

# Python's Gonna Get You

## Programming Project 0 and 1

due at 11 PM on Friday, 27 January 2023

This project is an introduction to Python, which is an interpreted, object-oriented language that shares some features with both Java and Scheme. This tutorial will walk through the primary syntactic constructions in Python, using short examples. Make sure that you can replicate the entire tutorial on your environment and make sure it's giving the same results. You may find the **Troubleshooting** section helpful if you run into problems. It contains a list of the frequent problems previous students have encountered when following this tutorial.

The source code for the tutorial part of the project is at the following link:

[blue.butler.edu/~agupta/CS445/Projects/](http://blue.butler.edu/~agupta/CS445/Projects/). It is available in both zip formats and manually if you wish to download each file separately.

## Setting Up a Python Environment

I recommend that you use the Python distribution that is on Thomas, because it has all the packages necessary in the distribution for all of the projects for this class. To that end, you can log in to Thomas and edit files there as you do for projects in other classes.

## Invoking the Interpreter

Python can be run in one of two modes. It can either be used interactively, via an interpreter, or it can be called from the command line to execute a script. We will first use the Python interpreter interactively. You invoke the interpreter by entering `python3` at the Unix command prompt on thomas.

## Python Basics

**Operators.** The Python interpreter can be used to evaluate expressions, for example simple arithmetic expressions. If you enter such expressions at the prompt (`>>>`) they will be evaluated and the result will be returned on the next line.

```
>>> 1 + 1
2
>>> 2 * 3
6
```

Boolean operators also exist in Python to manipulate the primitive True and False values.

```
>>> 1==0
False
```

```
>>> not (1==0)
True
>>> (2==2) and (2==3)
False
>>> (2==2) or (2==3)
True
```

**Strings.** Like Java, Python has a built-in string type. The + operator is overloaded to do string concatenation on string values.

```
>>> "artificial" + "intelligence"
"artificialintelligence"
```

There are many built-in methods which allow you to manipulate strings.

```
>>> 'artificial'.upper()
'ARTIFICIAL'
>>> 'HELP'.lower()
'help'
>>> len('Help')
4
```

Notice that we can use either single quotes ' ' or double quotes " " to surround a string. This allows for easy nesting of strings.

We can also store expressions into variables.

```
>>> s = 'hello world'
>>> print(s)
hello world
>>> s.upper()
'HELLO WORLD'
>>> len(s.upper())
11
>>> num = 8.0
>>> num += 2.5
>>> print(num)
10.5
```

In Python, you do not have declare variables before you assign to them.

**Help Yerself To String Manipulation.** Learn about the methods Python provides for strings. To see what methods Python provides for a datatype, use the dir and help commands:

```
>>> s = 'abc'

>>> dir(s)
['__add__', '__class__', '__contains__', '__delattr__', '__doc__', '__eq__', '
__ge__', '__getattribute__', '__getitem__', '__getnewargs__', '__getslice__',
 '__gt__', '__hash__', '__init__', '__le__', '__len__', '__lt__', '__mod__', '__
```

```
mul__', '__ne__', '__new__', '__reduce__', '__reduce_ex__', '__repr__', '__rmod__', '__rmul__', '__setattr__', '__str__', 'capitalize', 'center', 'count', 'decode', 'encode', 'endswith', 'expandtabs', 'find', 'index', 'isalnum', 'isalpha', 'isdigit', 'islower', 'isspace', 'istitle', 'isupper', 'join', 'ljust', 'lower', 'lstrip', 'replace', 'rfind', 'rindex', 'rjust', 'rsplit', 'rstrip', 'split', 'splitlines', 'startswith', 'strip', 'swapcase', 'title', 'translate', 'upper', 'zfill']
```

```
>>> help(s.find)
```

Help on built-in function find:

```
find(...)
    S.find(sub [,start [,end]]) -> int

    Return the lowest index in S where substring sub is found,
    such that sub is contained within s[start,end]. Optional
    arguments start and end are interpreted as in slice notation.

    Return -1 on failure.
```

```
>> s.find('b')
1
```

Try out some of the string functions listed in `dir` (ignore those with underscores `'_'` around the method name).

## Built-In Data Structures

Python comes equipped with some useful built-in data structures, broadly similar to Java's collections package.

