Project 1 due week of January 19. You must make an appointment to visit my office during the week of January 19 (or earlier), at a mutually agreeable time, in order to demonstrate the programming part of project 1 for me.

**1.** Let $f(x) = 1/(1-x)$ and $x_0 = 0$. Find the $n$th Taylor polynomial $P_n(x)$ for $f(x)$ about $x_0$. Find a value $n$ necessary for $P_n(x)$ to approximate $f(x)$ to within $10^{-6}$ on $[0, 0.5]$.

**2.** Let $f(x) = e^x$ and $x_0 = 1$. Find the $n$th Taylor polynomial $P_n(x)$ for $f(x)$ about $x_0$. Find a value $n$ necessary for $P_n(x)$ to approximate $f(x)$ to within $10^{-6}$ on $[0, 0.5]$.

**3.** Let $f(x) = \cos(2x)$ and $x_0 = 0$. Find the $n$th Taylor polynomial $P_n(x)$ for $f(x)$ about $x_0$. Find a value $n$ necessary for $P_n(x)$ to approximate $f(x)$ to within $10^{-6}$ on $[0, \pi]$.

**4.** Write a computer program that evaluates $P_n(x)$ where $P_n(x)$ is the Taylor series expansion derived in problem (3) above. Verify that $|f(x) - P_n(x)|$ satisfies the appropriate error bound. You must be able to convince me by plotting results and checking the error for your approximation that everything was programmed correctly. A sample program for $f(x) = e^x$ is posted on blackboard course library.

**5. (graphing)** Write a single computer program that outputs two data files corresponding to two different functions $f(x)$ and $g(x)$. Then plot the graphs for these two files on the same axis using gnuplot or matlab or scilab, etc. The first data file looks like,

$$\begin{array}{cc} x_0 & f(x_0) \\ x_1 & f(x_1) \\ x_2 & f(x_2) \\ & \cdots \\ x_N & f(x_N) \end{array}$$

The second data file looks like,

$$\begin{array}{cc} x_0 & g(x_0) \\ x_1 & g(x_1) \\ x_2 & g(x_2) \\ & \cdots \\ x_N & g(x_N) \end{array}$$

The $x_i$'s are defined as, $x_i = a + \frac{b-a}{N} i$, where $a = 0$, $b = 2\pi$ and $i = 0, 1, 2, \ldots, N$. $f(x) = \cos(x)$ and

$$g(x) = \begin{cases} -1 & x < \pi \\ 1 & x \geq \pi \end{cases} \tag{1}$$

A sample program that outputs a function to a file is posted on blackboard under course libraries.