

INTRODUCTION TO PYTHON: DAY THREE

STEPHANIE SPIELMAN

BIG DATA IN BIOLOGY SUMMER SCHOOL, 2015

CENTER FOR COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

UNIVERSITY OF TEXAS AT AUSTIN

SOME USEFUL FUNCTIONS

- **help()** will return information about a particular function

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- `help()` will return information about a particular function
- `dir()` will return a list of which methods/attributes/functions can be used with a given object
 - Ignore the ones with `__underscores__`

FUNCTIONS IN PYTHON

- **We've used several built-in functions:**
 - `len()`, `sum()`, `round()`

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- **We've used several built-in functions:**
 - `len()`, `sum()`, `round()`
- **We can *write our own* functions too**
 - Reusability
 - Modular design and organization
 - Readability
 - Debugging!!

WRITING CUSTOM FUNCTIONS

- **Reference example:**

```
my_list = [1, 2, 3, 4, 5, 6]
```

```
a = len(my_list)    # here, a = 6
```

WRITING CUSTOM FUNCTIONS

- **Reference example:**

```
my_list = [1, 2, 3, 4, 5, 6]
```

```
a = len(my_list)    # here, a = 6
```

`a`: the returned value

`len`: the function name

`my_list`: the argument to the function

WRITING CUSTOM FUNCTIONS

Anatomy of a function definition

```
def function_name(...arguments...):  
    ...  
    ... | Python code  
    ...  
    return returned_value
```


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    ...  
    ...  
    ...  
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Python code

SO HOW CAN WE RE-WRITE THE LEN() FUNCTION?

```
# Example function construction
def my_len(item):

    # Loop over item to count its size
    j = 0
    for entry in item:
        j += 1

    # Return the size
    return j
```

SO HOW CAN WE RE-WRITE THE LEN() FUNCTION?

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# Example function construction
def my_len(item):

    # Loop over item to count its size
    j = 0
    for entry in item:
        j += 1

    # Return the size
    return j
```

```
# Now we can use the function!
my_list = [1,2,3,4,5,6]
b = my_len(my_list)
print b
6
```

SO HOW CAN WE RE-WRITE THE LEN() FUNCTION?

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# Example function construction
def my_len(item):
```

```
    # Loop over item to count its size
```

```
    j = 0
```

```
    for entry in item:
```

```
        j += 1
```

```
    # Return the size
```

```
    return j
```

```
# Now we can use the function!
```

```
my_list = [1,2,3,4,5,6]
```

```
b = my_len(my_list)
```

```
print b
```

```
6
```

Function names should be meaningful

Arguments are *arbitrary variable names*

Variables defined/used in the function
exist only in the function

SO HOW CAN WE RE-WRITE THE LEN() FUNCTION?

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# Example function construction
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    for entry in item:
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        j += 1
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    # Return the size
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    return j
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# Now we can use the function!
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```
my_list = [1,2,3,4,5,6]
```

```
b = my_len(my_list)
```

```
print b
```

```
6
```

```
print j
```

```
    NameError: name 'j' is not defined
```

Function names should be meaningful

Arguments are *arbitrary variable names*

Variables defined/used in the function
exist only in the function

FUNCTIONS ARE GENERIC FORMULAS

```
def triangle_area(l, w):  
    area = l*w / 2.0  
    return area
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```

Why 2.0 and not 2?