**Lists.** Lists store a sequence of mutable items:

```
>>> fruits = ['apple', 'orange', 'pear', 'banana']
>>> fruits[0]
'apple'
```

We can use the `+` operator to do list concatenation:

```
>>> otherFruits = ['kiwi', 'strawberry']
>>> fruits + otherFruits
>>> ['apple', 'orange', 'pear', 'banana', 'kiwi', 'strawberry']
```

Python also allows negative-indexing from the back of the list. For instance, `fruits[-1]` will access the last element 'banana':

```

>>> fruits[-2]
'pear'
>>> fruits.pop()
'banana'
>>> fruits
['apple', 'orange', 'pear']
>>> fruits.append('grapefruit')
>>> fruits
['apple', 'orange', 'pear', 'grapefruit']
>>> fruits[-1] = 'pineapple'
>>> fruits
['apple', 'orange', 'pear', 'pineapple']

```

We can also index multiple adjacent elements using the slice operator. For instance, `fruits[1:3]`, returns a list containing the elements at position 1 and 2. In general `fruits[start:stop]` will get the elements in start, start+1, ..., stop-1. We can also do `fruits[start:]` which returns all elements starting from the start index. Also `fruits[:end]` will return all elements before the element at position end:

```

>>> fruits[0:2]
['apple', 'orange']
>>> fruits[:3]
['apple', 'orange', 'pear']
>>> fruits[2:]
['pear', 'pineapple']
>>> len(fruits)
4

```

The items stored in lists can be any Python data type. So for instance we can have lists of lists:

```

>>> lstOfLsts = [['a', 'b', 'c'], [1, 2, 3], ['one', 'two', 'three']]
>>> lstOfLsts[1][2]
3
>>> lstOfLsts[0].pop()
'c'
>>> lstOfLsts
[['a', 'b'], [1, 2, 3], ['one', 'two', 'three']]

```

Play with some of the list functions. You can find the methods you can call on an object via the `dir` and get information about them via the `help` command:

```

>>> dir(list)
['__add__', '__class__', '__contains__', '__delattr__', '__delitem__',
 '__delslice__', '__doc__', '__eq__', '__ge__', '__getattr__',
 '__getitem__', '__getslice__', '__gt__', '__hash__', '__iadd__', '__imul__',
 '__init__', '__iter__', '__le__', '__len__', '__lt__', '__mul__', '__ne__',
 '__new__', '__reduce__', '__reduce_ex__', '__repr__', '__reversed__',
 '__rmul__', '__setattr__', '__setitem__', '__setslice__', '__str__',
 'append', 'count', 'extend', 'index', 'insert', 'pop', 'remove', 'reverse',

```

```
'sort']
```

```
>>> help(list.reverse)
```

Help on built-in function reverse:

```
reverse(...)
    L.reverse() -- reverse *IN PLACE*
>>> lst = ['a','b','c']
>>> lst.reverse()
>>> ['c','b','a']
```

Note: Ignore functions with underscores “\_” around the names; these are private helper methods. Press ‘q’ to back out of a help screen.

**Tuples.** A data structure similar to the list is the *tuple*, which is like a list except that it is immutable once it is created (i.e. you cannot change its content once created). Note that tuples are surrounded with parentheses while lists have square brackets.

```
>>> pair = (3,5)
>>> pair[0]
3
>>> x,y = pair
>>> x
3
>>> y
5
>>> pair[1] = 6
TypeError: object does not support item assignment
```

The attempt to modify an immutable structure raised an exception. Exceptions indicate errors: index out of bounds errors, type errors, and so on, will all report exceptions in this way.

**Sets.** A set is another data structure that serves as an unordered list with no duplicate items. Below, we show how to create a set, add things to the set, test if an item is in the set, and perform common set operations (difference, intersection, union):

```
>>> shapes = ['circle','square','triangle','circle']
>>> setOfShapes = set(shapes)
>>> setOfShapes
set(['circle','square','triangle'])
>>> setOfShapes.add('polygon')
>>> setOfShapes
set(['circle','square','triangle','polygon'])
>>> 'circle' in setOfShapes
True
>>> 'rhombus' in setOfShapes
False
```

```
>>> favoriteShapes = ['circle','triangle','hexagon']
>>> setOfFavoriteShapes = set(favoriteShapes)
>>> setOfShapes - setOfFavoriteShapes
set(['square','polyon'])
>>> setOfShapes & setOfFavoriteShapes
set(['circle','triangle'])
>>> setOfShapes | setOfFavoriteShapes
set(['circle','square','triangle','polygon','hexagon'])
```

Objects in a set are unordered; you cannot assume that their traversal or print order will be the same across machines!

