PHY1112: Assignment 3

> Perfectly Functional

Assigned: January 23rd, 2024

Due: January 30th, 2024

Learning Objectives

1. Practice looping
2. Practice conditional statements
3. Defining functions and their required and optional arguments

Grade Breakdown

|  |  |  |  |
| --- | --- | --- | --- |
| Part | 1 | 2 | Total |
| Points | 9 | 10 | 19 |
| Score |  |  |  |

**Question 0: Stringing Me Along**

When writing your own functions, in this assignment as well as those that follow, it is very important to include *docstrings*. These are comments similar to a file header, however they go immediately beneath the function declaration.

It is good to include a description of the function, the input arguments, and the output. An example docstring would look like this:



These are immensely useful, and many IDEs will automatically parse them and display them like a help message in real time as you are writing your code. For example, look what happens as I open the bracket to a function call with `pow`:

A screenshot of a computer

Description automatically generated

Thus, when grading your code, things like docstrings will be looked for. **Include docstrings on all of your functions for this course from this assignment onward.**

**Question 1: Weather revisited**

In lab 3, you performed a counted loop (“for loop”) over a list of daily high temperatures in order to count the number of “hot”, “warm” and “temperate” days. This question will expand on this problem, now adding the data for daily low temperature in the same time period.

Using the template provided (“PHY1112\_A3\_Q1\_Template.py”) that already contains high and low temperature data:

1. Write a function `find\_max\_temperature` and use it to determine the *maximum* daytime temperature and the *minimum* nighttime temperature. Report your results.

Note: you may not use the built-in `max()` function.

Hint: how could one manipulate the data to use a maximum function to find a minimum?  
**(4 marks)**

1. Now loop over the elements in the high\_temperatures and low\_temperatures lists *at the same time*. Take the difference between the high and low temperatures for each day. Have your script determine which day of the month had the greatest overall range of temperature, and what that range was. Report your results.  
   **(4 marks)**

Don’t forget to add docstrings!

**(9 marks total, 1 for doc strings/file header/variable naming/comments)**

**Question 2: Hopefully not too “complex”**

You will revisit the quadratic equation function you created for lab 3. Up to now, complex roots were not really considered. In many physics problems, a complex root may be ignored, but in others you might still want it.

Since many times you don’t want complex roots, but sometimes you do, let us make a *keyword argument* (optional argument) to the quadratic formula function to control whether or not it will ignore complex roots. In the case where complex roots are being ignored, and there happen to be any, they should be returned as None.

Write a script that:

1. Modifies your quadratic equation function to now have a keyword argument `complex\_roots` that defaults to ignoring complex roots. Test each root using conditional statements (if statements) to determine whether or not it is complex, and replace any complex root with `None`.  
   **(2 marks)**
2. Further, add a check to ensure that the function input *a* is non-zero. In the case that it is zero, still find the roots accordingly and return them.

Hint: put a=0 into the quadratic equation, and find an expression for the root, then implement this expression in your code.   
**(2.5 marks)**

1. Print the roots for the following combinations of *a*, *b*, and *c.* Toggle your optional complex roots parameter on and off for each combination (using the keyword argment you created in part a).

Show the output for each case below (0.5 marks each)

|  |  |  |
| --- | --- | --- |
| **a** | **b** | **c** |
| 0 | 2 | 4 |
| 1 | -8 | 15 |
| 1 | 2 | 1 |
| 1 | 2 | 3 |
| 1 | -(1+1j) | 1j |

**(2.5 marks)**

1. Analytically find the roots for the parameters in the last row of the table in part c). How do these roots compare to the results your code gives? Comment on their differences and why you think they might be different.

**(2 marks)**

Don’t forget your doc strings!

**(10 marks total, 1 for doc strings/file header/variable naming/comments)**

**Code**