No. of Printed Pages : 7

MMTE-007

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

Term-End Examination

December, 2020

MMTE-007 : SOFT COMPUTING AND ITS APPLICATIONS

Time : 2 Hours *Maximum Marks : 50*

Note : (*i*) *Question No.* ***7*** *is compulsory.*

(*ii*) *Attempt any* ***four*** *questions from Question Nos.* ***1*** *to* ***6.***

(*iii*) *Use of non-programmable, scientific calculator is allowed.*

1. (a) Determine the fuzzy relation T as a composition between the fuzzy relations R and S given below by using max-min and max-product : 4

$$R = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{c} \begin{array}{cc} y_1 & y_2 \end{array} \\ \begin{bmatrix} 0.6 & 0.3 \\ 0.2 & 0.9 \end{bmatrix} \end{array}$$

and

$$S = \begin{array}{c} \\ y_1 \\ y_2 \end{array} \begin{array}{c} \begin{array}{ccc} z_1 & z_2 & z_3 \end{array} \\ \begin{bmatrix} 1 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{bmatrix} \end{array}$$

(b) Solve the network to approximate the function : 6

$$g(x) = 1 + \sin\left(\frac{\pi x}{2}\right)$$

for $-1 \leq x \leq 1$, choosing the initial weights and bias as the random numbers.

2. (a) 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) $S_4 = * 1 * 0 1 *$

(b) Consider the fuzzy sets A and B defined on the interval [0, 5]. Their membership functions are :

$$\mu_A(x) = \frac{x}{x+1}$$

and $$\mu_B(x) = 2^{-x}$$

Determine the membership function and graph them for each of the following : 6

(i) A^C, B^C

(ii) $A \cup B$

(iii) $A \cap B$

(iv) $(A \cup B)^C$

(v) $(A \cap B)^C$

3. (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) A single layer neural network is to have six inputs and three outputs. The outputs are continuous over the range 0 to 1. Now answer the following : 4

(i) How many neurons are required ?

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

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

(iv) Is a bias required ? Give reasons.

4. (a) Compute the output for the neurons in the Kohonen networks, the related data is given below : 6

(i) Input to Kohnen 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

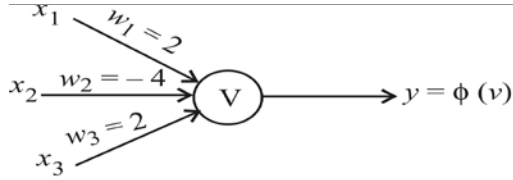
(b) Consider the two parents which are participating in partially mapped cross over as shown below :

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

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

Using partially mapped crossover assuming 2nd and 6th as the cross over sites, find the children solution. 4

5. (a) Consider the single layer perceptron given below : 6



The activation function is :

$$\phi(v) = \begin{cases} 1; & v \geq 0 \\ 0; & v < 0 \end{cases}$$

Obtain the output for each of the following input pattern :

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

(b) Consider the ADALINE filter with three neurons in the input layer having weights 3, 1 and –2 and the input sequence {....., 0, 0, 0, –4, 5, 0, 0, 0,.....}. Find the filter output. 4

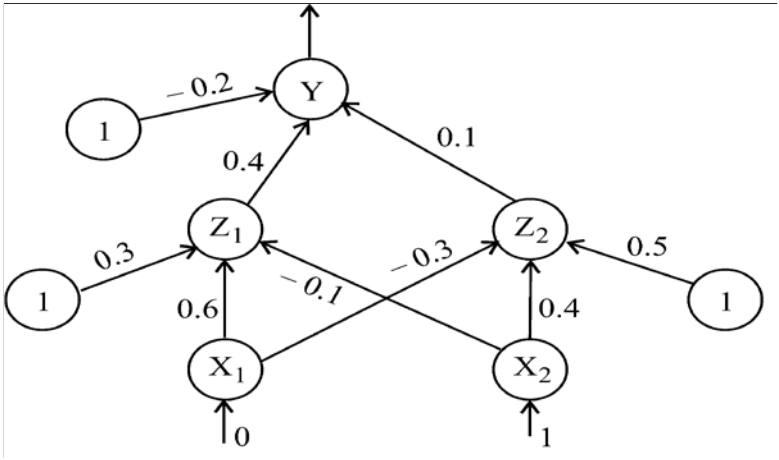
6. Determine the new weights for the following network by using Back propagation algorithm (perform one iteration). Given that : 10

(i) Input pattern is [0, 1]

(ii) Target output is 1

(iii) Learning rate $\alpha = 0.25$

(iv) Activation function is binary sigmoidal.



7. State whether the following statements are true or false. Give a short proof *or* a counter-example in support of your answer. 10

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

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

(ii) In the Hopfield network, the neurons belonging to the same layer receive input from the neurons of the previous layer and send their value only to the neurons of the next layer.

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

(iv) The fuzzy relation (R) given below, is an equivalence relation

$$R = \begin{bmatrix} 1 & 0.6 & 0 & 0.2 \\ 0.6 & 1 & 0.4 & 0 \\ 0 & 0.4 & 1 & 0 \\ 0.2 & 0 & 0 & 1 \end{bmatrix}$$

(v) The Self Organizing Map (SOM) is a supervised learning technique.