

**M.Sc. (MATHEMATICS WITH APPLICATIONS
IN COMPUTER SCIENCE)**

M.Sc. (MACS)

Term-End Examination

December, 2022

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

Time : 2 hours

Maximum Marks : 50

(Weightage : 50%)

Note :

- (i) Question no. 7 is **compulsory**.
 - (ii) Attempt any **four** questions from questions no. 1 to 6.
 - (iii) Use of non-programmable and non-scientific calculator is allowed.
 - (iv) All symbols have their usual meanings.
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1. (a) A single-layer neural network has six inputs and three outputs. The outputs are to be limited to and continuous over the range 0 to 1. Based on the description given, answer the following : 4

- (i) How many neurons are required in the neural network ?

- (ii) What are the dimensions of the weight matrix ?
 - (iii) What kind of transfer function could be used ?
 - (iv) Is a bias required ? Give reason.
- (b) The weight matrix (W) and the two test input vectors (PT₁ and PT₂) for Hopfield network are given below :

$$W = \frac{1}{3} \begin{bmatrix} 0 & -1 & 1 \\ -1 & 0 & -1 \\ 1 & -1 & 0 \end{bmatrix};$$

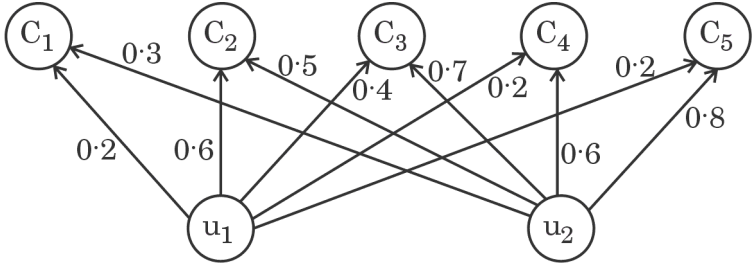
$$PT_1 = (2 \quad -2 \quad 2) \text{ and } PT_2 = (-2 \quad 2 \quad -2)$$

Check, whether the output state vectors satisfy the alignment conditions. 6

2. (a) Construct the α -cut at $\alpha = 0.7$ and $\alpha = 0.5$, for the fuzzy set given below : 4

X	x ₁	x ₂	x ₃	x ₄	x ₅
μ_x	0.2	0.3	0.4	0.7	0.1

- (b) 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 in a Kohonen self-organising map, as shown below : 6



3. (a) Maximize the function

$$f(x) = \frac{-x^2}{10} + 3x, \text{ where } 0 \leq x \leq 31,$$

using Genetic algorithm. 6

- (b) Solve the network to approximate the function $g(x) = 1 + \sin\left(\frac{\pi x}{4}\right)$ for $-2 \leq x \leq 2$,

choosing the initial weights and bias as the random numbers. 4

4. (a) Write the schema for the Gene sequence (1000110) and (0001100) . 2

- (b) Write at least four chromosomes sets, which are identified by schema $S = (10 * 0 *)$. 2

- (c) Determine $A \cup \bar{B}$, \bar{A} , $A \cap \bar{B}$ and $A \cup \bar{A}$ for the fuzzy sets A and B, given below : 4

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

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

- (d) Briefly discuss the term “Hedges”. 2

5. (a) How does ADALINE differ from MADALINE ? Discuss the MADALINE architecture, with suitable diagram. 5

- (b) Write short notes on the following, giving suitable example for each : 5

(i) Perception Learning Rule

(ii) Widrow-Hoff (LMS) Learning Rule

6. (a) Briefly discuss about McCulloch-Pitts Neuron. Implement NAND function using McCulloch-Pitts neuron, for binary data representation given below : 6

Input	x_1	0	0	1	1
	x_2	0	1	0	1

- (b) Consider a 5-bit chromosome ‘10011’. List all the schemas. Find the length and order of each of the schemas. 4

7. State whether the following statements are *True* or *False*. Justify your answer. 5×2=10

- (a) A multilayer network with linear transfer function is equivalent to a single-layer network.
- (b) The length of chromosomes to determine the maximum value of the set $S = \{x \mid 0 \leq x \leq 4096\}$ is 12.
- (c) Hopfield network is a particular case of Kohonen network.
- (d) Back propagation reduces to the LMS algorithm for a single-layer linear network (ADALINE).
- (e) In Radial Basis Function (RBF) network, the neurons belonging to the same layer send their output to the neurons of the next and previous layers.
