

Functions

Let's Write Our Own Function!

Define
(keyword)

Function name

Input
(Argument)

```
def square(x):  
    return x * x
```

Indentation

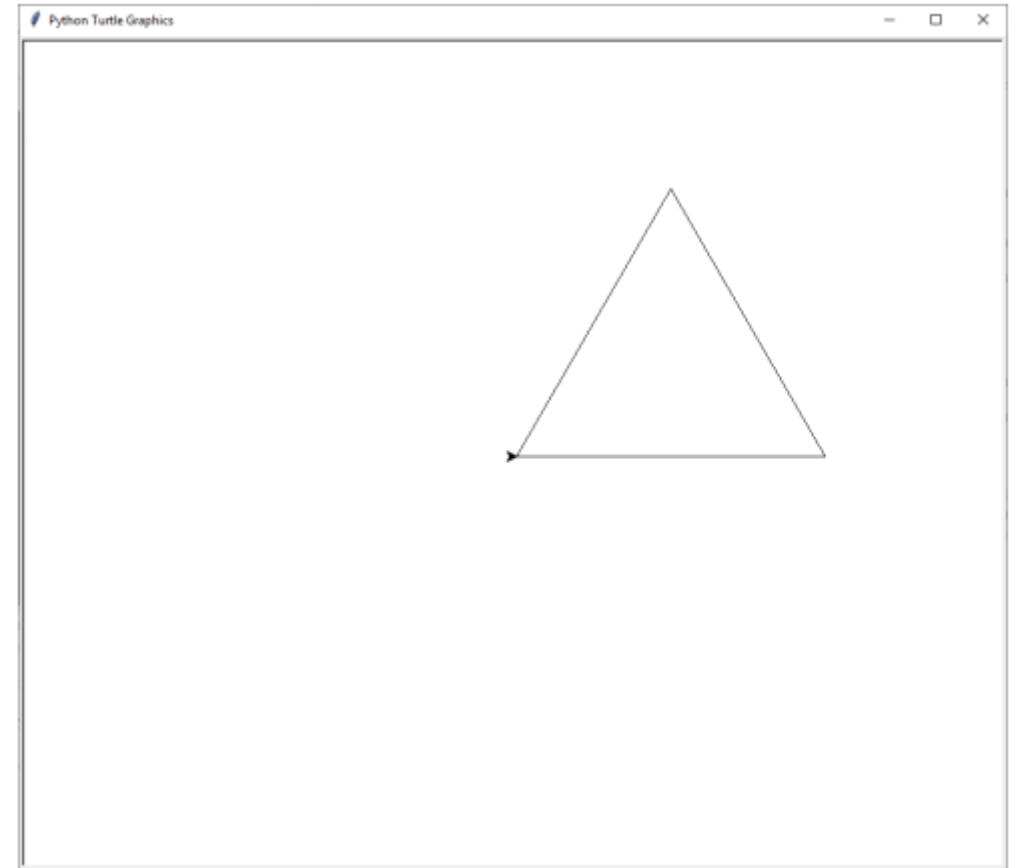
Output

Put Statements into a Function

- For the Assignment last week
- Your answer will be something like (yours maybe a bit different)

```
fd(300)
lt(120)
fd(300)
lt(120)
fd(300)
lt(120)
```

- But if I want to draw it again?
 - It's too troublesome to type the above lines again and again



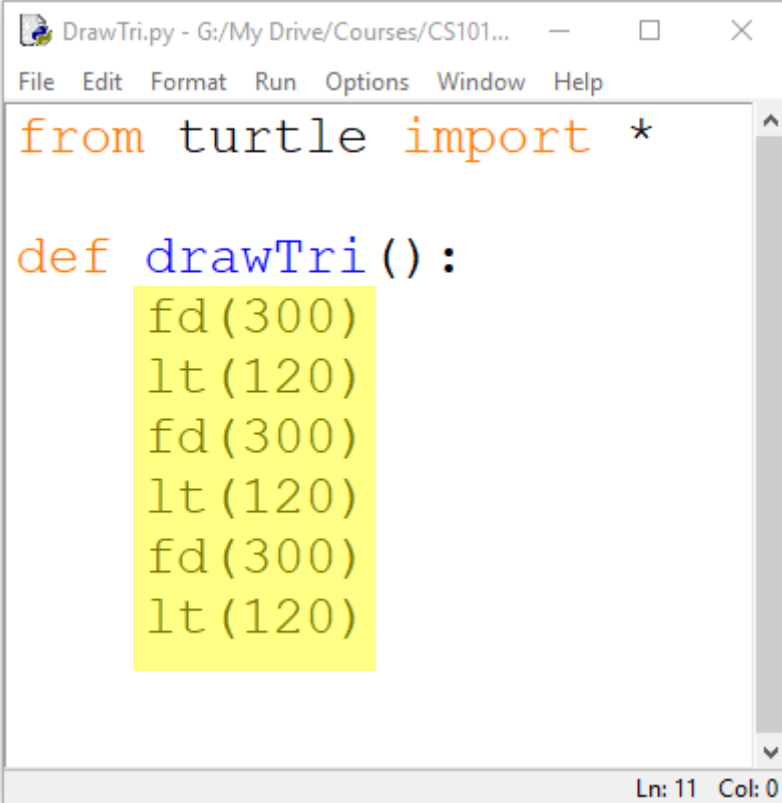
Put Statements into a Function

- Last week Assignment
- Your answer will be something like (yours maybe a bit different)

```
fd(300)
lt(120)
fd(300)
lt(120)
fd(300)
lt(120)
```

