Code No: 07A70210 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,December 2011
NEURAL NETWORKS AND FUZZY LOGIC
Common to Aeronautical Engineering, Instrumentation And Control Engineering, Electrical And Electronics Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the various active building blocks of neural networks? Explain the current mirror and inverter based neuron in detail. [16]

2. Distinguish between the feed forward and feedback neural networks. Compare their input-output mapping. [16]

3. (a) Define classical set
   (b) Differentiate fuzzy set from classical set and name the properties of classical (crisp) sets. [8+8]

4. Using your own intuition and your own definitions of the universe of discourse, plot fuzzy membership functions for the following variables :
   Age of people
   (a) Very Young.
   (b) Young.
   (c) Middle-aged.
   (d) old.
   (e) Very old. [16]

5. Suggest and explain activation model, learning method for solving non-linear activation problems. [16]

6. (a) What is XOR problem? Draw and explain the architectural graph of network for solving the XOR problem.
   (b) Discuss about output representation and decision rule. [8+8]

7. (a) Construct a Hopfield network to associate 3x3 input images with dots and dashes.
   (b) How many spurious attractors does this network have i.e how many patterns other than dots and dashes are stable attractors?
   (c) How many input errors can this network withstand i.e how much can the image of a dot (or dash) be corrupted while still allowing the network to retrieve a dot (or dash)? [16]

8. Discuss the operation of single neuron system. A neuron j receives inputs from four other neurons whose activity levels are 10, -20, 4 and -2. The respective synaptic weights of the neuron j are 0.8, 0.2, -1.0, and -0.9. Calculate the output of neuron for the following two situations

   (a) The neuron is linear.

   (b) The neuron is represented by a McCulloch-Pitts model. Assume that the bias applied to the neuron is zero. [16]

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

Answer any FIVE Questions
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1. (a) Describe the pattern sequence encoding in temporal associative memory.
   (b) Explain the traveling sales man problem of minimization of the tour length. Consider a 5 city problem. [8+8]

2. Write short notes on the following.
   (a) Fuzzification interface.
   (b) Knowledge base in fuzzy logic controller. [16]

3. State and prove the perceptron convergence theorem. [16]

4. Using your own intuition, develop fuzzy membership functions on the real line for the fuzzy number "approximately 2 *to* approximately 8", using the following function shapes:
   (a) Symmetric triangles
   (b) Trapezoids.
   (c) Gaussian functions. [16]

5. Write short notes on the following:
   (a) Adaptive fuzzy systems.
   (b) Fuzzy neural networks. [8+8]

6. (a) With help of suitable diagram, discuss the dynamics of the Hopfield network.
   (b) Taking a three-node net, why cannot the following states V1 V2 V3 = 000, 011, 110 and 101 be made stable well. [8+8]

7. Investigate the use of back-propagation learning using a sigmoidal nonlinearity to achieve one-to-one mapping as given below:
   f(x) = 1/x, $1 \leq x \leq 100$.
   Compute the following:
   (a) Set up two sets of data, one for network training and other for testing.
   (b) Use the training data set to compute the synaptic weights of the network, assumed to have a single hidden layer. [16]

8. What is meant by activation function? An odd sigmoid function is defined by $\Phi(V) = \tanh(av/2)$ where tanh denotes the hyperbolic tangent.
   (a) What are the limiting values of this function?
   (b) Find the derivative of $\Phi(v)$ with respect to v.
   (c) What is the value of this derivative at the origin?
   (d) Suppose that the shape parameter a is made infinitely large. What is the resulting form of $\Phi(v)$? [16]

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Code No: 07A70210 **R07** **Set No. 1**

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

Answer any FIVE Questions
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1. (a) Explain the properties of Commutativity,Associativity,Distributivity,Idempotence, Identity with respect to crisp sets
   (b) Given that A=0.2/3 + 0.5/4 + 0.8/5 and B=0.8/5 + 0.2/8, determine the Cartesian product of the two sets; A x B.