**Dictionaries.** The last built-in data structure is the dictionary which stores a map from one type of object (the key) to another (the value). The key must be an immutable type (string, number, or tuple). The value can be any Python data type.

Note: In the example below, the printed order of the keys returned by Python could be different than shown below. The reason is that unlike lists which have a fixed ordering, a dictionary is simply a hash table for which there is no fixed ordering of the keys (like HashMaps in Java). The order of the keys depends on how exactly the hashing algorithm maps keys to buckets, and will usually seem arbitrary. Your code should not rely on key ordering, and you should not be surprised if even a small modification to how your code uses a dictionary results in a new key ordering.

```
>>> studentIds = {'knuth': 42.0, 'turing': 56.0, 'nash': 92.0 }
>>> studentIds['turing']
56.0
>>> studentIds['nash'] = 'ninety-two'
>>> studentIds
{'knuth': 42.0, 'turing': 56.0, 'nash': 'ninety-two'}
>>> del studentIds['knuth']
>>> studentIds
{'turing': 56.0, 'nash': 'ninety-two'}
>>> studentIds['knuth'] = [42.0,'forty-two']
>>> studentIds
{'knuth': [42.0, 'forty-two'], 'turing': 56.0, 'nash': 'ninety-two'}
>>> studentIds.keys()
['knuth', 'turing', 'nash']
>>> studentIds.values()
[[42.0, 'forty-two'], 56.0, 'ninety-two']
>>> studentIds.items()
[('knuth',[42.0, 'forty-two']), ('turing',56.0), ('nash','ninety-two')]
>>> len(studentIds)
3
```

As with nested lists, you can also create dictionaries of dictionaries.

Use `dir` and `help` to learn about the functions you can call on dictionaries.

## Writing Scripts

Now that you've got a handle on using Python interactively, let's write a simple Python script that demonstrates Python's for loop. Open the file called `foreach.py` and update it with the following code:

```
# This is what a comment looks like
fruits = ['apples', 'oranges', 'pears', 'bananas']
for fruit in fruits:
    print(fruit + ' for sale')

fruitPrices = {'apples': 2.00, 'oranges': 1.50, 'pears': 1.75}
for fruit, price in fruitPrices.items():
    if price < 2.00:
        print('%s cost %f a pound' % (fruit, price))
    else:
        print(fruit + ' are too expensive!')
```

At the command line, use the following command in the directory containing `foreach.py`:

```
$ python3 foreach.py
apples for sale
oranges for sale
pears for sale
bananas for sale
oranges cost 1.500000 a pound
pears cost 1.750000 a pound
apples are too expensive!
```

Remember that the print statements listing the costs may be in a different order on your screen than in this tutorial; that's due to the fact that we're looping over dictionary keys, which are unordered. To learn more about control structures (e.g., if and else) in Python, check out the official Python tutorial section on this topic.

The next snippet of code demonstrates Python's list comprehension construction:

```
nums = [1,2,3,4,5,6]
plusOneNums = [x+1 for x in nums]
oddNums = [x for x in nums if x % 2 == 1]
print(oddNums)
oddNumsPlusOne = [x+1 for x in nums if x % 2 ==1]
print(oddNumsPlusOne)
```

This code is in a file called `listcomp.py`, which you can run:

```
$ python3 listcomp.py
[1,3,5]
[2,4,6]
```

Write a list comprehension which generates a lowercased version of each string that has length greater than five. You can find the solution in `listcomp2.py`, but I recommend writing it first!

# INDENTATION MATTERS

Unlike many other languages, Python uses the indentation in the source code for interpretation. So for instance, for the following script:

```
if 0 == 1:
    print('We are in a world of arithmetic pain')
print('Thank you for playing')
```

will output

Thank you for playing

But if we had written the script as

```
if 0 == 1:
    print('We are in a world of arithmetic pain')
    print('Thank you for playing')
```

there would be no output. The moral of the story: be careful how you indent! It's best to use four spaces for indentation – that's what the course code uses.