- But if I want to draw it again?
 - It's too troublesome to type the above lines again

- We save it into a file by
 - In IDLE, File > New



The screenshot shows a Python IDLE window titled 'DrawTri.py - G:/My Drive/Courses/CS101...'. The menu bar includes File, Edit, Format, Run, Options, Window, and Help. The code in the editor is as follows:

```
from turtle import *

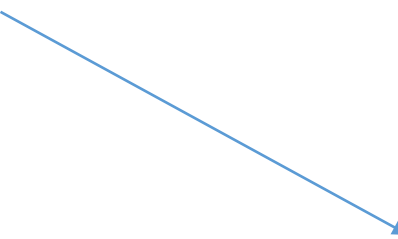
def drawTri():
    fd(300)
    lt(120)
    fd(300)
    lt(120)
    fd(300)
    lt(120)
```

The status bar at the bottom right indicates 'Ln: 11 Col: 0'.

Put Statements into a Function

- After you saved the file and run it
- You can call the function `drawTri()` by
 - `>>> drawTri()`
- Or
 - Directly put it into the file

```
from turtle import *  
  
def drawTri():  
    fd(300)  
    lt(120)  
    fd(300)  
    lt(120)  
    fd(300)  
    lt(120)  
  
drawTri()
```



Function Parameters

- What if we want to draw a triangle that is larger or smaller
 - Namely, the side length is different from 300?
 - Do we write...

```
def drawTri():  
    fd(200)  
    lt(120)  
    fd(200)  
    lt(120)  
    fd(200)  
    lt(120)
```

```
def drawTri():  
    fd(100)  
    lt(120)  
    fd(100)  
    lt(120)  
    fd(100)  
    lt(120)
```

- Etc...?

```
from turtle import *  
  
def drawTri():  
    fd(300)  
    lt(120)  
    fd(300)  
    lt(120)  
    fd(300)  
    lt(120)  
  
drawTri()
```

This is an important skill in computational thinking

Capture the COMMON Pattern

- What if we want to draw a triangle that is larger or smaller
 - Namely, the side length is different from 300?
 - Do we write...

```
def drawTri():  
    fd(200)  
    lt(120)  
    fd(200)  
    lt(120)  
    fd(200)  
    lt(120)
```

```
def drawTri():  
    fd(100)  
    lt(120)  
    fd(100)  
    lt(120)  
    fd(100)  
    lt(120)
```

- Etc...?

- No, we capture the common pattern and make it an input of the function

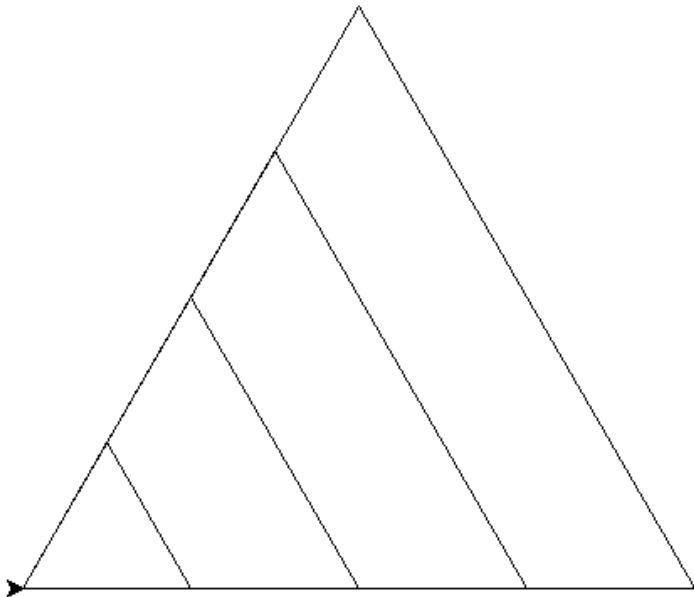
```
from turtle import *  
  
def drawTri(length):  
    fd(length)  
    lt(120)  
    fd(length)  
    lt(120)  
    fd(length)  
    lt(120)
```

```
drawTri(100)  
drawTri(200)  
drawTri(300)
```

