1 Assignment 3 - Interpolation and Curve Fitting

1. Fitting noisy data to $y = 5xe^{-3x}$.

   - The following MATLAB code segment creates a synthetic data set by adding noise to $g(x) = 5xe^{-3x}$. You should supply the value of n, which is the number of data points to be generated.

   ```
   % --- Generate synthetic data
   x0 = 0.01;          % Starting point ~= 0 avoids log(0)
   noise = 0.05;       % Magnitude of noise
   x = linspace(x0,2,n);
   y = 5*x.*exp(-3*x);% Create the true function y = g(x)
   yn = y + noise*(rand(size(x))-0.5);   %Noise multiplies
                       % random values v  in the range
      % -0.5 <= v <= 0.5
   yn = abs(yn);       % Make sure all data are positive
   ```

   - Now, we have a table (assume that obtained from an experiment). It is proposed that an unknown function has the form

   $$f(x) = c_1 x e^{c_2 x}$$

   - Write a MATLAB program to solve the normal equations to find the values of c_1 and c_2 for the given data set.
   Hint: Nonlinear function is transformed to linear function as $v = \alpha u + \beta$ and
   $$v = ln(x/y) \quad u = x$$
   $$\beta = ln c_1 \qquad \alpha = c_2$$

   - Your program should generate the data set, fit the data by using least-square approxmiation and plot the fitted and original functions.

   - Study with different n values (say 50,100,200). Discuss the effect of increasing n on the fitted curve.

2. Write a MATLAB program to fit a cubic to the data which is generated in the previous question. Evaluate the cubic on the data. Compare this polynomial with the functions ($f(x)$ and $g(x)$) used in the previous question by plotting all these functions on the same graph.