Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH-ME(CSE)/SE/SEM-3/CE-703/PGCSE-301B, PGSE-301B, PGCSE-302B, PGSE-302B/2011-12

2011

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 any *five* questions. 5 × 14 = 70

1. a) What is the necessity of activation function ?

   b) List the commonly used activation functions.

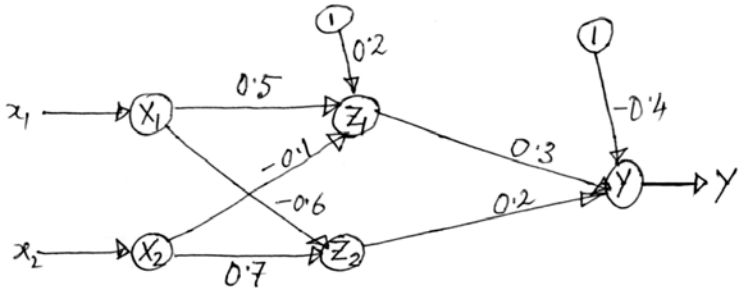
   c) Implement NAND function using McCulloch-Pitts neuron (take binary data).

   d) Design a Hebb net to implement logical AND function with bipolar inputs and targets. 2 + 2 + 5 + 5

2. a) List the stages involved in training of back propagation network.

b) What are the activations used in back propagation network algorithm ?

c) Using back propagation network, find the new weights for the network shown in the following figure. The network is presented with the input pattern [1, 0] and target output 1. Use learning rate $\alpha = 0 \cdot 3$ and binary sigmoid activation function.



3. a) Draw the architecture of an autoassociative network.

b) Train a heteroassociative memory network using Hebb rule to store input row vector $s = (s_1 \ s_2 \ s_3 \ s_4)$ to the output row vector $t = (t_1 \ t_2)$.

The vector pairs are given as below :

$s(1) = (1\ 0\ 0\ 1)$ $t(1) = (1\ 0)$

$s(2) = (1\ 1\ 1\ 1)$ $t(2) = (1\ 0)$

$s(3) = (1\ 1\ 0\ 0)$ $t(3) = (0\ 1)$

$s(4) = (0\ 0\ 1\ 1)$ $t(4) = (0\ 1)$

c) Find the weight matrix required to store the vectors [1 1 –1 1 – 1] , [1 1 1 1 – 1], [– 1 – 1 1 1 – 1] and [1 1 – 1 – 1 1] in w_1, w_2, w_3, w_4 respectively. Calculate the total weight matrix to store all the vectors and check whether it is capable of recognizing the same vectors presented. Perform the association for weight matrix with no self-connection. 2 + 6 + 6

4. a) Discuss the important features of Kohonen self-organizing maps.

b) Consider a Kohonen net with two cluster units and five input units. The weight vectors for the cluster units are

w_1 = (1·0 0·9 0·7 0·3 0·2)

w_2 = (0·6 0·7 0·5 0·4 1·0)

Use the square of the Euclidian distance to find the winning cluster unit for the input pattern x = (0·0 0·2 0·1 0·2 0·0). Using a learning rate of 0·2, find the new weights for the winning unit.

c) Construct an LVQ net to cluster five vectors assigned to two classes. The following input vectors represent two classes 1 and 2.

Vectors	Class
(1 0 0 1)	1
(1 1 0 0)	2
(0 1 1 0)	1
(1 0 0 0)	2
(0 0 1 1)	1

Perform only one epoch of training. 3 + 5 + 6

5. Let X be the universe of satellites of interest, as defined below :

$$X = \{\ a12,\ x15,\ b16,\ f4,\ f900,\ v111\ \}$$

Let $\underset{\sim}{A}$ be the fuzzy set of INSAT-V satellite :

$$\underset{\sim}{A} = \left\{\frac{0\cdot2}{a12} + \frac{0\cdot3}{x15} + \frac{1}{b16} + \frac{0\cdot1}{f4} + \frac{0\cdot5}{v111}\right\}$$

