,

CS 6673 fall 2016

Assignment 4 (100 points max), Due October 4, 2016
Submit a hardcopy before the start of class

Problem 1 (100 points max)

Consider an ADALINE with multiple bipolar output units. Train it using the delta (LMS) rule for the following training set (as encountered before in HW03) :

(class 1)

$$\mathbf{s}^{(1)} = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix},\ \mathbf{s}^{(2)} = \begin{bmatrix} 1 & 2 & 0 \end{bmatrix} \quad \text{with} \quad \mathbf{t}^{(1)} = \mathbf{t}^{(2)} = \begin{bmatrix} -1 & -1 \end{bmatrix},$$

(class 2)

$$\mathbf{s}^{(3)} = \begin{bmatrix} 2 & -1 & -1 \end{bmatrix},\ \mathbf{s}^{(4)} = \begin{bmatrix} 2 & 0 & 0 \end{bmatrix} \quad \text{with} \quad \mathbf{t}^{(3)} = \mathbf{t}^{(4)} = \begin{bmatrix} -1 & 1 \end{bmatrix},$$

(class 3)

$$\mathbf{s}^{(5)} = \begin{bmatrix} -1 & 2 & -1 \end{bmatrix},\ \mathbf{s}^{(6)} = \begin{bmatrix} -2 & 1 & 1 \end{bmatrix} \quad \text{with} \quad \mathbf{t}^{(5)} = \mathbf{t}^{(6)} = \begin{bmatrix} 1 & -1 \end{bmatrix},$$

(class 4)

$$\mathbf{s}^{(7)} = \begin{bmatrix} -1 & -1 & -1 \end{bmatrix},\ \mathbf{s}^{(8)} = \begin{bmatrix} -2 & -2 & 0 \end{bmatrix} \quad \text{with} \quad \mathbf{t}^{(7)} = \mathbf{t}^{(8)} = \begin{bmatrix} 1 & 1 \end{bmatrix}.$$

Assume zero initial weights and biases, find numerically the weights and biases as accurately as you can without using any kind of inverses (or solving a set of linear equations). You will have to experiment with different constant values of the learning rate α, as well as different scheduling schemes for gradually decreasing α.

Can all the training patterns be correctly classified? What are the weights and biases that you get?

If we define the rms-error as

$$\frac{1}{Q}\sum_{q=1}^{Q}\sum_{j=1}^{M}\left(y_j - t_j^{(q)}\right)^2,$$

how large is this error in your case after reaching convergence? Comment on your findings.

Include a copy of you computer program and all the key results that you find.