Code No: R05410201 **Set No. 1**

IV B.Tech I Semester Regular Examinations, November 2008
NEURAL NETWORKS AND FUZZY LOGIC
(Common to Electrical & Electronic Engineering,Electronics & Control Engineering,Production Engineering,Aeronautical Engineering,Instrumentation & Control Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain in detail the working of biological neuron.
   (b) Compare artificial and biological neural networks. [8+8]

2. (a) Explain in detail the different artifical neural network architectures in detail.
   (b) The feedforward network shown in figure 1 using bipolar binary neurons is mapping the entire plane x_1, x_2 into a binary '0' value. Find the segment of the x_1, x_2 plane for which 0_4=1, and its complement for which 0_4=-1. [8+8]

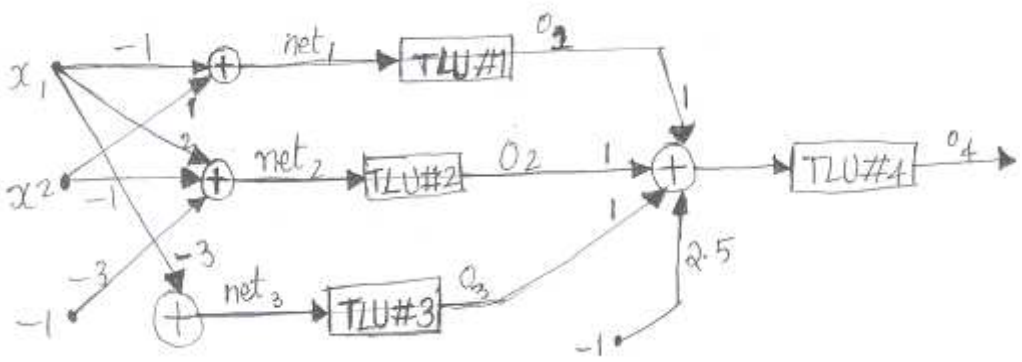

Figure 1:

3. (a) State and prove perceptron convergence theorem.
   (b) Explain in detail the limitations of perceptron model. [8+8]

4. (a) Derive the equation for weight change in the output and hidden layers of backpropopagation network.
   (b) Explain in detail the problems of backpropagation network. [8+8]

5. (a) i. The following vectors need to be stored in a recurrent autoassociative memory:
   $S^{(1)} = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \end{bmatrix}^t$
   $S^{(2)} = \begin{bmatrix} 1 & -1 & -1 & 1 & -1 \end{bmatrix}^t$

   $S^{(3)} = \begin{bmatrix} -1 & 1 & 1 & 1 & 1 \end{bmatrix}^t$
   compute the weight matrix W.

ii. Apply the input vector $V^0 = \begin{bmatrix} 1 & -1 & -1 & 1 & 1 \end{bmatrix}^t$ and allow for asynchronous convergence in ascending node order starting at node 1.

(b) State and prove BAM stability theorem. [8+8]

6. (a) Consider the fuzzy sets $\tilde{A}$ & $\tilde{B}$ defined on the interval X=[0,5] of real numbers, by the membership grade functions.
$\mu_{\tilde{A}}(x) = \frac{x}{x+1},\ \mu_{\tilde{B}}(x) = 2^{-x}$
Determine the mathematical formulae and graphs of the membership grade functions of each of the following sets.

i. $A^C,\ B^C$

ii. $A \cap B$

iii. $A \cup B$

iv. $(A \cup B)^C$

(b) What do you mean by CRISP Relations. Explain with an example max-min composition relation. [8+8]

7. (a) Let $\tilde{A}_1, \tilde{A}_2, \tilde{A}_3$ are three fuzzy sets as shown in figure 2, 3, 4,. Find the aggregated fuzzy set of $\tilde{A}_1, \tilde{A}_2, \tilde{A}_3$ & find the defuzzification using centroid method.

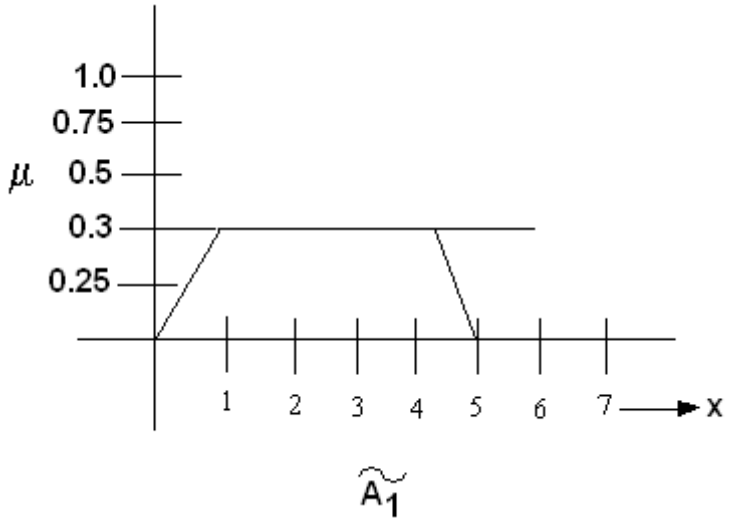

Figure 2:

