COMP 350 Numerical Computing

Assignment #5: Polynomial Interpolation, Spline Interpolation, and Least Squares Approximation

Date given: Monday, Nov 2. Date due: 5:00pm, Monday, Nov 16, 2015.

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

x	1	2	3	4
y	2	0	-10	-34

2. (14 points) (Programming by MATLAB) Let $f(x) = 1/(1 + 25x^2)$. Using 7 equally spaced nodes (knots) on the interval $[-1, 1]$,

   (a) find the interpolating polynomial $p(x)$ of degree 6 for $f(x)$ by the Newton approach.

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

   (c) find the function $g(x) = a + bx^2 + cx^4$ to approximate $f(x)$ by the least squares method.

   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 13 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. (extra credit: 5 points) Read the subsection "Space Curves" on p273 in Section 6.2 and the Computer Problem 6 on p280 of Cheney and Kincaid (7th 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.