University of Delaware
Department of Mathematical Sciences
Math 353 Engineering Mathematics III
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Homework 4

I) By hand. It is fine to use one of the simple codes from the course web page or from your text and Matlab to solve the appropriate parts of these problems. However, I recommend strongly that you be able to do them by hand so that you can do so on an exam if so asked.

1. Let $f(x) = x^2 - 10x + 23$. Apply the of bisection method 3 times by hand for for the interval $[a_0, b_0] = [3, 4]$ to find an approximation for a root (compute c_3).

2. Let $f(x) = x^3 - 3x - 2$. Find the iteration formula $x_{k+1} = g(x_k)$ produced by Newton's method. Start with $x_0 = 2.1$ and compute x_1 and x_2.

3. $f(x) = x^3 - A$. Find the iteration formula $x_{k+1} = g(x_k)$ produced by Newton's method.

4. Section §1.5 Let $f(x) = x^2 - x - 3$. Find the iteration formula $x_{k+1} = g(x_{k-1}, x_k)$ produced by the Secant Method. Start with $x_0 = 1.7$ and $x_1 = 1.67$ and compute x_2 and x_3.

II) For this part record a diary file showing your MATLAB work. You can use codes from the course web page or write your own. Include (paper) copies of script or function files **written by you**.

1. Use the bisection method to find the solution of the equation $x = e^{-x}$ to nine correct decimal places.

2. Use 100 secant method iterations to approximate the solution of the equation $x = e^{-x}$. Compare the result with the one from the previous problem.

3. Use **newton.m** function or another function or script file from the course web page to approximate the root r of $f(x) = tan(x) - x$ on the interval $[7, 8]$. Check that (N-R) iterations are not convergent if the initial guess is $x_0 = 7$ or $x_0 = 8$. Find two distinct values $a, b \in (7, 8)$, such that $|b - a| \geq 1/4$ and (N-R) iterations converge for both choices of the initial guess $x_0 = a$ and $x_0 = b$. Comment the result.

4. Modify **newton.m** function or write a new function called **convorder.m** to check that the Newton-Raphson iterations have quadratic convergence for simple roots and linear convergence for double roots. Consider the exact root as an input argument for your function. Use **convorder.m** to check the order of convergence for the Newton-Raphson iterations when solving for the root $r = 2$ of the function $f(x) = x^3 - 3x - 2$. Repeat the experiment with the root $r = -1$.