No. of Printed Pages : 7 **MMTE-007**

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

M.Sc. (MACS)

Term-End Examination

00212

December, 2014

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 questions no.* ***1*** *to* ***6****. Use of calculators is* ***not*** *allowed.*

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1. (a) The task is to recognize English alphabetical characters (F, E, X, Y, I, T) in an image processing system. Consider two fuzzy sets **I** and **F** to represent the identification of characters as given below :

I = {(F, 0·4), (E, 0·3), (X, 0·1), (Y, 0·1), (I, 0·9), (T, 0·8)}

F = {(F, 0·99), (E, 0·8), (X, 0·1), (Y, 0·2), (I, 0·5), (T, 0·5)}

(i) Find $\mathbf{I} \cup \mathbf{F}$, $\mathbf{I} - \mathbf{F}$ and $\mathbf{F} \cup \mathbf{F}^c$.

(ii) Verify De-Morgan's law

$(\mathbf{I} \cup \mathbf{F})^c = \mathbf{I}^c \cap \mathbf{F}^c$. 5

(b) What is the role of an activation function in neural networks ? Define the following activation functions along with their graphs : 5

(i) Linear Transfer Function

(ii) Threshold Function

(iii) Log-Sigmoid Function

(iv) Tan-Sigmoid Function

2. (a) The fuzzy sets **A** and **B** are defined as universe, x = {0, 1, 2, 3}, with the following membership fractions :

$$\mu_{\mathbf{A}}(x) = \frac{2}{x+3}, \qquad \mu_{\mathbf{B}}(x) = \frac{4x}{x+5}.$$

Define the intervals along x-axis corresponding to the α cut sets for each fuzzy set **A** and **B** for $\alpha = 0{\cdot}2$, $0{\cdot}5$ and $0{\cdot}6$. 5

(b) Find the modified weights for the training set having input $I_1 = 0{\cdot}3$, $I_2 = 0{\cdot}5$ and output $0{\cdot}2$ with initial weight matrices

$$[V]^0 = \begin{bmatrix} 0{\cdot}1 & 0{\cdot}4 \\ -0{\cdot}2 & 0{\cdot}2 \end{bmatrix} \text{ and } [W]^0 = \begin{bmatrix} 0{\cdot}1 \\ -0{\cdot}4 \end{bmatrix}.$$ 5

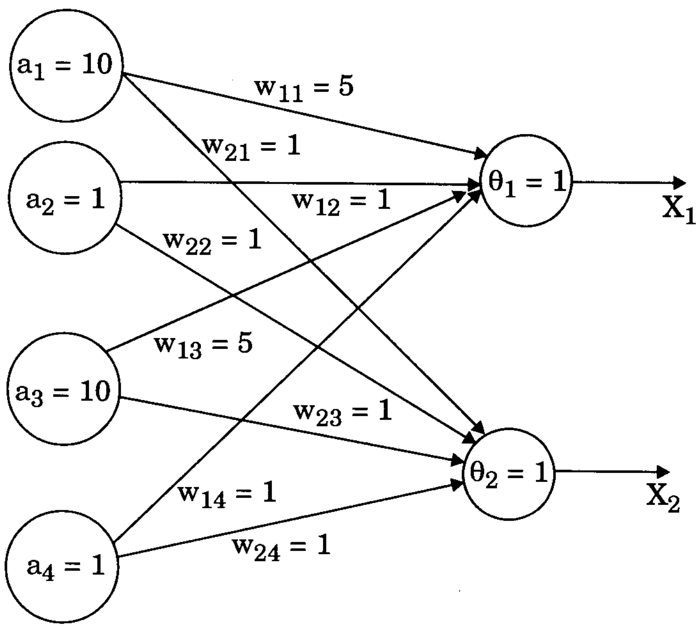
3. (a) Consider a data set of six-points given in the following table, each of which has two features f_1 and f_2. Assuming the values of parameter c and m as 2, the initial cluster centres as $V_1 = (6, 6)$ and $V_2 = (11, 11)$, apply fuzzy c-mean algorithm to find the new cluster centre after one iteration. *6*

	f_1	f_2
x_1	3	13
x_2	5	10
x_3	8	14
x_4	12	6
x_5	13	8
x_6	15	5

(b) Consider the ADALINE filter with three neurons in the input layer having weights $w_{11} = 2$, $w_{12} = -1$ and $w_{13} = 3$ and the input sequence as

