Getting up and running with python.

Homework assignment #1 PHY386 Spring 2023

Recap of chap. 1

We talked about four pillars of working with python to do scientific computing.

1. Holding data:
    a. individual numbers,
    b. complex numbers,
    c. vectors of numbers, and
    d. matrices of numbers.
2. Controlling the flow of a program with
    a. Loops, both
        i. for and
        ii. while
    b. functions
3. Conditional execution of code with
    a. if
    b. If, else
    c. If, elif, else statements.
4. Using comments to make code readable/documented with
    a. #single line comments
    b. “””
    c. Or multi line comments
    d. “””

These things were supported with 4 modules

- Math: for constants (e.g., pi, e) and real functions (e.g., sin(x), sqrt(x)).
- Cmath: for constants (e.g., j) and complex functions (e.g., sin(x), cos(x))
- Numpy: for vectors and arrays that work the way you would want (feeding lists into array() f^n) and functions to act on them (e.g. sin(x), sqrt(x), dot(arr1, arr2), arrange(min, max, step))
- Matplitlib.pyplot: for graphing data directly.

Homework questions for Chap. 1

1. Create a vector of numbers from 0.2 to 0.9 with a step size of 0.01 between them. Sum them and print the result. Compare the result with a direct sum. If they differ explain why.
2. Rotations are very complicated in general but if you restrict your attention to along a coordinate axis they are more straight forward. A rotation by θ about the y-axis is given by:

$$R_y(\theta) = \begin{matrix} \cos(\theta) & 0 & \sin(\theta) \\ 0 & 1 & 0 \\ -\sin(\theta) & 0 & \cos(\theta) \end{matrix}$$

Rotate the vector

$$\vec{r} = (4, 5, 6)$$

About the y-axis through an angle theta=25deg using the equation

$$\vec{r'} = R_y.\vec{r}$$

Do a sanity check by checking if the length of the vector is un-changed. That is calculate the difference between the size between $\vec{r'}$ and the size of $\vec{r}$ and test if it is less than 1e-10.

3. The logistic map is given by

$$x_{n+1} = r * x_n * (1 - x_n)$$

Use the starting value x_o=0.1 and r=1.5 to

- find how many steps for x to exceed 0.33
- From the same starting point find how many steps for x to exceed 0.3333
- Speculate on how many steps it will take for x to exceed 0.34.

4. Consider the following 3 complex numbers:
   - $z_1 = 4 + 3i$
   - $z_2 = 3 - 91i$
   - $z_3 = i/(2 - 3i)$

   Use python to calculate $\frac{z_2}{1/z_1 - 1/z_3}$. Compare with the analytical result.