EE 2347 Project #2 (Team of 4)
Due Date 10/14/2013

Title: Linear and Non-linear Regression

1 Objective:

The objective of this project is to implement the method of least squares to determine the equation of a line or curve that best fits the given data points in a 2-D plane.

2 Problem Statement 1 - Linear Regression:

Suppose you are running a construction company. You have taken the contract to construct a straight 8-lane road which should have the best connectivity from a set of locations. The X-Y co-ordinates of the locations are given in the file 'project_2_1.mat'. Your task is now to find the line which best fits these data points.Quite intuitively your strategy would be to minimize the total squared distance between the set of locations and your straight road.This technique is known as the "Method of Least Squares". I will suggest you to search literature on least quare based curve fitting techniques.

3 Problem Statement 2 - Non-linear Regression:

Here you are given the average temparature of a city during summer at different time of the day (between 00 to 24 hours). It is known that the temparature rises from midnight to noon and it falls from noon to midnight. Hence the time vs temperature relation can not be fitted by a straight line.Also it is known that the behavior follows some parabolic pattern. Having this fact known, try to find the best parabola fitting the time vs temperature plot.Again your approach would be to minimize the least square error between the real temparature and your fitted temperature curve.The temperature($Temp$) and time(t) values are given in the file 'project_2_2.mat'.

4 Problem Statement 3 - Sinusoidal Wave Estimation:

Suppose a transmitter transmits a sinusoidal wave of certain amplitude A given by $x(n) = Acos(2\pi fn)$. The wave is reached at the receiver after it passes through a communication channel.The channel contaminates the wave by adding noise and delay(phase shift) in the signal. Hence the receiver receives $y(n) = x(n) + noise(n) = Acos(2\pi fn + \phi) + noise(n)$. The receiver has to estimate the correct amplitude(A) and phase delay(ϕ) from the received $y(n)$. The frequency $f = 0.1$ is known to both Tx and Rx. Hence knowing that the received signal should be a cosine waveform, you have to find A and ϕ using the idea of linear regression.The received signal(y) and discrete time points(n) are given in the file 'project_2_3.mat'.

5 Computational Tools:

- Mathematical background:
  Method of least square, linear/non-linear regression, vector derivative, good understanding of Linear Algebra

6 Tasks

1. Develop a high level algorithm (sketch the flowchart) for this project; identify major functions for the entire program.

2. Develop and validate a computer method and codes to perform :-
   Linear Regression : Assuming that the line is fitted by $y = ax + b$ (where (x, y) denotes the locations given in Problem Statement 1) find a and b for best fitting line.
   Non-linear Regression : Assuming that the temperature(T) vs time(t) is fitted by $T = at^2 + bt + c$ find a, b and c for the best fitting parabola (for Problem Statement 1).

3. Analyze and present the results using test inputs.

4. Submit a project report (in MS Word) with at least the following sections (i.e. follow the IEEE format):
   - Abstract of this study - Theory section which includes,
   (i) brief description of the concept of Method of Least Square and its use in Regression Analysis
   (ii) brief description of your methods to implement the regression

   - Validation and result analysis section which include test results using the sample user input and show/plot the results.
   - Summary/Conclusions of this project

5. Submit the project report (printed copy) in class and email the GTA the electronic file for the report along with the complete MATLAB program.

6. Your email must contain the subject : "EE 2347: Project #2". E-mail it to both of the GTA's:
   tanmoy.bhowmik@mavs.uta.edu
   mohammad.hasan@mavs.uta.edu

7. Provide an 8-minute presentation and demonstration of your project during the lab/class sessions.

If your team has any question (or difficulty) please see the GTAs as soon as possible.