No. of Printed Pages : 6

MMTE-007

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

M.Sc. (MACS)

Term-End Examination

00484

December, 2016

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 calculator is **not** allowed.*

---

1. (a) Let R and S be two fuzzy relations as given below :

R = "X considerably larger than Y" =

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

S = "X is very close to Y" =

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

Define the following fuzzy relations :

(i) X is considerably larger or very close to Y.

(ii) X is considerably larger and very close to Y. *3*

(b) Let X be a linguistic variable that measures a company's intellectual assets, which takes values from the Universe of discourse U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. Suppose the term set of X includes Excellent, Good, Fair and Bad. Express these fuzzy sets through enumeration. Construct the α-cut at $\alpha = 0{\cdot}4$ for these fuzzy sets. *4*

(c) Design a neural network for XOR problem. *3*

2. (a) Consider a single input neuron, whose input is 2·0, weight is 2·3 and bias is –3. Find

(i) Net input to the transfer function,

(ii) Neuron output for transfer functions : Hard Limit, Linear, and Sigmoid (use a = 1). *5*

(b) Show that backpropagation reduces to the LMS algorithm for a single layer linear network (ADALINE). 5

3. (a) Consider a Hopfield network, whose weight matrix is given by

$$W = \frac{1}{4}\begin{bmatrix} 0 & -2 & 2 & 2 \\ -2 & 0 & -2 & 2 \\ 2 & -2 & 0 & -2 \\ 2 & 2 & -2 & 0 \end{bmatrix}.$$

Consider the two test input vectors $\mathbf{pt}_1 = (1\ -1\ 1\ 1)$ and $\mathbf{pt}_2 = (-1\ 1\ 1\ -1)$. Check whether the output state vectors satisfy the alignment condition. 5

(b) Consider two normally distributed probability distributions given by

$$P(x \mid \omega_i) = \frac{1}{\sqrt{2\pi}\,\sigma} \exp\left[-\frac{1}{2}\left(\frac{x-\mu_i}{\sigma}\right)^2\right], i = 1, 2$$

with equal deviations $\sigma = 1$ and priori probabilities $P(\omega_1) = P(\omega_2)$. Determine a classifier with a minimum classification error. 5

4. Calculate the modified weights found after training the competitive layer with Kohonen's rule, with learning rate (α) 0·5 on the input-series in order I_1, I_2 and I_3.

where, $I_1 = [-1 \quad 0]^T$; $I_2 = [0 \quad 1]^T$ and $I_3 = \left[\sqrt{2} \quad \frac{1}{\sqrt{2}}\right]^T$ and the initial values of three weight vectors are : $[0 \quad -1]^T$; $\left[\frac{-2}{\sqrt{5}} \quad \frac{1}{\sqrt{5}}\right]^T$; $\left[\frac{-1}{\sqrt{5}} \quad \frac{2}{\sqrt{5}}\right]^T$. *10*

5. (a) Minimize the fitness function $f(x) = x^2$, subject to $0 \leq x \leq 16$, using genetic algorithm approach. *6*

(b) Consider the following travelling salesman problem involving 9 cities :

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

Determine the children solution using

(i) Order crossover #1, where two crossover sites are at positions 3rd and 7th.

(ii) Order crossover #2, for selected position 2, 4, 7, 8 as key positions. *4*

6. (a) State Schema theorem and perform the following : 5

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

(ii) Write at least 4 chromosome sets, which are directly identified by schema S = (0 1 * 1 *).

(b) Derive the updation rule for weights in backpropagation algorithm, when the activation function is tanh x. 5

7. Which of the following statements are *True*, and which are *False* ? Give reasons. 10

(a) In a multilayer neural network, if the number of nodes at input, hidden and output layers are 6, 4 and 2 respectively, then the number of edges involved in the network is 32.

(b) If A and B are two fuzzy sets with $\mu_A(x) = 0{\cdot}4$ and $\mu_B(x) = 0{\cdot}8$, then $\mu_{A \cap B}(x) = 0{\cdot}4$.

(c) The order of the schema * * 0 1 * * is 2.

(d) In genetic algorithm, minimization problems can be transformed into maximization problems.

(e) In a single-layer neural network, the output corresponding to the input vector $[1 \quad 1]^t$ with weight vector [1 1] and bias $-1{\cdot}5$ is 0.

You may like to use the following table wherever required :

x	exp(x)
1·6	4·95
− 1·6	0·20
1·5	4·48
− 1·5	0·22
2	7·39