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[This question paper contains 7 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1108

Unique Paper Code : 32341601

Name of the Paper : BHCS13: Artificial Intelligence

Name of the Course : B.Sc. (H) Computer Science

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question 1 is compulsory.
3. Attempt any **four** questions from Question 2 to Question 8.
4. Parts of a question must be answered together.

1. (a) Describe the following terms : (4)

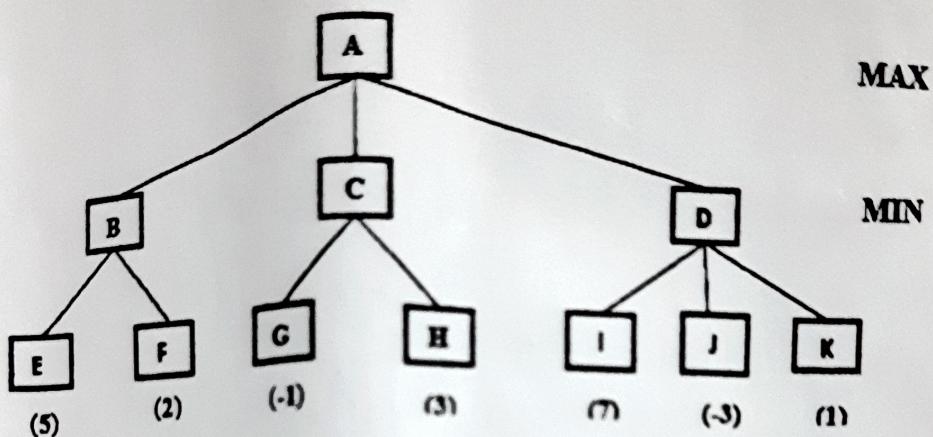
(i) Heuristic Function

(ii) Software Agent

(b) Write a context free grammar that can accept the sentence: "Ram hit the ball". (3)

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- (c) In the following two-ply game tree, the terminal nodes show the utility values computed by the utility function. Use the Minimax algorithm to compute the utility values for other nodes in the given game tree. (2)



- (d) Find whether the following set is unifiable or not. If unifiable, find the most general unifier(m.g.u.).

$w = \{\text{PARENTS}(x, \text{FATHER}(x), \text{MOTHER}(\text{bill})), \text{PARENTS}(\text{bill}, \text{FATHER}(\text{bill}), y)\}$ (2)

- (e) Express the following sentence as conceptual dependency structure:

"Sohan gave Tina a box of chocolate" (2)

- (f) Write the conceptual graph and FOPL representation for the following sentence:

"Every motorbike has a handle"

(4)

- (g) Consider that $\text{append}(L1, L2, L3)$ is a function in Prolog, in which list $L1$ is contacted with $L2$ and the result is stored in $L3$. What would be the output of the following statement in Prolog?

?- $\text{append}([2,3,4], L, [2,3,4, a, b]).$ (2)

- (h) Find the meaning of the statement

$$(\sim P \vee Q) \ \& \ R \rightarrow S \vee (\sim R \ \& \ Q)$$

for the interpretation: P is true, Q is false, R is true, S is true. (2)

- (j) Transform the following sentence into disjunctive normal form :

$$\sim(P \vee \sim Q) \ \& \ (R \rightarrow S) \quad (3)$$

- (k) Determine whether the following sentence is satisfiable, contradictory or valid:

$$S : P \rightarrow Q \rightarrow \sim P \quad (2)$$

- (l) Why should the heuristic function of A* algorithm always underestimate? Give reason, example.

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(m) What is non-monotonic reasoning? Give an example. (3)

(n) Prove that if A and B are independent events, $P(A|B) = P(A)$. (Note that A and B are independent if and only if $P(A \& B) = P(A)P(B)$). (3)

2. (a) Differentiate between partially observable and fully observable task environment of an agent. Give an example of each. (5)

(b) Create a frame network for terrestrial motor vehicles (cars, trucks, motorcycles) and given one complete frame in detail for cars which includes the slots for the main component parts, their attributes, and relations between parts. (5)

3. (a) What is closed world assumption? Give an example. (3)

(b) Define Modus ponens rule. Elaborate using an example. (3)

(c) Given formula S_1 and S_2 below, show that $Q(a)$ is a logical consequence of the two.

$$S_1: (\forall x)(P(x) \rightarrow Q(x)) \text{ and } S_2: P(a) \quad (4)$$

4. (a) Create a script for shopping in a supermarket. (5)

(b) Joint probability $P(x_1, x_2, \dots, x_7)$ by inspection as a product of chain conditional probabilities is :

$$P(x_1, x_2, \dots, x_7) = P(x_7 | x_3) \cdot P(x_6 | x_5) \cdot P(x_5 | x_2 \\ x_3) \cdot P(x_4 | x_1 x_2) \cdot P(x_3) \cdot P(x_2 | x_1) \cdot P(x_1)$$

Draw the Bayesian belief network for the same. (5)

5. (a) Write a program in Prolog to compute the sum of elements of a list. (5)

(b) What are alpha and beta cutoffs? How alpha-beta pruning is used to improve the efficiency of Minimax procedure? (5)

6. (a) Compare and contrast Best-first search and Hill Climbing search. You can use example. (4)

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- (b) What is a Recursive Transition Network (RTN)?
Give an example. (4)
- (c) Give two limitations of propositional logic. (2)

7. (a) Consider the following axioms :

January

Clouds

Cold & Precipitation → Snow

January → Cold

Clouds → Precipitation

Convert them into clausal form and prove the truth of "Snow" using resolution. (5)

(b) Develop a parse tree for the sentence "The cruel man locked the dog in the house" using the following rules.

$S \rightarrow NP VP$

$NP \rightarrow N$

$NP \rightarrow DET\ N$

$VP \rightarrow V\ NP$

$VP \rightarrow V\ PP$

$VP \rightarrow V\ NP\ PP$

$PP \rightarrow PREP\ NP$

DET → ART ADJ

DET → ART

N → man | dog | house

V → locked

ART → the | a

ADJ → cruel

PREP → in

(5)

8. (a) Solve the following crypt arithmetic problem using constraint satisfaction.

ODD

+ ODD

EVEN

(4)

- (b) Describe the limitations of Hill Climbing Methods.

(3)

- (c) Define the PEAS for vacuum cleaner agent.

(3)