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MMTE-007

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

M.Sc. (MACS)

00028

Term-End Examination

June, 2015

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.*

(iv) *Calculations may be rounded off to two decimal places.*

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1. (a) In a Marathon race, the following membership functions are defined based on the speed of the athletes :

$$\text{Low} = \left\{\frac{0}{100}, \frac{0{\cdot}1}{200}, \frac{0{\cdot}3}{300}\right\}$$

$$\text{Medium} = \left\{\frac{0{\cdot}5}{100}, \frac{0{\cdot}57}{200}, \frac{0{\cdot}6}{300}\right\}$$

$$\text{High} = \left\{\frac{0{\cdot}8}{100}, \frac{0{\cdot}9}{200}, \frac{1{\cdot}0}{300}\right\}$$

Find the following relations : 6

(i) Low × Medium (R)

(ii) Medium × High (S)

(iii) $T_1 = R \bullet S$ using Max-Min composition

(iv) $T_2 = R \bullet S$ using Max-Product composition

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

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

Determine the children solution using order crossover (#1), assuming 3^{rd} and 7^{th} sites as crossovers. 4

2. (a) Minimise $f(x) = x^2$ using Genetic algorithm, subject to $1 \leq x \leq 51$. 7

(b) Write the output at different nodes using back propagation algorithm for an artificial Neural Network with one hidden layer of N nodes. The number of nodes in the output layer is one. The output node is linear while the hidden layer nodes use the log sigmoid or the logistic activation function. The number of inputs to the network is 3. 3

3. (a) Consider the ADALINE filter with two neurons with the following parameters :

Weight matrix $\mathbf{W} = [2 \quad 3]$

Bias $b = 1.2$

Input vector $\mathbf{X} = [6 \quad -5]^t$

Find the output using threshold function. *4*

(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

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

Check if the output state vectors satisfy alignment conditions. *6*

4. (a) For the given fuzzy sets

$$A = \left\{\frac{1}{1{\cdot}0} + \frac{0{\cdot}65}{1{\cdot}5} + \frac{0{\cdot}4}{2{\cdot}0} + \frac{0{\cdot}35}{2{\cdot}5}\right\}$$

$$B = \left\{\frac{0}{1{\cdot}0} + \frac{0{\cdot}25}{1{\cdot}5} + \frac{0{\cdot}6}{2{\cdot}0} + \frac{0{\cdot}25}{2{\cdot}5}\right\}$$

$$C = \left\{\frac{0{\cdot}5}{1{\cdot}0} + \frac{0{\cdot}25}{1{\cdot}5} + \frac{0{\cdot}3}{2{\cdot}0} + \frac{0{\cdot}25}{2{\cdot}5}\right\}$$

Prove the associativity and the distributivity properties for A, B and C. *4*

(b) Given a two input Neuron with the following parameters :

$b = 1.2$, $W = [3 \quad 2]$ and

$x = [-5 \quad 6]^T$.

Calculate the neuron output for the following transfer functions :

(i) A symmetrical hard limit transfer function

(ii) A linear transfer function

(iii) A hyperbolic tangent sigmoid transfer function *6*

5. (a) Find the modified weights for the training set having input $I_1 = 0{\cdot}3$, $I_2 = 0{\cdot}5$ and output $= -0{\cdot}1$ with initial weights

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

Perform one iteration. *4*

(b) Find the length and order of the following Schema : *6*

$S_1 = (0 ** 11 * 0 **)$

$S_2 = (* 11 * 0 **)$

$S_3 = (*** 1 ***)$

6. (a) Consider a data set of six points given in the following table where each data point is represented by two features f_1 and f_2.

	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

Apply fuzzy c-mean algorithm (FCM) to find the new cluster centre after one iteration, where the values of the parameters c and m are 2 and the initial cluster centres

$V_1 = (5, 5)$ and $V_2 = (10, 10)$. *6*

(b) Draw the architecture of an MLP with two hidden layers, where the number of input nodes, nodes at hidden layer 1, nodes at hidden layer 2 and output layers are 3, 3, 2 and 2, respectively. *4*

7. State which of the following statements are *True* or *False*. Give reason for your answer. *10*

(i) The length of chromosomes to determine the minimum value of the set

$$S = \{x^2 + 4 \mid 0 \leq x \leq 1024\} \text{ is } 11.$$

(ii) If $\alpha_1 > \alpha_2$, then the subset relation is $A_{\alpha_1} \supseteq A_{\alpha_2}$.

(iii) If the inputs of 3-input neurons having weights 0·1, 0·2 and 0·3 are 0·4, 0·1 and 0·5, respectively, then the output will be – 1 using threshold function.

(iv) Mutation defines how chromosomes of the parents are mixed to obtain genetic codes of their off-springs.

(v) Only linearly separable data can be classified by multilayer perceptron.