

EE401- Neural Networks Midterm 1

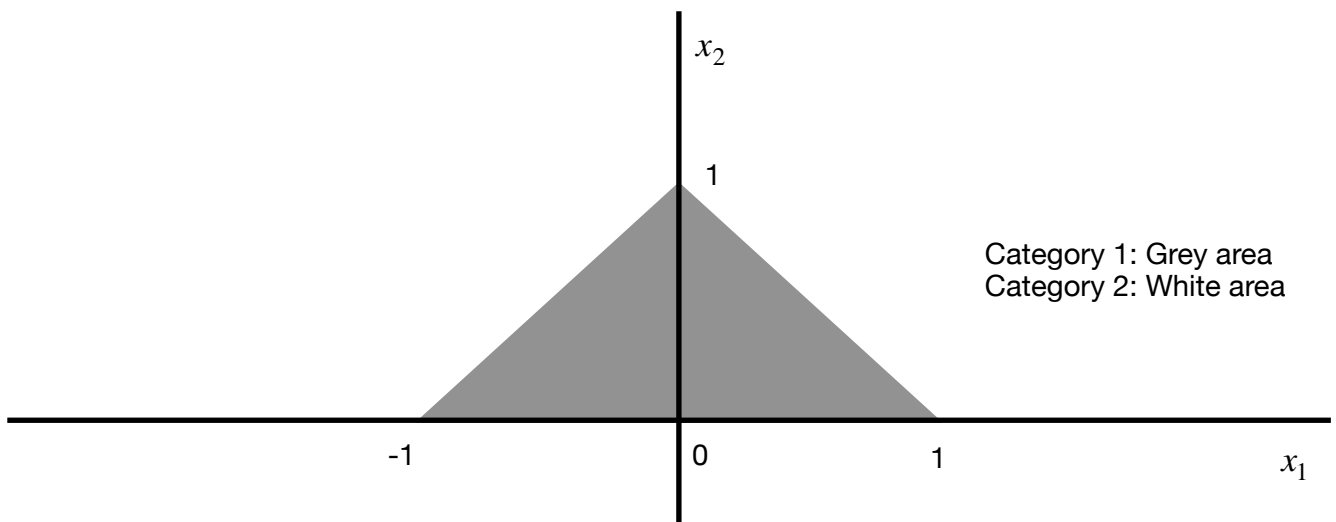
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1- A planar input pattern region of class 1 and 2 is shown in the figure below. The grey area in the figure below belongs to Category 1 and the rest of the pattern space belongs to Category 2

i-) Is this configuration linearly separable? Why?

ii-) If yes, then construct a single layer perceptron classifier.

If no, then construct a multi-layer discrete-perceptron classifier.



2- Apply “Error Back-Propagation Training Algorithm” to obtain multi-perceptron layer for the XOR problem for two variables.(choose $\eta = 0.1$) Choose the activation function as bipolar activation function as given in (2.3a) of the textbook and choose $\lambda = 10$.

Initialize the weight matrices $W_{1 \times 3}$ and $V_{2 \times 3}$ as

$$W^{(0)} = [-3.3 \quad 6.9 \quad -6.6]$$

$$V^{(0)} = \begin{bmatrix} 3.1 & 5.54 & -6.09 \\ -0.74 & 5.46 & -3.18 \end{bmatrix}$$

3- Prototype points are given as

$$X_1 = \begin{bmatrix} 6 \\ 2 \end{bmatrix}, X_2 = \begin{bmatrix} 8 \\ 4 \end{bmatrix}, X_3 = \begin{bmatrix} 4 \\ 3 \end{bmatrix}, X_4 = \begin{bmatrix} 6 \\ 5 \end{bmatrix} : \text{Class 1}$$

$$X_5 = \begin{bmatrix} -1 \\ -1 \end{bmatrix}, X_6 = \begin{bmatrix} -2 \\ -4 \end{bmatrix}, X_7 = \begin{bmatrix} -3 \\ 2 \end{bmatrix}, X_8 = \begin{bmatrix} -4 \\ -1 \end{bmatrix} : \text{Class 2}$$

- Determine if the classes of patterns are linearly separable.
- Determine the center of gravity for patterns of each class and find & draw the decision surface in pattern space.
- Using equations (3.9) and (3.11) design the dichotomizer for the given prototype points and determine how it would recognize the following input patterns of unknown class membership.

$$X_1 = \begin{bmatrix} 3 \\ 4 \end{bmatrix}, X_2 = \begin{bmatrix} 2 \\ 5 \end{bmatrix}, X_3 = \begin{bmatrix} 1.80 \\ 3 \end{bmatrix}, X_4 = \begin{bmatrix} 0 \\ 3.2 \end{bmatrix}$$

4- The multi-category trainable classifier using the maximum selector requires weight adjustment as expressed in equation (3.54) in text book. Implement the sequence of training steps that is needed to classify correctly the three classes as in example 3.2 and Figure 3.8. Present the patterns in the sequence P_1, P_2, P_3 and start from initial weights $w = 0$. Assume $c = 1$. The augmented pattern component equals -1 .

Assumed prototype points are;

$$X_1 = \begin{bmatrix} 12 \\ 3 \end{bmatrix}, X_2 = \begin{bmatrix} 4 \\ -4 \end{bmatrix}, X_3 = \begin{bmatrix} -3 \\ 6 \end{bmatrix}$$

Good Luck!