MANIPAL INSTITUTE OF TECHNOLOGY

Reg. No.

# SECOND SEMESTER M.TECH. (CONTROL SYSTEMS)

## **END SEMESTER DEGREE EXAMINATION, APRIL/MAY - 2019**

### SUBJECT: SOFT COMPUTING TECHNIQUES [ICE 5222]

#### TIME: 3 HOURS

# MAX. MARKS: 50

#### Instructions to candidates : Answer ALL questions and missing data may be suitably assumed.

- 1A For a speed control of DC motor, the membership functions of series resistance, armature current and speed are given as follows:  $R_{se} = \left\{\frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120}\right\}, I_s = \left\{\frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120}\right\} \text{ and } N = \left\{\frac{0.35}{500} + \frac{0.67}{1000} + \frac{0.97}{1500} + \frac{0.25}{1800}\right\}.$  Compute relation *T* for relating series resistance to motor speed i.e  $R_{sc}$  to N.
- 1B Define Membership function. Explain the features of membership functions with necessary diagram.
- 1C Using the inference approach, find the membership values for the triangular shapes I, R, E, IR and T for a triangle with angles 45°, 55° and 80°.
- 2A Write a short note on fuzzy propositions.

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(A constituent unit of MAHE, Manipal)

- 2B With suitable block diagram, explain the working of Fuzzy Logic Controller.
- 2C Design a fuzzy Inference system to simulate washing machine.
- 3A Using delta rule, find the weights required to perform following classifications: Vectors (1, 1,-1,-1) and (-1, -1, -1, -1) are belonging to the class having target value 1; vectors (1,1,1,1) and (-1,-1,1,-1) are not belonging to class having target value -1. Use a learning rate of 0.5 and assume random weights. Also using each of the training vectors as input, test the response of the net.
- 3B With a flow chart explain different stages involved in training of Back propagation network algorithm.
- 3C Design a Hebb net to implement AND function with a) binary inputs and targets b) binary inputs and bipolar targets.
- 4A Construct and test an auto associative discrete Hopfield network with input vector [1 -1 1 1]. Test the network with missing entries in first and fourth components of the stored vector.
- 4B Consider a Kohonen net with two cluster units and five input units. The weight vectors for the cluster units are

$$w_1 = (1.0, 0.9, 0.7, 0.3, 0.2)$$
  
 $w_2 = (0.6, 0.7, 0.5, 0.4, 1.0)$ 

Use the square of Euclidean distance to find the winning cluster unit for the input pattern x=(0, 0.2, 0.1, 0.2, 0). Find the new weights for the winning unit for the learning rate of 0.2.

4C Consider a LVQ with five vectors assigned to different classes

(2+3+5)

(2+3+5)

(3+4+3)

Vectors	Class
$(1\ 0\ 0\ 1)$	1
(0 1 0 0)	2
$(1\ 1\ 1\ 1)$	2
$(1\ 1\ 0\ 0)$	1
$(0\ 1\ 1\ 0)$	2

Assuming the first two vectors as the initial weights, calculate the new weights.

(3+3+4)

5A Consider an ART1 network with 9 input F1 units and two cluster F2 units. After some training, the bottom up and top down weights have the following values

The bottom up weights

 $b_{ij} = \begin{bmatrix} 1/3 & 1/10 \\ 0 & 1/10 \\ 1/3 & 1/10 \\ 0 & 1/10 \\ 1/3 & 1/10 \\ 0 & 1/10 \\ 1/3 & 1/10 \\ 0 & 1/10 \\ 1/3 & 1/10 \\ 1/3 & 1/10 \end{bmatrix}$ Top down weights  $t_{ji} = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$ 

The pattern (1 1 1 1 0 1 1 1 1) is presented to the network. Compute the action of the network if the vigilance parameter is 0.8.

- 5B Discuss the applications of neural network in forecasting
- 5C Describe the basic operators and terminologies used in genetic algorithm.

(5+3+2)

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