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MMTE-007

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

M.Sc. (MACS)

Term-End Examination

December, 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.*

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1. (a) Let two fuzzy sets be given by

$$A = \left\{\frac{0{\cdot}1}{0}, \frac{0{\cdot}2}{1}, \frac{0{\cdot}4}{2}, \frac{0{\cdot}6}{3}, \frac{1}{4}\right\} \text{ and}$$

$$B = \left\{\frac{1}{0}, \frac{0{\cdot}5}{1}, \frac{0{\cdot}7}{2}, \frac{0{\cdot}3}{3}, \frac{0}{4}\right\}.$$

Find : 4

(i) $A \cup \tilde{B}$

(ii) $\tilde{A}$

(iii) $A \cap \tilde{B}$

(iv) $A \cup \tilde{A}$

(b) Consider the following table for the connections between the input neurons and the hidden layer neurons :

Input neurons	*Hidden layer neurons*	*Connection weights*
1	1	– 1
1	2	– 0·1
1	3	1
2	1	– 1
2	2	1
2	3	1
3	1	– 0·2
3	2	– 0·3
3	3	– 0·6

The connection weights from the hidden layer neurons to the output neurons are – 0·6, – 0·3 and – 0·6 for first, second and third neurons, respectively. Corresponding threshold value for the output layer is 0·5 and for the hidden layer is 1·8, 0·05 and 0·2 for the first, second and third neurons, respectively.

(i) Draw the diagram of the network.

(ii) Write the output at each node. 6

2. (a) Find the weights required to perform the following classifications using Perceptron Network. The vectors (1, 1, –1, –1) and (1, –1, 1, –1) are belonging to the class with target value 1, vectors (–1, –1, –1, 1) and (–1, –1, 1, 1) are not belonging to the class with target value –1. Assume learning rate as 1, initial weights as [0·1, –0·2, 0·3, –0·1], and activation function to be sigmoidal (a = 1). 6

(b) Write the schema for the Gene sequence (1000111) and (0001100). 2

(c) Write at least four chromosomes sets, which are identified by schema S = (10*0*). 2

3. (a) Consider the following two-dimensional data set that consists of 10 points in $\mathbf{R}^2$:

R	1	2	3	4	5	6	7	8	9	10
x_{k_1}	0	1	1	2	3	3	4	5	5	6
x_{k_2}	0	2	4	1	3	2	2	3	0	4

Assume that $c = 2$, $m = 1{\cdot}25$, $\| * \|$ is the Euclidean distance and the initial fuzzy pseudo-partition is $P^{(0)} = \{ A_1, A_2 \}$ with

$$A_1 = \left\{ \frac{0{\cdot}854}{x_1} + \frac{0{\cdot}854}{x_2} + \ldots + \frac{0{\cdot}854}{x_{10}} \right\},$$

$$A_2 = \left\{ \frac{0{\cdot}146}{x_1} + \frac{0{\cdot}146}{x_2} + \ldots + \frac{0{\cdot}146}{x_{10}} \right\}.$$

Starting with the initial membership values given above, obtain the final fuzzy pseudo-partition and the cluster centers assuming that convergence is achieved when the difference between the two values is $\leq 0{\cdot}01$. *6*

(b) Out of three genetic operators, viz. selection, crossover and mutation, list and justify which operator or combination thereof will be required for the following : *4*

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

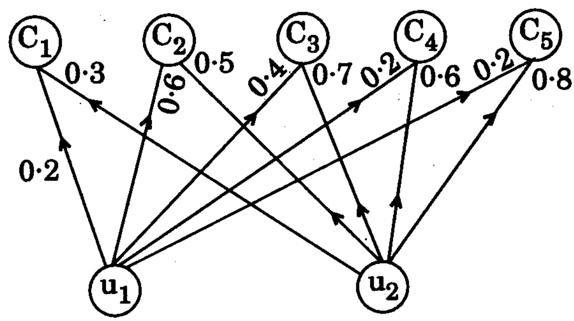
(ii) To cause the algorithms to converge on a good but sub-optimal solution.

4. (a) Maximize $f(x) = \dfrac{-x^2}{10} + 3x$, where $0 \leq x \leq 31$

using Genetic algorithm. *6*

(b) Solve the network to approximate the function $g(x) = 1 + \sin(\pi x/4)$ for $-2 \leq x \leq 2$, choosing the initial weights and bias as the random numbers. 4

5. (a)



A Kohonen self-organising map is shown with weights in the above figure. Find the cluster unit C_j, j = 1, 2, 3, 4, 5 that is closest to the input vector (0·3, 0·6) by using square of the Euclidean distance. 6

(b) Construct the α-cut at α = 0·7 and α = 0·5 for the fuzzy sets defined as follows : 4

X	x_1	x_2	x_3	x_4	x_5
μ_A	0·2	0·3	0·4	0·7	0·1

6. (a) A single layer neural network is to have six inputs and three outputs. The outputs are to be limited to and continuous over the range 0 to 1.

(i) How many neurons are required ?

(ii) What are the dimensions of the weight matrix ?

(iii) What kind of transfer functions could be used ?

(iv) Is a bias required ? Give reason. *4*

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

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

Consider two test input vectors

$PT_1 = (2 \;\; -2 \;\; 2)$ and $PT_2 = (-2 \;\; 2 \;\; -2)$.

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

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

(i) 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.

(ii) Every original pattern of a discrete Hopfield network with a synchronous update provides a global minimum.

(iii) The fuzzy relation

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

is an equivalence relation.

(iv) The order of schema **10** is 6.

(v) For two fuzzy sets A and B and $x \in U$, if $\mu_A(x) = 0{\cdot}3$ and $\mu_B(x) = 0{\cdot}9$, then $\mu_{\overline{A} \cup \overline{B}} = 0{\cdot}6$.