This is an important skill in computational thinking

Capture the COMMON Pattern

```
>>> drawTri(100)
>>> drawTri(200)
>>> drawTri(300)
>>> drawTri(400)
>>>
```



- No, we **capture the common pattern** and make it an input of the function

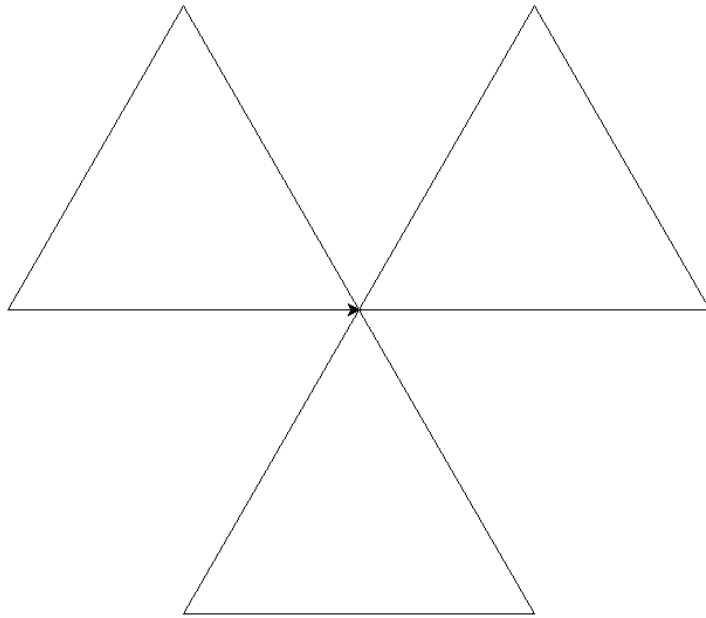
```
from turtle import *

def drawTri(length):
    fd(length)
    lt(120)
    fd(length)
    lt(120)
    fd(length)
    lt(120)

drawTri(100)
drawTri(200)
drawTri(300)
```


Moreover

- What does this code do?
 - Output:



```
from turtle import *

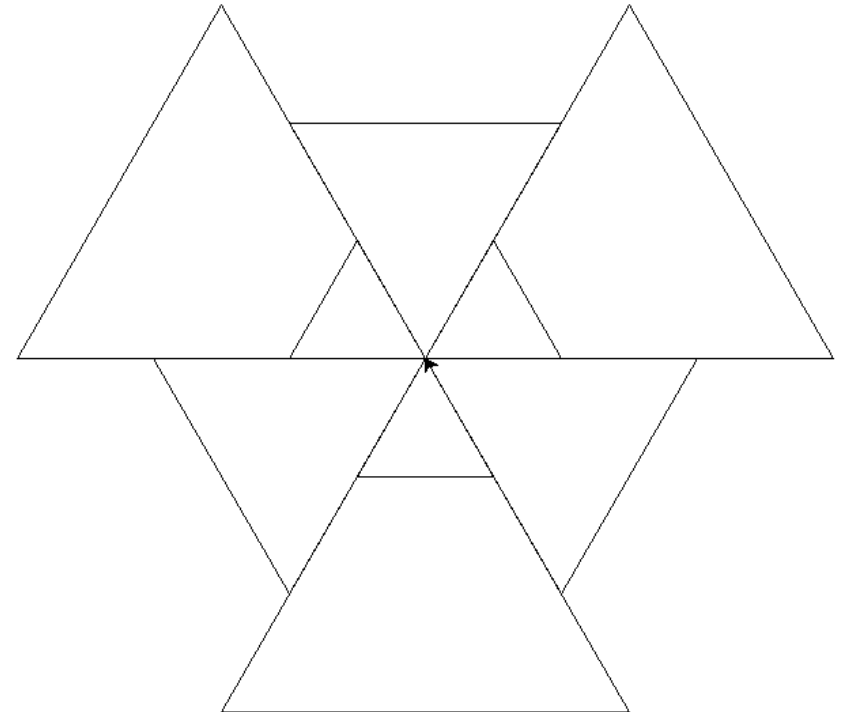
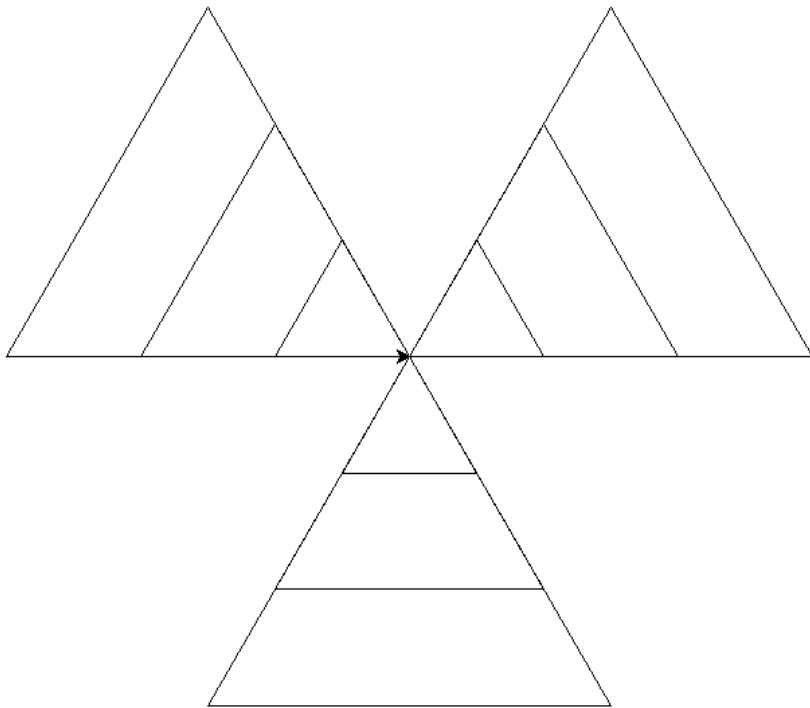
def drawTri (length) :
    fd (length)
    lt (120)
    fd (length)
    lt (120)
    fd (length)
    lt (120)

def foo () :
    drawTri (100)
    lt (120)
    drawTri (100)
    lt (120)
    drawTri (100)
    lt (120)

foo ()
```

