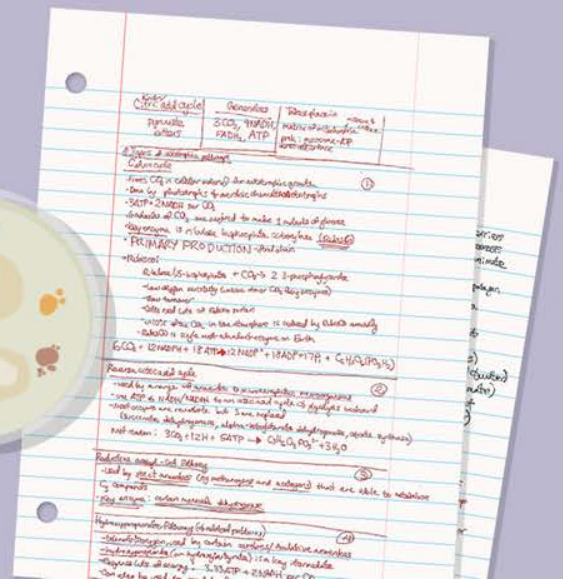
Lecture 2

Functions & Modules

Want to be a part of the largest network of campus women in STEM?

THE SCIENTISTA FOUNDATION

WOMEN IN STEM



Accepting applications until 11:59PM on Feb 12 2017
Apply here: bit.ly/2ksNk3k

Information Session 4:45-5:45PM on Feb 1
Goldwin Smith G76

ScientistaCornellUniversity@gmail.com

/ScientistaCornell

@Scientista_Cornell

Labs Start this Week

- Labs are Wednesday here Thurston 205
  - Can do them at home (instructions on web)
  - Bring a laptop if you come to the lab
- Lab is due **before beginning** of next lab
  - Can check off *on the day it is handed out*
  - Can check off during *consultant hours*
- **Cannot spend lab time on previous lab**

Announcements

If Not Done Already

- Enroll in Piazza
- Sign into CMS
  - To make sure you've been added
- Website
  - Text
  - Video!

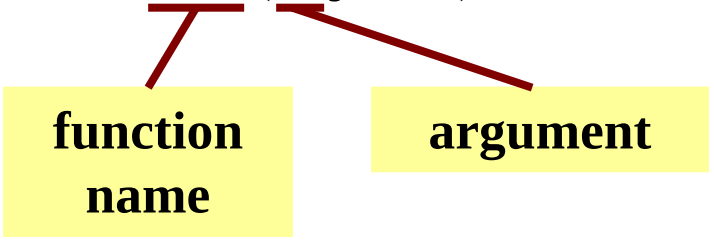
Reading (Optional)

- Readings this week
  - Chapter 1 (browse)
  - Chapter 2 (in detail)
  - Chapter 3 (in detail)
- Next week
  - Sections 8.1, 8.2, 8.4, 8.5

[xkcd.com]

Function Calls

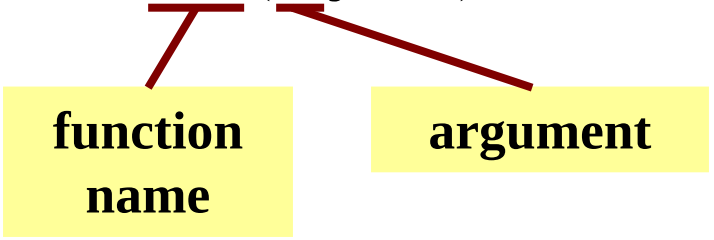
- Python supports expressions with math-like functions
  - A function in an expression is a **function call**
  - Will explain the meaning of this later
- Function expressions have the form **fun**(x,y,…)



- **Examples** (math functions that work in Python):
  - round(2.34)
  - max(a+3,24)

Function Calls

- Python supports expressions with math-like functions
  - A function in an expression is a **function call**
  - Will explain the meaning of this later
- Function expressions have the form **fun**(x,y,…)



- **Examples** (math functions that work in Python):
  - round(2.34)
  - max(a+3,24)

Arguments can be any **expression**

Built-In Functions

- You have seen many functions already
  - Type casting functions: int(), float(), bool()
  - Dynamically type an expression: type()
  - Help function: help()
  - Quit function: quit()

Arguments go in (), but name() refers to function in general

- print <string> is **not** a function call
  - It is simply a statement (like assignment)
  - But it is in Python 3.x: print(<string>)

Built-in Functions vs Modules

- The number of built-in functions is small
  - http://docs.python.org/2/library/functions.html
- Missing a lot of functions you would expect
  - **Example**: cos(), sqrt()
- **Module**: file that contains Python code
  - A way for Python to provide optional functions
  - To access a module, the import command
  - Access the functions using module as a *prefix*

Example: Module math

```
>>> import math
>>> math.cos(0)
1.0
>>> cos(0)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'cos' is not defined
>>> math.pi
3.141592653589793
>>> math.cos(math.pi)
```

Example: Module math

```
>>> import math
>>> math.cos(0)
1.0
>>> cos(0)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'cos' is not defined
>>> math.pi
3.141592653589793
>>> math.cos(math.pi)
```

To access math functions

Example: Module math

```
>>> import math
>>> math.cos(0)
1.0
>>> cos(0)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'cos' is not defined
>>> math.pi
3.141592653589793
>>> math.cos(math.pi)
```

To access math functions

Functions require math prefix!