**Tabs vs Spaces.** Because Python uses indentation for code evaluation, it needs to keep track of the level of indentation across code blocks. This means that if your Python file switches from using tabs as indentation to spaces as indentation, the Python interpreter will not be able to resolve the ambiguity of the indentation level and throw an exception. Even though the code can be lined up visually in your text editor, Python “sees” a change in indentation and most likely will throw an exception (or rarely, produce unexpected behavior).

This most commonly happens when opening up a Python file that uses an indentation scheme that is opposite from what your text editor uses (aka, your text editor uses spaces and the file uses tabs). When you write new lines in a code block, there will be a mix of tabs and spaces, even though the whitespace is aligned. For a longer discussion on tabs vs spaces, see this discussion on StackOverflow at

<https://stackoverflow.com/questions/119562/tabs-versus-spaces-in-python-programming>.

## Writing Functions

In Python, you can define your own functions:

```
fruitPrices = {'apples':2.00, 'oranges': 1.50, 'pears': 1.75}

def buyFruit(fruit, numPounds):
    if fruit not in fruitPrices:
        print("Sorry we don't have %s" % (fruit))
    else:
        cost = fruitPrices[fruit] * numPounds
        print("That'll be %f please" % (cost))
```



```
# Main Function
if __name__ == '__main__':
    buyFruit('apples',2.4)
    buyFruit('coconuts',2)
```

Rather than having a main function as in Java or C++, the `__name__ == '__main__'` check is used to delimit expressions which are executed when the file is called as a script from the command line. The code after the main check is the same sort of code you would put in a main function in Java.

Save this script as `fruit.py` and run it:

```
python3 fruit.py
That'll be 4.800000 please
Sorry we don't have coconuts
```

**Challenge:** Write a `quickSort` function in Python using list comprehensions. Use the first element as the pivot. You can find the solution in `quickSort.py`.

## Basic Objects

Although this isn't a class in object-oriented programming, you'll have to use some objects in the programming projects, and so it's worth covering the basics of objects in Python. An object encapsulates data and provides functions for interacting with that data.

**Defining Classes.** Here's an example of defining a class named `FruitShop`:

```
class FruitShop:

    def __init__(self, name, fruitPrices):
        """
            name: Name of the fruit shop

            fruitPrices: Dictionary with keys as fruit
            strings and prices for values e.g.
            {'apples':2.00, 'oranges': 1.50, 'pears': 1.75}
        """
        self.fruitPrices = fruitPrices
        self.name = name
        print('Welcome to the %s fruit shop' % (name))

    def getCostPerPound(self, fruit):
        """
            fruit: Fruit string
            Returns cost of 'fruit', assuming 'fruit'
            is in our inventory or None otherwise
        """
        if fruit not in self.fruitPrices:
            print("Sorry we don't have %s" % (fruit))
```

```

        return None
    return self.fruitPrices[fruit]

def getPriceOfOrder(self, orderList):
    """
        orderList: List of (fruit, numPounds) tuples

    Returns cost of orderList. If any of the fruit are
    """
    totalCost = 0.0
    for fruit, numPounds in orderList:
        costPerPound = self.getCostPerPound(fruit)
        if costPerPound != None:
            totalCost += numPounds * costPerPound
    return totalCost

def getName(self):
    return self.name

```

The `FruitShop` class has some data, the name of the shop and the prices per pound of some fruit, and it provides functions, or methods, on this data. What advantage is there to wrapping this data in a class? Encapsulating the data prevents it from being altered or used inappropriately and the abstraction that objects provide make it easier to write general-purpose code.

