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

---

1. (a) Take any two fuzzy sets and verify De Morgan's laws, graphically and numerically. *4*

(b) Minimize the function $f(x_1, x_2)$, given below (perform one iteration only) : *6*

$$f(x_1, x_2) = x_1 + x_2 - 2x_1^2 - x_2^2 + x_1 x_2,$$

where $0 \leq x_1, x_2 \leq 5$,

by using binary-coded Genetic Algorithm. Use a random population of size N = 6, a single point crossover with probability $P_c = 1$ and neglect mutation. Assume 3 bits for each variable.

2. (a) Write and compare/differentiate the formula describing the function, defined by : *4*

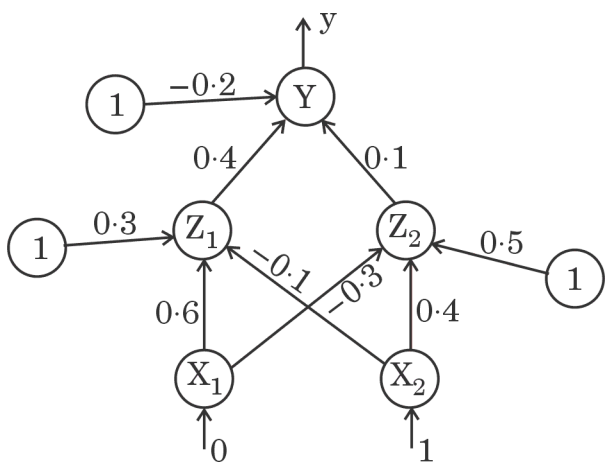
(i) One-hidden layer (already trained) MLP with single output

(ii) RBFN with single output

(b) What is Roulette Wheel criterion ? Use it to generate the population in the next iteration, for the data given below : *6*

k :	1	2	3	4	5
F_k :	3·5	4·6	5	2·8	1·8

3. Write a Back-propagation algorithm, and use it to find the new weights for the following network (perform one iteration) : *10*



Given that :

(a) Input pattern is [0, 1]

(b) Target output is 1

(c) Learning rate $\alpha = 0{\cdot}25$

(d) Activation function is binary sigmoidal

4. (a) Determine the fuzzy relation T as a composition between the two fuzzy relations R and S given below : *4*

$$R = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{c} \begin{array}{cc} y_1 & y_2 \end{array} \\ \begin{bmatrix} 0{\cdot}6 & 0{\cdot}3 \\ 0{\cdot}2 & 0{\cdot}9 \end{bmatrix} \end{array} \text{ and}$$

$$S = \begin{array}{c} \\ y_1 \\ y_2 \end{array} \begin{array}{c} \begin{array}{ccc} z_1 & z_2 & z_3 \end{array} \\ \begin{bmatrix} 1 & 0{\cdot}5 & 0{\cdot}3 \\ 0{\cdot}8 & 0{\cdot}4 & 0{\cdot}7 \end{bmatrix} \end{array}$$

Using (i) Max-min

(ii) Max-product

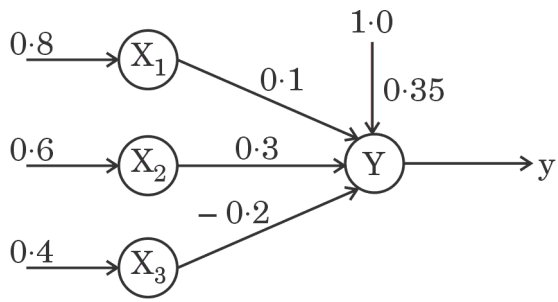
(b) Consider the vectors (1, 1, 1, 1) and (– 1, 1, – 1, – 1), belonging to the class (so have target value 1), and vectors (1, 1, 1, – 1) and (1, – 1, – 1, 1) are not belonging to the class (so have target value – 1). Determine the weights required to perform the given classification by using perceptron network, assuming the learning rate as 1 and initial weights as 0. *6*

5. (a) Implement AND function, by using McCulloch-Pitts neuron. *5*

(b) Determine the output of the neuron Y for the network given below, using the following activation functions : *5*

(i) Binary Sigmoidal

(ii) Bipolar Sigmoidal



6. (a) Compare and contrast the following with suitable examples : *4*

(i) Supervised pattern recognition and Unsupervised pattern recognition

(ii) Crisp K-NN classification technique and Fuzzy K-NN classification technique

(b) How do Classical sets differ from Fuzzy sets ? Consider the fuzzy sets A and B, given below : *6*

$$A = \left\{\frac{1}{2} + \frac{0{\cdot}3}{4} + \frac{0{\cdot}5}{6} + \frac{0{\cdot}2}{8}\right\} \text{ and}$$

$$B = \left\{\frac{0{\cdot}5}{2} + \frac{0{\cdot}4}{4} + \frac{0{\cdot}1}{6} + \frac{1}{8}\right\}$$

Perform Union, Intersection, Complement and Difference operations over fuzzy sets A and B.

7. State whether the following statements are *True* or *False*. Give reasons in support of your answer. *5×2=10*

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

(b) The order of schema $* * 10 * *$ is 6.

(c) The fuzzy relation (R) given below is an equivalence relation :

$$R = \begin{bmatrix} 1 & 0{\cdot}6 & 0 & 0{\cdot}2 \\ 0{\cdot}6 & 1 & 0{\cdot}4 & 0 \\ 0 & 0{\cdot}4 & 1 & 0 \\ 0{\cdot}2 & 0 & 0 & 1 \end{bmatrix}$$

(d) Radial Basis Function (RBF) network is a local network.

(e) For two fuzzy sets A and B, and $x \in U$, if $\mu_A(x) = 0{\cdot}3$ and $\mu_B(x) = 0{\cdot}9$, then $\mu_{\overline{A} \cup \overline{B}} = 0{\cdot}6$.