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

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKEUP EXAMINATIONS, DECEMBER 2019

SOFT COMPUTING [ELE 4026]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 26, December 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Graph sheet shall be supplied if necessary.
- Missing data may be suitably assumed.

1A. A neural network consists of 2 inputs and 3 neurons in a particular layer. Three input training patterns and initial weights are as given below:

$W^{(0)} = \begin{bmatrix} 1 & -0.5 & -1 \\ -0.5 & 2 & -1.5 \end{bmatrix}$ and $X^{(1)} = \begin{bmatrix} 1 \\ 0.5 \end{bmatrix}$ $X^{(2)} = \begin{bmatrix} -1 \\ 1.5 \end{bmatrix}$ $X^{(3)} = \begin{bmatrix} 2.5 \\ -1 \end{bmatrix}$

Assume a learning constant c =1, obtain the modified weights at the end of one cycle using winner-take-all algorithm. ***(04)***

1B. Design a discrete bipolar neural network to perform the following classification:

Class A : $P_1 = (-1, 2)$ $P_2 = (2, -3)$ output $d_A = -1$

Class B : $P_3 = (2, 0.5)$ $P_4 = (0.5, 1)$ output $d_B = +1$

Draw the designed neural network with all synaptic and biasing weights indicated. ***(03)***

1C. A neural network has one layer consisting of two neurons. The available information of the network are $W = \begin{bmatrix} 2 & -1 \\ 0.5 & 0.75 \end{bmatrix}$ Bias = $\begin{bmatrix} 1 \\ -0.5 \end{bmatrix}$ and O = $\begin{bmatrix} 0.28 \\ -0.73 \end{bmatrix}$

Biasing input = -1. The activation function is bipolar continuous with $\lambda = 1.25$.

Sketch the neural network and determine the input matrix X. ***(03)***

2A. Design and draw the schematic of a Hopfield network to store the following bit patterns:

$S_1 = [1\ -1\ 1\ -1]^t$ $S_2 = [-1\ 1\ -1\ 1]^t$ and $S_3 = [-1\ -1\ 1\ 1]^t$.

Obtain the stored pattern of the above network at the end of one iteration when an arbitrary input $[-1\ 1\ 1\ 1]^t$ is initially applied to the network using state transition concept in asynchronous mode. ***(04)***

2B. A 2-layered bipolar sigmoidal neuron with $\lambda_1 = 1.2$, $\lambda_2 = \lambda_3 = 2.5$ is shown in **Fig. Q2B**:

$V = [0.9 \quad -0.4]^t$ $W = [-0.7 \quad 0.3]^t$ $d = [-0.5 \quad 0.8]^t$

For an input $Z = [1.2 \quad -0.8]^t$, modify weight vectors W & V for one iteration by Back propagation using Delta learning rule with learning constant c=1.0. ***(06)***

3A. Let 'a' = $\mu_A(x) = 0.52$ and 'b' = $\mu_B(x) = 0.79$. Obtain:

(i) A U B by DOMBI class with $\lambda = 2.5$

(ii) A $\cap$ B by DUBOI-PRADE class with $\alpha = 0.4$

(iii) compliment of 'a' by YAGER class with $\omega = 6$

(iv) compliment of 'b' by SUGENO class with $\lambda = 3$ ***(04)***

3B. Certain fuzzy set A defined by membership function shown below:

$$\mu_A(a) = \begin{cases} \dfrac{(a-1.5)}{4} & 1.5 \le a \le 5.5 \\ 1 & 5.5 \le a \le 8 \\ \dfrac{(10-a)}{2} & 8 \le a \le 10 \end{cases}$$

Defuzzify to obtain the crisp value A* by centroid method. ***(03)***

3C. Given two relations R_1 and R_2 as shown below, obtain

(i) max-product composition Q = R_1 o R_2

(ii) projection of Q on power and

(iii) projection of Q on Voltage

R_1 = Voltage / Current

	1	5	10
150	0.2	0.7	0.5
210	0.65	0.8	1.0
350	0.5	0.8	0.6
400	0.1	0.4	1.0

R_2 = Current / Power

	1000	5000
1	0.6	0.1
5	0.4	0.8
10	0.5	1.0

(03)

4A. Two linguistic variables A and B are defined as given below:

$$A = \left\{\frac{0.2}{10} + \frac{0.6}{20} + \frac{0.8}{30}\right\} \qquad B = \left\{\frac{0.3}{100} + \frac{0.9}{200}\right\}$$

and $\overline{\mathbf{A}}$ = YAGER compliment of A with $\omega = 1.5$

Given fuzzy inference,

X is $\overline{\mathbf{A}}$

IF X is **A** *THEN* Y is **B**

Y is $\overline{\mathbf{B}}$

Find (i) unary fuzzy set $\overline{\mathbf{B}}$ using (a) Luckasiewicz (b) Mamdani product implications

(ii) Crisp value of $\overline{\mathbf{B}}$ using weighted average method in each implication ***(04)***

4B. A fuzzy controller is to be designed to control speed of a DC shunt motor. For a given armature voltage and shunt field current, the speed is to be determined. The universe of discourse are VOLTAGE [0:300] in Volt, CURRENT [0:2] in Amp and SPEED [0: 2000] in rpm. The design shall include

(i) Linguistic values and respective equation for triangular membership functions for all linguistic variables considered

(ii) List of IF-THEN rules required

Calculate crisp value of speed for a sample input of 200 V and 0.5 A using weighted average method of defuzzification. ***(06)***

5A. Explain the terms with relevant illustrations as applied in Soft Computing:
(i) learning constant (ii) linguistic hedges ***(04)***

5B. Using Genetic Algorithm, the function f(x, y) = $e^{(2-x)}$ with boundary conditions of $0 \leq x \leq 6$ is to be optimized. Obtain (i) initial average fitness and (ii) average fitness at the end of first iteration after passing through the stages of crossover and mutation. Use population with chromosomes as mentioned below:
[0 1 1 0 1], [1 1 0 0 1], [0 0 0 0 1] and [0 0 1 1 0] ***(06)***

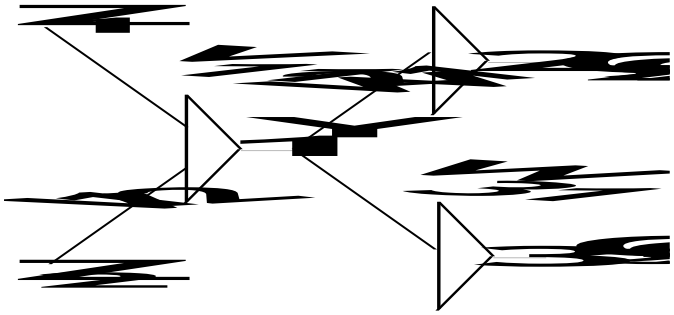

Fig. Q2B