No. of Printed Pages : 4 **MMTE-007**

M.Sc. MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE

Term-End Examination

June, 2010

MMTE-007 : SOFT COMPUTING AND APPLICATIONS

Time : 2 hours | *Maximum Marks : 50*

Note : *Question No. 7 is* ***Compulsory****. Attempt* ***any four*** *questions from question no.* **1** *to* **6**. *Use of calculator is not allowed.*

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1. (a) Let R and S be binary relations defined in space $X \times Y$ and $Y \times Z$ respectively by matrices M_R and M_S, where **8**

$$M_R = \begin{array}{c} \\ x_1 \\ x_2 \end{array}\begin{array}{c} \begin{matrix} y_1 & y_2 \end{matrix} \\ \begin{bmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{bmatrix} \end{array} \text{ and } M_S = \begin{array}{c} \\ y_1 \\ y_2 \end{array}\begin{array}{c} \begin{matrix} z_1 & z_2 & z_3 \end{matrix} \\ \begin{bmatrix} 0.9 & 0.6 & 0.2 \\ 0.1 & 0.7 & 0.5 \end{bmatrix} \end{array}$$

then find the following compositions.

(i) Max – Min

(ii) Max – Product

(iii) Max – Average

(iv) Min – Max

(b) Define a feed forward neural network. How does it differ from a recurrent neural network ? **2**

2. (a) Show that De-Morgan's Law holds for fuzzy sets, i.e. **5**

(i) $(A \cup B)' = A' \cap B'$

(ii) $(A \cap B)' = A' \cup B'$,

(b) Let us consider the fuzzy set, defined on universe of discourse $X = \{a, b, c, d, e\}$, **5**

$$A = \left\{\frac{0.6}{a} + \frac{0.8}{b} + \frac{1}{c} + \frac{0.9}{d} + \frac{0.7}{e}\right\}.$$

Find α-cut sets for the value of $\lambda = 1, 0.8, 0.6, 0^{+}$ and 0 and give reasons for your answer.

3. (a) Input to a single - input neuron is 2, its weight is 2.3 and its bias (β) is -3. What is the net input to the transfer function ? Also, find the output of the neuron, if it has following transfer functions : **4**

(i) hard limiting

(ii) linear

(iii) log-sigmoid

(b) Consider 3-layer perceptron with three inputs, three hidden and one output units. Given the initial weight matrix for hidden and output nodes as. **6**

$$W_H = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & 2 \\ 0 & 3 & 1 \end{bmatrix} \text{ and } W_O = \begin{bmatrix} -1 \\ 1 \\ 2 \end{bmatrix}.$$

If input vector is $I = (3\ 4\ 0)$, calculate the output using hard limiting function as activation function.

4. (a) If the input vectors are $I_1 = [-1\ 0]^T$, and $I_2 = [0\ 1]^T$, and initial values of two weight vectors are $[0\ -1]^T$, and $[-2/\sqrt{5}\ \ 1/\sqrt{5}\ ]^T$. Calculate the resulting weights found after training the competitive layer with the Kohonen's rule and a learning rate α of 0.5 on the input series in order I_1 and I_2. **8**

(b) Differentiate between 'Algebraic Sum' and "Bounded Sum" of two fuzzy sets. 2

5. (a) Out of three genetic operators viz. Selection, Crossover and Mutation, list and justify which operator or combination thereof will be required for the following ? 6

(i) To fill the population with copies of the best individual from the population.

(ii) To cause the algorithms to converge on a good but sub-optimal solution.

(iii) To induce a random walk through the search space.

(iv) To create a parallel, noise-tolerant, hill climbing algorithm.

(b) Why is ranking selection preferred over Roulette - wheel selection in GA ? 4

6. Create two clusters of the five patterns X1 to X5 given in the following table by the e-means procedure using Euclidean distance. 10

Name of Pattern	Values of attributes	
	A1	A2
X_1	1	1
X_2	2	3
X_3	3	1
X_4	4	4
X_5	5	2

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

(a) If $\alpha_1 < \alpha_2$, then $A\alpha_1 \supseteq A\alpha_2$, where $\supseteq$ denotes a crisp superset relation.

(b) Let A and B are two fuzzy sets and $X \in U$. If $\mu_A(x) = 0.3$ and $\mu_B(x) = 0.9$, then $\mu_{\bar{A} \cup \bar{B}} = 0.6$.

(c) The two children chromosomes produced by applying one point crossover on the following parent chromosomes are

$$\text{Parents} \begin{bmatrix} 1 & 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 \end{bmatrix},$$

$$\text{Children} \begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 0 \end{bmatrix}.$$

(d) Minkowski metric reduces to Hamming distance when the variables are binary.

(e) The neurons lying on the output layer are assumed to have log-sigmoid transfer function. The output of the k-th output neuron is estimated by the following :

$$O_{ok} = \frac{e^{a O_{Ik}} - e^{-a O_{Ik}}}{e^{a O_{Ik}} + e^{-a O_{Ik}}}$$

where a is the co-efficient of the transfer function.