MAT335 **Due: 11:59pm January 15**

HOMEWORK 0 (*January 4, 2023*)

In this class, we'll be doing a lot of math, but we'll also be focusing on our writing and communication skills as well as using computers to simulate results and make pictures. This homework is to help familiarize you with the tools we'll be using. In particular, your math writeups will be completed in LaTeXand your simulations will be done in the `Python` programming language.

In this course, you'll be doing *a lot* of googling, trying to get LaTeX and `Python` to do what you want. Don't worry about making mistakes or trying something that you don't understand. Dive right in!

You should submit your answers to parts 1 and 2 to Gradescope.

1. Prepare a 1-page LaTeX[1] document that has

   (a) A one-to-two paragraph math biography. Explain how you feel about math: Have you always felt that way? Have you had experiences that brought you to like math more? Less?

   (b) A footnote (you can use the `\footnote{}` command).

   (c) A figure (if you're feeling adventurous, you can use `tikz` to draw your figure; otherwise, you can just include an image).

   (d) Your two favorite equations, one in *inline* and *display* style. (Inline is when they show up in a paragraph by using `$...$`, display is when the math forms its own paragraph by using `\[...\]`.)

   (e) A $2 \times 3$ matrix.

   You can either install LaTeX or use a free, online version available at https://overleaf.com. Please see https://www.overleaf.com/learn/latex/Creating_a_document_in_LaTeX for a basic introduction to LaTeX. For a more advanced introduction, you can read https://tobi.oetiker.ch/lshort/lshort.pdf.

   You can find a LaTeX template for writing your homeworks here: https://github.com/siefkenj/2023-MAT-335-webpage/raw/main/homework/sample-homework.tex

2. Do the following programming exercises in a https://utoronto.syzygy.ca Jupyter notebook[2].

   To "Do" a programming exercise means (i) to write the required code *with comments* explaining any complicated parts, (ii) execute the code on appropriate examples and show their outputs, and (iii) upload the result to Gradescope. You can do a *File>Print Preview* in your Jupyter notebook and then *Print to file* to save your notebook output as a PDF. That PDF can be uploaded to Gradescope.

   (a) Clone the `homework0-intro.ipynb` into your syzygy account by clicking the link: https://utoronto.syzygy.ca/jupyter/user-redirect/git-pull?repo=https://github.com/siefkenj/2023-MAT-335-webpage&subPath=homework/homework0-intro.ipynb

   Alternatively, if you have installed `Python` and Jupyter notebooks on your local computer, you may clone the notebook from https://github.com/siefkenj/2023-MAT-335-webpage/tree/main/homework

   When you have finished going through the `intro` notebook, clone the `exercises` notebook and do the rest of the exercises. *You will only turn in the* `exercises` *notebook to Gradescope. The* `intro` *notebook is just for your edification.*

   https://utoronto.syzygy.ca/jupyter/user-redirect/git-pull?repo=https://github.com/siefkenj/2023-MAT-335-webpage&subPath=homework/homework0-exercises.ipynb

[1] LaTeX is a programming language designed for typsetting mathematics. It is the language used to make many of your textbooks, and is the standard for Math/CS writeups (but there are also libraries for econ, chemistry, and other disciplines!).

[2] Jupyter notebooks provide an interactive programming environment where you can write `Python` code and get the results immediately.

**Note:** The `homework0-exercises.ipynb` file has *stubs* for each of the programming tasks. This is, there are pre-defined functions in the notebook with the correct and which accept the correct arguments. **These functions do not produce the correct output.** Your job is to modify these functions so that they produce the correct output.

(b) Write a function called `hi()` which takes a first name and a last name and prints

`Hi` ⟨*first name*⟩`. What is the origin of '`⟨*last name*⟩`'?`

(c) Write a function `square_the_list()` which inputs a list of numbers and returns a list of each of the numbers squared.

(d) Use `numpy` and `matplotlib` to produce a graph of the function $f(x) = x^2$ and the tangent line to $f$ at $x = 1$ on the same grid. Color the graph of $f$ red (any shade) and the graph of the tangent line blue (again, any shade you like!).

(e) Make a function `is_prime()` that returns 1 if the input is prime and 0 otherwise.

(f) Use ⟨*axis*⟩`.imshow` to make a $50 \times 50$ black-and-white image. The $n$th square in your image should be black if the number $n$ is not prime and white if the number $n$ is prime. Index your image in the following way: the square at coordinates $(i, j)$ corresponds to the number $i + 50 * j$. And remember, in `Python` the first element of a list is 0 (not 1!).