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MMTE-007

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

M.Sc. (MACS)

00546

Term-End Examination

June, 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.*

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1. (a) Let A and B be two fuzzy sets as given below :

$$A = \left\{ \frac{0.5}{\text{Mohan}}, \frac{0.9}{\text{Sohan}}, \frac{0.7}{\text{John}}, \frac{0}{\text{Abdul}}, \frac{0.2}{\text{Abraham}} \right\}$$

$$B = \left\{ \frac{0.75}{\text{Mohan}}, \frac{0.4}{\text{Sohan}}, \frac{0}{\text{John}}, \frac{0.8}{\text{Abdul}}, \frac{0}{\text{Abraham}} \right\}$$

Determine the following : 3

(i) Universe of discourse for sets A and B.

(ii) Compliment of sets A and B.

(iii) $A \cap B$

(iv) $A \cup B$

(b) Determine the α-cut of the fuzzy set (A) as given below, at 0·7 and 0·2 :

$$A = \left\{ \frac{0}{10}, \frac{0}{20}, \frac{0{\cdot}2}{30}, \frac{0{\cdot}8}{40}, \frac{1{\cdot}0}{50}, \frac{1{\cdot}0}{60}, \frac{0{\cdot}6}{70}, \frac{0{\cdot}2}{80}, \frac{0}{90}, \frac{0}{100} \right\}$$

Compare the α-cut of two outcomes, and give comments for status of α-value variation. 3

(c) Consider the following travelling salesman problem involving 10 cities :

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

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

Determine the children solution using order crossover (#1), assuming 4^{th} and 8^{th} sites as crossovers and cyclic crossover with 4^{th} position as initial position. 4

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

(a) Dataset for features f_1 and f_2 :

Point	X_1	X_2	X_3	X_4	X_5	X_6
f_1	2	4	7	11	12	14
f_2	12	9	13	5	7	4

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

(c) The initial cluster centers are $v_1 = (6, 6)$ and $v_2 = (11, 11)$. *10*

3. Draw the multilayer architecture and determine the updated weights for the first input of the training set given below after one iteration :

Input		Output
I_1	I_2	O
0·3	− 0·2	0·2
0·4	0·6	0·3
0·6	− 0·2	0·1

The initial vectors are $[W]^0 = \begin{bmatrix} 0{\cdot}3 \\ -0{\cdot}4 \end{bmatrix}$ and

$[V]^0 = \begin{bmatrix} 0{\cdot}2 & 0{\cdot}5 \\ -0{\cdot}1 & 0{\cdot}3 \end{bmatrix}$. Assume that the activation function is sigmoidal function, and learning rates are $\alpha = 1$ and $\eta = 0{\cdot}5$. *10*

4. Approximate the function $f(x) = 1 + \cos \pi x$ for $-1 \leq x \leq 1$, by solving 1-2-1 network, using Back propagation algorithm. The weighted structure and initial input are as follows :

(a) Weighted structure

$$[W]^0 = \begin{bmatrix} -0{\cdot}25 \\ -0{\cdot}40 \end{bmatrix}, \text{ bias } \phi_{(0)}^{(1)} = \begin{bmatrix} -0{\cdot}50 \\ -0{\cdot}1 \end{bmatrix}$$

$$[V]^0 = [0{\cdot}1 \quad -0{\cdot}2], \text{ bias } \phi_{(0)}^{(2)} = [0{\cdot}5]$$

(b) Initial input is 1. *10*

5. (a) Compute the output for the neurons in the Kohonen networks, the related data is given below :

(i) Input to Kohonen neural network

Input Neuron-1(I_1) = 0·5

Input Neuron-2(I_2) = 0·75

(ii) Connected weights between the neurons are as given below :

$I_1 \rightarrow O_1$	0·1
$I_2 \rightarrow O_1$	0·2
$I_1 \rightarrow O_2$	0·3
$I_2 \rightarrow O_2$	0·4

6

(b) Find the length and order of the following schema : 4

(i) $S_1 = 1 * * 0\ 0 * 1 * *$

(ii) $S_2 = * 0\ 0 * 1 * *$

(iii) $S_3 = * * * 0 * * * *$

(iv) $S_4 = * 1 * 0\ 1 *$

6. (a) Verify whether the Genetic Algorithm (GA) improves the solution from one generation to the next generation, for the function given below :

Maximize $f(x) = \sqrt{x}$

subject to $1 \leq x \leq 16$

Assume that chromosomes of length 6 are created at random and modified by Roulette-wheel selection. 6

(b) Consider a Hopfield network whose weight matrix is given by

$$\mathbf{W} = \frac{1}{3}\begin{bmatrix} 0 & -2 & 2 \\ -2 & 0 & -2 \\ 2 & -2 & 0 \end{bmatrix}.$$

Consider the two test input vectors

$$\mathbf{P}_1 = [1\ \ -1\ \ \ 1] \text{ and } \mathbf{P}_2 = [-1\ \ 1\ \ -1].$$

Check whether the output state vectors satisfy alignment conditions. 4

7. State whether the following statements are *true* or *false*. Give reasons for your answers. *5×2=10*

(a) If a 3-input neuron is trained to output a zero when the input is 110 and output one when the input is 111, then after generalization, the output will be zero when the input is 000 or 010 or 110 or 100.

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

$$S = \{x \mid 0 \leq x \leq 4096\} \text{ is } 12.$$

(c) The fuzzy relation

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

is an equivalence relation.

(d) The backpropagation algorithm is used for both classification and clustering.

(e) In a single layer neural network, if $\sum_{i=0}^{n} x_i w_i > 0$, then the output is –1, otherwise 1.

You may like to use the following table, wherever required :

x	e^x
– 0·09	0·91
– 0·08	0·92
– 0·75	0·47
– 0·7	0·50
– 0·5	0·61
– 0·1	0·90
0·1	1·11
0·2	1·22
0·115	1·27
0·08	1·08