

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Subject Code: CST 812

Full Marks: 100

Time: 3 hrs

Answer any five questions. All questions carry equal marks.

1. (a) Find a good state space representation, for each of the problems given below:
(i) CHESS, (ii) WATER-JUG, (iii) 8-PUZZLE and (iv) TRAVELLING SALESMAN.

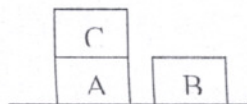
[2×4]

(b) Why appropriate state space representation is needed for solving the problems?

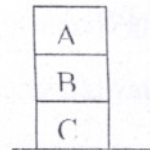
[3]

(c) Try to describe a good heuristic function for the following problem:

[3]



Start State



Goal State

(d) Show different steps to reach from start state to Goal State.

[6]

2. (a) When would best-first search be worse than simple breadth-first search?

[3]

(b) Why and how the A* algorithm work properly on graphs containing cycles?

[2+5]

(c) Write the differences between the algorithms used for searching OR graphs and AND-OR graphs respectively.

[5]

(d) Write the algorithm for checking duplicate nodes when a new node is added to the graph.

[5]

3. Consider the following sentences:

- John likes all kinds of food.
- Apples are food.
- Chicken is food.
- Anything anyone eats and isn't killed by is food.
- Bill eats peanuts and is still alive.
- Sue eats everything Bill eats.

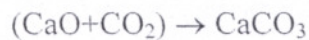
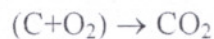
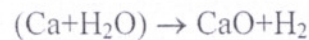
(a) Translate these sentences into formulas in predicate logic. [6]

(b) Prove that John likes peanuts. [2]

(c) Convert these formulas into clause form. [6]

(d) Using resolution principle, answer the question, "What food does Sue eat?" [6]

4. Suppose you can perform the following chemical reactions:



(a) Assume you have some quantities of Ca, H₂O, C and O₂. Show that it is possible to produce CaCO₃. [6]

(b) Write the steps of converting a formula into Prenex Normal Form. [6]

(c) How validity and inconsistency of a formula is checked in case of First order Logic? [4+4]

5. (a) How information is represented using Semantic Net? [3]

(b) Draw the semantic net for representing the predicate "Score(Cubs, Dodgers, 5-3)" [3]

(c) How quantified expressions are represented using Semantic net? Illustrate with an example. [6]

(d) State Bayes' Theorem and describe how the theorem is used to reasoning when information is not certain and precise? [2+6]

6. Consider a relational system that relates *Fast-Runners* with *Young* people by the following production rule PR1:

PR1: If X-is *Young* Then X-is-a-*Fast Runner*.

Suppose membership distributions of subsets *Young* and *Fast-Runner* represent Age/membership and speed/membership values respectively, given as;

$Young = \{10/0.1, 20/0.6, 30/0.8, 40/0.6\}$ and
 $Fast-Runner = \{5/0.1, 8/0.2, 10/0.4, 12/0.9\}$

(a) Construct Fuzzy Relational Matrix, which denotes the membership value of relation between Age and Speed. [6]

(b) Suppose the measured membership distribution of a *Young* person is: $Young = \{10/0.01, 20/0.8, 30/0.7, 40/0.6\}$. Find out the fuzzy membership distribution of the person being a *Fast-Runner*. [4]

(c) Why Fuzzy set is called generalization of Crisp set? [3]

(d) Define Linguistic variable using a suitable example and describe the relationship between Fuzzy variable and Linguistic variable. [4+3]

7.(a) Show the computation of the first 3 moves in a tic-tac-toe game using the α - β cut-off algorithm. [8]

(b) State the differences between Monotonic and Non-Monotonic Reasoning? [4]

(c) Describe the architecture of Truth Maintenance system used for Non-Monotonic reasoning. [5]

(d) Why Fuzzy Reasoning is called Approximate Reasoning not Exact Reasoning? [3]

8. Write Short Notes: (Any four)

Expert Systems, (ii) Logical Consequence of propositional Logic, (iii) Default Reasoning, (iv) Production Systems, (v) Blind Search Procedures and (vi) Hill-Climbing method.

[4×5]