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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (COMPUTER SCIENCE & ENGINEERING)

END SEMESTER EXAMINATION, NOVEMBER 2018

SUBJECT: ELECTIVE – IV– SOFT COMPUTING PARADIGMS [CSE 4031]

REVISED CREDIT SYSTEM
(27/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Missing data may be suitably assumed.

1A. What are the three characteristics of Hebbian learning? State Hebbian hypothesis and its limitation. How it is overcome by Covariance hypothesis. State the important observations of Covariance hypothesis. **3M**

1B. Solve the following classification problem with perceptron rule. Apply each input vector in order, for as many repetitions it takes to ensure that problem is solved. **3M**

$$\left\{X_1 = \begin{bmatrix}2\\2\end{bmatrix}, d_1 = 0\right\} \quad \left\{X_2 = \begin{bmatrix}1\\-2\end{bmatrix}, d_1 = 1\right\}$$

$$\left\{X_3 = \begin{bmatrix}-2\\2\end{bmatrix}, d_3 = 0\right\} \left\{X_4 = \begin{bmatrix}-1\\1\end{bmatrix}, d_4 = 1\right\}$$

Assume learning rate, $\eta = 1$ and initial weight vector and bias to be zero.

Use the following hard limiter

$$y = \left\{\begin{matrix} 1 & if\ v \geq 0 \\ 0 & otherwise \end{matrix}\right\}$$

1C. In the following equation **4M**

$$\boldsymbol{Y} = \sum_{k=1}^{m} \boldsymbol{Y}_k \boldsymbol{X}_k^T \boldsymbol{X}_j$$

Prove that for the perfect recall of $\boldsymbol{Y}$, the key vectors $\boldsymbol{X}_k$ and $\boldsymbol{X}_j$ should be orthogonal. Also give your comments on memory capacity.

2A. Prove that for any two linearly separable classes there is a solution weight vector $\mathbf{w_0}$ after at most n_{max} iterations given by **5M**

$$n_{max} = \frac{\beta \|\mathbf{w_0}\|^2}{\alpha^2}$$

where α and β are positive constants.

2B. Derive the following local gradients in a Back propagation neural network with the help of a neat signal flow graph. **5M**

(i) $\delta_j(n) = e_j(n)\varphi_j'(v_j(n))$ neuron j is output neuron.

(ii) $\delta_j(n) = \varphi_j'(v_j(n))\sum_k \delta_k(n)w_{kj}(n)$ neuron j is hidden.

3A. Using proper mathematical representation, explain the following three essential processes involved in the formation of self-organizing map. **5M**

(i) Competition. (ii) Cooperation (iii) Synaptic adaptation.

3B. Consider a Kohonen network with two cluster units and three input units. The weight vector for the cluster units are (0.9, 0.7, 0.6) and (0.4, 0.3, 0.5). Find the winning cluster unit for the input vector (0.4, 0.2, 0.1). Use learning rate $\eta = 0.2$. Also find new weights for the winning neuron. **2M**

3C Explain the working of discrete Hopfield network with an example. What will happen if nodes are updated simultaneously in a network? Give an example of that condition. Find the weight matrix required to store the pattern vectors [1, 1, -1, -1], [-1, 1, 1, -1] and [-1, 1, -1, 1]. Take any one pattern and show whether it is capable of recognizing input pattern. **3M**

4A. You are asked to select an implementation technology for a numerical processor. Computation throughput is directly related to clock speed. Assume that all implementations will be in the same family (eg., CMOS). You are considering whether the design should be implemented using medium scale integration (MSI), field programmable array parts (FPGA), or multichip modules (MCM). Define the universe of potential clock speeds as X, and define MSI, FPGA and MCM as fuzzy sets of clock frequencies that should be implemented in each of these technologies. The following table defines the membership values for each of the three fuzzy sets. **2M**

Clock frequency , MHz	MSI	FPGA	MCM
1	0	0.3	0
10	0.7	1	0
20	0.4	1	0.5
40	0	0.5	0.7
80	0	0.2	1
100	0	0	1

Representing the three fuzzy sets as MSI=M, FPGA=F and MCM =C, find the following:

(i) $\mu_{M\cup F}(x)$ (ii) $\mu_{M\cap F}(x)$ (iii) $\mu_{\overline{M\cap C}}(x)$ (iv) $\mu_{\overline{F\cup C}}(x)$

4B. Explain the process of assigning membership values using intuition, inference and rank ordering methods with an example for each. Use the inference approach to find the membership values for triangular shapes Isosceles, right angled, equilateral and others. **5M**

4C. For a given membership functions as shown in the Figure 1 below, determine the defuzzified output value by centroid, weighted average and Mean-max methods. **3M**

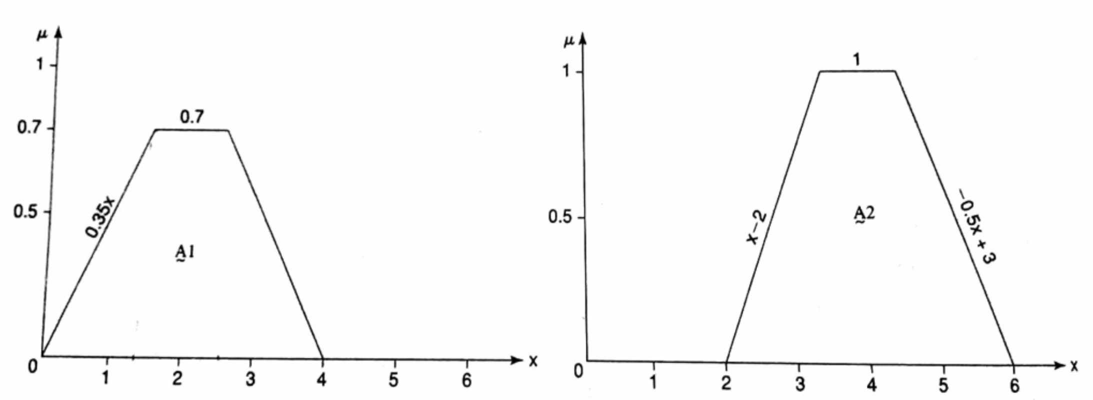

Figure 1: Membership functions

5A. What are fuzzy relation and composition of fuzzy relations? Assume the following universes: X = {x1, x2}, Y = {y1, y2}, and Z = {z1, z2, z3}, with the following fuzzy relations. **3M**

$R = \begin{bmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{bmatrix}$ and $S = \begin{bmatrix} 0.9 & 0.6 & 0.2 \\ 0.1 & 0.7 & 0.5 \end{bmatrix}$

Find the fuzzy relation between X and Z using max-min and max-product composition.

5B. What is the momentum constant in learning? Derive the equivalent time series representation of the following equation **2M**

$$\Delta w_{i,j}(n) = \alpha \Delta w_{i,j}(n-1) + \delta_j(t) y_i(t)$$

5C. Compared to traditional optimization algorithms, how genetic algorithm are different? Briefly explain a simple genetic algorithm. **5M**

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