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

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKEUP EXAMINATIONS, DECEMBER 2018
SUBJECT: SOFT COMPUTING [ELE 4026]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 27, December 2018** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. In a universe of discourse DISTANCE = [2…….15 km], define fuzzy sets SMALL, MEDIUM and LARGE relevant to distance to be covered. Give equations for each fuzzy set using triangular membership functions. Show graphical representation of all sets in the given universe of discourse.
If distance to be covered is 8 km, obtain the degree of each fuzzy set. ***(04)***

1B. Consider fuzzy sets

$$P(x)=\left\{\frac{0.3}{-2}+\frac{0.5}{-1}+\frac{0.75}{2}\right\} \text{ and } Q(y)=\left\{\frac{0.6}{0}+\frac{0.8}{1}+\frac{0.2}{2}\right\}$$

Using max-min composition, obtain fuzzy set R (z) such that $z = x^2 + y^2 - 2 * x * y$ ***(03)***

1C. Given a fuzzy set $GOOD=\left\{\frac{0.3}{10}+\frac{1.0}{30}+\frac{0.8}{50}+\frac{0.4}{100}\right\}$ Obtain fuzzy sets:

(i) very GOOD (ii) Intensely GOOD (iii) approximately GOOD ***(03)***

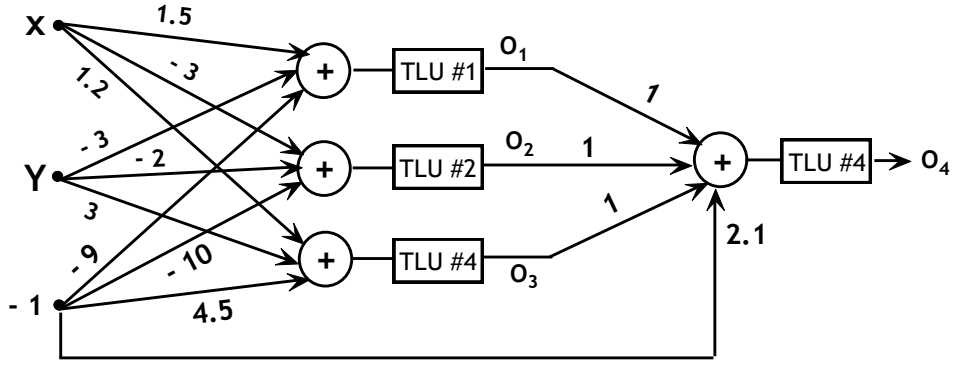
2A. Three output fuzzy sets are defined as given below in a universe of discourse X [0:9]:
A = trapezoidal (1, 3, 4, 6), B = triangular (3, 5, 7) and C = triangular (5, 7, 9)
The truncation levels of A, B and C are 0.6, 0.25 and 1.0 respectively during fuzzy rule implication. Determine the crisp output by centroid method. ***(04)***

2B. A fuzzy controller is to be designed for field current control method (speed is inversely proportional to field current) of speed control of a DC shunt motor. For a given terminal voltage and required speed, the field current is to be determined. The universe of discourse are VOLT [0:250], RPM [0:1200] and AMP [0.25: 1.25]. 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 field current for a sample input of 220 V and 900 rpm using mean of maximum method of defuzzification. ***(06)***

3A. Given O =1 if TLU > 0, sketch pattern represented by the two layer signum network shown below on X-Y plane.



(05)

3B. A single layer discrete bipolar network has four input patterns, respective desired outputs and initial weight vector as shown below. Using Perceptron learning rule with learning constant as 0.5, obtain weight vector at the end of one iteration.

$X_1 = \begin{bmatrix} -0.5 \\ 2 \end{bmatrix}$ $X_2 = \begin{bmatrix} -1.5 \\ 1 \end{bmatrix}$ $X_3 = \begin{bmatrix} -0.5 \\ -1 \end{bmatrix}$ $X_4 = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

$D_1 = -1;$ $D_2 = +1;$ $D_3 = +1;$ $D_4 - 1$

$W = \begin{bmatrix} 2 \\ 2.5 \end{bmatrix}$

Sketch transition of weight vector on $W_1 - W_2$ plane. ***(05)***

4A. A Hopfield single later feedback network has its weight matrix as shown below:

$$W = \begin{bmatrix} \mathbf{0} & \mathbf{-1} & \mathbf{-1} & \mathbf{3} \\ \mathbf{-1} & \mathbf{0} & \mathbf{-1} & \mathbf{-1} \\ \mathbf{-1} & \mathbf{-1} & \mathbf{0} & \mathbf{-1} \\ \mathbf{3} & \mathbf{-1} & \mathbf{-1} & \mathbf{0} \end{bmatrix}$$

For an initial input pattern $X^{(0)} = [1 \ \ 1 \ \ 1 \ \ 1]^t$, obtain the stored pattern using asynchronous mode transition. Also calculate initial energy level and energy levels at each transition. ***(05)***

4B. 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:

$W^{(0)} = \begin{bmatrix} 1 & -0.5 & -1 \\ -0.5 & 2 & 1 \end{bmatrix}$ 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. ***(05)***

5A. Explain the terms with relevant illustrations as applied in Genetic Algorithm:
(i) Ranking (ii) Crossover (iii) Mutation (iv) Objective function ***(04)***

5B. Using Genetic Algorithm, perform one iteration covering ranking, cross over, mutation and replacement to optimize the function $f(x, y) = 1.5x^2 + 3y$ with boundary conditions of $3 < x < 6$ and $1 < y < 5$. Use a population size of 4 and 5-bit binary string representation of each chromosome. Assume initial population as
[1 0 0 1 1 0 0 1 0 1], [0 1 1 1 0 1 1 1 0 0], [0 0 1 0 1 0 1 0 1 1] and [1 1 1 0 0 1 0 0 0 1] ***(06)***