Your Task: Draw These

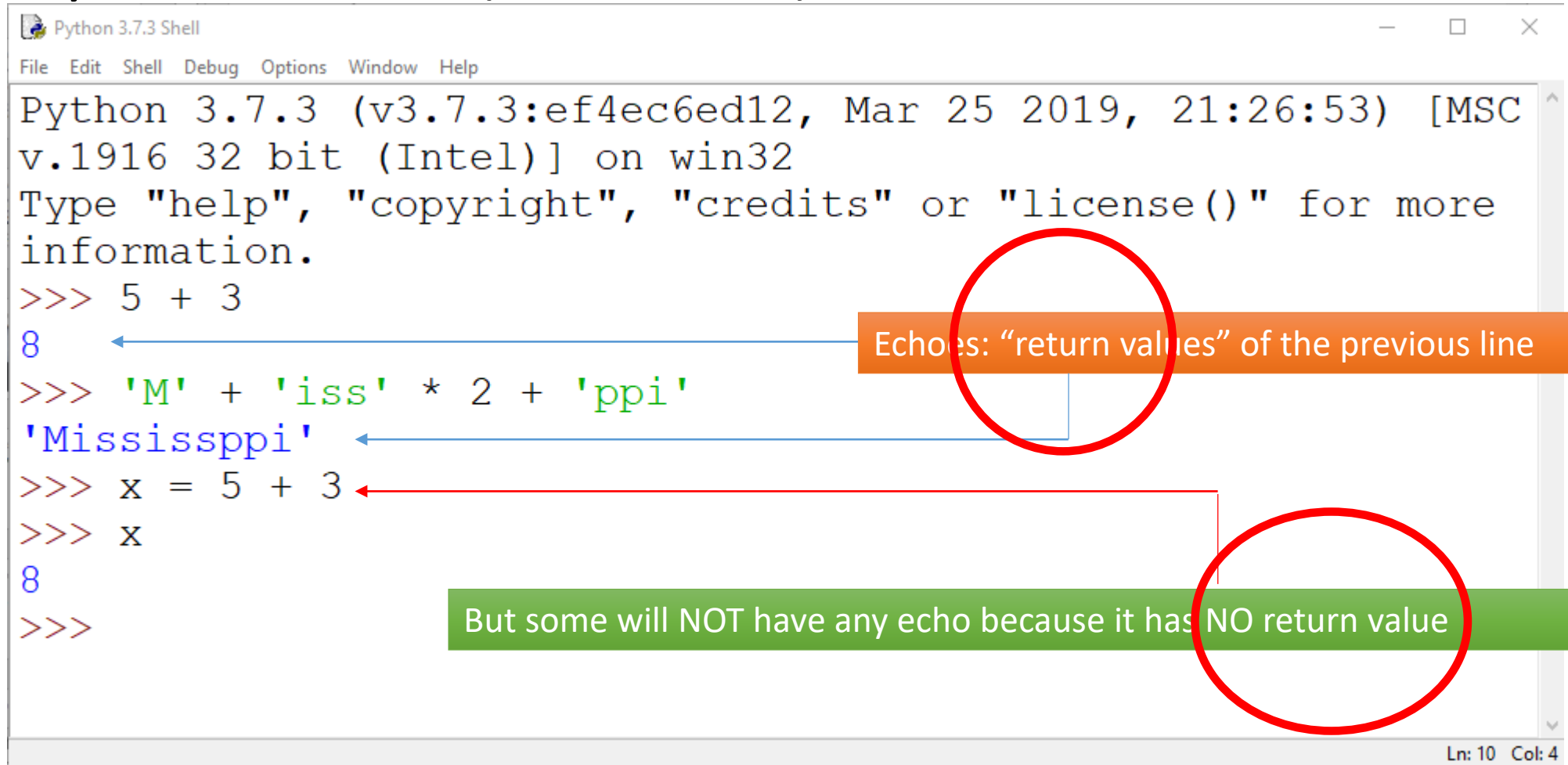
- (10 min)
- Advance Challenge: Try to draw these with for loop
 - Or some other interesting patterns



