MAT 325 Numerical Analysis I

Computer Lab 2: Finding Roots

(Due day: March 08, 2019)

Consider the problem of finding the zeros of the function

$$F(x) = x^3 + 2x^2 + 10x - 20$$

1. Is there a root in the interval [1,2]? Estimate how many iterations would the Bisection algorithm need to find such a root accurate to 15 decimals. (2 pts)
2. Write a code (in double precision) implementing the Bisection method for $F(x) = 0$ on an interval [a,b]. Evaluation of $F(x)$ should be done in a subprogram FCN(x). Debug on a simple problem, say $1.3 - x$ on [1,2].
3. Use your code to find the root mentioned in 1. Output your final approximate root (with all appropriate digits) and how many iterations it takes. (3 pts)
4. Write another code (in double precision) implementing Newton's method. Evaluation of $F(x)$ and $F'(x)$ should be done in a subprogram FCN(x). Debug on a simple problem, say $x^2 - 3 = 0$. Test it on the above $F(x)$.

Now consider the problem of finding zeros of

$$G(x) = x - \tan(x) \quad \text{near } x = 99 \text{ (radians).}$$

5. Is there any root? How many? How do you know? (2 pts)
6. Use your Newton code to find the zero of $G(x)$ closest to $x = 99$ (radians) to 9 decimals (use TOL = 10^{-9} and max. number of iterations = 20). Output your final approximate root and how many iterations it takes. (3 pts)
   [Hint: Extremely accurate starting value is needed for this function. Using Matlab to plot the function, or produce values of $G(x)$ around x=99 to determine a good starting value.]

How to submit your work:

1. Create a plain txt file titled "MAT325-Lab2_<WCU_Student_Account>.txt"
2. Type your answer to 1, 3, 5, 6 in the file.
3. Attach your code of Bisection and Newton code to the end of the file.
4. Submit the file onto Assignment in D2L.