B **377B3** **Total pages: 3**

Register No: …… Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION(R), MAY 2024

Computer Science and Engineering

(2020 SCHEME)

Course Code : **20CST442**

Course Name : **Soft Computing**

Max. Marks : **100** **Duration:3 Hours**

(Scientific calculator is allowed in the examination hall.)

PART A

(Answer all questions. Each question carries 3 marks)

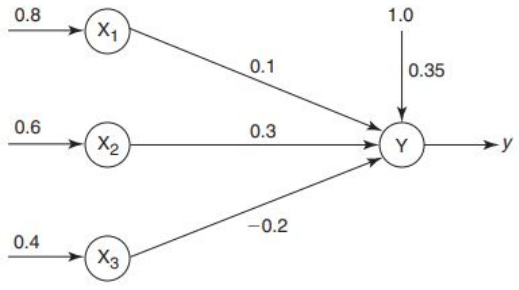
1. Explain the training algorithm for Hebb network.
2. Differentiate between supervised and unsupervised learning.
3. Implement one epoch of Adaline algorithm for OR logic function with bipolar inputs and targets. Initial weights are w1 = w2 = 0.1 and learning rate parameter $\alpha = 0.1$.
4. A Perceptron has a weight vector w = [1, −1] and bias b = 0.5. For an input vector x = [2, 3], what is the output prediction ŷ? Is this prediction correct if the actual label y = −1?
5. Compare first of maxima and last of maxima method.
6. Define (i) core (ii) support (iii) boundary of a fuzzy set.
7. Explain the steps of genetic algorithm.
8. What are the three mutation methods?
9. Define multi-objective optimization.
10. Write any three advantages of neuro-genetic hybrid system.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Explain the three categories of learning in ANN. 14
    b) Obtain the output of the neuron Y for the given network using activation functions as:
    (i) binary sigmoidal and (ii) bipolar sigmoidal.



OR

12. a) With diagram, explain any three basic connection architectures of neural networks. 14
b) Design a Hebb network to realize logical OR function. Consider bipolar inputs and targets.

MODULE II

13. a) Draw the architecture of back-propagation network. How is error propagated in BPN? 14
b) Explain the three phases of BPN training algorithm.

OR

14. a) Explain how the Perceptron algorithm can be used for multi-class classification. Providing the training and testing algorithm . 14
b) Explain how Perceptron networks can be applied to the problem of email spam classification. Discuss the features used for classification, the training process and the evaluation of the model's performance.

MODULE III

15. a) For the fuzzy 14
sets $\tilde{D_1} = \left\{\frac{1}{1.0} + \frac{0.75}{1.5} + \frac{0.3}{2.0} + \frac{0.15}{2.5} + \frac{0}{3.0}\right\}$ and $\tilde{D_2} = \left\{\frac{1}{1.0} + \frac{0.6}{1.5} + \frac{0.2}{2.0} + \frac{0.1}{2.5} + \frac{0}{3.0}\right\}$, find the following:
(i) $\tilde{D_1} \cup \tilde{D_2}$ (ii) $\tilde{D_1} \cap \tilde{D_2}$ (iii) $\overline{\tilde{D_1}}$ (iv) $\overline{\tilde{D_2}}$ (v) $\tilde{D_1}|\tilde{D_2}$ (vi) $\overline{\tilde{D_1} \cap \tilde{D_2}}$.

b) Let $\tilde{B}$ represent a fuzzy set “good effluent”, $\tilde{T}$ represent a fuzzy set "optimal retention time" and fuzzy set $\tilde{U}$ represent “high utilization rates" in a water treatment process, defined by the membership functions
$\mu_{\tilde{B}} = \left\{\frac{0.5}{60} + \frac{0.8}{40} + \frac{1.0}{20}\right\}$, $\mu_{\tilde{T}} = \left\{\frac{0.9}{10} + \frac{0.6}{8} + \frac{0.4}{6}\right\}$ and $\mu_{\tilde{U}} = \left\{\frac{1}{0.9} + \frac{0.8}{0.8} + \frac{0.6}{0.7} + \frac{0.4}{0.6}\right\}$.
Find (i) $\tilde{R} = \tilde{B} \times \tilde{T}$ (ii) $\tilde{S} = \tilde{T} \times \tilde{U}$ (iii) $\tilde{W} = \tilde{R} \circ \tilde{S}$ using max–min composition
(iv) $\tilde{W} = \tilde{R} \circ \tilde{S}$ using max–product composition.

OR

16. a) Describe the concept of a fuzzy equivalence relation. Explain with proper graphs, which of the following are equivalence relations: 14

Set	Relation on the set
(i) people	is the brother of
(ii) lines in plane geometry	is perpendicular to
(iii) people	has the same parents as
(iv) points on map	is connected by a rail to

b) Briefly describe any four methods for assigning membership values to fuzzy variables.

MODULE IV

17. a) Explain the Mamdani fuzzy inference model. Discuss its components and the steps involved in fuzzy inference using this model. 14
b) Describe the Sugeno fuzzy inference model. How does it differ from the Mamdani model, and what are its advantages?

OR

18. a) With a neat sketch, explain the basic architecture of a fuzzy logic control system. 14
b) Briefly explain the various steps involved in designing a controller for a complex physical system.

MODULE V

19. a) Based on the type of optimization problems, describe the different optimality conditions used. 14
b) Briefly explain the procedure for finding a non-dominated set in a multi-objective optimization problem.

OR

20. a) With illustrative examples, discuss the significance of crowding distance in multi-objective optimization (MOOP) algorithms. Describe the process of computing crowding distance for these solutions. 14

b) Explain the concept of Pareto-optimal solutions and the Pareto-optimal front in MOOP. Discuss how the Pareto-optimal front provides valuable insights into the trade-offs between conflicting objectives.

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