Assignment #6

Due Friday 11 November 2011 at the start of class

Read subsections 3.8, 4.1, 4.2, 4.3, 5.1, 5.2, and 5.3 of the text J. Epperson, *An Introduction to Numerical Methods and Analysis*, rev. ed., 2007.

Do the following exercises:

P5. Consider these three functions which appear in exercise # 3 of section 3.1 about bisection:

(a) $f(x) = x^3 - 2$, $[a, b] = [0, 2]$
(b) $f(x) = x - e^{-x}$, $[a, b] = [0, 1]$
(c) $f(x) = 5 - x^{-1}$, $[a, b] = [0.1, 0.25]$

For each function there is a solution to $f(x) = 0$ on the given interval $[a, b]$. Write a MATLAB/OCTAVE code which does bisection, Newton's method, and secant method to solve each of these problems. Stop each algorithm when its estimate of the root α is within 10^{-10} of the correct value. Produce a reasonably neat table which shows both the estimate of the root and the number of function evaluations.

Notes: *For Newton's method always choose $x_0 = a$. For secant method always choose $x_0 = a$ and $x_1 = b$. This table has three problems (a),(b),(c) and three algorithms, so it should have 9 estimates of roots and 9 counts of function evaluations. When showing the estimates of roots, use* `format long` *to show lots of digits.*

Page 124, Exercise 6.

Page 166, Exercise 1.

Page 166, Exercise 6.

P6. (a) Together Algorithms 4.1 and 4.2 on page 169 allow you to compute the value of the polynomial interpolant $p_n(x)$ at a particular input `xx`. In fact, combine Algorithms 4.1 and 4.2 to write a MATLAB/OCTAVE single function

```
function z = polyget(n,x,y,xx)
```

which computes `z` $= p_n($`xx`$)$ where $p_n(x)$ is the unique polynomial of degree n which goes through the $n + 1$ points (x_0, y_0), (x_1, y_1), ..., (x_n, y_n). Note inputs `x` and `y` to your function are vectors (lists) of length $n + 1$. Test this code on the problem in exercise #1 on page 166 using `xx`$= 0.6$.

(b) Also test this code in the $n = 10$ case by computing $p_{10}(0.654321)$ where x_i are the eleven equally-spaced points on the unit interval $[0, 1]$, namely $x_i = 0.1i$ for $i = 0, 1, 2, \dots, 10$, and where $y_i = e^{x_i}$. That is, interpolate $f(x) = e^x$ and evaluate the interpolant at `xx`$= 0.654321$. What is the error? Repeat with $n = 20$.

(c) Compare your function, in the $n = 10$ case from part **(b)**, to this command using built-in methods from MATLAB/OCTAVE:

```
>> polyval(polyfit(x,y,n),xx)
```

Explain what are the inputs and outputs of the built-in commands `polyval` and `polyfit`. (*That is, explain what kinds of objects they are and what they mean.*)

Pages 172–173, Exercise 3.

Page 173, Exercise 4.

Page 259, Exercise 2.