Homework 1 "Programming Basics"
Math 166, Fall 2022

Assigned: Monday, September 19, 2022
Due: Friday, September 23, 2022 in class

This first assignment is to make sure you are comfortable with the type of programming required in this course. I recommend MATLAB (free through your SCU account). There are some included MATLAB tutorials at

https://www.mathworks.com/learn/tutorials/matlab-onramp.html

However, you are welcome to use any programming language that you are comfortable with. This assignment will ensure that you are comfortable with the type of scientific programming tasks we are interested in in the programming language of your choice. I don't expect you to know how to do all of this immediately, but with a little bit of help from either me or the internet, you should become comfortable with the following tasks.

(1) **(Plotting)** Plot the function $f(x) = \sin(x)$ from 0 to π. Turn in both your code and the resulting plot.

(2) **(Linear Algebra)** For each part, turn in both your code and the result.

(a) Create and store the following matrices and vectors

$$A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}, \qquad B = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & -1 \end{bmatrix}, \qquad x = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$$

(b) Compute the following three products: AB, Ax, and $B^T x$ where $\cdot^T$ is the transpose operation.

(3) **(Programming Loops)** Write programs to complete the following tasks. Turn in your code.

(a) Write code that creates a 10×12 matrix A whose entries are given by the formula

$$A_{ij} = \begin{cases} i + j & \text{if } i + j \text{ is even} \\ i - 2j & \text{if } i + j \text{ is odd} \end{cases}$$

(b) Write code that creates a vector x of length 100 such that the first entry is $x_1 = 1$, with all other entries following the rule

$$x_{n+1} = \frac{3x_n}{x_n^2 + 1}$$

(4) **(Displaying Results in a Table)** Let $f(x) = \sin(x)/x$ and $e(x) = |f(x) - 1|$. Write code that outputs x, $f(x)$, and $e(x)$ in a table for $x = 1, 0.1, 0.01, 0.001, 0.0001$. Your answers should have at least 6 significant digits. The first row should look something like:

```
==========================================================================
x          f(x)          e(x)
==========================================================================
1         0.841471       0.158529
==========================================================================
```

Your result does not have to look exactly like this by any means, but should be well organized.