6. What are the fuzzy Inference Systems (FIS) ? Formulate a problem that you know to derive inference through fuzzy systems. 10

7. Given two Fuzzy Relations

$$R = \begin{array}{c} \\ x1 \\ x2 \end{array} \begin{array}{c} \begin{array}{cc} y1 & y2 \end{array} \\ \begin{pmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{pmatrix} \end{array}$$

$$S = \begin{array}{c} \\ y1 \\ y2 \end{array} \begin{array}{c} \begin{array}{ccc} z1 & z2 & z3 \end{array} \\ \begin{pmatrix} 0.9 & 0.6 & 0.2 \\ 0.1 & 0.7 & 0.5 \end{pmatrix} \end{array}$$

Find $T = R \times S$ using max-product decompositions. 10

8. (a) If the activation function of all hidden unit is linear, show that a MLP is equivalent to a single layer Perception. 5

(b) What are the advantages of a sigmoid function as the activation function over a hard limiting function ? 5

Total number of printed pages – 8

B. Tech

PECS 3401

Seventh Semester Examination – 2006

SOFT COMPUTING

Full Marks – 70

Time : 3 Hours

Answer the Questions from either Set A or Set B (not from both the sets).

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

Set – A

1. Answer the following questions : 2×10

(a) How does an ANN differs from biological neuron ?

(b) What are the different activation functions used in ANN ?

(c) State different learning methods of ANN.

(d) Sketch a 3-4-5-2 neural network.

(e) Distinguish between ADALINE and MADALINE.

(f) Write the weight update equation of a back propagation algorithm.

(g) Distinguish between fuzzy and probability with example.

(h) Differentiate between mutation and crossover operator.

(i) When GAs are preferred ?

(j) What are the benefits of GA ?

2. (a) Find the input u to the perception activation function for the following input vectors x and weight vectors w: 5

(i) $x = [-1, 0, 2]^T$ $w = [-1, -3, 2, -5]^T$

(ii) $x = [-1, 0, 2, 4]^T$ $w = [-1, -3, 2, -5]^T$

(b) Find the output using the activation function as defined for the 3-3 neural network with given input $x = [3, 0, 1]$ and

$$w = \begin{bmatrix} 3 & -1 & 1 \\ 1 & -2 & -2 \\ -1 & 0 & -3 \end{bmatrix}, \; output = \begin{bmatrix} -1, u < 0 \\ 1, u > 0 \end{bmatrix}$$

5

3. Derive the back propagation algorithm for 2-3-1 neural network with the activation function $\frac{1}{1 + e^{-x}}$. 10

4. Find the output u from the network with input $x = [-1, 2]^T$ $w = [-1, 2]$ with activation function in hidden layer as : 10

(i) Unipolar activation function

(ii) Bipolar sigmoidal function.

5. Two fuzzy relations are given as : 10

$$R1 = \begin{matrix} 0.3 & 0.0 & 0.7 & 0.3 \\ 0.0 & 1.0 & 0.2 & 0.0 \end{matrix} \quad \text{and} \quad R2 = \begin{matrix} 1.0 & 0.0 & 1.0 \\ 0 & 0.5 & 0.4 \\ 0.7 & 0.9 & 0.6 \\ 0 & 0 & 0 \end{matrix}$$

Find :

(a) Max-Min composition

(b) Max-Prod composition

(c) Max-Average composition of two relations.

6. Two fuzzy sets are given as : 10

$A = \{0.4/2, 0.6/3, 0.8/4, 1/5, 0.8/6, 0.6/7, 0.4/8\}$

$B = \{0.4/2, 0.8/4, 1/5, 0.6/7\}$

Find :

(i) intersection of A and B by applying three different T-norms.

(ii) Union

(iii) Difference.

7. (a) What is a fuzzy inference system ? Thus define the followings with examples : 5

(i) generalized modus ponens

(ii) generalized modus tollens.

(b) What do you mean by defuzzyfication ? Duscuss different methods of defuzzification. 5

8. (a) Write the algorithm for a simple Genetic algorithm. 5

(b) Following non-linear problems needs to be solved by GA. It is decided to give three and two decimal places of accuracy to variables x_1 and x_2 respectively. 5

(i) How many bits are required for coding the variables ?

(ii) What will be the fitness function ?

Minimize $(x_1 - 2.5)^2 + (x_2 - 5)^2$

Such that $5.5x_1 + 2x_2^2 - 18 \leq 0$

$0 \leq x_1, x_2 \leq 5.$

Set – B

1. Answer briefly : 2×10

(a) Specify the components of Soft Computing techniques.

(b) What are the different learning methods of NN ?

(c) Distinguish between Fuzzy and Probability theory.

(d) State different models of NN.

(e) Why learning is essential for a NN with nonlinear units ?

(f) What is the significance of momentum term in BP learning ?

(g) Why LMS algorithm is called as stochastic gradient descent method ?

(h) Why BP algorithm is called generalized delta rule ?

(i) Explain the limitations of BP learning.

(j) Distinguish between fixed and adaptive crossover operator.

2. Derive the Back Propagation algorithm for a FLANN structure with 2-inputs and 1-output, where the inputs are expanded to x, cos (pi*x), sin (pi*x). 10

3. (a) Distinguish between MLP and RBF NN with their relative merits and demerits. 5

(b) Specify different Properties of NN. 5

4. What are genetic Algorithms (GAs) ? Specify the steps followed in GAs. Illustrate the steps with a suitable example. 10

5. Given A = {1/2 + 0.5/3 + 0.3/4 + 0.2/5},

B = {0.5/2 + 0.7/3 + 0.2/4 + 0.4/5}

Find A', B', A V B , A B, A | B, A' A, B' B. 10