Lab 1: Intro to Python

Step 0: Install Anaconda

- see the notes on Blackboard under `python_stuff`

Main Topics

- basic syntax and creating variables
- working with Jupyter Notebooks
- `for` loops
- `if/then` statements
- plotting
- working with data

Step 1: Presentations by Dr. Krauss

Download and follow along:

- intro_to_Python.ipynb
- intro_to_scientific_and_engineering_python.ipynb

Step 2: Notebooks to read and work through on your own

- for_loops.ipynb
- plotting_with_matplotlib.ipynb

Step 3: First Batch of Tasks

Task 1: Plotting

- generate a plot of a sine wave vs. time:
  - create a time vector using `np.arange`
  - use `plt.figure` and `plt.plot` to create the graph
  - also use `plt.xlabel`, `plt.ylabel`, and `plt.title` to complete the plot

Task 2: loadtxt and for loops

- write Python code that finds all of the `*.csv` files in a folder, loads each `*.csv` file into an array, and then generates on plot per file
  - assume each `*.csv` file contains data in columns where the first column is time
  - plot the remaining columns vs. time on one plot
  - the data files may have different numbers of columns in them
- Here are links to three csv files:
  - data file 1
  - data file 2
  - data file 3

- download all three files to the same folder
- use `glob.glob` to find all of the `*.csv` files in a given folder
- use `np.loadtxt` to load the data from one `*.csv` file into an array
- use `plt.figure`, `plt.plot`, ... to generate the plots

Task 3: Writing a Function

- create a function that takes the coefficient p as its input and returns the step response of the corresponding first order transfer function $G(s)$:

$$G(s) = \frac{p}{s+p}$$

- then call your function inside of a `for` loop and overlay the step responses for three different values of p: `[1,5,30]`
- in order to complete this task, you will need to install the `python-control` module using the command `pip install python-control`
  - windows users should use the `Anaconda Prompt`
  - mac users should use the terminal
- use the function `control.TransferFunction` to create $G(s)$
- use the function `control.step_response` to find the step response

Step 4: Another Notebook to read and work through

- extracting rows or columns from a 2d array is called indexing or slicing
- Notebook: slicing_and_indexing.ipynb

Step 5: Final Task

The data file pendulum_data.txt contains data from the pendulum vibration suppression test we did in class. Download the data and load it into Python using `np.loadtxt`.

Analyze the data by creating several plots:

- first, make a separate plot for each column of data
  - extract the column label from the first row of the csv file and use the labels for the title of each plot
- pick 3 columns to slice out from the data and overlay on one plot
  - use the corresponding column labels in the legend for the plot