Let $\underset{\sim}{B}$ be the fuzzy set of INSAT-B satellite :

$$\underset{\sim}{B} = \left\{\frac{0\cdot1}{a12} + \frac{0\cdot25}{x15} + \frac{0\cdot9}{b16} + \frac{0\cdot7}{f4} + \frac{0\cdot3}{f900} + \frac{0\cdot2}{v111}\right\}$$

Find the following sets of combinations for these two sets :

(a) $\underset{\sim}{A} \cup \underset{\sim}{B}$ (b) $\underset{\sim}{A} \cap \underset{\sim}{B}$ (c) $\overline{\underset{\sim}{A}}$ (d) $\overline{\underset{\sim}{B}}$ (e) $\overline{\underset{\sim}{A} \cup \underset{\sim}{B}}$

(f) $\overline{\underset{\sim}{A} \cap \underset{\sim}{B}}$ (g) $\overline{\underset{\sim}{A}} \cup \overline{\underset{\sim}{B}}$ (h) $\overline{\underset{\sim}{A}} \cap \overline{\underset{\sim}{B}}$ (i) $\underset{\sim}{A} \mid \underset{\sim}{B}$ (j) $\underset{\sim}{B} \mid \underset{\sim}{A}$

(k) $\underset{\sim}{A} \cup \overline{\underset{\sim}{A}}$ (l) $\underset{\sim}{A} \cap \overline{\underset{\sim}{A}}$ (m) $\underset{\sim}{B} \cup \overline{\underset{\sim}{B}}$ (n) $\underset{\sim}{B} \cap \overline{\underset{\sim}{B}}$.

6. Three fuzzy sets are defined as follows :

$$\underset{\sim}{A} = \left\{\frac{0\cdot1}{30} + \frac{0\cdot2}{60} + \frac{0\cdot3}{90} + \frac{0\cdot4}{120}\right\}$$

$$\underset{\sim}{B} = \left\{\frac{1}{1} + \frac{0\cdot2}{2} + \frac{0\cdot5}{3} + \frac{0\cdot7}{4} + \frac{0\cdot3}{5} + \frac{0}{6}\right\}$$

$$\underset{\sim}{C} = \left\{\frac{0\cdot33}{100} + \frac{0\cdot65}{200} + \frac{0\cdot92}{300} + \frac{0\cdot21}{400}\right\}$$

Find the following :

a) $\underset{\sim}{R} = \underset{\sim}{A} \times \underset{\sim}{B}$

b) $\underset{\sim}{S} = \underset{\sim}{B} \times \underset{\sim}{C}$

c) $\underset{\sim}{T} = \underset{\sim}{R} \circ \underset{\sim}{S}$ using max-min composition

d) $\underset{\sim}{T} = \underset{\sim}{R} \bullet \underset{\sim}{S}$ using max-product composition. 2 + 2 + 5 + 5

7. a) Using inference method find the membership values of the triangular shapes for each of the following triangles :

i) 30°, 60°, 90°

ii) 45°, 65°, 70°

The triangular shapes are : Isosceles $\left(\underset{\sim}{I}\right)$, Right angled $\left(\underset{\sim}{R}\right)$, Equilateral $\left(\underset{\sim}{E}\right)$, other triangles $\left(\underset{\sim}{T}\right)$.

b) Consider the following fuzzy set defined on the universe

$X = \{ a, b, c, d, e \}$ as

$$\underset{\sim}{A} = \left\{ \frac{1}{a} + \frac{0 \cdot 9}{b} + \frac{0 \cdot 6}{c} + \frac{0 \cdot 3}{d} + \frac{0}{e} \right\}$$

Using Zadeh's notation, find the λ-cut set for $\lambda = 1, 0{\cdot}9, 0{\cdot}6, 0{\cdot}3$.

8. Write short notes on any *two* of the following : 7 + 7

a) Genetic Algorithm

b) Simulated Annealing

c) Unsupervised learning.

==========