

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (CSE)/SEM-3/CST-631/2009-10

2009

SOFT COMPUTING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. 1 and any *four* from the rest.

1. a) Consider a universe of aircraft speed near the speed of sound as $\chi = \{ 0.72, 0.725, 0.75, 0.775, 0.78 \}$ and a fuzzy set on this universe for the speed "near mach 0.75" = \tilde{M} where

$$\tilde{M} = \{ 0/0.72 + 0.8/0.725 + 1/0.75 + 0.8/0.775 + 0/0.78 \}$$

Define a universe of altitudes as $Y = \{ 21, 22, 23, 24, 25, 26, 27 \}$ in k -feet and a fuzzy set on this universe for the altitude fuzzy set "approximately 24000 feet" = \tilde{N} , where

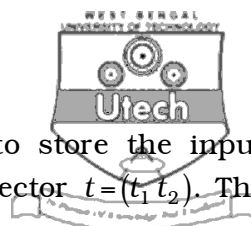
$$\tilde{N} = \{ 0/21k + 0.2/22k + 0.7/23k + 1/24k + 0.7/25k + 0.2/26k + 0/27k \}$$

- i) Construct a relation $\tilde{R} = \tilde{M} \times \tilde{N}$
ii) For another aircraft speed, say \tilde{M}_1 , in the region of mach 0.75, where

$$\tilde{M}_1 = \{ 0/0.72 + 0.8/0.725 + 1/0.75 + 0.6/0.775 + 0/0.78 \}$$

Find the relation $\tilde{S} = \tilde{M}_1 \circ \tilde{R}$ using max-min composition.

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- b) Train a hetero-associative network to store the input vectors $s = (s_1 s_2 s_3 s_4)$ to the output vector $t = (t_1 t_2)$. The vector pairs are given in the following table :

| | s_1 | s_2 | s_3 | s_4 | t_1 | t_2 |
|-----|-------|-------|-------|-------|-------|-------|
| 1st | 1 | 0 | 0 | 0 | 0 | 0 |
| 2nd | 1 | 1 | 0 | 0 | 0 | 0 |
| 3rd | 0 | 0 | 0 | 1 | 1 | 0 |
| 4th | 0 | 0 | 1 | 1 | 1 | 0 |

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2. a) State Perceptron training algorithm for single output classes. 5

- b) Find the weights required to perform the following classification using Perceptron network. The vectors $(1, 1, 1, 1)$ and $(-1, 1, -1, -1)$ are belonging to the class (so have target value 1). Vectors $(1, 1, 1, -1)$ and $(1, -1, -1, 1)$ not belonging to the class (so have the target value - 1). Assume learning rate as 1 and initial weights are zero (Perform only 1st epoch). 10

3. a) Consider two fuzzy sets :

$$\tilde{A} = \{ 0.2/1 + 0.3/2 + 0.4/3 + 0.5/4 \} \text{ and}$$

$$\tilde{B} = \{ 0.1/1 + 0.2/2 + 0.2/3 + 1/4 \}$$

Find the algebraic sum, algebraic product and bounded sum of the given fuzzy sets. 3

- b) Describe the importance of fuzzy sets. 1



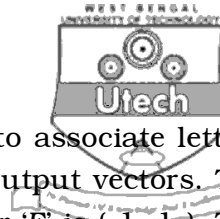
- c) Using Madaline network, implement XOR function with bipolar inputs and targets. Assume the required parameters for training of the network. Take bipolar data [Calculate only 1st epoch]. 11

4. a) Two fuzzy relations are given by

$$\tilde{R} = \begin{matrix} & y_1 & y_2 \\ \begin{matrix} x_1 \\ x_2 \end{matrix} & \begin{bmatrix} 0.6 & 0.3 \\ 0.2 & 0.9 \end{bmatrix} \end{matrix} \text{ and } \tilde{S} = \begin{matrix} & z_1 & z_2 & z_3 \\ \begin{matrix} y_1 \\ y_2 \end{matrix} & \begin{bmatrix} 1 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{bmatrix} \end{matrix}$$

Obtain fuzzy relation \tilde{T} as a composition between the fuzzy relations. 5

- b) What are tolerance and equivalence relations ? 5
- c) Compare between supervised learning and unsupervised learning with proper diagrams. 5
5. a) Describe the training algorithm for 'Back-Propagation' network. 6



- b) Construct and test a 'BAM' network to associate letters 'E' and 'F' with simple bipolar input-output vectors. The target output for 'E' is $(-1, 1)$ and for 'F' is $(1, 1)$. The display matrix size is 5×3 . The input patterns are :

| | | | | | |
|---|---|---|---|---|---|
| * | * | * | * | * | * |
| * | ■ | ■ | * | * | * |
| * | * | * | * | ■ | ■ |
| * | ■ | ■ | * | ■ | ■ |
| * | * | * | * | ■ | ■ |

[* = + 1 & ■ = - 1].

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6. a) What do you mean by 'Topological preserving' maps ? 1
 b) Define 'Euclidean distance'. 1
 c) For a given Kohonen self-organizing feature map with weights shown in figure.

Use the square of the Euclidean distance to find the cluster unit Y_j closest to the input vector $(0.2, 0.4)$. Using a learning rate of 0.2, find the new weights for unit Y_j .

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- d) Briefly discuss about Hamming net. Also describe the algorithm.

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