

# EE 550

## Artificial Neural Networks

### Homework 1

At this project, I implemented the computation of LMS solution of a multivariate linear model. I used python and spyder as the compiler for the implementation.

Firstly, I generated random x matrix(15x4) randomly chosen between 0-10 and it's multiplied by parameters given. Zero mean gaussian noise with standard deviations ( std=0.2 and std=0.4) are added to generate two seperate cases (y with noise).

$$y(i) = \theta_1 x_1(i) + \theta_2 x_2(i) + \theta_3 x_3(i) + \theta_4 x_4(i) + e(i); e(i) = N(0; \sigma^2).$$

I called this y(i) as y1 and y2 for with noise.

$$y_1(i) = \theta_1 x_1(i) + \theta_2 x_2(i) + \theta_3 x_3(i) + \theta_4 x_4(i) + e(i); e(i) \sim N(0; 0.2^2)$$

$$y_2(i) = \theta_1 x_1(i) + \theta_2 x_2(i) + \theta_3 x_3(i) + \theta_4 x_4(i) + e(i); e(i) \sim N(0; 0.4^2).$$

Secondly, using the LMS algorithm I estimated parameters for each two cases.

$$\Theta = (x^T x)^{-1} x^T y \gg \Theta_1 = (x^T x)^{-1} x^T y_1 \text{ and } \Theta_2 = (x^T x)^{-1} x^T y_2$$

I called these  $\Theta_1$  and  $\Theta_2$  as param1 and param2 at the implementation.

Thirdly, I calculated estimated y using estimated parameters and x. I called them as yy1 and yy2.

$$yy_1 = x \Theta_1 \text{ and } yy_2 = x \Theta_2$$

Finally, I calculated errors using the formula mentioned at the description.