CZ Biohub R&D Engineer Programming Challenge v. 2.0

Objective

The objective of this programming challenge is to assess your ability to develop a feature according to a pre-defined spec and your ability to write clean, well-structured code using object-oriented programming.

Task

Please develop a basic graph viewer that allows users to plot functions f(x) with two user-adjustable parameters A and B. Examples of functions include f(x)=Asin(Bx) and f(x)=Ax^B.

Your graph viewer should be able to support a variety of functions, including functions with **no simple mathematical representation**. An example of such a function, a **sawtooth wave**, is provided below.

Your graph viewer should:

- Allow the user to select from a list of supported functions, each of which is implemented as a class in Python. Each of your functions should extend an abstract base class Function that defines standard methods and properties that all functions should have. It should be easy for a developer to add additional functions to your graph viewer by adding another class that extends Function.
- Should plot the function for default parameters A and B as soon as the function is selected.
- Should plot the function over a user-selectable range in X (and the X resolution).
- Allow the user to change the adjustable parameters A and B.
- The viewer should re-plot the function whenever the A and B parameters or the X range are changed.
- Display the name of the currently selected function, as well as the descriptions of the A and B parameters.
- Handle any invalid inputs by displaying an error message and resetting to the previous valid value.

Functions should:

- Have a name, which is used to identify the function in the graph viewer.
- Have descriptions for the adjustable parameters A and B.
- Have other methods and properties as needed.

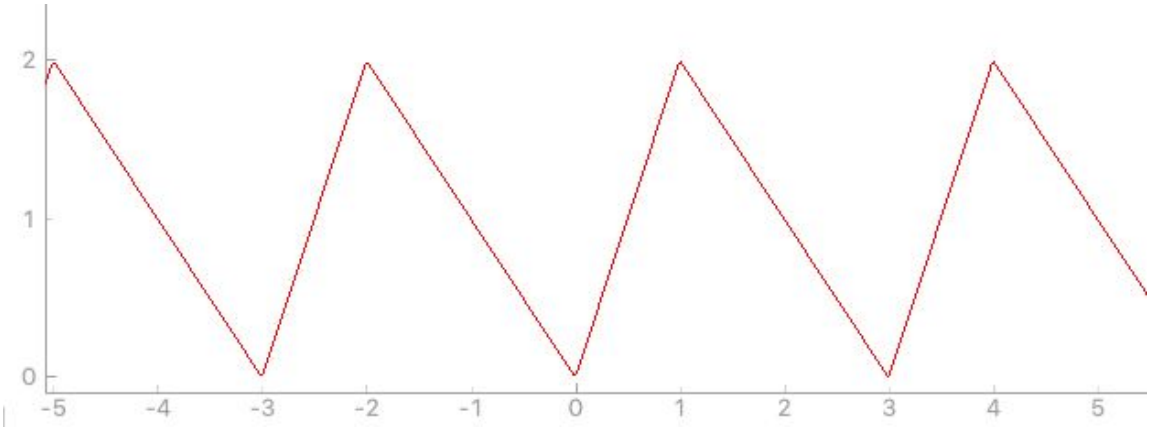
Please include **three example functions** with your graph viewer, one of which must be the sawtooth wave, described below.

The sawtooth wave

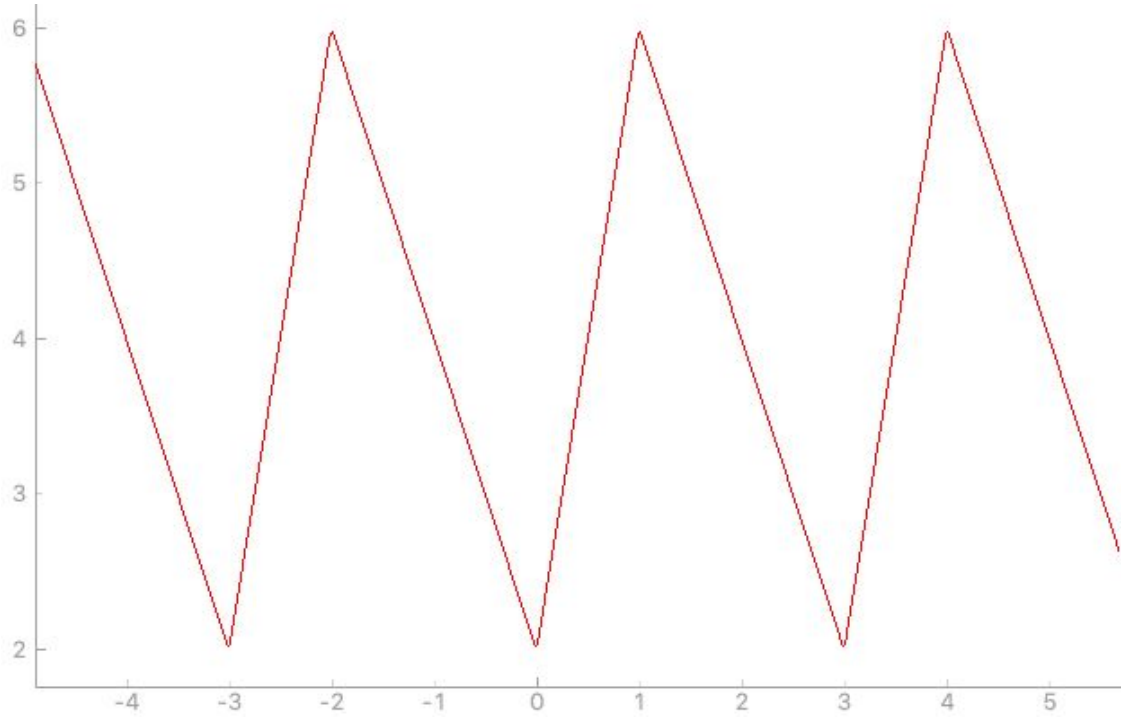
The sawtooth wave is an asymmetric triangle wave function, with a wavelength of 3 X-units. Notice that the up-slope is 1 X-unit long, and the down-slope is 2 X-units long.

The A parameter controls the vertical scaling (i.e. amplitude) of the function.
The B parameter controls the vertical shift of the function.

When A = 2 and B = 1:



When A = 4 and B = 4:



Note that the scaling parameter A is applied before the shifting parameter B. Please implement the sawtooth wave exactly as described.

Requirements

- All source code, a list of dependencies required, and instructions on how to run the program should be emailed to Rafael (rafael.gomez@czbiohub.org) by the time and date specified in the email that contained these instructions.
- The program should be written in Python 3.6 or 3.7 and only use modules that can be installed via pip. You may use any Python UI library (some examples are PyGUI, PyQT, Tkinter).
- There is no limitation on the number of lines of code, functions or files.
- Please focus on
    - implementing the described functionality as closely as possible.
    - testing your solution to make sure it is free of bugs.
    - writing clean, well-structured, well-documented code that follows coding best practices. We will be paying particular attention to the quality of your code.
- The user interface does not need to be pretty (e.g. don't worry about any graphical styling), but should be functional.
- Please don't hesitate to reach out if any instructions are unclear.