BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS : BE
BRANCH : EEE

SEMESTER : VII
SESSION : MO/13

SUBJECT : EE7117 - NEURAL NETWORKS

TIME : 3 HOURS

FULL MARKS: 60

INSTRUCTION :
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/ Data, hand book/Graph Paper etc. to be supplied to the candidates in the examination hall.

Q1. (a) Sketch different neural network architecture and draw and represent mathematically different types of activation function used in ANN. [2]

(b) A sigmoid function is defined by [4]

$$\phi(v) = \frac{1}{1+\exp(-av)}$$

Show that

$$\phi'(v) = \frac{d\phi(v)}{dv} = a\phi(v)[1-\phi(v)]$$

What is the value of $\phi(v)$ at the origin? Sketch $\phi(v)$ and $\phi(v)$,

(c) A neuron j receives input from four other neurons whose activity levels are 10, -20, 4 and -2. The respective synaptic weights of neuron j are 0.8. 0.2, -1.0 and -0.9. Calculate the output of neuron j for the following situations: [6]

(i) The neuron is linear
(ii) The neuron is represented by Mc Culloach-Pitts model.
(iii) The neuron zises sigmoid activation function.
Assume that the threshold applied to neuron is Zero.

Q2. (a) Construct OR, AND and AND-NOT gates using Mc-Culloach-Pitts ANN model. Are these linearly separable patterns? [2]

(b) What are the weight updating rules of a perceptron network? Is a perceptron network a linear classifier? [4]

(c) Prove that a perceptron network converges is a finite number of iterations. [6]

Q3. (a) Develop Wiener - Hopf equation to design an optimal spatial filter. What are the difficulties in solving this equation? [2]

(b) For LMS algorithm to be convergent in mean prove that the learning rate η should have to limit. [4]

$$0 < \eta < 2/\lambda_{\max}$$

Where λ_{max} is the maximum eigen value of the auto-correlation matrix R of x(n) (input to the filter).

(c) The auto correlation matrix R of the input vector X(n) in the LMS algorithm is defined by [6]

$$R = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$$

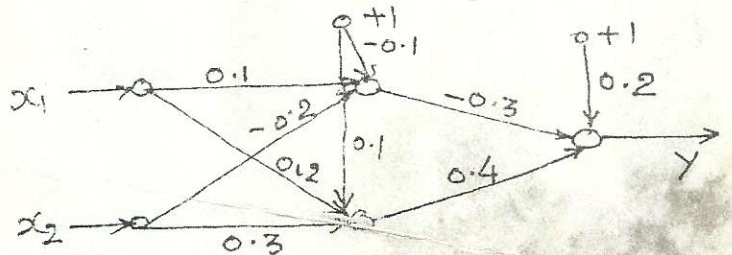
Define the range of values for the learning rate parameter η of the LMS algorithm for (a) the algorithm to be convergent in the mean, and (b) for it to be convergent in the mean square.

Q4. (a) Draw the graph of MLP (Back propagation) network having 2-3-3-2 structure. Use proper notation to denote each component. [2]

(b) Develop back propagation algorithm to update the weights. [4]

(c) For the neural network shown in fig.1 neurons in hidden layer and output layer have activation function $\phi(v)$. Where $\phi(v) = \frac{1}{1+e^{-v}}$. The input layer neurons are linear. If input X = $[0, 1]^T$ and desired output d = 1 obtain change in weight $\Delta\omega_{kj}^{(2)}(n)$ for k = j = 1 and $\Delta\omega_{ji}^{(2)}(n)$ for i = j = 2. [6]

PTO



Q5. (a) Discuss how to measure Hamming distance between two binary vectors using Hamming Network. [2]
(b) Discuss how a SOFM network works. [4]
(c) Discuss the working of an ART1 network. How does it solve the problem of plasticity and stability. [6]

Q6. (a) Draw the architecture of a Hopfield neural network. [2]
(b) Discuss the stability of a discrete Hopfield d network. [4]
(c) Consider a Hopfield network made up of five neurons, which is required to store the following three fundamental memories: [6]

$X_1 = [+1, +1, +1, +1, +1]^T$
$X_2 = [+1, -1, -1, +1, -1]^T$
$X_3 = [-1, +1, -1, +1, +1]^T$

(i) Evaluate the 5 by 5 synaptic weight matrix of the network.
(ii) Demonstrate that all three fundamental memories X_1, X_2, X_3 satisfy the alignment condition using a synchronous updating

Q7. (a) Enumerate the areas where neural networks can be applied. [2]
(b) Discuss how to simulate inverse dynamics of a plant using neural network. [4]
(c) Write a brief summary of a neural network application that you have discussed in the class. [6]

***** 27.11.2013 M*****