EEL 784 and EEL 709 Minor I **Marks: 100** **Time: 60 mts**

Q. 1. Determine if the following set of points is linearly separable. Write the optimization problem, solve it in LINGO, and copy the LINGO output onto your answer sheet.

Class 1: (0, 0, 0, 1), (1, 0, 0, 3), (0, 0, 3, 0)

Class -1: (0, 0, 4, 1), (4, 0, 0, 3), (1, 0, 5, 5).

(30)

Q. 2. 6 Input samples $x = (x_1, x_2, x_3, x_4)$ are mapped to a higher dimensional space by using a mapping $\phi(x) = (x_1, x_2, x_3, x_1x_2, x_2x_3, x_3x_4)$.

(a) How many ϕ dichotomies are possible ? These are linear dichotomies in the ϕ space.

(b)

(c) There are 2 fixed points A and B in the ϕ space. A and B are not part of the training set of 6 samples. What is the maximum number of ϕ dichotomies that is possible if there is an added restriction that all the separating hyperplanes must pass through **A and B**.

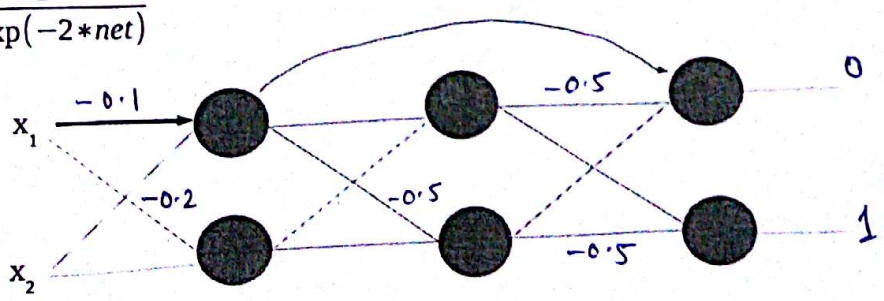
(30)

Q. 3. The network below has weights as indicated. The learning rate is 0.1. All the weights are initially equal to 0.5, except the ones indicated in the figure. All bias inputs (w0) are assumed to be connected to a constant input of 1. All w0 values are initially zero. Neurons are numbered in each layer as : top = 1, bottom = 2.

An input of (0.3, 0.7) is applied to the network. The desired outputs are 0 and 1 for the output neurons (top and bottom, respectively).

The activation function for all neurons is given by

$$f(net) = \frac{1}{1+\exp(-2*net)}$$



(a) Copy the network onto your answer sheet and prepare a table of all neuron outputs. Indicate all outputs and weights with the right notation.

(b) Determine the change in the highlighted weight for the first iteration. Indicate all steps followed.

(40)