$\{..., 0, 0, 0, 10, -8, 0, 0, 0, ...\}$. Find the output. *4*

4. (a) The neural network below uses "winner-takes-it-all" learning rule. At some instant t during the network training, inputs to the network and the weights of connections are as shown below :



(i) What will the input at the output units be ?

(ii) What will the output be assuming threshold θ_1 and θ_2 at two different nodes ? *6*

(b) Consider a 4-bit chromosome '1011'. List all the schemas. Find the length and order of each of the schemas. *4*

5. (a) Consider the two parents which are participating in the partially mapped crossover as shown below :

Parent 1 : 1 2 3 4 5 6 7 8 9

Parent 2 : 3 4 5 1 2 9 8 7 6

Assuming 2^{nd} and 6^{th} sites as the crossover sites, find the children solution. *4*

(b) Consider the training sets given in the following table :

Input		Output
I_1	I_2	O
0·2	– 0·1	0·1
0·3	0·5	0·2
0·5	– 0·1	0·1

The initial weight vectors are $[W]^0 = \begin{bmatrix} 0{\cdot}2 \\ -0{\cdot}5 \end{bmatrix}$ and $[V]^0 = \begin{bmatrix} 0{\cdot}1 & 0{\cdot}4 \\ -0{\cdot}2 & 0{\cdot}2 \end{bmatrix}$.

(i) Draw the multilayer architecture.

(ii) Modify weights to improve the network after one iteration. Given $\alpha = 0{\cdot}5$. *6*

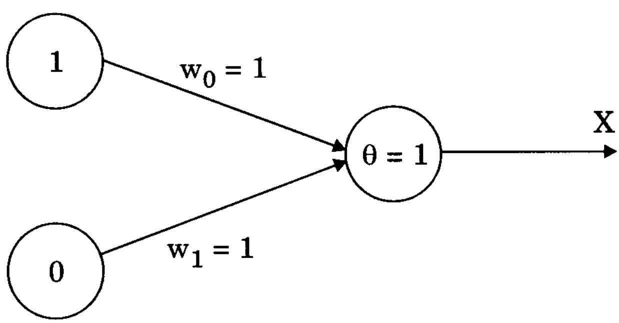
6. (a) Improve the solution of the following problem :

Max. $f(x) = \sqrt{x}$, subject to $1 \le x \le 15$ by considering the length of the string 4. Show only one iteration. 5

(b) A small perceptron with two inputs and one output unit is trained using the following training set :

Pattern No.	Input	Output
1	1	1
2	0	0

At some instant, current weights of connections and inputs to the network are as shown below :



(i) What training pattern has been used at that instant ?

(ii) What output will the network produce ?

(iii) Let the network learning rate be set to 0·25. How will the weights of connections, w_0 and w_1, change ? 5

7. Which of the following statements are *true* or *false* ? Give reasons for your answer. *10*

(a) For a constant input, Hopfield networks always reach a stable state after a finite number of iterations.

(b) SOMs can reduce the dimensionality of a given data space.

(c) In a 4-input neuron with weights 1, 2, 3 and 4 having the transfer function linear with the constant of proportionality being equal to 2, if the inputs are 4, 10, 5 and 20, respectively, then the output will be 76.

(d) For a fuzzy set **A**, if $\alpha_1 < \alpha_2$ then $\mathbf{A}_{\alpha_1} \supseteq \mathbf{A}_{\alpha_2}$.

(e) Maximization problem can be transformed into minimization problem through Max (F(x)) = – Min (– f(x)).