BE2-R3: ARTIFICIAL INTELLIGENCE AND APPLICATIONS

NOTE:

1.	**Answer question 1 and any FOUR questions from 2 to 7.**
2.	**Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Suppose $h_1(x, y)$ and $h_2(x, y)$ are two heuristic functions constructed for use in the water jug problem. x and y denote the contents of the 4L and 3L jugs respectively. Given $h_1(x, y) > h_2(x, y)$ for all x, y. Which of the two heuristic functions should we use and why?

b) Given the following two propositional statements, find the interpretation(s), which satisfy these statements.

$(p \rightarrow q) \rightarrow p$

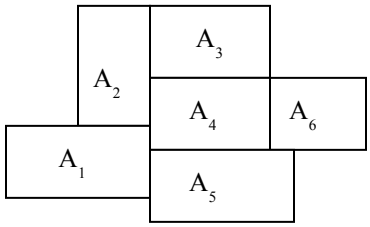
and $(q \rightarrow p) \rightarrow q$

c) Given P (B/ A) = 0.7, P (A $\cap$B) = 0.2, P (A $\cap \neg$B)= 0.4 and P (B)= 0.9, find P(A/ B).

d) Draw CD representation of the following sentence: "Smoking is harmful to health."

e) Let S={(1,3), (2,5), (3,4), (9,22), (4,16)} be a set of co-ordination of 5 points and y=2x+3 be a linear classifier of the region. Determine the two classes.

f) Determine the minimal number of colors required to color the following map.



g) Given $\mu_A(x)$={20/ 0.2, 30/0.4, 40/ 0.6} and $\mu_B(x)$ = {20/ 0.4, 30/0.6, 40/ 0.2}, find $\mu_{A \cap B}(x)$.

(7×4)

2. Consider 8-puzzle problem:

a) State the rules you need to use to solve the above problem.

b) Suggest 2 heuristic functions to handle the problem using A* algorithm.

c) Consider a starting state and a goal state. Expand the starting state using A* algorithm. Use any one heuristic function you considered in part b) above.

(4+4+10)

3.

a) Given the query Query : ← Taxpayer (X), draw the SLD tree for the following logic program. Show back-tracking on the diagram.

1. Taxpayer (X) ← Foreigner (X), cut, fail.
2. Taxpayer (X) ← Spouse (X, Y), Annual-Inc (Y, Earning), Earnings > 40,000, cut fail.
3. Taxpayer (X) ← Annual-Inc (X, Earning), 30,000 < Earnings, 50,000 > Earnings.
4. Foreigner (ram) ←

5. Spouse (ram, mita) ←
6. Annual-Inc (mita, Earnings) ←
7. Earnings = 45,000 ←
8. Annual-Inc (Lakshman, 35,000) ←

b) State the most general unifier:
W = {P (a, x, f (g(y))), P(z, f(z), f(u)))}

c) Define soundness and completeness of propositional logic using Axiomatic System.

(12+3+3)

4.

a) Write grammar rules, which can handle the following sentence and also generate the parse tree

'**A barking dog seldom bites.**'

b) Draw the semantic network for the following sentence.

Every town dog has bitten the watchman.

(9+9)

5.

a) In a blocks world planning problem, given the state: On (A, B), On (B, Table), On (C, Table), Clear (A) and Clear (C), and the goal state: On (B, A), On (C, B), On (A, Table) and Clear (C), where On (X, Y) means the object X is on object Y and clear (X) means there is nothing on top of object X. The operators in the present context are given by the following if-add-delete rules.

Rule 1: If On (X, Y), Clear (X), Clear (Z)
Then Add-List: On (X, Z), Clear (Y),
and Delete-List: On (X, Y), Clear (X).

Rule 2: If On (X, Y), Clear (X)
Then Add-List: On (X, Table), Clear (Y),
and Delete-List: On (X, Y).

Rule 3: If On (X, Table), Clear (X), Clear (Z)
Then Add-List: On (X, Z),
and Delete-List: Clear (Z), On (X, Table).

Design a plan by forward/backward reasoning on the state-space.

b) Consider a problem with a constraint set which exhibits a partial satisfaction w.r.t primitive constraints but total satisfiability is not feasible. The problem is: given the constraint $C=(x<y)\wedge(y<z)$ where x, y, $z \in \{1, 2\}$, test the satisfiability of the constraint and show backtracking on the constraint tree.

(9+9)

6.

a) Show that

$$P(Y \mid X, E) = \frac{P(X \mid Y, E).P(Y \mid E)}{P(X \mid E)}$$

b) Consider a temporal world describing the seasons in a year. Probability that "now it is winter" is denoted by p (winter). Thus for 4 seasons suppose we are given that,

P (winter) =1/4
P (summer) ½
P (spring) 1/8
P (rainy season)= 1/8

Let s be a fact denoting that "it is very cold today." Given that

P (s/ winter) = 0.2
P (s/ rainy season) = 0.6
P (s/ summer) = 0.1
P (s/ spring) = 0.1

Determine the probability that the statement s is true.

(9+9)

7.

a) Let

$\mathbf{X_1}$ = [1 –1 1]
$\mathbf{X_2}$ = [-1 1 –1]
and $\mathbf{X_3}$ = [-1 –1 1]

be three such stable states in a discrete Hopfield net. Encode the weight matrix **W** for such system, and hence check that X_1 is a stable state.

b) Design a perceptron classifier that classifies a 2D space into two regions using the inequality: $3x_1 + 4x_2 \leq 12$.

(9+9)