(b) What is Fuzzy inference. Explain the two important inferring procedures. [8+8]

8. (a) Explain how ANN is used for process control

(b) Explain in detail how classification is done using Fuzzy logic. [8+8]

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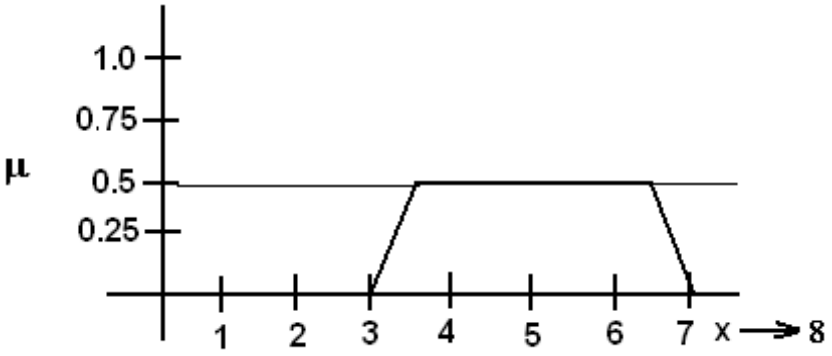

Figure 3:

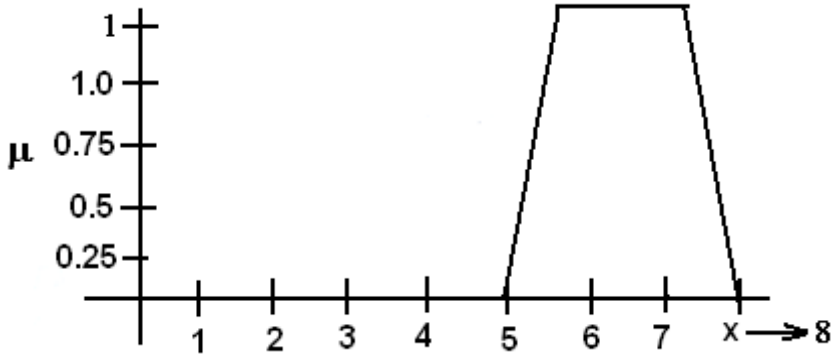

Figure 4:

Code No: R05410201 **Set No. 2**

IV B.Tech I Semester Regular Examinations, November 2008
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1. (a) Explain in detail the applications of artificial neural networks.
   (b) Explain the architectures of the following artificial neuron models.
      i. Hodgein-Huxley neuron model.
      ii. Integrate and fire neuron model.
      iii. Spiking neuron model. [8+8]

2. (a) Explain with block diagrams the different learning strategies.
   (b) The network shown in the figure 1 uses neurons with bipolar sigmoid activation functions with $\lambda = 1$. The neurons output has been measured as O_1=0.28 and 0_2 =-0.73. Find the input vector $x = \begin{bmatrix} x_1 & x_2 \end{bmatrix}^1$ that has been applied to the network. Also find the slope values of the activation function at the activations net_1 and net_2. [8+8]

3. (a) Explain the architecture and algorithm of discrete perceptron network.
   (b) Explain why perceptron network would not solve even the Ex-OR problem. [16]

4. (a) Prove that for n=2, the number of hidden layer neurons J needed for hyper-plane partition into M regions is
   $J = \frac{1}{2}\left(\sqrt{8M-7}-1\right)$
   (b) State and explain kolmogorov theorem. [8+8]

5. (a) Give the energy analysis of discrete hopfield network.
   (b) Compute the energy values for all 16 bipolar binary vectors for a five-bit autoassociative recurrent memory having the following weight matrix.
   $$W = \begin{bmatrix} 0 & 0 & 2 & 0 & -2 \\ 0 & 0 & 0 & -2 & 0 \\ 2 & 0 & 0 & 0 & -2 \\ 0 & -2 & 0 & 0 & 0 \\ -2 & 0 & -2 & 0 & 0 \end{bmatrix}$$
   By comparing the energy levels, prepare a hypothesis regarding the two stored vectors. [8+8]

6. (a) Compare & contrast Fuzzy & Crisp sets.