**Using Objects.** So how do we make an object and use it? Make sure you have the `FruitShop` implementation in `shop.py`. We then import the code from this file (making it accessible to other scripts) using `import shop`, since `shop.py` is the name of the file. Then, we can create `FruitShop` objects as follows:

```

import shop

shopName = 'the Butler Bowl'
fruitPrices = {'apples': 1.00, 'oranges': 1.50, 'pears': 1.75}
butlerShop = shop.FruitShop(shopName, fruitPrices)
applePrice = butlerShop.getCostPerPound('apples')
print(applePrice)
print('Apples cost %.2f at %s.' % (applePrice, shopName))

otherName = 'the Hinkle Fieldhouse'
otherFruitPrices = {'kiwis': 6.00, 'apples': 4.50, 'peaches': 8.75}
otherFruitShop = shop.FruitShop(otherName, otherFruitPrices)
otherPrice = otherFruitShop.getCostPerPound('apples')
print(otherPrice)
print('Apples cost %.2f at %s.' % (otherPrice, otherName))
print("My, that's expensive!")

```

This code is in `shopTest.py`; you can run it like this:

```
python3 shopTest.py
Welcome to the Butler Bowl fruit shop
1.0
Apples cost 1.00 at the Butler Bowl.
Welcome to the Hinkle Fieldhouse fruit shop
4.5
Apples cost 4.50 at the Hinkle Fieldhouse.
My, that's expensive!
```

So what just happened? The `import shop` statement told Python to load all of the functions and classes in `shop.py`. The line `butlerShop = shop.FruitShop(shopName, fruitPrices)` constructs an instance of the `FruitShop` class defined in `shop.py`, by calling the `__init__` function in that class. Note that we only passed two arguments in, while `__init__` seems to take three arguments: (`self`, `name`, `fruitPrices`). The reason for this is that all methods in a class have `self` as the first argument. The `self` variable's value is automatically set to the object itself; when calling a method, you only supply the remaining arguments. The `self` variable contains all the data (`name` and `fruitPrices`) for the current specific instance (similar to this in Java). The print statements use the substitution operator (described in the Python docs if you're curious).

**Static vs Instance Variables.** The following example illustrates how to use static and instance variables in Python.

Create the `person_class.py` containing the following code:

```
class Person:
    population = 0
    def __init__(self, myAge):
        self.age = myAge
        Person.population += 1
    def get_population(self):
        return Person.population
    def get_age(self):
        return self.age
```

We first compile the script:

```
python3 person_class.py
```

Now use the class as follows:

```
>>> import person_class
>>> p1 = person_class.Person(12)
>>> p1.get_population()
1
>>> p2 = person_class.Person(63)
>>> p1.get_population()
2
>>> p2.get_population()
2
>>> p1.get_age()
```

```
12
>>> p2.get_age()
63
```

In the code above, `age` is an instance variable and `population` is a static variable. `population` is shared by all instances of the `Person` class whereas each instance has its own `age` variable.

More Python Tips and Tricks This tutorial has briefly touched on some major aspects of Python that will be relevant to the course. Here are some more useful tidbits:

Use `range` to generate a sequence of integers, useful for generating traditional indexed for loops: `for index in range(3): print(lst[index])` After importing a file, if you edit a source file, the changes will not be immediately propagated in the interpreter. For this, use the `reload` command:

```
>>> reload(shop)
```

## Troubleshooting

These are some problems (and their solutions) that new Python learners commonly encounter.

Problem:

```
ImportError: No module named py
```

Solution: When using `import`, do not include the `".py"` from the filename. For example, you should say: `import shop` NOT: `import shop.py`

Problem:

```
NameError: name 'MY VARIABLE' is not defined
```

Even after importing you may see this.

Solution: To access a member of a module, you have to type `MODULE NAME.MEMBER NAME`, where `MODULE NAME` is the name of the `.py` file, and `MEMBER NAME` is the name of the variable (or function) you are trying to access.

Problem:

```
TypeError: 'dict' object is not callable
```

Solution: Dictionary look ups are done using square brackets: `[ and ]`. NOT parenthesis: `( and )`.

Problem:

```
ValueError: too many values to unpack
```

Solution: Make sure the number of variables you are assigning in a for loop matches the number of elements in each item of the list. Similarly for working with tuples.

For example, if `pair` is a tuple of two elements (e.g. `pair = ('apple', 2.0)`) then the following code would cause the "too many values to unpack error":

`(a,b,c) = pair` Here is a problematic scenario involving a for loop:

```
pairList = [('apples', 2.00), ('oranges', 1.50), ('pears', 1.75)]
for fruit, price, color in pairList:
    print('%s fruit costs %f and is the color %s' % (fruit, price, color))
```

Problem:

`AttributeError: 'list' object has no attribute 'length' (or something similar)`

Solution: Finding length of lists is done using `len(NAME OF LIST)`.

