M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M.Sc. (MACS)
Term-End Examination
June, 2018

00575

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 scientific calculator is allowed.*

1. (a)   Given the two fuzzy sets

$$A = \left\{ \frac{1}{1 \cdot 0}, \frac{0 \cdot 75}{1 \cdot 5}, \frac{0 \cdot 3}{2 \cdot 0}, \frac{0 \cdot 15}{2 \cdot 5}, \frac{0}{3 \cdot 0} \right\}$$

$$B = \left\{ \frac{1}{1 \cdot 0}, \frac{0 \cdot 6}{1 \cdot 5}, \frac{0 \cdot 2}{2 \cdot 0}, \frac{0 \cdot 1}{2 \cdot 5}, \frac{0}{3 \cdot 0} \right\}$$

Find the following :   3

(i) $A \cup B$

(ii) $A \cap B$

(iii) $A \cap \overline{B}$

(iv) $A \cap \overline{A}$

(b) Calculate the net input to the output neuron for the network shown below. Here b is the bias included in the network.　　*2*
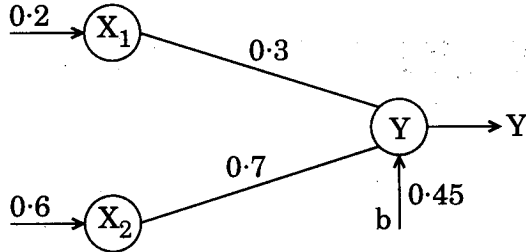
(c) Implement AND NOT function using McCulloch-Pitts neuron.　　*5*

2. (a) Consider the following travelling salesman problem involving 10 cities :

Parent 1 :	A	B	C	D	E	F	G	H	I	J
Parent 2 :	C	D	E	A	B	I	J	H	G	F

Determine the children solution using　　*4*

(i) Order crossover # 1, where two crossover sites are at positions 4th and 8th.

(ii) Order crossover # 2, for selected positions 3, 5, 7, 9 as key positions.

(b) Determine the new cluster centre, using Fuzzy C-Mean (FCM) algorithm. Perform only one iteration. The relevant data is given below : 6

(i) Data set for features f_1 and f_2 :

| Point	X_1	X_2	X_3	X_4	X_5
f_1	1	3	5	7	9
f_2	11	8	12	4	6

(ii) The number of clusters are 2 and the value of parameters which influence membership grade (m) is 2.

(iii) The initial cluster centres are $v_1 = (6, 6)$ and $v_2 = (11, 11)$.

3. (a) Perform the following for the Kohonen self-organizing feature map with weights, given below.
Find the cluster unit Y_j closest to the input vector (0·2, 0·4). Also find the new weights for unit Y_j.
Use learning rate of 0·2 and square of the Euclidean distance to find the cluster unit. 7
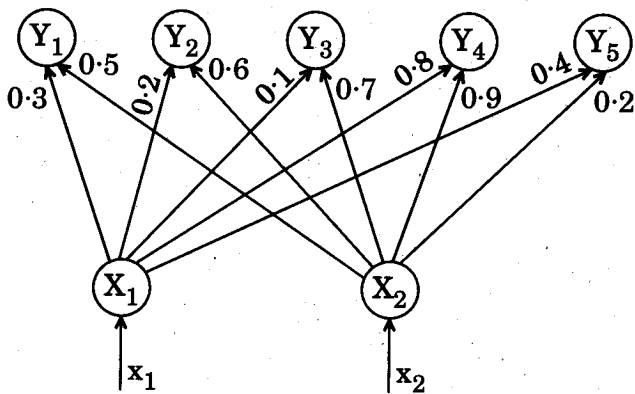

(b) Discuss the XOR problem. 3

4. **(a)** Find the alpha (α) cut relation for   *2*

$\alpha = 0{\cdot}2, 0{\cdot}4, 0{\cdot}7$ and $0{\cdot}9$ on the fuzzy relation R given as

$$R = \begin{bmatrix} 0{\cdot}2 & 0{\cdot}5 & 0{\cdot}7 & 1 & 0{\cdot}9 \\ 0{\cdot}3 & 0{\cdot}5 & 0{\cdot}7 & 1 & 0{\cdot}8 \\ 0{\cdot}4 & 0{\cdot}6 & 0{\cdot}8 & 0{\cdot}9 & 0{\cdot}4 \\ 0{\cdot}9 & 1 & 0{\cdot}8 & 0{\cdot}6 & 0{\cdot}4 \end{bmatrix}$$

(b) Find the new weights, using Back-Propagation network, for the network shown below. The network is presented with the input pattern [− 1, 1] and target output is + 1. Use learning rate of 0·25 and bipolar sigmoidal activation function.   *8*
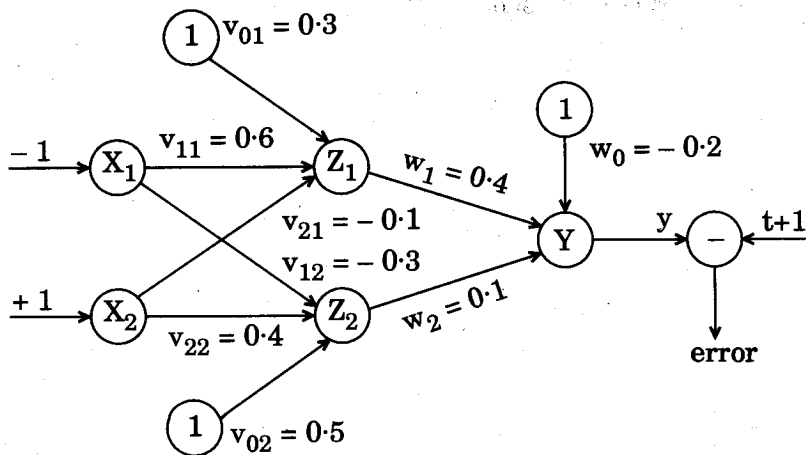
5. (a) Differentiate between Classical and Fuzzy clustering with example. *3*

(b) Generate the population in the next iteration using Roulette-Wheel Criterion. *5*

Variable No. K	1	2	3	4	5
Fitness Value F_k	3·5	4·6	5	2·8	1·8

(c) Apply single point crossover on the following binary strings and generate two offsprings

$$A \rightarrow 0\ 1\ 1\ 0\ 1\ 0\ 0\ 1\ 0\ 1$$

$$B \rightarrow 0\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 1\ 0$$

Consider 4th bit as the crossover site. *2*

6. (a) Show that a multi-layer network with linear transfer function is equivalent to a single layer linear network. *3*

(b) Write the schema for the gene sequence {0 1 1 1 0 0 0} and {1 1 1 0 0 1 1}.

Find the length and order of the schema. *3*

(c) The input to a single-input neuron is 2·0, its weight is 2·3 and its bias is − 3. *4*

(i) What is the net input to the transfer function ?

(ii) What is the neuron output for the following transfer function :
(a) Hard Limit
(b) Linear
(c) Log-Sigmoid

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

(a) The cardinality of fuzzy sets on any universe is finite.

(b) Laws of excluded middle are not valid for fuzzy sets.

(c) The Self Organizing Map (SOM) is unsupervised learning technique.

(d) If $w(k_0) = w(k_0 + 1) = w(k_0 + 2)$, then perceptron is non-linear separable.

(e) The length of chromosomes to determine maximum value of the set

$$S = \{x \mid 0 \leq x \leq 4096\} \text{ is } 10.$$