List out all the states reached by hill climbing algorithm till the algorithm terminates. [3 marks][CO2]

(e). Suppose there are "n" locations, what can be the maximum size of the search space, i.e., maximum number of states in the search space.

[1 mark][CO1]

Q.6. (a) Compare the two blind search algorithms on the basis of time complexity, space complexity, completeness and quality of solution by representing your analysis with suitable diagrams and mathematical analysis as applicable. [5 marks][CO4]

(b). Briefly explain Ant Colony optimization with an example.

[3 marks] [CO2]

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