EEL4930/EEL5840 Fall 2016 – Homework 3
Gradient-based Least Mean Square (LMS) Algorithm

September 29, 2016

Due: October 6, 2016, 11:59 PM

Instructions

For this homework, please show any plots, tables and your explanations. Do **not** include code. However, you should **mention** whether you programmed the solutions yourself or if you downloaded a package online and from which website.

Remember that commenting your results is very important. It is expected of you to systematically discuss your results. If no explanation is given, your grade will be penalized.

Your homework submission must cite any references used (including articles, books, code, websites, and personal communications). All solutions must be written in your own words, and you should program the algorithms yourself (unfortunately, you only understand the details when you do it yourself!). If you do work with others, you must list the people you worked with. Submit your solutions as a **single PDF file** to the course website in http://elearning.ufl.edu/.

If you have any questions address them to:

- Catia Silva (TA) – catiaspsilva@ufl.edu
- Isaac Sledge (TA) – isledge@ufl.edu

Problems

In this homework, we will be reusing the datasets given in homework 2. The goal of this homework assignment is to design a **linear filter adapted with the gradient-based least mean square (LMS) algorithm** to predict the signal. Since this is a prediction problem, compute and plot the mean square difference between consecutive samples. This error corresponds to the trivial predictor, because you can always use the current value as the predicted one! So whatever your method, it has to produce an error less than this, right? Explain why this is or isn't the case.

1. (3 points) In this problem, the two hyper parameters are the filter order and the step-size. Repeat the validation of these two parameters and produce a three-dimensional plot of the MSE versus step-size and filter order. Is the step size related to the filter order or independent of it?

2. (2 points) Plot the learning curve of the filter for the best step-size. Pick two other step-sizes to show that the filter learns slower when compared to the best step-size.

3. (3 points) Repeat the problem using the normalized MSE algorithm. Which algorithm provides the best performance for real world signals? Which algorithm should you be using for regression? Provide answers for both questions and corresponding explanations.

4. (2 points) Finally, compare the results of the best LMS with the results of homework 2. Given the performance and the computation cost, which algorithm would you use? Why?