“Return” of Functions

(The previous drawing examples do not have any return values)

Python Shell(Console)



The screenshot shows a Python 3.7.3 Shell window with the following content:

```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 21:26:53) [MSC
v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license()" for more
information.
>>> 5 + 3
8
>>> 'M' + 'iss' * 2 + 'ppi'
'Mississppi'
>>> x = 5 + 3
>>> x
8
>>>
```

Annotations in the image:

- A red circle highlights the orange box: "Echoes: 'return values' of the previous line". A blue arrow points from this box to the output '8' of the first calculation.
- A red circle highlights the green box: "But some will NOT have any echo because it has NO return value". A red arrow points from this box to the assignment statement `x = 5 + 3`.

The status bar at the bottom right indicates "Ln: 10 Col: 4".

- However, this should NOT be the main area we work in

A Function may or may not return a value

```
def square(x):  
    return x * x
```

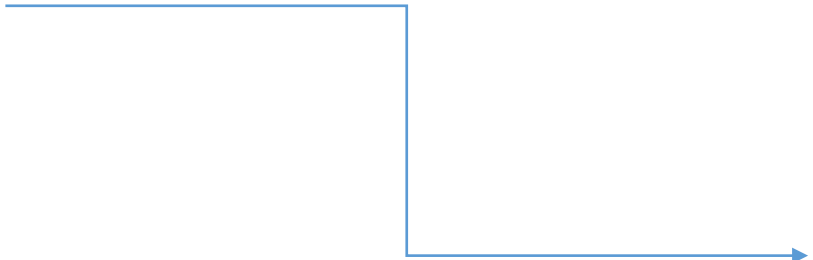
← This function returns a value

```
def say3Times(s):  
    print(s)  
    print(s)  
    print(s)
```

← This function does NOT return a value
However, in Python, it “returns” a value of
“None”

Python Echo in the Shell

- Wait a minute? I thought you say the second function does not return any value?



```
>>> square(3)
9
>>> say3Times("Hello ")
Hello
Hello
Hello
```

- The 9 is a return value from the function square and Python shell **echo** it
- The 3 “Hello” are **NOT** return value but from the “print()” function

Function that “doesn’t” return any value

- Note that the function print also only returns a “None”

```
>>> print(square(3))
9
>>> print(say3Times("Hello "))
Hello
Hello
Hello
None
>>> print(print())

None
```

Selection Statements

What will it return?

```
def foo():  
    if True:  
        if False:  
            print(1)  
        else:  
            print(2)
```

A Computer Science
thing:

If you don't want to
name a function.
Anyhow name it "foo()"

But DON'T do it in
practise

if-else

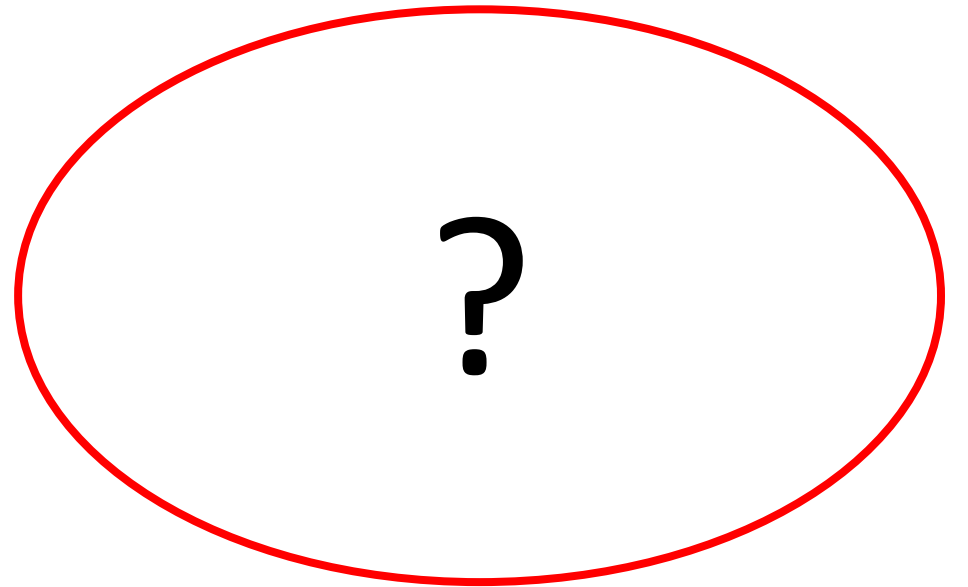
```
def foo():  
    if False:  
        if True:  
            return 1  
    else:  
        return 2
```

```
def foo():  
    if False:  
        return 1  
    elif False:  
        return 2  
    elif True:  
        return 3  
    elif True:  
        return 4  
    else:  
        return 5
```

elif statements will 'break' the
moment one of them is True

if-else

```
def foo():  
    if not True:  
        if True:  
            print(1)  
        else:  
            print(2)
```



Be careful with your if-else. You might return nothing!