Problem: Changes to a file are not taking effect.

Solution: Make sure you are saving all your files after any changes. If you are editing a file in a window different from the one you are using to execute python, make sure you `reload(YOUR_MODULE)` to guarantee your changes are being reflected. `reload` works similarly to `import`.

The place to go for more Python information: [www.python.org](http://www.python.org)

# Autograding Your Project

To get you familiarized with the autograder, we will ask you to code, test, and submit solutions for three questions. You can download all of the files associated the autograder tutorial at the following link: [blue.butler.edu/~agupta/CS445/Projects/](http://blue.butler.edu/~agupta/CS445/Projects/). The files you downloaded are:

This contains a number of files you'll edit or run:

`addition.py`: source file for question 1 `buyLotsOfFruit.py`: source file for question 2 `shop.py`: source file for question 3 `shopSmart.py`: source file for question 3 `autograder.py`: autograding script (see below) and others you can ignore:

`test_cases`: directory contains the test cases for each question `grading.py`: autograder code `testClasses.py`: autograder code `tutorialTestClasses.py`: test classes for this particular project `projectParams.py`: project parameters The command `python3 autograder.py` grades your solution to all three problems. If we run it before editing any files we get a page or two of output:

```
python3 autograder.py
Starting on xx-xx at 23:39:51
```

Question q1

```
=====
*** FAIL: test_cases/q1/addition1.test
*** add(a,b) must return the sum of a and b
*** student result: "0"
*** correct result: "2"
*** FAIL: test_cases/q1/addition2.test
*** add(a,b) must return the sum of a and b
*** student result: "0"
*** correct result: "5"
*** FAIL: test_cases/q1/addition3.test
*** add(a,b) must return the sum of a and b
*** student result: "0"
*** correct result: "7.9"
*** Tests failed.
```

### Question q1: 0/1 ###

Question q2

```
=====
*** FAIL: test_cases/q2/food_price1.test
*** buyLotsOfFruit must compute the correct cost of the order
*** student result: "0.0"
*** correct result: "12.25"
*** FAIL: test_cases/q2/food_price2.test
*** buyLotsOfFruit must compute the correct cost of the order
*** student result: "0.0"
*** correct result: "14.75"
*** FAIL: test_cases/q2/food_price3.test
*** buyLotsOfFruit must compute the correct cost of the order
```

```
*** student result: "0.0"
*** correct result: "6.4375"
*** Tests failed.
```

```
### Question q2: 0/1 ###
```

```
Question q3
```

```
=====
```

```
Welcome to shop1 fruit shop
Welcome to shop2 fruit shop
*** FAIL: test_cases/q3/select_shop1.test
*** shopSmart(order, shops) must select the cheapest shop
*** student result: "None"
*** correct result: "<FruitShop: shop1>"
Welcome to shop1 fruit shop
Welcome to shop2 fruit shop
*** FAIL: test_cases/q3/select_shop2.test
*** shopSmart(order, shops) must select the cheapest shop
*** student result: "None"
*** correct result: "<FruitShop: shop2>"
Welcome to shop1 fruit shop
Welcome to shop2 fruit shop
Welcome to shop3 fruit shop
*** FAIL: test_cases/q3/select_shop3.test
*** shopSmart(order, shops) must select the cheapest shop
*** student result: "None"
*** correct result: "<FruitShop: shop3>"
*** Tests failed.
```

```
### Question q3: 0/1 ###
```

```
Finished at 23:39:51
```

```
Provisional grades
```

```
=====
```

```
Question q1: 0/1
```

```
Question q2: 0/1
```

```
Question q3: 0/1
```

```
-----
```

```
Total: 0/3
```

For each of the three questions, this shows the results of that question's tests, the questions grade, and a final summary at the end. Because you haven't yet solved the questions, all the tests fail. As you solve each question you may find some tests pass while other fail. When all tests pass for a question, you get all the points.

Looking at the results for question 1, you can see that it has failed three tests with the error

message "add(a,b) must return the sum of a and b". The answer your code gives is always 0, but the correct answer is different. We'll fix that in the next section.