FUNCTIONS ARE GENERIC FORMULAS

```
def triangle_area(l, w):  
    area = l*w / 2.0  
    return area
```

```
# Usage 1  
area = triangle_area(7, 6)
```


FUNCTIONS ARE GENERIC FORMULAS

```
def triangle_area(l, w):  
    area = l*w / 2.0  
    return area
```

```
# Usage 1  
area = triangle_area(7, 6)
```

```
# Usage 2  
length = 7  
width = 6  
area = triangle_area(length, width)
```

FUNCTIONS ARE GENERIC FORMULAS

```
def triangle_area(l, w):  
    area = l*w / 2.0  
    return area
```

```
# Usage 1  
area = triangle_area(7, 6)
```

```
# Usage 2  
length = 7  
width = 6  
area = triangle_area(length, width)
```

```
# Usage 3  
l = 7  
w = 6  
area = triangle_area(l, w)
```

USE TEST CASES TO ENSURE YOUR FUNCTION WORKS

- After writing a function, ***always*** test it with input that you know should work

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- **After writing a function, **always** test it with input that you know should work**

```
def triangle_area(l, w):  
    area = l*w/ 2.0  
    return area
```

```
# Before using the function all over the place, make sure  
    that l=7, w=6 prints 21
```

```
print triangle_area(7,6)  
21
```

A NOTE ON SCOPE

- **Scope: the portion of your code where a certain variable/function exists**
- **In Python, scope is basically top-to-bottom**
- **Punch-line: define functions at the *top* of your script!**

FUNCTIONS DON'T NEED TO RETURN ANYTHING!

```
def square_cube(x):  
    square = x**2  
    cube   = x**3  
    print str(x) + " squared is " + str(square) + ", and " +  
          str(x) + " cubed is " + str(cube)
```

FUNCTIONS DON'T NEED TO RETURN ANYTHING!

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def square_cube(x):  
    square = x**2  
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    print str(x) + " squared is " + str(square) + ", and " +  
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```

```
# Simply call the function  
square_cube(3)  
    3 squared is 9, and 3 cubed is 27
```

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def square_cube(x):  
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```

```
# Simply call the function  
square_cube(3)  
    3 squared is 9, and 3 cubed is 27
```

```
# What if you try to save a returned value?  
a = square_cube(3)
```


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def square_cube(x):  
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          str(x) + " cubed is " + str(cube)
```

```
# Simply call the function  
square_cube(3)  
    3 squared is 9, and 3 cubed is 27
```

```
# What if you try to save a returned value?  
a = square_cube(3)  
print a  
    None
```

RETURNING MULTIPLE VALUES

```
def square_cube(x):  
    square = x**2  
    cube   = x**3  
    return square, cube    # separate values with a comma
```

RETURNING MULTIPLE VALUES

```
def square_cube(x):  
    square = x**2  
    cube   = x**3  
    return square, cube    # separate values with a comma  
  
s, c = square_cube(5)  
print s  
    25  
print c  
    125
```

RETURNING MULTIPLE VALUES

```
def square_cube(x):  
    square = x**2  
    cube   = x**3  
    return square, cube    # separate values with a comma
```

```
s, c = square_cube(5)  
print s  
    25  
print c  
    125
```

```
# Equivalent usage  
answer = square_cube(5)  
print answer[0]  
    25  
print answer[1]  
    125
```

EXERCISE BREAK

HANDLING ERRORS IN PYTHON

- **Error messages in Python are informative!**
 - See attached error cheatsheet

READING AND WRITING FILES IN PYTHON

- **This is where Python really shines!**

READING AND WRITING FILES IN PYTHON

- **Python does not deal with files directly**
 - We interact with files via special variables, called **handles**

READING AND WRITING FILES IN PYTHON

- **Python does not deal with files directly**
 - We interact with files via special variables, called **handles**
- **Interact with files in 3 main *modes*:**
 - Read-only ("r")
 - Write-only ("w")
 - Append ("a")

OPENING FILES FOR READING

```
# Name of file to open
filename = "my_file_with_important_stuff.txt"

# Define handle with the .open() function
file_handle = open(filename, "r") # two arguments

# Read the file contents with the .read() method
file_contents = file_handle.read()

# Close the file when done with the .close() method (!!!)
file_handle.close()
```

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# Close the file when done with the .close() method (!!!)
file_handle.close()

print file_contents
    Line 1 of file.
    Line 2 of file.
    Line 3 of file.
    ...
```

The entire body of the file, as a **single string**!