Can you spot the difference?

Example 1

```
def foo():  
    if True:  
        if False:  
            print(1)  
    else:  
        print(2)
```

Example 2

```
def foo():  
    if True:  
        if False:  
            print(1)  
    else:  
        print(2)
```

Get's get some real coding!



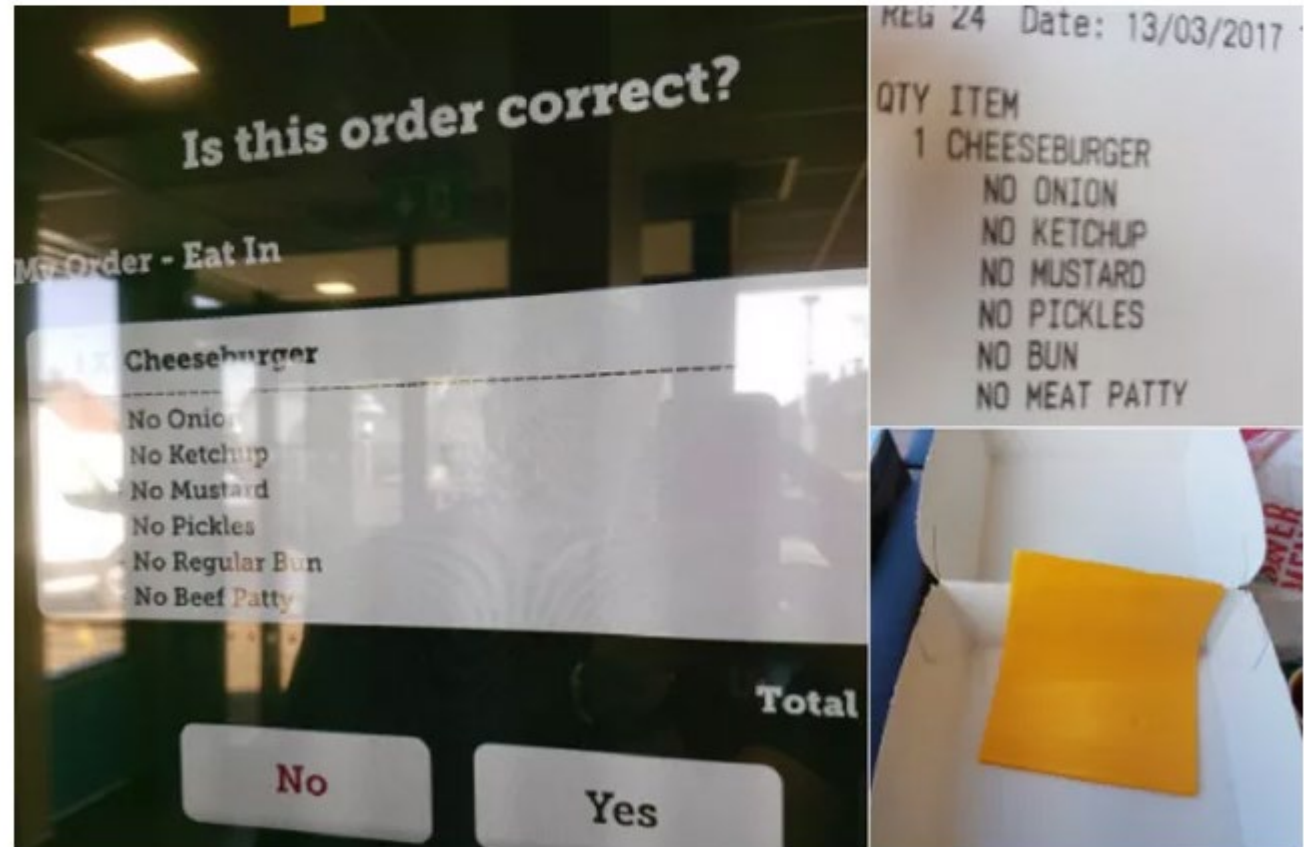
Some Fast food has Food Customization

- Meaning, you can micro-manage what will be or will not be in your burgers

This guy went to McDonald's and ended up just ordering a slice of cheese



Miranda Larbi Wednesday 15 Mar 2017 11:36 am



Burger Customization

- 'B' stands for a piece of bun
- 'C' stands for cheese
- 'P' stands for patty
- 'V' stands for veggies
- 'O' stands for onions
- 'M' stands for mushroom
- (maybe you can come up with more?)

