COMP 350 Numerical Computing
Assignment #5: Polynomial Interpolation, Spline Interpolation, and Least Squares Approximation

Date given: Wednesday, November 6. Date due: 5pm, Monday, November 18, 2013.

1. (6 points) Find the Vandermonde form, the Lagrange form, and the Newton form of the interpolating polynomial for the data

x	1	2	3	4
y	2	1	6	47

2. (14 points) (Programming by MATLAB) Let $f(x) = 1/(1 + 25x^2)$. Using 9 equally spaced nodes (knots) on the interval $[-1, 1]$,

   (a) find the interpolating polynomial $p(x)$ of degree 8 for $f(x)$ by the Newton approach.

   (b) find the natural cubic spline function $S(x)$ to interpolate $f(x)$.

   (c) find the function $g(x) = a \ln |x| + b \cos(x) + ce^x$ to approximate $f(x)$ by the least squares method (don't use the point (0,1)).

   You do not need to write explicit expressions of $p(x)$ and $S(x)$. But you need to write the explicit expression of $g(x)$. Print the four values $f(x)$, $f(x) - p(x)$, $f(x) - S(x)$, and $f(x) - g(x)$ at 17 equally spaced points, including the 9 nodes (knots) and the 8 points midway between the nodes (knots). Plot $y = f(x)$, $y = p(x)$, $y = S(x)$ and $y = g(x)$ on the same graph. Print your MATLAB codes.

   Note: You are not allowed to use MATLAB built-in functions `polyfit`, `polyval`, and `spline`.

3. (Bonus 5 points) Read the subsection "Space Curves" on p394 and Computer Problem 6 on p404 of Cheney and Kincaid (6th ed). Then make a plot of your hand. Start with

   ```
   figure('position', get(0,'screensize'))
   axes('position',[0 0 1 1])
   [x,y] = ginput;
   ```

   Place your hand on the computer screen. Use the mouse to select a few dozen points outlining your hand. Terminating the `ginput` with a carriage return. You might find it easier to trace your hand on a piece of paper and then put the paper on the computer screen. You should be able to see the `ginput` cursor through the paper. Print your MATLAB code and the plot of your hand including the points you selected.

   Hint: MATLAB documentation provides an example of using `ginput` to select plotting points from the screen.