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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2018
SUBJECT: SOFT COMPUTING TECHNIQUES (ECE -4033)

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

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

1A. The mean and variance of the height and weight of 4 male and 4 female subjects are given in Table.Q1A. Design a Bayes Classifier for gender classification and find the output of the classifier for a test subject whose height is 6 feet tall and weighing 130lbs.

1B. Design a perceptron classifier using unipolar binary neurons to perform 2-input OR classification using linear discriminant analysis. Assume c=1 & unipolar discrete inputs x_1 and x_2 (both take on either 0 or 1)

1C. Implement XOR logic function using McCulloch Pitts model.

(5+3+2)

2A. Design a discrete Hopfield auto associative memory to store 4-bit patterns a, b shown in Fig.Q.2A. Use bipolar discrete neurons to perform async update with the initial pattern c (Fig.Q.2A) and find the energy at each step. Comment on your result.

2B. The initial transposed weight matrix of a Kohenen's feature map is given by

$W = \begin{bmatrix} 0.1 & 0.5 & 1 \\ 0.01 & 0.5 & 0.03 \\ 0.9 & 0.6 & 0.1 \end{bmatrix}$. Perform single step training for the input vector using correlation metric.

The input vector is X = $[0.05\ 0.5\ 1]^t$. Assume α=1, R=1. After weight updation, calculate the correlation metric with new weights and same input. Comment on your results.

2C. Find the sensitivity and specificity of a classifier given that the confusion matrix is:

		PREDICTED CLASS	
		+	-
ACTUAL CLASS	+	150	40
	-	60	250

(5+3+2)

3A. Design a spatio temporal memory network using bipolar discrete neurons to store the following sequence: $S^0 = [1 \quad -1 \quad -1]^t \rightarrow S^1 = [-1 \quad 1 \quad -1]^t \rightarrow S^2 = [1 \quad 1 \quad 1]^t$

Perform both forward and backward recall.

3B. In a certain pattern classification problem, error back propagation training was used using one input layer consisting of 2 linear neurons and one output layer consisting of one linear neuron. In the forward pass, the hidden layer outputs are 0.8 & -0.5 respectively while the output layer neuron responds with 0.5 with the desired output equal to -1 and the output layer weight vector $W^t = [0.3 \quad 1 \quad 0]$.The input is $z = [0.5 \quad -1]^t$.Assume η=1.Find new weights in the output layer after single backward pass

3C. Prototype points are given as

$$x_1 = [-5 \quad 1]^t, x_2 = [-7 \quad 3]^t \quad , x_3 = [-3 \quad 2]^t \quad , x_4 = [-5 \quad 4]^t : class1$$
$$x_5 = [0 \quad 0]^t, \quad x_6 = [1 \quad -3]^t, \quad x_7 = [2 \quad -3]^t, \quad x_8 = [3 \quad 0]^t : class2$$

Design a R-category perceptron classifier and perform one step learning by assuming net (0)=1. The initial weight vectors are $W_1^{1t} = [1 \quad 0 \quad 0.5], W_2^{1t} = [-1 \quad 0.5 \quad 1], W_3^{1t} = [1 \quad 1 \quad -0.5]$. Take bias input= -1.

(5+3+2)

4A. With basic fuzzy complement , interpret the following fuzzy IF-THEN rule: 'IF speed is very SLOW THEN acceleration is not HIGH', where the fuzzy sets slow, HIGH are defined on a universe of speed and acceleration respectively as:

$\text{SLOW} = {}^{1}/_{10} + {}^{0.5}/_{30} + {}^{0.2}/_{50}$ $\quad \text{HIGH} = {}^{0.3}/_{30} + {}^{0.8}/_{50} + {}^{0.2}/_{70}$ using Zadeh and Mamadani minimum implication.

4B. Consider the following fuzzy relations:

$$Q1 = \begin{pmatrix} 0.02 & 1 & 1 \\ 0.8 & 0.5 & 0.6 \\ 0.7 & 0 & 0.3 \end{pmatrix}, Q2 = \begin{pmatrix} 0.1 & 1 & 0.8 \\ 0.5 & 0.01 & 0.7 \\ 0.9 & 0.4 & 0.2 \end{pmatrix}$$

Perform Q1 o Q2 by max-product composition. Is composition operation commutative? Justify your answer with proof.

4C. Find whether max, min and basic fuzzy complement form an associated class or not.

(5+3+2)

5A. Design a 3-rule based fuzzy system to simulate the nonlinear function given by: $y = cosx,$ The universes for input and output are defined as x = [0,360] and y = [-1 ,1]. Use Mamadani minimum implication for interpreting fuzzy IF-THEN rules, min for t-norm and max for union. Test the output of the system for x = 0, -180, +90 using centre average defuzzification.

5B. Determine the output for the fuzzy set shown in fig Q5B by center of gravity defuzzification method.

5C. Using Genetic Algorithm, maximize the nonlinear function, $y = x^2, \; for \; x = [0,3]$. Assume 1001, 1011, 0111 and 1000 as the initial population and perform 2 iterations only.

(5+3+2)

Table. Q1A

Gender	mean (height)	variance (height)	mean (weight)	variance (weight)
male	5.855	3.5033e-02	176.25	1.2292e+02
female	5.4175	9.7225e-02	132.5	5.5833e+02

Fig Q2A

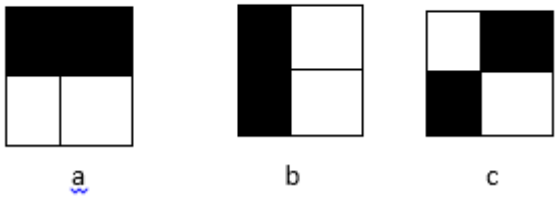

Fig Q5B