Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION NOV/DEC 2015

SUBJECT: SOFT COMPUTING TECHNIQUES (ECE – 425)

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

Instructions to candidates

- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Perform two training steps of delta learning rule of a continuous neuron for $\lambda = 0.5$, c=1.Train the network using the following input –target pairs :

$$X1 = \left(\begin{bmatrix} 2 \\ 0 \\ -1 \end{bmatrix}, d_1 = -1 \right) ; \; X2 = \left(\begin{bmatrix} 1 \\ -2 \\ -1 \end{bmatrix}, d_2 = 1 \right)$$; The initial weight vector is given by

$$W^1 = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix}^t$$

1B. Prototype points are given as

$$x_1 = \begin{bmatrix} -5 & 1 \end{bmatrix}^t, x_2 = \begin{bmatrix} -7 & 3 \end{bmatrix}^t \quad , x_3 = \begin{bmatrix} -3 & 2 \end{bmatrix}^t \quad , x_4 = \begin{bmatrix} -5 & 4 \end{bmatrix}^t : class1$$

$$x_5 = \begin{bmatrix} 0 & 0 \end{bmatrix}^t, \quad x_6 = \begin{bmatrix} 1 & -3 \end{bmatrix}^t, \quad x_7 = \begin{bmatrix} 2 & -3 \end{bmatrix}^t, \quad x_8 = \begin{bmatrix} 3 & 0 \end{bmatrix}^t : class2$$

Design a minimum distance linear classifiers for the given prototypes points and determine the class association of the classifier for the following inputs: $x = \begin{bmatrix} 0.5 & 2 \end{bmatrix}^t, x = \begin{bmatrix} 4 & 2 \end{bmatrix}^t, x = \begin{bmatrix} -5 & 0 \end{bmatrix}^t$

1C. Implement logical NOR function using McCulloch Pitt model

(5+3+2)

2A. Analyse a single feed forward and back propagation step for a two layered feed forward network with the following data: The transposed weight matrices for both the layers are:

1st layer

$$V = \begin{bmatrix} -0.5 & -1 \\ 1 & -1 \end{bmatrix}$$

2nd layer

$$W = \begin{bmatrix} -0.5 & -1 & -1 \end{bmatrix}$$

The input to the network, z = 0.25 and the bias input is -1.The desired output is d = 1. Use unipolar continuous neurons in the first layer and f (net) =net in the 2^{nd} layer .Assume η=1

2B. A four –neuron Hopfield auto associative memory has been designed for

$S^{(1)} = [-1 \;\; 1 \;\; 1 \;\; -1]^t$ Assuming that the recall is performed synchronously, compute E(v) in each case:

i) $S^{(t1)} = \begin{bmatrix} -1 & 1 & -1 & -1 \end{bmatrix}^t$ ii) $S^{(t2)} = \begin{bmatrix} -1 & -1 & -1 & -1 \end{bmatrix}^t$.

2C. Specify all missing weights for the multilayer network shown in **Fig Q2C**, that implements XOR classification using unipolar discrete neurons.

(5+3+2)

3A. The initial weight matrix of a Kohenen's feature map is given by: $W^t = \begin{bmatrix} 0.01 & 0.5 & 1 \\ 0.1 & 0.5 & 0.3 \\ 0.9 & 0.6 & 0.01 \end{bmatrix}$. Perform single step training for the input [1 0.08 0.4]. Use Euclidian distance metric for winner selection. Assume α=0.9, R=2.

3B. Discuss the training and learning issues in back propagation learning algorithm

3C. A feed forward network consists of 1 hidden layer and 1 output layer. The input vector i $X = [x1 \quad x2 \quad -1]^t$ and the weight matrices for both the layers are given by $W_1^t = \begin{bmatrix} -2 & 1 & 0 \\ -1 & -1 & -3 \\ 1 & 3 & 1 \end{bmatrix}$ W_2^t = [1 1 1 2.5] respectively. Find the regions of classification for which the network output responds with +1 and its complement with -1.

(5+3+2)

4A. Draw the flowchart for function optimization using Genetic Algorithm. Find the maximum value of the function f(x) = x^2, $0 \le x \le 3$, using Genetic algorithm with the initial population as 1101, 1110,1000,1010.

4B. Given two fuzzy sets $A = \frac{1}{1} + \frac{0.8}{2} + \frac{0.6}{3} + \frac{0.4}{4} + \frac{0.1}{5}$ and $B = \frac{0.2}{1} + \frac{0.4}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{1}{5}$

Determine the following:

i) Fuzzy union of $A_{0.5}$ and B by Yager sum

ii) Fuzzy intersection of A and B by Einstein product

4C. Determine whether the basic fuzzy complement, algebraic sum and algebraic product form an associated class or not?

(5+3+2)

5A. Explain the ART1 algorithm with the help of a flowchart and summarize the steps. Draw the network architecture.

5B. Prove that the Dombi s-norm converges to basic fuzzy union max (a, b) as the parameter goes to Infinity and converges to the drastic sum as λ goes to zero.

5C. Consider the following fuzzy relations:

$$Q1 = \begin{pmatrix} 0.2 & 1 & 1 \\ 0.8 & 0.5 & 0.6 \\ 0.7 & 1 & 0.3 \end{pmatrix} \quad Q2 = \begin{pmatrix} 1 & 1 & 0.8 \\ 0.5 & 0.1 & 0.7 \\ 0.9 & 0.04 & 0.2 \end{pmatrix}$$

Perform Q1 o Q2 by max-min composition

(5+3+2)

6A. Consider a 2-input 1-output fuzzy system that is constructed from the following two rules:

If x1 is A1 and x2 is A2, then y is A2

If x1 is A2 and x2 is A1, then y is A1

where A1 and A2 are fuzzy sets with membership functions:

$\mu_{A_1}(u) = 1 - |u|, if\ -1 \le u \le 1$ $\qquad$ $\mu_{A_2}(u) = 1 - |u-1|, if\ 0 \le u \le 2$

= 0 otherwise $\qquad$ = 0 otherwise

If the input to the fuzzy system is [x1*, x2*] = [0.4 0.8], use singleton fuzzifier to determine the output of the fuzzy system y* in the following cases:

i) Minimum inference engine and mean of maxima defuzzifier

ii) Product inference engine and center average defuzzifier

6B. Discuss cross validation and ROC performance evaluation parameters of a classifier

6C. Given fuzzy set $A = \frac{1}{1} + \frac{0.3}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{0.1}{5}$ and $B = \frac{0.2}{1} + \frac{0.5}{2} + \frac{0.7}{3} + \frac{0.9}{4} + \frac{1}{5}$

Determine Fuzzy AND with p = 0.5

(5+3+2)

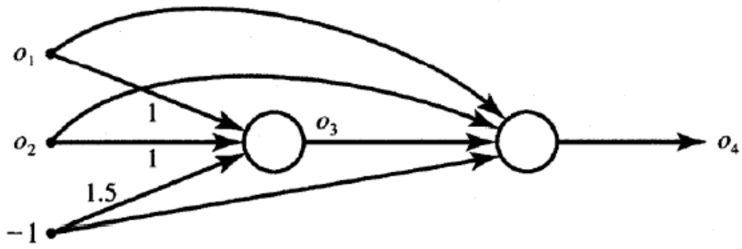

Fig Q2C