Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATIONS, DECEMBER - 2020

SUBJECT: Neural Networks and Fuzzy Logic [ICE 4014]

28-12-2020

TIME : 3 HOURS **MAX. MARKS : 50**

Instruction to Candidates: Answer all Questions. Missing data may be suitably assumed.

1A. i) Draw a simple artificial neuron and describe the calculation of net input.
ii) What are the necessities of activation function and weight in an artificial neural network?

1B. For the network shown in Fig Q1B, Use Madaline network to implement XOR function with bipolar inputs and targets. Assume the required parameters for training of the network.

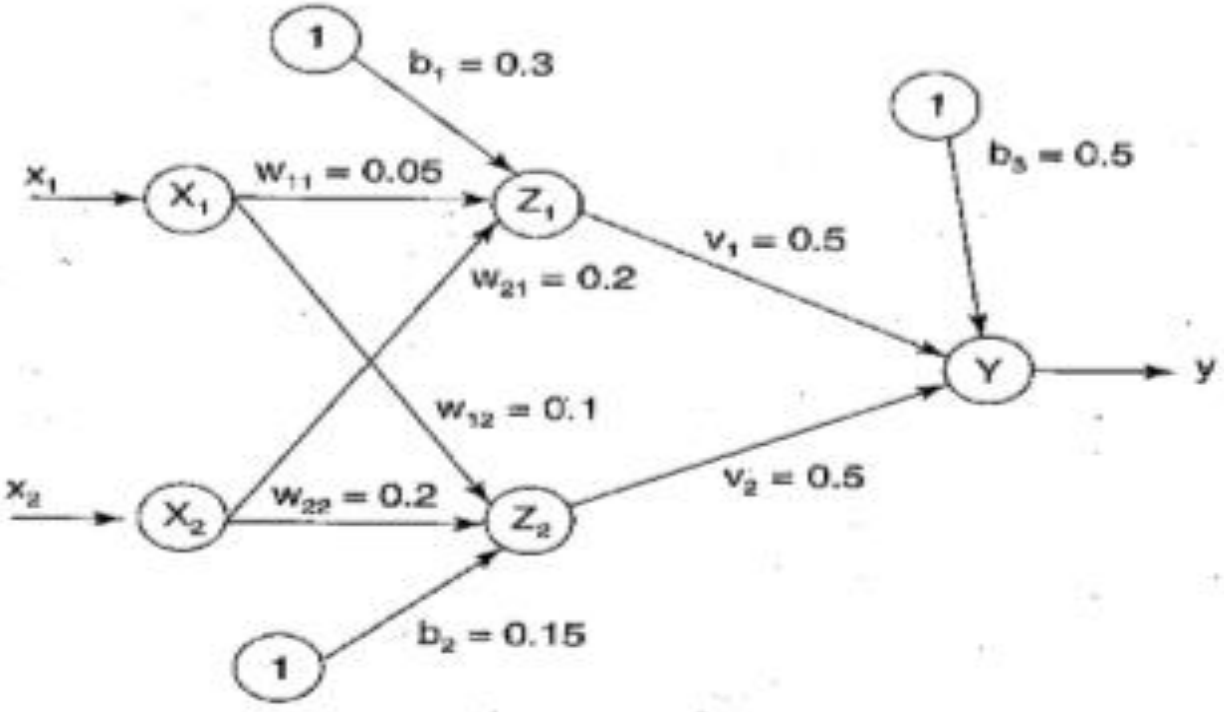

Fig. Q1B

1C. Find the weights required to perform the following classifications of given input patterns shown in Fig.Q1C using the Hebb rule.

The inputs are "1" where "+" is present and "-1" where "." is present. "L" pattern belongs to the class (target value +1) and "U" pattern does not belongs the class (target value is -1).

