

ELL 784 Minor I Time: 60 mts Marks: 100

Q. 1.

(a) How many dichotomies can be learnt with 6 points by surfaces of the form

$$w_1x_1 + w_2x_2 + w_{11}x_1^2 + w_{22}x_2^2 = 0$$

Explain your answer. Note that all variables starting with the letter w denote weights.

(b) How would this number change if all such dichotomies were generated by the above kind of surface, but when the surface is forced to pass through 2 fixed points (not included in the 6 mentioned above).

(30)

Q. 2. The initial values of all weights and the input pattern are shown in the figure. Determine the output at each neuron. Assume that we use gradient descent to find the optimal set of weights. Determine the rate of change of the weight marked in bold. Explain your calculations. The activation function used is $f(net) = \frac{1}{1 + \exp(-net)}$.

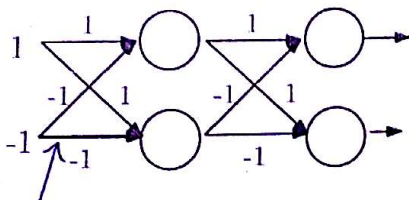


Fig. 1: Q2

(30)

Q.3. A set of M data points in n dimensions is to be learnt by using a hyperplane classifier. A feature selection step is first used to extract n features and then build the classifier. The user can control this process and hence, n can be changed to suit the requirements. The classifier is trained to produce an error of less than 10% on the training data set. It is desired to have less than 20% error on the test data set. For a given M and a chosen set of n features, the chance with which test error exceeds 20% on many trials is approximately 1.44×10^{-7} . When the number of features is increased by 1, the chance of test error exceeding 20% rises to 0.00144. Find M and n . Clearly write all steps, including the values of any important variables involved in the derivation of the final result.

(40)