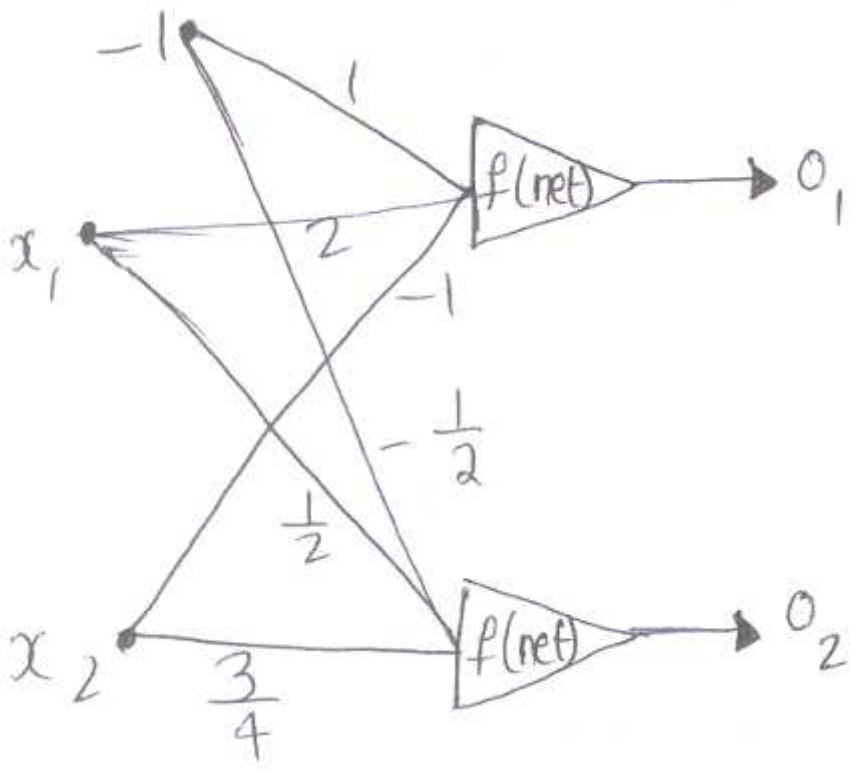

Figure 1:

(b) Illustrate & explain the properties of Fuzzy sets. [8+8]

7. (a) What do you mean by predicate logic? Explain the interpretations of prediacte logic formula?

   (b) Given

   i. Every soldier is strong-willed
   ii. All who are strong willed & sincere will succeed in their carrer
   iii. Indira is soldier
   iv. Indira is sincere.

   Prove: Will indira succeed in her carrer. [8+8]

8. Write short notes on:

   (a) Application of ANN for process fault diagnosis.

   (b) Application of Fuzzy logic for classification. [8+8]

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Code No: R05410201 **Set No. 3**

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1. (a) Using MC-Culloch pitts model implement the following logic functions.
   i. Ex-OR gate
   ii. Ex-NOR gate
   iii. AND gate
   iv. NAND gate
   (b) Explain the organization of the brain in detail. [8+8]
2. (a) Explain the following learing rules.
   i. Delta learning
   ii. Outstar learning
   iii. Instar learning
   iv. Correlation learning.
   (b) Explain in detail different activation functions used in ANN and compare them. [8+8]
3. (a) Explain linear seperable and non-linear seperable classes.
   (b) State and prove perceptron convergence theorem. [8+8]
4. (a) Explain the modifications suggested to back propagation network.
   (b) Give the architecture and algorithm of back propagation network. [8+8]
5. (a) Explain why linear associative network provides no means for supression of cross talk noise term.
   (b) The following unipolar binary vectors must be stored in the recurrent autoassociative memory using the outer product method with the nullification of the diagonal.
   $S^{(1)} = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \end{bmatrix}^t$
   $S^{(2)} = \begin{bmatrix} 0 & 1 & 1 & 0 & 1 \end{bmatrix}^t$
   $S^{(3)} = \begin{bmatrix} 1 & 1 & 0 & 1 & 0 \end{bmatrix}^t$

   i. Compute matrix W.

ii. Find the analytical expression for the energy function that the memory is minimizing. [8+8]

6. (a) Give and explain the properties of crisp sets

   (b) Let R,S be defined on the sets {1, 3, 5} × {1,3,5}. Let R: $\{(x, y)/y = x + 2\}$, $S : \{(x, y)/x \leq y\}/$. Using max min composition find

   i. RoS

   ii. SoR. [8+8]

7. (a) Explain with example MOM method for defuzzification.