Encoding as a String

- A simple burger
 - 'BVPB'
- A double cheese burger
 - 'BVCPCPB'
- A Big Mac?



Write a function `burgerPrice()` to calculate the **price**

- 'B' stands for a piece of bun \$0.5
- 'C' stands for cheese \$0.8
- 'P' stands for patty \$1.5
- 'V' stands for veggies \$0.7
- 'O' stands for onions \$0.4
- 'M' stands for mushroom \$0.9
- E.g.

```
>>> burgerPrice('BVPB')
```

```
3.2
```

Discuss With your Neighbor
on how to start/do it

(5 min)

Write a function `burgerPrice()` to calculate the **price**

- 'B' stands for a piece of bun \$0.5
- 'C' stands for cheese \$0.8
- 'P' stands for patty \$1.5
- 'V' stands for veggies \$0.7
- 'O' stands for onions \$0.4
- 'M' stands for mushroom \$0.9
- E.g.

```
>>> burgerPrice('BVPB')
```

```
3.2
```

How will you do that in real life?

- You receive a string into your function
- Go through each character of the string one by one
- Accumulate the price for that character
- Output the final price

- E.g.

```
>>> burgerPrice( 'BVPB' )
```


```
3.2
```

Which line(s) is the repetition if there are many characters in the string?

How will you do that in real life?

- You receive a string into your function
- Go through each character of the string one by one
 - Accumulate the price for that character
- Output the final price

Which line(s) is the repetition if there are many characters in the string?



- E.g.

```
>>> burgerPrice( 'BVPB' )
```

```
3.2
```

How will you do that in real life?

Then you need to start with 0

- You receive a string into your function
- Set the “**final price**” to be zero
- Go through each character of the string one by one
 - Accumulate the price for that character to the “**final price**”
- Output the **final price**

Whenever you want to accumulate some kind of sum or produce, you need a variable to store it

• E.g.

```
>>> burgerPrice('BVPB')
```

```
3.2
```

How do I go through each character of the sting?

- You receive a string into your function
- Set the “final price” to be zero
- Go through each character of the string one by one
 - Accumulate the price for that character to the “final price”
- Output the final price

• E.g.

```
>>> burgerPrice( 'BVPB' )
```

```
3.2
```


Now it's a good time to start
your IDLE and code together!



How do I go through each character of the string?

E.g. Just print out the letters one-by-one

- You receive a string into your function
- Set the “**final price**” to be zero
- Go through each character of the string one by one
 - Accumulate the price for that character to the “**final price**”
- Output the **final price**

```
def burgerPrice(burger):  
    length = len(burger)  
    for i in range(length):  
        print(burger[i])
```

```
burgerPrice('BVPB')
```

Output:

```
>>> burgerPrice('BVPB')  
B  
P  
B
```

Note that this is NOT the final code.

However, we usually write some immediate code to make sure what is right. E.g. This code make sure that “burger[i]” will give you each character in the loop

How do I find the price of each ingredient?

- You receive a string into your function
- Set the “**final price**” to be zero
- Go through each character of the string one by one
 - Accumulate the price for that character to the “**final price**”
- Output the **final price**

Output:

```
burgerPrice('BVPB')  
0.5  
0.7  
1.5  
0.5  
>>>
```

How do I find the price of each ingredient?

```
def burgerPrice(burger):  
    length = len(burger)  
    for i in range(length):  
        if burger[i] == 'B':  
            print(0.5)  
        elif burger[i] == 'C':  
            print(0.8)  
        elif burger[i] == 'P':  
            print(1.5)  
        elif burger[i] == 'V':  
            print(0.7)
```

```
burgerPrice('BVPB')
```

- Output:


```
0.5  
0.7  
1.5  
0.5  
>>>
```

- How to sum them?

“Finally”

```
def burgerPrice(burger):  
    price = 0  
    length = len(burger)  
    for i in range(length):  
        if burger[i] == 'B':  
            price = price + (0.5)  
        elif burger[i] == 'C':  
            price = price + (0.8)  
        elif burger[i] == 'P':  
            price = price + (1.5)  
        elif burger[i] == 'V':  
            price = price + (0.7)  
    return price
```

burgerPrice('BVPB')



- Wait? Nothing happened if I run this code?

```
def burgerPrice(burger):  
    price = 0  
    length = len(burger)  
    for i in range(length):  
        if burger[i] == 'B':  
            price = price + (0.5)  
        elif burger[i] == 'C':  
            price = price + (0.8)  
        elif burger[i] == 'P':  
            price = price + (1.5)  
        elif burger[i] == 'V':  
            price = price + (0.7)  
    return price
```

```
print(burgerPrice('BVPB'))
```

- If you run a .py file, there will be NO Python Echo

Are we done?

- Always give it a thought on
 - Can we do it another way?
 - Or, is there any other better way?

