No. of Printed Pages : 6

MMTE-007

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

Term-End Examination

00040

December, 2013

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 Q. No.* **1** *to* **6**.

(iii) Use of calculator is ***not*** *allowed.*

1. (a) Two sensors based upon their detection levels and gain settings are compared. The following table of gain settings and sensor detection levels with a standard item being monitored provides typical membership values to represent the detection levels for each of the sensors. **5**

Gain Setting	Sensor 1 detection levels	Sensor 2 detection levels
0	0	0
20	0.5	0.35
40	0.65	0.5
60	0.85	0.75
80	1	0.90
100	1	1

The universe of discourse is

$x = \{0, 20, 40, 60, 80, 100\}$. Find the membership function for the two sensors. Also, verify De-morgon's laws for these membership functions.

(b) Maximize $f(x, y) = 8x + 6y$ 5

Subject to $2x + 3y \leq 6$

$$-3x + 2y \leq 3$$

$$2x + y \leq 4$$

$$0 \leq x \leq 2.$$

Using genetic algorithm.

2. (a) Find max - average composition for $R(x, y)$ and $S(x, y)$ defined by the following relational matrices : 6

$$R = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array} \begin{array}{c} \begin{array}{ccccc} y_1 & y_2 & y_3 & y_4 & y_5 \end{array} \\ \begin{bmatrix} 0.1 & 0.2 & 0 & 1 & 0.7 \\ 0.3 & 0.5 & 0 & 0.2 & 1 \\ 0.8 & 0 & 1 & 0.4 & 0.3 \end{bmatrix} \end{array}$$

$$S = \begin{array}{c} \\ y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{array} \begin{array}{c} \begin{array}{cccc} z_1 & z_2 & z_3 & z_4 \end{array} \\ \begin{bmatrix} 0.9 & 0 & 0.3 & 0.4 \\ 0.2 & 1 & 0.8 & 0 \\ 0.8 & 0 & 0.7 & 1 \\ 0.4 & 0.2 & 0.3 & 0 \\ 0 & 1 & 0 & 0.8 \end{bmatrix} \end{array}$$

(b) Consider the following travelling salesman problem involving 9 cities. 4

Parent 1	G	J	H	F	E	D	B	I	C
Parent 2	D	C	H	J	I	G	E	F	B

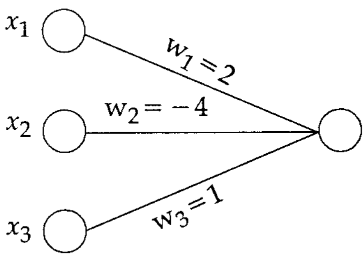
Determine the children solution using.

(i) Order crossover # 1, assuming 4^{th} and 7^{th} sites as the crossover sites.

(ii) Order crossover # 2, assuming 3^{rd}, 5^{th} and 7^{th} as the key positions.

3. (a) Write a formula describing the function defined by a one - hidden - layer (already trained) MLP with a single output. Also, write the formula describing the function defined by a RBFN with a single output. How do they differ ? 4

(b) Consider the following single layer perceptron as shown in the following figure. 6



and the activation function of each unit is defined as $\Phi(v) = \begin{cases} 1, \text{ if } v \geq 0 \\ 0, \text{ otherwise.} \end{cases}$

Calculate the output y of the unit for each of the following input patterns :

Patterns	P_1	P_2	P_3	P_4
x_1	1	0	1	1
x_2	0	1	0	1
x_3	0	1	1	1

Also, find the modified weights after one iteration.

4. (a) Consider the problem of finding the shortest route through several cities, such that each city is visited only once and in the end traveller returns to the starting city (the travelling salesman problem). Suppose that in order to solve this problem we use a genetic algorithm, in which genes represent links between pairs of cities. For example, a link between Delhi and Mumbai is represented by a single gene 'DM : Also assume that the direction in which we travel is not important, so that DM = MD. 3

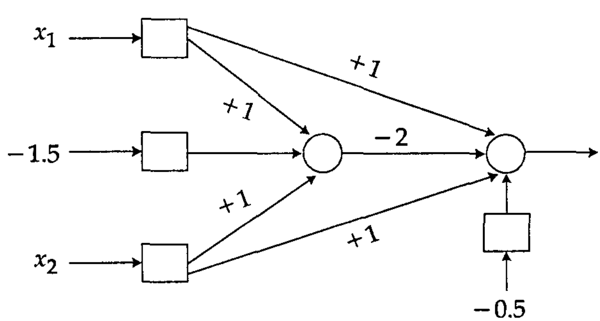
(i) How many genes will be used in a chromosome of each individual if the number of cities is 10 ?

(ii) How many genes will there be in the alphabet of the algorithm ?

(b) What is competitive learning ? How does it differ from Hebbian learning ? 3

(c) Write **any four** activation function used in neural networks. Also, draw the graph of the output of these functions. 4

5. (a) A single hidden neural network for solving the XOR problem is shown in the figure given below : 5



Show that the given network solves the XOR problem by constructing
(i) decision regions,
(ii) a truth table for the network.

(b) Write **any three** terminating conditions used in learning of a neural network. 3

(c) Consider a 4 - input neuron with weights 1, 2, 3 and 4. The transfer function is linear with the constant of proportionality being equal to 2. The inputs are 4, 10, 5 and 20, respectively. Find the output. 2

6. (a) Find the length and order of the following schema : 6
(i) $S_1 = (1 * * 0 0 * 1 * *)$
(ii) $S_2 = (* 0 0 * 1 * *)$
(iii) $S_3 = (* * * 1 * * *)$

(b) Let an activation function be defined as 4

$$\phi(v) = \frac{1}{1+e^{-av}}, \ a>0$$

Show that $\frac{d\phi}{dv} = a\phi(v)\left[1-\phi(v)\right]$. What is the value of $\phi(v)$ at the origin ? Also, find the value of $\phi(v)$ as v approaches $+\infty$ and $-\infty$.

7. Which of the following statements are true or false ? Give a short proof or a counter example in support of your answers. 10

(a) There is chance of occurrence of the premature convergence in Roulett-wheel selection scheme used in GA.

(b) Gradient based optimization methods are used when the objective function is not smooth and one needs efficient local optimization.

(c) The $\alpha -$ cut of a fuzzy set A in $\cup$ is defined as $A\alpha_0 = \{x \in U \mid \mu_A(x) \leq \alpha_0\}$

(d) A single perceptron with preprocessing is neither an auto associative network nor a multiple layer neural network.

(e) If $W(k_0) = W(k_0 + 1) = W(k_0 + 2)$, then perceptron is non-linear separable.