   (b) Let H = High, VH = very high, $\tilde{S}$ = slow and $\tilde{Q}$ (Quite slow) indicate, the associated fuzzy sets as follows.
   For X={30,40,50,60,70,80,90,100}, the set of temperatures and Y={10,20,30,40,50,60}, the set of rotations per minute.
   $\tilde{H} = \{(70, 1)\ (80, 1)\ (90, 0.3)\ \}$
   $\tilde{V}H = \{(90, 0.9)\ (100, 1)\}$
   $Q\tilde{S} = \{(10, 1)\ (20, 0.8)\}$
   $\tilde{S} = \{(30, 0.8)\ (40, 1)\ (50, 0.6)\}$
   Apply the fuzz Modus ponens rule to deduce Rotation is quite slow given.

   i. If the temperature is high then rotation is slow.

   ii. The temperature is very high. [8+8]

8. (a) Explain how ANN is used for load forecasting.

   (b) Explain how Fuzzy logic is used for logic control. [8+8]

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Code No: R05410201 **Set No. 4**

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1. (a) For the following nework shown in figure 1 find of the region when O_5=1 if the Activation function used is bipolar binary.

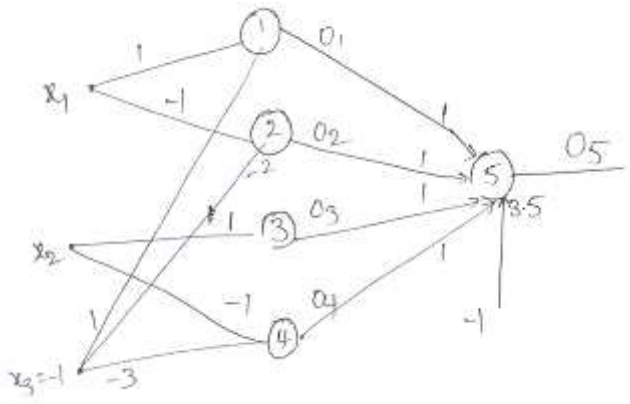

Figure 1:

(b) Explain the Historical Development of ANN. [8+8]

2. (a) Explain clearly the Neural Dynamics and Learning strategies of ANN.
(b) Using Hebbian learning rule find the weight vectors to train the following input vectors
$X_1 = \begin{bmatrix} 1 & -2 & 1.5 & 0 \end{bmatrix}^T$, $X_2 = \begin{bmatrix} 1 & -0.5 & -2 & -1.5 \end{bmatrix}$ $X_3 = \begin{bmatrix} 0 & 1 & -1 & 1.5 \end{bmatrix}^T$
Assume initial weight vector to be
$W^1 = \begin{bmatrix} 1 & -1 & 0 & 0.5 \end{bmatrix}^T$. [16]

3. (a) Derive the equation for weight change for discrete perceptron Network.
(b) Explain why single layer perceptron Network couldnot solve even Ex-OR problem. [16]

4. (a) Explain in detail how to decide the number of hidden layer neurons, input layer neurons & output layer neurons in back propagation Network.
(b) The network shown in figure 2 using unipolar binary activation function has been trained to classify all 8,3-bit pattern vectors. Analyze the network & find the function it implements in terms of inputs O_1, O_2 & O_3. [8+8]

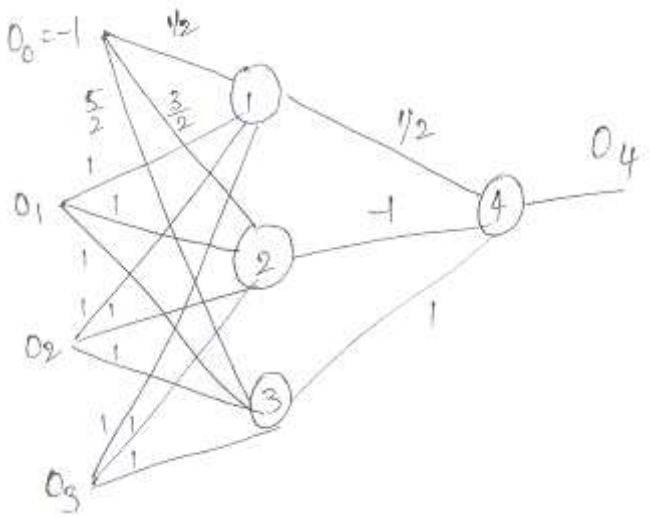

Figure 2:

5. (a) State & prove BAM theorem.
   (b) Explain how linear associator networks couldnot suppress cross terms due to noise. [16]

6. (a) If the fuzzy set $\tilde{A} = \{(x_1, 0.4), (x_2, 0.6), (x_3, 0.8)\}$ is multiplied with a crisp number a = 0.3. Find the new fuzzy set formed along with its membership function.
   (b) Explain the following terms in sets:
      i. CON
      ii. DIL
      iii. Membership function
      iv. CRISP. [16]

7. (a) Explain in detail what are fuzzy quantifiers & their classes.
   (b) Explain with example centre of sums method of defuzzification. [16]

8. (a) Explain how ANN is used for process Identification.
   (b) Write a short notes on Memory based learning Algorithms. [16]

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