LOOPING OVER LINES IN A FILE

```
filename = "my_file_with_important_stuff.txt"

file_handle = open(filename, "r")
file_contents = file_handle.read()
file_handle.close()
```

LOOPING OVER LINES IN A FILE

```
filename = "my_file_with_important_stuff.txt"
```

```
file_handle = open(filename, "r")  
file_contents = file_handle.read()  
file_handle.close()
```

```
# We can convert file_contents to a list using .split()  
file_contents_list = file_contents.split("\n") # or \r
```

LOOPING OVER LINES IN A FILE

Better option: use the *.readlines()* method

```
file_handle = open(filename, "r")  
file_lines = file_handle.readlines()  
file_handle.close()
```

```
# file_lines is a list  
print file_lines
```

```
["Line 1 of file.\n", "Line 2 of file.\n", "Line 3 of  
file.\n", ...]
```

LOOPING OVER LINES IN A FILE

Better option: use the `.readlines()` method

```
file_handle = open(filename, "r")
file_lines = file_handle.readlines()
file_handle.close()
```

```
# file_lines is a list
print file_lines
```

```
["Line 1 of file.\n", "Line 2 of file.\n", "Line 3 of
file.\n", ...]
```

```
for line in file_lines:
    print line
```

```
Line 1 of file.
Line 2 of file.
Line 3 of file.
...
```


OPENING FILES FOR WRITING

```
# Name of file to open
filename = "my_file_to_write_to.txt"

# Define handle with the .open() function
file_handle = open(filename, "w") # note the mode!

# Write to the file with the .write() method
file_handle.write("Line 1 of the file.\n")
file_handle.write("Line 2 of the file.\n")

# Close the file when done with the .close() method (!!!)
file_handle.close()
```

OPENING FILES FOR WRITING

```
# Name of file to open
filename = "my_file_to_write_to.txt"

# Define handle with the .open() function
file_handle = open(filename, "w") # note the mode!

# Write to the file with the .write() method
file_handle.write("Line 1 of the file.\n")
file_handle.write("Line 2 of the file.\n")

# Close the file when done with the .close() method (!!!)
file_handle.close()
```

CAUTION: writing to file **overwrites** the file, if it exists already.

ADD TO AN EXISTING FILE WITH APPEND-MODE

```
filename = "my_file_to_append_to.txt"

# Define handle with the .open() function
file_handle = open(filename, "a") # note the mode!

# Write to the file with the .write() method
file_handle.write("Adding this line to the file.\n")

# Close the file when done with the .close() method (!!!)
file_handle.close()
```

**BUT STEPHANIE, I'M REALLY
LAZY!**

```
# Use open and close  
file_handle = open(filename, "r")  
file_handle.close()
```

BUT STEPHANIE, I'M REALLY LAZY!

```
# Use open and close
file_handle = open(filename, "r")
file_handle.close()
```

```
# Use with control-flow (no need for close!)
with open(filename, "r") as file_handle:
    # do stuff to file_handle
```

BUT STEPHANIE, I'M REALLY LAZY!

```
# Use open and close
file_handle = open(filename, "r")
file_handle.close()
```

```
# Use with control-flow (no need for close!)
with open(filename, "r") as file_handle:
    # do stuff to file_handle
```

REMEMBER FILE PATHS!!

```
filename = "my_file.txt"
```

```
file_handle = open(filename, "r")
```

```
    IOError: [Errno 2] No such file or directory:  
'my_file.txt'
```

REMEMBER FILE PATHS!!

```
filename = "my_file.txt"
```

```
file_handle = open(filename, "r")
```

```
    IOError: [Errno 2] No such file or directory:  
'my_file.txt'
```

Solution: include the full path!

```
filename = "my_file.txt"
```

```
path = "/path/to/files/"
```

```
file_handle = open(path + filename, "r")
```


EXERCISE BREAK