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Ref. No. EX/PG/ETCE/T/114A/2018

MASTER OF ETCE/EE/BIOMED ENGG/MCSE/ILLUMINATION ENGG FIRST YEAR

FIRST SEMESTER EXAMINATION, 2018

Artificial Intelligence and Soft Computing

Time: 3 Hours **Full marks: 100**

Answer any FOUR questions.

1. Read the following paragraph and hence answer the queries listed below.

"A farmer wants to transfer his three belongings: a wolf, a goat and a cabbage, by a boat from the left to the right bank of a river. The boat can carry at most two items including the farmer. If unattended, the wolf may eat up the goat, and the goat may eat up the cabbage."

a) Design the rule-base required to solve the problem of the farmer. [10]

b) How will you represent the problem states? State the starting and the terminal states. [3 + 3]

c) Solve the necessary steps of forward/backward reasoning to solve the problem. [9]

2. a) State the rule-base for the water-jug problem. [8]

b) Develop 2 heuristic functions for the problem, and explain which one is better and why? [4 + 3]

c) Use the better heuristic to solve the problem using A^* algorithm. [6]

d) Explain following the A^* algorithm what you had to do when the new-born child node already exists in the tree as a closed node. [4]

3. a) Write down the steps of the Wang's algorithm. [9]

b)Using Wang's algorithm prove the following logical statement.

$(p \rightarrow q) \wedge (q \rightarrow p) \Leftrightarrow (p \wedge q) \vee (\neg p \wedge \neg q)$. [10]

c) Prove by syntactic method that $p \rightarrow (q \rightarrow r) \Rightarrow (p \wedge q) \rightarrow r$. [6]

4. a) Illustrate the resolution theorem of prepositional logic. [4]

b) Using prepositional resolution principle show that the 'r' follows from the following prepositional clauses:

i) $p \vee q$

ii) $\neg q \vee r$

iii) $\neg p \vee s$

iv) $\neg s$. [8]

c) Define and illustrate the resolution principle in predicate logic. [4]

d) Given the following predicate logic statements:

Biscuit (coconut-crunchy)

Child (mary)

Takes (mary, coconut-crunchy)

Child (X) $\wedge$ Biscuit (Y) $\wedge$Takes (X, Y) $\rightarrow$Loves (john, X)

Prove that John loves Mary. [9]

5. a) What is gradient descent learning? [3]

b) Explain how gradient descent learning can be applied to adapt a single weight of a neuron employing Sigmoid function. [5]

c) Derive the weight adaptation rules in Back-propagation algorithm. [9]

d) Write down the steps of multi-input, multi-output training of a Neural Net using Back-propagation algorithm. [8]

6. a) What is a fuzzy set? How is it different from classical sets? [2 + 3]

b) How do you represent a binary relation by a matrix? How will you represent the distance between two point sets: X={1, 2, 3}and Y={2, 3, 4} by a fuzzy relation? [5]

c) Represent a 3-point membership function of the fuzzy concepts: height is MEDIUM and speed is HIGH. Then describe the rule: If height is MEDIUM Then speed is HIGH by Lukasiewicz type implication function. [5]

d) Now, consider a 3-point membership function to represent *height is NOT SO MEDIUM*, and determine the membership function of speed is *NOT SO HIGH.* [5]

e) De-fuzzify the final membership function. [5]

7. Write a technical essay on any ONE of the following topics: [25]

a) Theorem-proving by forward and backward chaining,
b) The A^* algorithm
c) EEG-based position control of a robot arm,
d) Particle Swarm Optimization algorithm.