CSE 5526 - Autumn 2018

Introduction to Neural Networks

Homework #2

Due Thursday, Sept. 11

Grader: Hao Zhang
Office: 474 Dreese Lab
Office hours: 11:30-12:30 T & W
Email: zhang.6720@osu.edu

Problem 1. (a) For the following training samples:

$\mathbf{x}_1 = (0, 0)^T \in C_1$

$\mathbf{x}_2 = (0, 1)^T \in C_1$

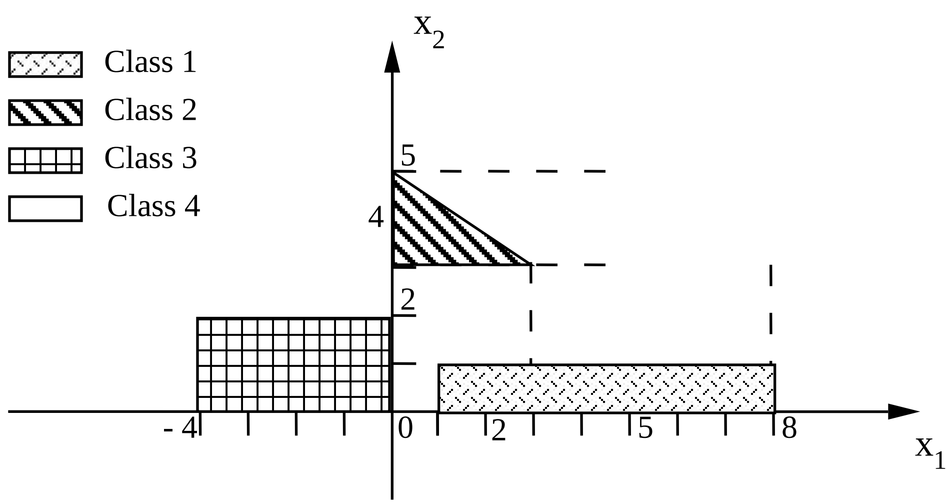
$\mathbf{x}_3 = (1, 0)^T \in C_2$

$\mathbf{x}_4 = (1, 1)^T \in C_2$

Plot them in input space. Apply the perceptron learning rule to the above samples one-at-a-time to obtain weights that separate the training samples. Set η to 0.5. Work in the space with the bias as another input element. Use $\mathbf{w}(0) = (0, 0, 0)^T$. Write the expression for the resulting decision boundary.

(b) XOR. For $\mathbf{x}_2$, $\mathbf{x}_3 \in C_1$ and $\mathbf{x}_1$, $\mathbf{x}_4 \in C_2$, describe your observation when you apply the perceptron learning rule following the same procedure as in (a).

Problem 2. The following figure shows the decision regions of four classes. Design a classifier for these linearly inseparable classes, using a network of M-P neurons with three output units. For class i ($1 \le i \le 3$), classification requires that $y_i = 1$, while $y_j = -1$ for $j \neq i$; Class 4 is recognized when $y_i = -1$ for $1 \le i \le 3$. (HINT: try a two-layer feedforward network.)



Problem 3. Given the following input points and corresponding desired outputs:

X = {-0.5, -0.2, -0.1, 0.3, 0.4, 0.5, 0.7}
D = {-1, 1, 2, 3.2, 3.5, 5, 6}

write down the cost function with respect to w (setting the bias to zero). Compute the gradient at the point w = 2 using both direct differentiation and LMS approximation (average for all data samples in both cases), and see if they agree.