## 1 Question 1: Addition

Open `addition.py` and look at the definition of `add`:

```
def add(a, b):
    "Return the sum of a and b"
    "*** YOUR CODE HERE ***"
    return 0
```

The tests called this with `a` and `b` set to different values, but the code always returned zero. Modify this definition to read:

```
def add(a, b):
    "Return the sum of a and b"
    print("Passed a=%s and b=%s, returning a+b=%s" % (a,b,a+b))
    return a+b
```

Now rerun the autograder (omitting the results for questions 2 and 3):

```
python3 autograder.py -q q1
Starting on 1-21 at 23:52:05
```

```
Question q1
=====
Passed a=1 and b=1, returning a+b=2
*** PASS: test_cases/q1/addition1.test
*** add(a,b) returns the sum of a and b
Passed a=2 and b=3, returning a+b=5
*** PASS: test_cases/q1/addition2.test
*** add(a,b) returns the sum of a and b
Passed a=10 and b=-2.1, returning a+b=7.9
*** PASS: test_cases/q1/addition3.test
*** add(a,b) returns the sum of a and b
```

```
### Question q1: 1/1 ###
```

```
Finished at 23:41:01
```

```
Provisional grades
```

```
=====
Question q1: 1/1
Question q2: 0/1
Question q3: 0/1
-----
Total: 1/3
```



You now pass all tests, getting full points for question 1. Notice the new lines "Passed a=..." which appear before "\*\*\* PASS: ...". These are produced by the print statement in add. You can use print statements like that to output information useful for debugging. You can also run the autograder with the option `-mute` to temporarily hide such lines, as follows:

```
python3 autograder.py -q q1 --mute
Starting on 1-22 at 14:15:33
```

```
Question q1
```

```
=====
```

```
*** PASS: test_cases/q1/addition1.test
*** add(a,b) returns the sum of a and b
*** PASS: test_cases/q1/addition2.test
*** add(a,b) returns the sum of a and b
*** PASS: test_cases/q1/addition3.test
*** add(a,b) returns the sum of a and b
```

```
### Question q1: 1/1 ###
```

## 2 Question 2: buyLotsOfFruit function

Add a `buyLotsOfFruit(orderList)` function to `buyLotsOfFruit.py` which takes a list of `(fruit,pound)` tuples and returns the cost of your list. If there is some fruit in the list which doesn't appear in `fruitPrices` it should print an error message and return `None`. Please do not change the `fruitPrices` variable.

Run `python3 autograder.py` until question 2 passes all tests and you get full points. Each test will confirm that `buyLotsOfFruit(orderList)` returns the correct answer given various possible inputs. For example, `test_cases/q2/food_price1.test` tests whether the cost of

`('apples',2.0), ('pears',3.0), ('limes',4.0)`

is 12.25.

## 3 Question 3: shopSmart function

Fill in the function `shopSmart(orders,shops)` in `shopSmart.py`, which takes an `orderList` (like the kind passed in to `FruitShop.getPriceOfOrder`) and a list of `FruitShop` and returns the `FruitShop` where your order costs the least amount in total. Don't change the file name or variable names, please. Note that we will provide the `shop.py` implementation as a "support" file, so you don't need to submit yours.

Run `python3 autograder.py` until question 3 passes all tests and you get full points. Each test will confirm that `shopSmart(orders,shops)` returns the correct answer given various possible inputs. For example, with the following variable definitions:

```
orders1 = [('apples',1.0), ('oranges',3.0)]
orders2 = [('apples',3.0)]
dir1 = {'apples': 2.0, 'oranges':1.0}
```

```
shop1 = shop.FruitShop('shop1',dir1)
dir2 = {'apples': 1.0, 'oranges': 5.0}
shop2 = shop.FruitShop('shop2',dir2)
shops = [shop1, shop2]
```

```
test_cases/q3/select_shop1.test tests whether
shopSmart.shopSmart(orders1, shops) == shop1
and test_cases/q3/select_shop2.test tests whether
shopSmart.shopSmart(orders2, shops) == shop2
```

## 4 Turn In Materials

What you must turn in:

1. The source files of the three Python scripts that you edited for questions 1, 2, and 3.
2. The output of your autograder, executed on those scripts.