R2	Z1	Z2	Z3
Y1	1	0	1
y2	0	.5	.4
y3	.7	.9	.6
y4	0	0	0

R1	Y1	Y2	Y3	Y4
X1	.3	0	.7	.3
X2	0	1	.2	0

[8+8]

2. Explain the following terms:
   (a) Resting potential.
   (b) Nernst equation.
   (c) Action potential.
   (d) Refractory periods.
   (e) Chemical synapses. [16]

3. Write notes on:
   (a) Error correction learning.
   (b) Reinforcement learning. [8+8]

4. What is backpropagation? With a schematic two-layer feed forward neural network, derive its learning algorithm. Also discuss its learning difficulties and improvements. [16]

5. Design and develop a pressure process control by FLC model. Formulate necessary membership functions and required fuzzy rules for the application. [16]

6. (a) State two assumptions in fuzzy control system design
   (b) Explain the fuzzy logic is being implemented for image processing. [8+8]

7. (a) Explain the working of a hopfield network with a neat sketch of its architecture
   (b) A hopfield network made up of 5 neurons, which is required to store the following three fundamental memories
   $E_1 = \{+1, +1, +1, +1, +1, \}^T$
   $E_2 = \{+1, -1, -1, +1, -1, \}^T$
   $E_3 = \{-1, +1, -1, +1, +1, \}^T$
   Evaluate the 5-by-5 synaptic weight matrix of the network. [8+8]

8. Implement the single Discrete Perceptron training algorithm for C = 1 for the discrete Perceptron dichotomizer which provides the following classification of six patterns.

$$\mathrm{X} = \begin{bmatrix} 0.8 \\ 0.5 \\ 0 \end{bmatrix}, \begin{bmatrix} 0.9 \\ 0.7 \\ 0.3 \end{bmatrix}, \begin{bmatrix} 1 \\ 0.8 \\ 0.5 \end{bmatrix} : \text{Class 1}$$

$$\mathrm{X} = \begin{bmatrix} 0 \\ 0.2 \\ 0.3 \end{bmatrix}, \begin{bmatrix} 0.2 \\ 0.1 \\ 1.3 \end{bmatrix}, \begin{bmatrix} 0.2 \\ 0.7 \\ 0.8 \end{bmatrix} : \text{Class 2.}$$

[16]

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

Answer any FIVE Questions
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1. (a) Write in detail about error-detection learning.
   (b) Write in detail about memory brief learning. [8+8]

2. What are the characteristics of feed forward neural networks. What is the significance of number of neurons in the input and output layers. [16]

3. Given three sets A, B and C. Prove De Moragan's laws using Venn diagrams. [16]

4. (a) Define recurrent network. Give some examples.
   (b) Draw the flowchart of producing solution of optimization problems using feedback networks. [8+8]

5. (a) How pattern mode and batch mode of training affect the result of back propagation learning?
   (b) What is the significance of momentum term in back propagation learning?
   (c) Briefly explain the refinements of the back propagation learning and also the Interpretation of the result of the learning. [16]

6. Describe the design of fuzzy logic control with an Air Conditioner controller as an example. [16]

7. Design and analyze a fuzzy controller for the simplified version of the inverted pendulum system. The differential equation describing the system is given by

$$-ml^2 d^2\theta/dt^2 + (m\,\lg)\sin(\theta) = \tau = u(t)$$

   where m is the mass of the pole located at the tip point of the pendulum, l is the length of the pendulum, θ is the deviation angle from vertical in the clockwise direction, $\tau = u(t)$ is the torque applied to the pole in the counterclockwise direction (u(t) is the control action), t is time, and g is the gravitational acceleration constant. [16]

8. (a) Explain with diagrams the different connections between neurons
   (b) Using McCulloch-Pitts rule draw the architecture for XOR function. Comment about the architecture. [8+8]

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