

**M. SC. (MATHEMATICS WITH
APPLICATIONS IN COMPUTER
SCIENCE) [M. SC. (MACS)]**

Term-End Examination

December, 2024

**MMTE–007 : SOFT COMPUTING AND ITS
APPLICATIONS**

Time : 2 Hours

Maximum Marks : 50

Weightage : 50%

Note : *Question No. 7 is compulsory. Attempt any
four questions from Question No. 1 to 6. Use
of non-programmable, scientific calculator is
allowed.*

1. (a) Let X and Y be two fuzzy sets, given
below :

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$$X = \left\{ \frac{0.1}{0}, \frac{0.2}{1}, \frac{0.4}{2}, \frac{0.6}{3}, \frac{1}{4} \right\}$$

and $Y = \left\{ \frac{1}{0}, \frac{0.5}{1}, \frac{0.7}{2}, \frac{0.3}{3}, \frac{0}{4} \right\}$

Determine :

- (i) $X \cup \bar{Y}$
 - (ii) $\bar{X}$
 - (iii) $X \cap \bar{Y}$
 - (iv) $X \cup \bar{X}$
- (b) Find the weights required to perform the following classification, using perceptron network : 4
- (i) The vectors $(1, 1, -1, -1)$ and $(1, -1, 1, -1)$ are belonging to the class with target value 1.
 - (ii) The vectors $(-1, -1, -1, 1)$ and $(-1, -1, 1, 1)$ are not belonging to the class with target value -1 .

Assume learning rate as 1, initial weights as $[0.1, -0.2, 0.3, -0.1]$ and active function to be sigmoidal ($\alpha = 1$).

- (c) Write the schema for the gene sequence (1000111) and (0001100). 2

2. (a) Maximize the function $f(x) = \frac{-x^2}{10} + 3x$, where $0 \leq x \leq 31$, using Genetic algorithm. 6

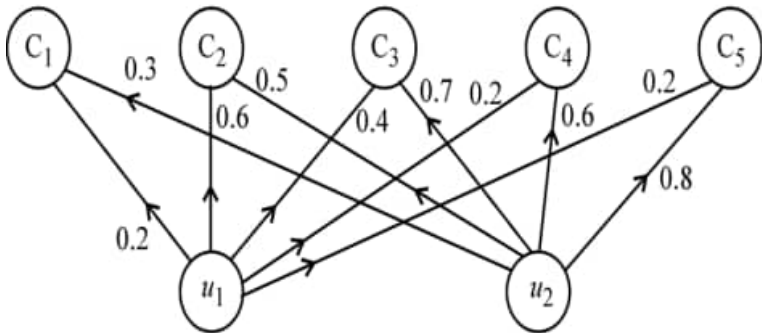
- (b) Construct the α -cut at $\alpha = 0.7$ and $\alpha = 0.5$ for the fuzzy sets defined below. Also compare and comment on the α -cut of two outcomes :

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X	μ_A
x_1	0.2
x_2	0.3
x_3	0.4
x_4	0.7
x_5	0.1

3. (a) Given, A single layer neural network with six inputs and three outputs. The outputs are to be limited to and continuous over the range 0 to 1. Answer the following :
- 4
- How many neurons are required ?
 - What are the dimensions of the weight matrix ?
 - What kind of transfer function could be used ?
 - Is a bias required ? Give reason.

- (b) A Kohonen self organizing map with weights, is shown below : 6



Determine the cluster unit $C_j, j = 1, 2, 3, 4, 5$ that is closest to the input vector $(0.3, 0.6)$ by using square of the Euclidean distance.

4. (a) Discuss Multilayer Perceptron (MLP) model. How does MLP differ from Sigma-Pi Network ? Briefly discuss the limitations of Sigma-Pi Network. 6
- (b) Give *two* major limitations of Hopfield Networks. Under what conditions, a Hopfield model of 'N' nodes can achieve 100% correct retrieval of 'P' patterns ? 4

5. (a) In a neural network if input, weight and bias to a single-input neuron are 2.0, 2.3 and -3 respectively, then : 8
- (i) find the net input to the transfer function.
- (ii) find neuron output for the following transfer functions :
- (1) Hard limit
- (2) Linear
- (3) Log-Sigmoid
- (b) Write the expression for triangular membership function. 2
6. (a) Apply Fuzzy C-mean algorithm on the data given below, to find the new cluster center after one iteration : 6

	X_1	X_2	X_3	X_4
f_1	1	2	3	4
f_2	10	8	6	5

(Use $C = m = 1$ and $V_1 = (8, 8)$; $V_2 = (4, 4)$).

- (b) Write schema for the gene sequence (1000111) and (0001100). Also, write six chromosome sets identified by the schemas written by you. 4

7. State whether the following statements are true or false. Give reasons : $5 \times 2 = 10$

- (i) For two fuzzy sets A and B and $x \in U$, if $\mu_A(X) = 0.3$ and $\mu_B(X) = 0.9$, then $\mu_{\overline{A \cup B}} = 0.6$.

- (ii) The order of schema * * 10 * * is 6.

- (iii) The fuzzy relation :

$$R = \begin{bmatrix} 1 & 0.6 & 0 & 0.2 \\ 0.6 & 1 & 0.4 & 0 \\ 0 & 0.4 & 1 & 0 \\ 0.2 & 0 & 0 & 1 \end{bmatrix}$$

is an equivalence relation.

- (iv) Every original pattern of a discrete Hopfield network with a synchronous update provides a global minimum.

- (v) If a 3-input neuron is trained to output a zero when the input is 110 and output one when the input is 111, then after generalization, the output will be zero, when the input is 000 or 010 or 110 or 100.

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