MMTE-007

M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M. Sc. (MACS)
Term-End Examination
June, 2023

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 Question Nos.* **1** *to* **6**.

(*iii*) *Use of non-programmable scientific calculator is allowed.*

(*iv*) *All symbols used have their usual meanings.*

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1. (a)　Maximize the function

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

using Genetic Algorithm. You may assume the initial population of size 5.　　　6

P. T. O.

(b) Construct the α-cut at α = 0.7 and α = 0.5 for the fuzzy set given below :   4

X	μ_x
X_1	0.2
X_2	0.3
X_3	0.4
X_4	0.7
X_5	0.1

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

Input	
x_1	x_2
0	0
0	1
1	0
1	1

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

3. (a) Compare Classical clustering and Fuzzy clustering, give suitable example of each. 4

(b) What is Perceptron ? Use perceptron network to find the weights required to perform the following classification : 6

(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 weight as [0.1, − 0.2, 0.3, − 0.1], and activation function to be sigmoidal ($a = 1$).

4. (a) Briefly discuss the Kohonen self-organizing map. Determine the cluster unit $C_j, j = 1, 2, 3, 4, 5$ that is closest to the input vector (0.3, 0.6), by applying square of Euclidean distance, over the Kohonen self-organizing map given below : 6
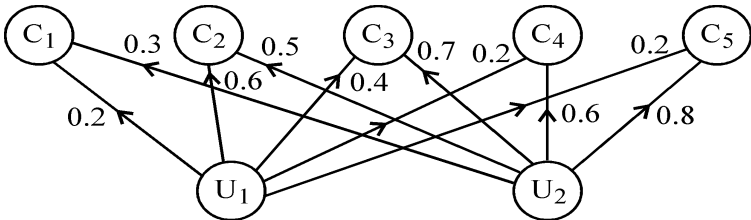
(b) Determine the fuzzy relation T by using the Max-Min and Max-product composition over the fuzzy relation R and S, given below :   4

$$R = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{cc} y_1 & y_2 \\ \left[\begin{array}{cc} 0.6 & 0.3 \\ 0.2 & 0.9 \end{array} \right] \end{array} \text{ and}$$

$$S = \begin{array}{c} \\ y_1 \\ y_2 \end{array} \begin{array}{ccc} z_1 & z_2 & z_3 \\ \left[\begin{array}{ccc} 1 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{array} \right] \end{array}$$

5. (a) What is Sigma-Pi Network ? How is it different from Multilayer Perception (MLP) ? What are the limitations of Sigma-Pi Network ?   6

(b) Compare and contrast the following :   4

   (i) Supervised pattern recognition and unsupervised pattern recognition

   (ii) K-NN   algorithm   and   K-means algorithm

6. (a) State Travelling Salesman Problem (TSP) and give an example of TSP. Consider the following TSP, involving 9 cities :

Parent—1	Parent–2
F	C
I	B
G	G
E	I
D	H
C	F
A	D
H	E
B	A

Determine the children solution using : 6

(i) Order crossover # 1, assuming 4th and 7th sites as the crossover sites

(ii) Order crossover # 2, assuming 3rd, 5th and 7th as the key positions

(b) Write De Morgan's laws. Verify any *one* De Morgan's law (both graphically and numerically) by taking and two fuzzy sets.

4

7. State whether the following statements are True or False. Give reasons : 5×2=10

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

(ii) Every original pattern of a discrete Hopfield Network with a synchronous update provides a global minimum.

(iii) The order of schema **10** is 6.

(iv) 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.

(v) Radial Basis Function (RBF) is a Local Network.