AMATH 481/581 Autumn Quarter 2024

Homework 1: Warm Up!
DUE: Soon

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I Consider the function

$$f(x) = x\sin(3x) - \exp(x)$$

and solve for the x-value near $x \approx -0.5$ that satisfies $f(x) = 0$. In the first part, use the Newton-Raphson method with the initial guess $x(1) = -1.6$ to converge (in absolute value) to the solution to 10^{-6}. Keep track of the number of iterations until convergence is achieved (NOTE: please check convergence with $f(x_n)$ not $f(x_{n+1})$). In the second part, use bisection with the initial end points $x = -0.7$ and $x = -0.4$. Keep track of the mid point values and number of iterations until an accuracy of 10^{-6} is achieved.

ANSWERS: Should be written out as A1.npy, A2.npy, and A3.npy. Specifically, A1.npy is the vector of x-values in the Newton method starting with the initial guess $x(1) = -1.6$, and A2.npy is the mid point (x_{mid}) values in the bisection method for successive iterations. A3.npy is a 1x2 vector with the number of iterations for the Newton and bisection respectively as the two components.

II Let the following be defined:

$$\mathbf{A}=\begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix}, \mathbf{B}=\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}, \mathbf{C}=\begin{bmatrix} 2 & 0 & -3 \\ 0 & 0 & -1 \end{bmatrix}, \mathbf{D}=\begin{bmatrix} 1 & 2 \\ 2 & 3 \\ -1 & 0 \end{bmatrix} \mathbf{x}=\begin{bmatrix} 1 \\ 0 \end{bmatrix}, \mathbf{y}=\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \mathbf{z}=\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix},$$

Calculate the following:

(a) **A**+**B**, (b) 3**x** - 4**y**, (c) **Ax**, (d) **B**(**x**-**y**), (e) **D x**, (f) **D y** + **z**, (g) **AB**, (h) **BC**, (i) **CD**

ANSWERS: Should be written out as A4.npy–A12.npy