BE2-R4 : ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS

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) What is Heuristic knowledge ? Give an example.
 - (b) Discuss learning rule of Neural Network.
 - (c) Not all knowledge is suitable for inclusion in a knowledge based system. Is dynamic knowledge suitable or not? Please explain your answer.
 - (d) Outline the principal components of a Production System for AI.
 - (e) Create a semantic network to describe a car. Your network should include the concepts : car, person, driver, engine, petrol, petrol tank, and road.
 - (f) What is a Turing test ?
 - (g) Consider the statement "The bird can fly." And the tag sequence DT NNP MD VB. Use bigram approximation to find the probability. (7x4)
- **2.** (a) Discuss Kohonen's Self Organizing Map.
 - (b) Consider the following fuzzy expert system for weather forecast: The air pressure is measured in millibars, and the speed of its change in millibars per hour.

Rule	Condition	Action	Confidence
R1	If arrow is down	Then Clouds	M = 0.8
R2	If arrow is in the middle AND moving down	Then Clouds	M = 0.6
R3	If arrow is in the middle AND moving up	Then Sunny	$M \!=\! 0.6$
R4	If arrow is up	Then Sunny	M = 0.8

The following two plots represent the membership functions of two Fuzzy variables describing the position of arrow of barometer and the direction of its movement respectively.

- (i) How much is the arrow Down, Up or in the Middle if it indicates that the pressure is 1020 millibars ? Use membership functions on the graphs.
- (ii) How much is the arrow moving Down or Up if the pressure changes -2 millibars/hour ?

(iii) Using the membership values found above and confidences of the rules in the table calculate the degree of confidence in that the sky is clear or cloudy.



- **3.** You are given two jugs, a 4 litre one and a 3 litre one. Neither have any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 litres of water into 4 litre jug ? Formulate the problem as a state-space problem.
 - (a) Define a state space that contains all the possible configurations of the relevant objects.
 - (b) Specify the initial and goal states.
 - (c) Specify a set of rules

Represent a state of the problem as a tuple (x, y) where x represents the amount of water in the 4 - gallon jug and y represents the amount of water in the 3 - gallon jug. (18)

4. Consider the problem of moving a knight on a 3x4 board, with start and goal states labeled as S and G in figure below. The search space can be translated into the following graph. The letter in each node is its name and the subscript digit is the heuristic value. All transitions have cost 1.





Write the sequence of nodes in the order visited by the specified methods.

- (a) Depth-first search
- (b) Breadth-first search
- (c) A* search

Assumptions :

- All the algorithms do not generate paths with loops.
- Nodes are selected in alphabetical order when the algorithm finds a tie.
- A node is visited when that node is at the front of the search queue.
- 5. When comparing tree-search algorithms, we measure the number of nodes expanded. How many nodes are expanded (in the worst case) by each of the following search techniques when searching a tree with branching factor (b) to find a goal at a depth of (d) ?
 - (a) Breadth-first search
 - (b) Depth-first search
 - (c) Depth-limited search (limit = d)
 - (d) Iterative deepening depth-first search
- 6. In the following minimax tree, alpha/beta pruning was utilized. Answer the following :
 - (a) The value at Node A indicates the outcome will be _____ than 3.
 - (b) Why Node B is pruned ?
 - (c) The value at Node C indicates the outcome will be _____ than 3.
 - (d) Why Node D is pruned ?
 - (e) Why Node E pruned ?



(18)

(18)

(a) In the following two examples, provide a unification if one exists. Label all cases where you standardize sentences apart in order to complete the unification:

Knows (John, *x*) and Knows (*x*, Elizabeth)

Knows (John, *x*) and Knows (*y*, Mother(*y*))

Older (Father (y), y) and Older (Father(x), John) {x/John, y/John}

- (b) For each of these arguments, explain which rules of inference are used for each step.
 - (i) "Doug, a student in this class, knows how to write programs in JAVA. Everyone who knows how to write programs in JAVA can get a high-paying job. Therefore, someone in this class can get a high-paying job."
 - (ii) "Somebody in this class enjoys whale watching. Every person who enjoys whale watching cares about ocean pollution. Therefore, there is a person in this class who cares about ocean pollution."
 - (iii) "Each of the 93 students in this class owns a personal computer. Everyone who owns a personal computer can use a word processing program. Therefore, Zeke, a student in this class, can use a word processing program."
 - (iv) "Everyone in New Jersey lives within 50 miles of the ocean. Someone in New Jersey has never seen the ocean. Therefore, someone who lives within 50 miles of the ocean has never seen the ocean." (9+9)

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