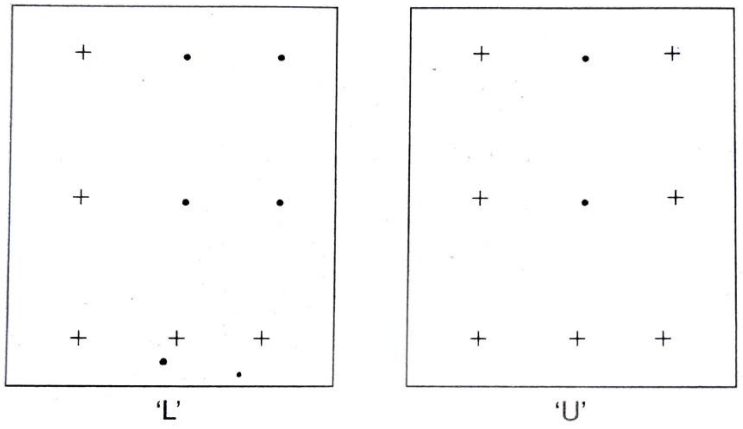

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Fig. Q1C

(3+4+3)

2A Using Widrow Hoff rule find the weights required to perform following classification. 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 the class having target value -1. Use a learning rate of 0.5. Assume the initial value of weight as 0.2. Also, using each of the training vectors as input, test the response of the net.

2B Construct a Kohonen self-organizing map to cluster the four given vectors [0 0 1 1], [1 0 0 0], [0 1 1 0] and [0 0 0 1]. The number of clusters to be formed is two. Assume an initial learning rate of 0.5. Consider the weight matrix as $W=\begin{bmatrix}0.2 & 0.9\\ 0.4 & 0.7\\ 0.6 & 0.5\\ 0.8 & 0.3\end{bmatrix}$

2C Develop Mexican Hat algorithm for a simple net with seven units. The activation function for this unit is $\begin{cases}0 & if\ x<0\\ x & if\ 0\le x\le 2\\ 2 & if\ x>2\end{cases}$ $Given\ R_1=1,\quad R_2=2,\quad C_1=0.6\quad and\quad C_2=-0.4$ and the external signal

s = (0.0, 0.5, 0.8, 1.0, 0.8, 0.5, 0.0)

(4+3+3)

3A Construct a Maxnet with four neurons and inhibitory weight $\varepsilon = 0.2$, given the initial activations as follows:

$$a_1(0)=0.3,\ a_2(0)=0.5,\ a_3(0)=0.7,\ a_4(0)=0.9$$

3B The discretized membership functions for a transistor and resistor are given below

$$\mu_T=\left\{\frac{0}{0}+\frac{0.2}{1}+\frac{0.7}{2}+\frac{0.8}{3}+\frac{0.9}{4}+\frac{1}{5}\right\}$$

$$\mu_R=\left\{\frac{0}{0}+\frac{0.1}{1}+\frac{0.3}{2}+\frac{0.2}{3}+\frac{0.4}{4}+\frac{0.5}{5}\right\}$$

Find the following a) Algebraic sum; b) Algebraic product; c) Bounded sum; d) Bounded product

3C Define Membership function and explain the features of membership functions with necessary diagram and state its importance in fuzzy logic.

(3+4+3)

4A Using inference approach find the membership values for each of the triangular shapes (isosceles, equilateral, right angle, isosceles and right angle and other triangles) with angle $20^{\circ}, 40^{\circ}, 120^{\circ}$.

4B Determine the crisp lambda cut relation for lambda=0.1, 0+, 0.3, 0.6, 0.7, 1.0 for the fuzzy relation given by

$$R = \begin{bmatrix} 1 & 0 & 0.2 & 0.1 & 0.4 \\ 0.6 & 0.7 & 0.3 & 0.5 & 0 \\ 0.8 & 0.9 & 0.6 & 0.3 & 0.2 \\ 0.1 & 0 & 1 & 0.9 & 0.7 \end{bmatrix}$$

4C Discuss Mamdani inference method with one example

(3+4+3)

5A Write the block diagram of Fuzzy logic control system and design a fuzzy logic controller to simulate Traffic control problem.

5B Write short notes on i) Formation of rules and ii) Decomposition of Rules

5C Explain how a neural network can be used in Natural Language Processing.

(4+3+3)