MATLAB Programming NCTU Spring 2017 LAB#3 2017/3/17

For this lab, you will write a script that does function approximation and plot the results. Let the approximation function $y=f(x)$ be a polynomial of degree r, so it has $r+1$ coefficients. You need to find these coefficients using the matrix-division operator (\) given a set of sample points $\{(x_i,y_i)\}$.

- Generate the sample points from a polynomial function plus small random numbers. Example:

  ```
  xi = -10:2:10;  yi = -.03*xi.^2 + .1*xi + 2 + .5*(rand(1,length(xi))-.5);
  ```

- Now our goal is to fit these points to the equation $y=f(x)=a_0+a_1x+...+a_rx^r$. This leads to the following over-specified set of linear equations (n = the number of sample points):

  $$\begin{bmatrix} 1 & x_1 & \cdots & x_1^{\ r} \\ 1 & x_2 & \cdots & x_2^{\ r} \\ \cdots & & & \\ 1 & x_n & \cdots & x_n^{\ r} \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ \vdots \\ a_r \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$

- Use the matrix-division operator (\) to solve for the coefficients in minimum-squared-error manner. (Check previous lecture slides for the explanation.) Note: You are not allowed to use the `poly*` functions in this lab.

- Plot the sampled (x_i,y_i) pairs together with the function $y=f(x)$ with the estimated coefficients. You need to use `hold on`.

- After doing these steps successfully, try to repeat them using polynomials of different degrees. At least do degree-1 to degree-3 polynomials. Plot them all together.