M.TECH. INTELLIGENT AUTOMATION AND ROBOTICS FIRST YEAR FIRST SEMESTER - 2024

Intelligent Systems

Time: 3 hours   Full Marks: 100

Answer any 4 questions

1. a) Explain a constraint satisfaction problem.
    b) Consider the following crypt-arithmetic problem to show that the value of 'S' is greater than or equal to 3:

    CROSS + ROADS = DANGER.   [10+15]

2. a) Use the following training examples to simulate the learning concepts: " blue or square object". Build up the concept description in clusters using the methods of inductive learning:

    (blue pyramid soft large +)
    (yellow square soft small +)
    (blue pyramid hard small +)
    (green large square hard +)
    (blue cube soft large +)
    (yellow cube soft small -)
    (yellow pyramid soft large -)

    b) Explain the main steps of Analogical learning with an example.   [20+5]

3. a) Use truth-tables to decide which of the following bi-conditionals are tautologies.
    i) $p \equiv [p \wedge (q \wedge \neg q)]$
    ii) $p \equiv [p \vee (p \wedge q)]$
    iii) $p \equiv [p \wedge (q \to p)]$

    b) Give the clausal form of the following predicate logic expression:

    $\exists X \, \forall Y \, ((\forall Z) \, P \, (\, f \, (X), Y, Z) \to (\exists U \, Q \, (X, U) \wedge \exists V \, R \, (Y, V)))$.

    c) Prove by resolution theorem that the opposite angles formed by the intersection of two straight lines at a point are equal (Fig. 1).
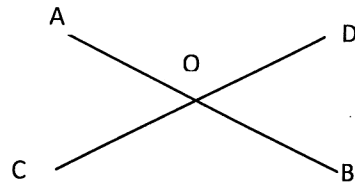
[Turn over

Fig. 1

Use the following axioms:

i) The angles at a point on a straight line is always180°

ii) If $\angle X + \angle Y = \angle X + \angle Z$, then $\angle Y = \angle Z$. [5+10+10]

4. a) Develop a grammar and draw the parse tree for the following sentence:

The police caught a thief.

b)What is "Transition Network Parser"?

c) Illustrate backtracking in Transition network parser with the help of the following sentence:

The thief ran.

d) Give the semantic network of the following sentences:

i) Every child loves every chocolate.
ii) Mouse is a rodent, rodent is a mammal that has hairs and drinks milk.

[7+3+10+5]

5. a) You are provided with a 8L water jug and a 5L water jug. You need to get 4L water in any of the two jugs without the use of any other utensil or a measuring glass. You are provided with a water source.
List the production rules that are needed to expand the State Space Search tree to reach the goal state.

b) You are provided with 2 heuristic functions for the Water-Jug problem.
   i) $|x-2|+|y-2|$
   ii) $|x-2| \cdot |y-2|$

Only one of these heuristic is correct. Chose the correct heuristic function and draw the search tree (till Level-4) using A* algorithm. Justify why the other heuristic function is wrong.

c) Explain the expression: $h'(x) \leq h(x)$, where $h'(x)$ stands for the predicted heuristic cost and $h(x)$ stands for optimal heuristic function.   [10+10+5]

6. a) Construct a formal proof of validity for the following using the rule of Inferences.

1. $I \rightarrow (B \equiv M)$
2. $M \rightarrow T$
3. $\neg T \wedge B$ $/ \therefore \neg I$

1.$T \rightarrow K$
2.$(V \rightarrow M) \wedge (M \wedge K) \rightarrow P]$
$/ \therefore (T \wedge V) \rightarrow P$

b) Explain the drawback of Backward reasoning with an example.

c) Explain Hill Climbing algorithm and its pitfalls.   [5+5+8 + 7]

7. Write short notes on any two of the following:

   i) Dempster Shafers Theory

   ii) α- β pruning algorithm

   iii) Act-Recognition Cycle   [12 ½ x 2]