MAE384, Spring 2022 Homework #3

A statement of collaboration is required. If there is no collaboration, write "No collaboration".
For this homework, you are allowed to use Matlab function **`inv`** or *backslash operator* (**`x = A\b`**) to solve a N x N matrix problem. Please include computer codes in your work.

Problem 1 (4 points)
A set of 8 data points is given:

x	y
3	41
4	45
7	50
8	57
10	69
11	81
12	97
15	115

(a) Perform linear least-squares regression (Sec 6.2.2) to obtain a line, $y = ax + b$, to represent the data. In addition, calculate the error of the least-squares fit, E, as defined by Eq. (6.6) in textbook. The deliverables are the linear formula (please provide the values of a and b) and the value of E.

(b) Perform quadratic least-squares regression (pp. 207-208; Eq. (6.22)-(6.28)) to obtain a quadratic formula, $y = p\,x^2 + q\,x + r$, to represent the data. In addition, calculate the error of the least-squares fit, E, as defined by Eq. (6.22) in textbook. The deliverables are the quadratic formula (please provide the values of p, q, and r) and the value of E. Compare this E value with that obtained in Part (a). Does the quadratic fit produce a smaller error compared to linear fit?

(c) Draw the two curves obtained in (a) and (b), i.e., the linear and quadratic curves, along with the original data points in a single plot. (Do not connect the original data points. Present them as isolated points. See Matlab Example 41-44 for the proper Matlab commands to use.)

Problem 2 (3 points)
A set of 4 data points is given:

x	y
1	1.2
1.4	3
3.2	2.8
5	4

(a) Following the procedure in Sec. 6.6.2, determine the **quadratic splines** that fit the data. Plot the quadratic splines and the original data points in a single figure, in the fashion of the figure in Example 6-7 in textbook. Show your procedure.

(b) Directly fit the data by a single 3rd-order polynomial that runs through all of the data points. It is recommended that you use the Lagrange interpolation method (Sec 6.5.1), but a solution obtained by directly solving the 4 x 4 matrix equation (Sec 6.5, pp. 211-212) will also be acceptable. Show your procedure. Plot the 3rd-order polynomial and the original data points in a single figure.

If you choose to do so, it is fine to merge the plots for Part (a) and Part (b) into a single plot. Note that the "original data points" are the same for the two tasks.