Ref. No.: Ex/IEBE/T/423C/2018

B. INS. & ELEC. ENGINEERING 4TH YEAR 2ND SEMESTER EXAMINATION 2018

NEURAL NETWORKS: THEORY AND APPLICATIONS

TIME: 3 HOURS **FULL MARKS: 100**

List of Course Outcomes (CO):

CO1: Recognize and interpret elementary components of artificial neural networks (K3, A1)

CO2: Characterize and examine various learning rules pertaining to the training of neural network (K4, A2)

CO3: Identify suitable areas of applications of neural networks (K4, A1-recognize)

CO4: Design and examine neural network models to address emerging problems of recent interest (K5, A2)

Instructions to the Examinees:

- Each module in the question paper matches up with the corresponding CO
- Attempt questions from **ALL** the modules for the attainment of all the COs
- Alternative questions (if any) exist within a module, not across the modules
- Different parts of same question should be answered together

MODULE 1

1.

(a) Draw and explain the schematic architecture of McCulloch-Pitts neuron. Show how McCulloch-Pitts model can be used as a memory element.

(b) "Bidirectional associative memory extends the concept of auto-association of neurons"- Justify the statement.

(c) What do you understand by adaptive resonance theory (ART) network?

(d) Outline different configurations of two layered recurrent networks for competitive learning.

6+5+4+5

MODULE 2 *(Any four questions)*

2. Discuss about the convergence of perceptron learning algorithm. 10

3. An ADALINE with sigmoid (S) type non-linearity having an input vector X_k and a weight vector W_k is shown in Fig. 1. Show that the learning algorithm for the system is given by $W_{k+1} = W_k + 2\epsilon_k S'(Net_k)X_k$ where the desired input is a scalar d_k and $Out_k = S(X_k^T . W_k)$

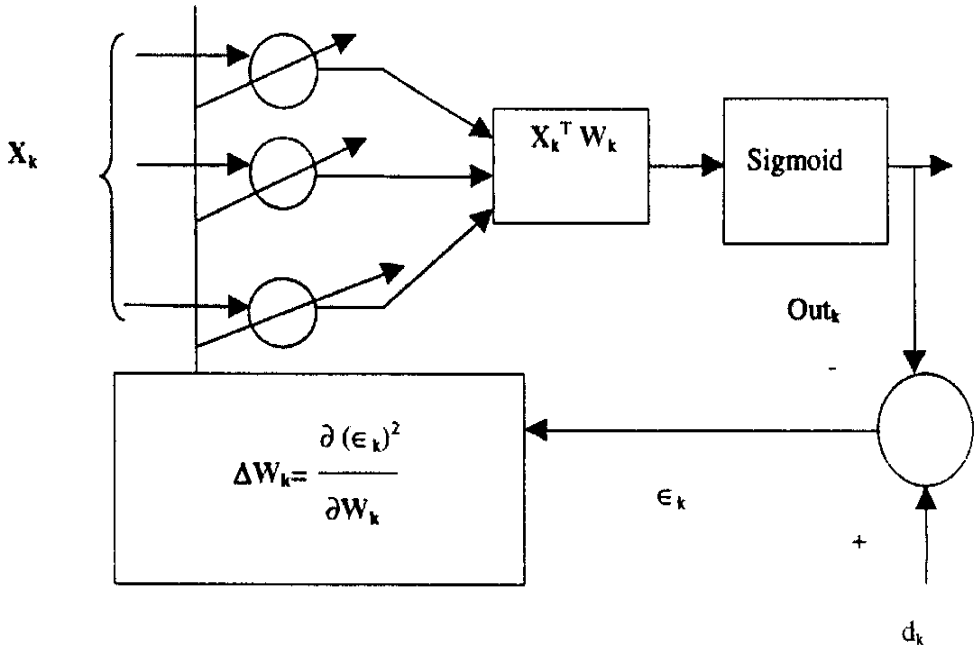

Fig. 1: ADALINE with sigmoid type non-linearity

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4. A fragment of a neural network comprising of 4 neurons is shown in Fig. 2. N_1, N_2 *and* N_3 are three neurons at the penultimate layer and neuron N_4 is present in the output (last) layer. Given $out(N_1) = 0.9\ units, out(N_4) = 0.5\ units,\ error\ at\ neuron\ N_4 = 0.3\ units,\ w_{14} = 0.6,$ $w_{24} = 0.4,\ w_{34} = 0.7\ and\ learing\ rate\ (\alpha) = 0.03$; update the value of w_{14} by Back-propagation algorithm. Compute also the back-propagated error at neuron N_1.

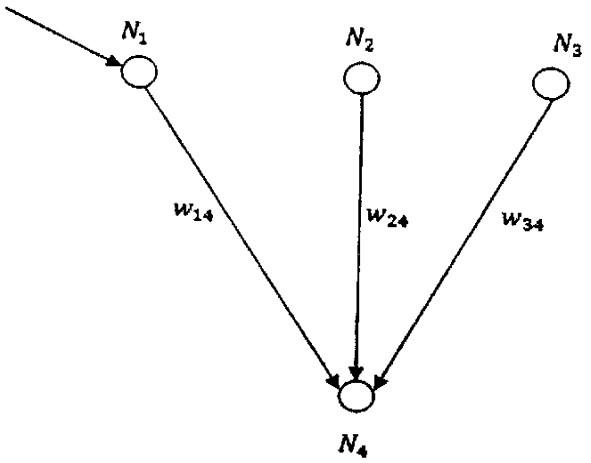

Fig. 2: Fragment of a neural network

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5. Represent the following binary matrices by one-dimensional vectors and hence store them as stable points of a discrete Hopfield net.

$$A = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix}$$

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6. Establish the near-equilibrium condition for classification by continuous Hopfield nets. Hence develop a simplified algorithm for approximate classification of patterns by continuous Hopfield nets.

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MODULE 3

7. Explain the application of perceptron in classifying the region which satisfies the inequality $3x_1 + 5x_2 > 15$ from the remaining region in the real space. 10
8. Describe with appropriate mathematical illustration the process of determining the shape of a complete aircraft, occluded partially by cloud, with the aid of Hopfield network. 10

MODULE 4 *(Any one question)*

9. Develop a scheme for translation, rotation and size invariant pattern recognition using planes of ADALINE neurons. Explain with suitable mathematical illustrations. 20

10. Volume of an object is a function of its radius and height. Given the following table of a number of cylinders. How many cluster centers can you select? Also indicate how to determine the mean and variance of each cluster center. How will you determine volume of the object using an RBF neural net if you know its radius and height?

Cylinder no.	*Radius in cm*	*Height in cm*	*Volume in cc*
1	10	12	1200
2	11	12	1210
3	20	28	4000
4	21	28	4040
5	40	48	10000
6	41	47	10042
7	80	90	30000
8	81	91	31545
9	82	90	31879
10	82	91	33676

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