

# Homework 1: Functions, Control

**hw01.zip (hw01.zip)**

*Due by 11:59pm on Monday, September 9*

## Instructions

Download [hw01.zip](#) ([hw01.zip](#)).

**Submission:** When you are done, submit the assignment by uploading all code files you've edited to Gradescope. You may submit more than once before the deadline; only the final submission will be scored. Check that you have successfully submitted your code on Gradescope. See [Lab 0](#) ([../..lab/lab00#task-c-submitting-the-assignment](#)) for more instructions on submitting assignments.

**Using Ok:** If you have any questions about using Ok, please refer to [this guide](#). ([../..articles/using-ok](#))

**Readings:** You might find the following references useful:

- [Section 1.1](https://www.composingprograms.com/pages/11-getting-started.html) (<https://www.composingprograms.com/pages/11-getting-started.html>)
- [Section 1.2](https://www.composingprograms.com/pages/12-elements-of-programming.html) (<https://www.composingprograms.com/pages/12-elements-of-programming.html>)
- [Section 1.3](https://www.composingprograms.com/pages/13-defining-new-functions.html) (<https://www.composingprograms.com/pages/13-defining-new-functions.html>)
- [Section 1.4](https://www.composingprograms.com/pages/14-designing-functions.html) (<https://www.composingprograms.com/pages/14-designing-functions.html>)
- [Section 1.5](https://www.composingprograms.com/pages/15-control.html) (<https://www.composingprograms.com/pages/15-control.html>)

**Grading:** Homework is graded based on correctness. Each incorrect problem will decrease the total score by one point. **This homework is out of 2 points.**

Getting Started Videos

## Required Questions

## Q1: A Plus Abs B

Python's `operator` module contains two-argument functions such as `add` and `sub` for Python's built-in arithmetic operators. For example, `add(2, 3)` evaluates to 5, just like the expression `2 + 3`.

Fill in the blanks in the following function for adding `a` to the absolute value of `b`, without calling `abs`. You may **not** modify any of the provided code other than the two blanks.

```
def a_plus_abs_b(a, b):
    """Return a+abs(b), but without calling abs.

    >>> a_plus_abs_b(2, 3)
    5
    >>> a_plus_abs_b(2, -3)
    5
    >>> a_plus_abs_b(-1, 4)
    3
    >>> a_plus_abs_b(-1, -4)
    3
    """
    if b < 0:
        f = _____
    else:
        f = _____
    return f(a, b)
```

Use Ok to test your code:

```
python3 ok -q a_plus_abs_b
```



Use Ok to run the local syntax checker (which checks that you didn't modify any of the provided code other than the two blanks):

```
python3 ok -q a_plus_abs_b_syntax_check
```

## Q2: Two of Three

Write a function that takes three *positive* numbers as arguments and returns the sum of the squares of the two smallest numbers. **Use only a single line for the body of the function.**

```
def two_of_three(i, j, k):
    """Return m*m + n*n, where m and n are the two smallest members of the
    positive numbers i, j, and k.

    >>> two_of_three(1, 2, 3)
    5
    >>> two_of_three(5, 3, 1)
    10
    >>> two_of_three(10, 2, 8)
    68
    >>> two_of_three(5, 5, 5)
    50
    """
    return _____
```

**Hint:** Consider using the `max` or `min` function:

```
>>> max(1, 2, 3)
3
>>> min(-1, -2, -3)
-3
```

Use Ok to test your code:

```
python3 ok -q two_of_three
```



Use Ok to run the local syntax checker (which checks that you used only a single line for the body of the function):

```
python3 ok -q two_of_three_syntax_check
```

### Q3: Largest Factor

Write a function that takes an integer `n` that is **greater than 1** and returns the largest integer that is smaller than `n` and evenly divides `n`.

```
def largest_factor(n):  
    """Return the largest factor of n that is smaller than n.  
  
    >>> largest_factor(15) # factors are 1, 3, 5  
    5  
    >>> largest_factor(80) # factors are 1, 2, 4, 5, 8, 10, 16, 20, 40  
    40  
    >>> largest_factor(13) # factor is 1 since 13 is prime  
    1  
    """  
    "*** YOUR CODE HERE ***"
```

**Hint:** To check if  $b$  evenly divides  $a$ , use the expression  $a \% b == 0$ , which can be read as, "the remainder when dividing  $a$  by  $b$  is 0."

Use Ok to test your code:

```
python3 ok -q largest_factor
```



## Q4: Hailstone

Douglas Hofstadter's Pulitzer-prize-winning book, *Gödel, Escher, Bach*, poses the following mathematical puzzle.

1. Pick a positive integer  $n$  as the start.
2. If  $n$  is even, divide it by 2.
3. If  $n$  is odd, multiply it by 3 and add 1.
4. Continue this process until  $n$  is 1.

The number  $n$  will travel up and down but eventually end at 1 (at least for all numbers that have ever been tried -- nobody has ever proved that the sequence will terminate).

Analogously, a hailstone travels up and down in the atmosphere before eventually landing on earth.

This sequence of values of  $n$  is often called a Hailstone sequence. Write a function that takes a single argument with formal parameter name  $n$ , prints out the hailstone sequence starting at  $n$ , and returns the number of steps in the sequence:

```
def hailstone(n):
    """Print the hailstone sequence starting at n and return its
    length.

    >>> a = hailstone(10)
    10
    5
    16
    8
    4
    2
    1
    >>> a
    7
    >>> b = hailstone(1)
    1
    >>> b
    1
    """
    "*** YOUR CODE HERE ***"
```

Hailstone sequences can get quite long! Try 27. What's the longest you can find?

Note that if  $n == 1$  initially, then the sequence is one step long.

**Hint:** If you see 4.0 but want just 4, try using floor division `//` instead of regular division `/`.

Use Ok to test your code:

```
python3 ok -q hailstone
```



**Curious about hailstone sequences? Take a look at this article:**

- In 2019, there was a major development (<https://www.quantamagazine.org/mathematician-terence-cao-and-the-collatz-conjecture-20191211/>) in understanding how the hailstone conjecture works for most numbers!

## Check Your Score Locally

You can locally check your score on each question of this assignment by running

```
python3 ok --score
```

**This does NOT submit the assignment!** When you are satisfied with your score, submit the assignment to Gradescope to receive credit for it.

# Submit Assignment

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Submit this assignment by uploading any files you've edited **to the appropriate Gradescope assignment**. [Lab 00 \(../lab/lab00/#submit-with-gradescope\)](#) has detailed instructions.

