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MANIPAL INSTITUTE OF TECHNOLOGY
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SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: SOFT COMPUTING TECHNIQUES (ECE - 425)

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

Instructions to candidates
- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. Design a supervised multi-layered perceptron classifier for the classification of XOR logic. Assume the augmented input = -1. Draw the classifier diagram.

1B. Design a Hopfield auto associative memory to store S_1= [-1 1 1]^t. Test the retrieval by applying a test vector S_{test} = [-1-1-1]^t using async update and find the energy after each iteration. Comment on your results.

1C. Design a linear discriminant classifier to perform logical AND classification

(5+3+2)

2A. Perform single step back propagation algorithm to simulate a non-linear function $y = z^2$. The input z = 1. and the augmented input is -1. Assume linear neurons in both layers. The initial weights for the first layer is $V^t = \begin{bmatrix} 1 & 0.5 \\ 0 & -1 \end{bmatrix}$ and for the second layer $W^t = [1 \quad 1 \quad -1]$. Assume $\eta = \lambda = 1$.

2B. Design a spatio temporal memory to store the following sequences of patterns:
[1 -1 1 -1]^t , [-1 -1 -1 1]^t , [11-1 -1]^t and test the performance in forward and backward recall.

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

(5+3+2)

3A. The initial weight matrix of a Kohenen's feature map is given by:

$$W^t = \begin{bmatrix} -0.5 & 1 & 0 \\ 1 & 2 & 3 \\ 0 & 1 & 0 \end{bmatrix}$$

Perform single step training for the input [1 0.05 0.4]. Use correlation metric for winner selection. Assume α=0.5, R=1.

3B. A linear classifier is to be trained to assign x_1=-1 and x_2=1 to class 1 & 2 respectively. Display the movement of weight vector on the weight plane starting from the initial weights of [0 1]^t and perform iteration for 4 steps only. Use c=1 and bias input = -1.

3C. A feed forward network consists of 1 hidden layer and 1 output layer. The input vector is $X = [x1 \quad x2 \quad -1]^t$ and the weight matrices for both the layers are given by $W_1^t = \begin{bmatrix} -1 & -1 & 0 \\ 1 & -2 & 3 \\ 0 & -2 & 0 \end{bmatrix}$

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) = 2x-1, $0 \le x \le 3$, using Genetic algorithm with the initial population as 1101, 1011,1100,0110. Comment on your answer.

4B. Consider the following fuzzy relation defined on U1×U2×U3×U4 where U1={a, b, c} U2={s, t} U3={x, y}& U4={i, j}: $Q = 0.7/b,t,y,i + 0.1/a,s,x,i + 0.1/b,s,y,i + 0.9/b,s,y,j + 0.5/a,t,y,j + 0.6/c,s,y,i$

i) Compute the projections of Q on U1×U3×U4 , U1×U2 and U3

ii) Compute the cylindrical extensions of the projections in i) to U1×U2×U3×U4

4C. Show that the α-cut of a convex fuzzy set is also convex with illustration.

(5+3+2)

5A. Draw the network architecture of a Probabilistic Neural Network (PNN) and bring out at least 3 differences between Multilayer perceptron –back propagation and PNN network.

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

5C. Consider the following fuzzy relations:

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

Perform Q2 o Q1 by max-product composition

(5+3+2)

6A. Design a simple fuzzy rule based system to simulate a non-linear function Y=cos X, where *X* is defined in the universe [0 180] and *Y* is defined in the universe [-1 1] .Use Mamadani minimum implication with min for t-norm operator and max for s-norm operator. Use weighted average defuzzifier and test by applying the following fuzzy singletons: *X* = 0, 90,180.

6B. Define validation, sensitivity and specificity for a classifier in general.

6C. Given the fuzzy sets $A = \frac{1}{1} + \frac{0.2}{2} + \frac{0.5}{3} + \frac{0.8}{4} + \frac{0.1}{5}$ and $B = \frac{0.3}{1} + \frac{0.6}{2} + \frac{0.7}{3} + \frac{0.8}{4} + \frac{1}{5}$, determine Fuzzy OR with γ = 0.5

(5+3+2)

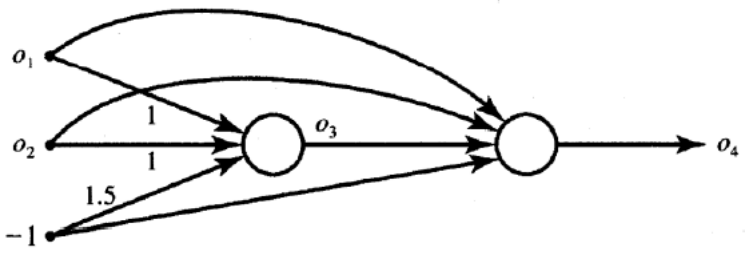

Fig. Q2C