- In lecture we learnt:

```
for <var> in <sequence>:  
    <body>
```

Other than “range”, a string is a “**sequence**”!!!

- **sequence**
 - a sequence of values
- var
 - variable that take each value in the sequence
- body
 - statement(s) that will be evaluated for each value in the sequence

“for i in <sequence>:”

- Originally
- The variable i is the index of the string
 - So you need to get the character by burger[i]

```
def burgerPrice(burger):  
    length = len(burger)  
    for i in range(length):  
        print(burger[i])
```

```
burgerPrice('BVPB')
```



- However, Python can **iterate** through a sequence by giving each **element** in the sequence directly in a for loop
 - The variable c is a character in burger

```
def burgerPrice(burger):  
    for c in burger:  
        print(c)
```

```
burgerPrice('BVPB')
```

Finally

- New version

```
def burgerPrice(burger):  
    price = 0  
    for char in burger:  
        if char == 'B':  
            price = price + (0.5)  
        elif char == 'C':  
            price = price + (0.8)  
        elif char == 'P':  
            price = price + (1.5)  
        elif char == 'V':  
            price = price + (0.7)  
    return price
```

```
print(burgerPrice('BVPB'))
```

- Compare to the old version

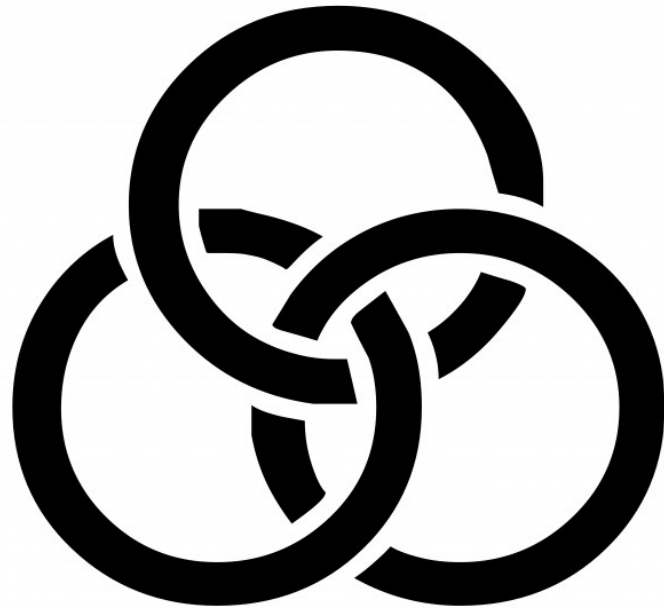
```
def burgerPrice(burger):  
    price = 0  
    length = len(burger)  
    for i in range(length):  
        if burger[i] == 'B':  
            price = price + (0.5)  
        elif burger[i] == 'C':  
            price = price + (0.8)  
        elif burger[i] == 'P':  
            price = price + (1.5)  
        elif burger[i] == 'V':  
            price = price + (0.7)  
    return price
```

```
print(burgerPrice('BVPB'))
```


Learning Points

- Not only about how to get the final code but..
- Plan and write your code in English first
- You may need to write some intermediate code for a “semi finished product” to test out your idea
- After you finally get your code working, you should think about how to improve it
 - Not only for that single shot, you are improving your coding skill for your future coding

Three Types of Loops



Three Types of Loops

- For A and C, it means you know the number N when your loop starts
-
- A. Must run exactly N times (definite)
 - B. Run any number of times (indefinite)
 - C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Which Type is it?

- Iteration version of computing the factorial of N
-
- A. Must run exactly N times (definite)
 - B. Run any number of times (indefinite)
 - C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Which Type is it?

- Given a string, e.g. 'abcdef', compute its length
 - The function len()
 - First, think of how to do it without using the function len()
- A. Must run exactly N times (definite)
- B. Run any number of times (indefinite)
- C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Which Type is it?

- Check if a string contains any vowel, e.g. the word 'sky' does not have any vowel
-
- A. Must run exactly N times (definite)
 - B. Run any number of times (indefinite)
 - C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Which Type is it?

- Check if a number is prime
- A. Must run exactly N times (definite)
- B. Run any number of times (indefinite)
- C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Think of an Example of Each Type?

- A. Must run exactly N times (definite)
- B. Run any number of times (indefinite)
- C. Run at most N times (definite loop that may break)
 - Check all True (or check all False)
 - Find any True (or False)

Comments in Python

Comments in Python

- Usually denoted by # at the start of a line
- Can also be done between pairs of triple quotes

```
#Example of single line comment
```

```
'''
```

```
Example of triple quotes comment
```

```
Wow I can do multiple lines
```

```
'''
```

Comments in Python

- Good habit to have comments in your code
 - Remind yourself what the code is for
 - Help others understand your code
-
- Remember to make sure you mark out your comments properly.
Otherwise, you might get an error when trying to run your program.