Machine Learning and Adaptive Systems
(ECE656)

Computer Assignment 1 (Supervised Learning for Parameter Estimation & Prediction- Due in Three Weeks)

The purpose of this computer assignment is to show how supervised learning rules can be used to estimate the unknown parameters of a linear predictor directly from the data. Use MATLAB toolboxes for this assignment.

1. Download 3 years worth of historical data associated with the daily closing price of a particular stock index (e.g., APPLE) from one of the financial sites e.g., http://finance.yahoo.com/. Use 1/2 of the data for training and the rest for validation and testing.
2. Consider your data as a time series that could be modeled using a linear autoregressive (AR) model of the form,

$$y(n) = a_1 y(n-1) + a_2 y(n-2) + ...a_N y(n-N) + x(n)$$

   where N is the order of the AR process, the driving input, x(n), is assumed to be a zero mean white Gaussian random process with variance σ^2_x , and a_i' s are the model coefficients that need to be estimated (training).
3. Choose N=3 i.e. a 3rd order AR model and using an appropriate learning rule covered in class, devise a scheme to estimate the parameters a_1, a_2 and a_3 directly from the data. Present the plot of the learning curve of your algorithm. Check the validity of your results by comparing them with those of the direct approach using $\underline{w}^* = R_{xx}^{-1} R_{xd}$. Comment on the convergence behavior and accuracy (i.e. misadjustment vs speed) of the learning.
4. Study the effects of step size μ on the results. Choose $\mu = 10^{-2}, 10^{-3}, 10^{-4}$ and compare the results.
5. Validate the performance of your stock price predictor,

$$\hat{y}(n) = a_1 y(n-1) + a_2 y(n-2) + ...a_N y(n-N)$$

   on the validation data set by determining the MSE of the estimates i.e $\varepsilon = \frac{1}{N}\sum_{n=1}^{N}(y(n) - \hat{y}(n))^2$ and distribution of the error. How reliable is your predictor? What are the issues with this predictor?
6. Devise a scheme to make your predictor adaptive to the changes in the data. Test the behavior of this adaptive predictor on a subset (testing) of the data.
7. Provide your results and thorough discussions on your results in a brief report. **Note: Please follow the guidelines for preparing report on** http://www.engr.colostate.edu/ECE656/Report%20Guidelines.pdf