Example: Module math

```
>>> import math
>>> math.cos(0)
1.0
>>> cos(0)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'c
defined
>>> math.pi
3.141592653589793
>>> math.cos(math.pi)
```

To access math functions

Functions require math prefix!

Module has variables too!

Example: Module math

```
>>> import math
>>> math.cos(0)
1.0
>>> cos(0)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'c
defined
>>> math.pi
3.141592653589793
>>> math.cos(math.pi)
```

To access math functions

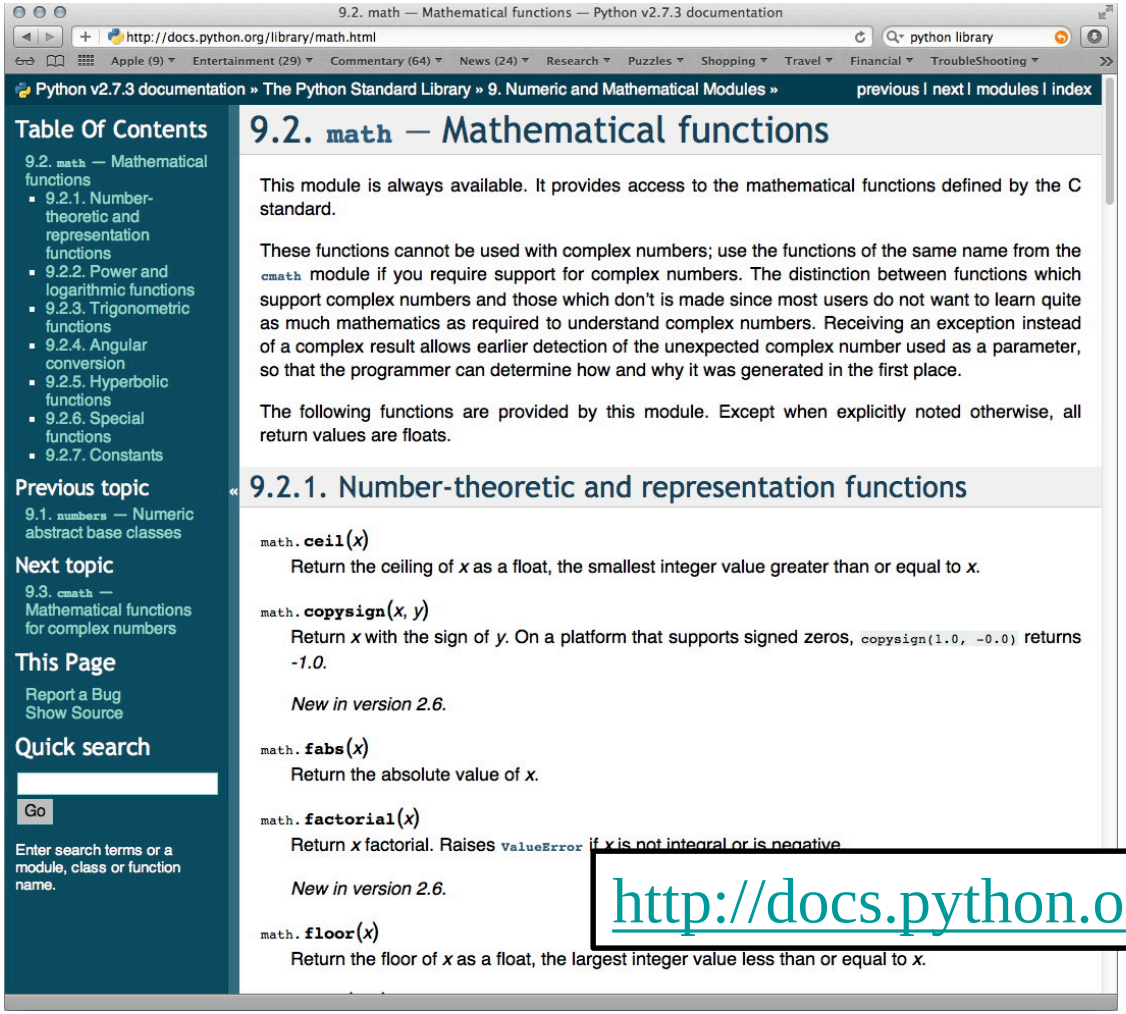
Functions require math prefix!

Module has variables too!

Other Modules

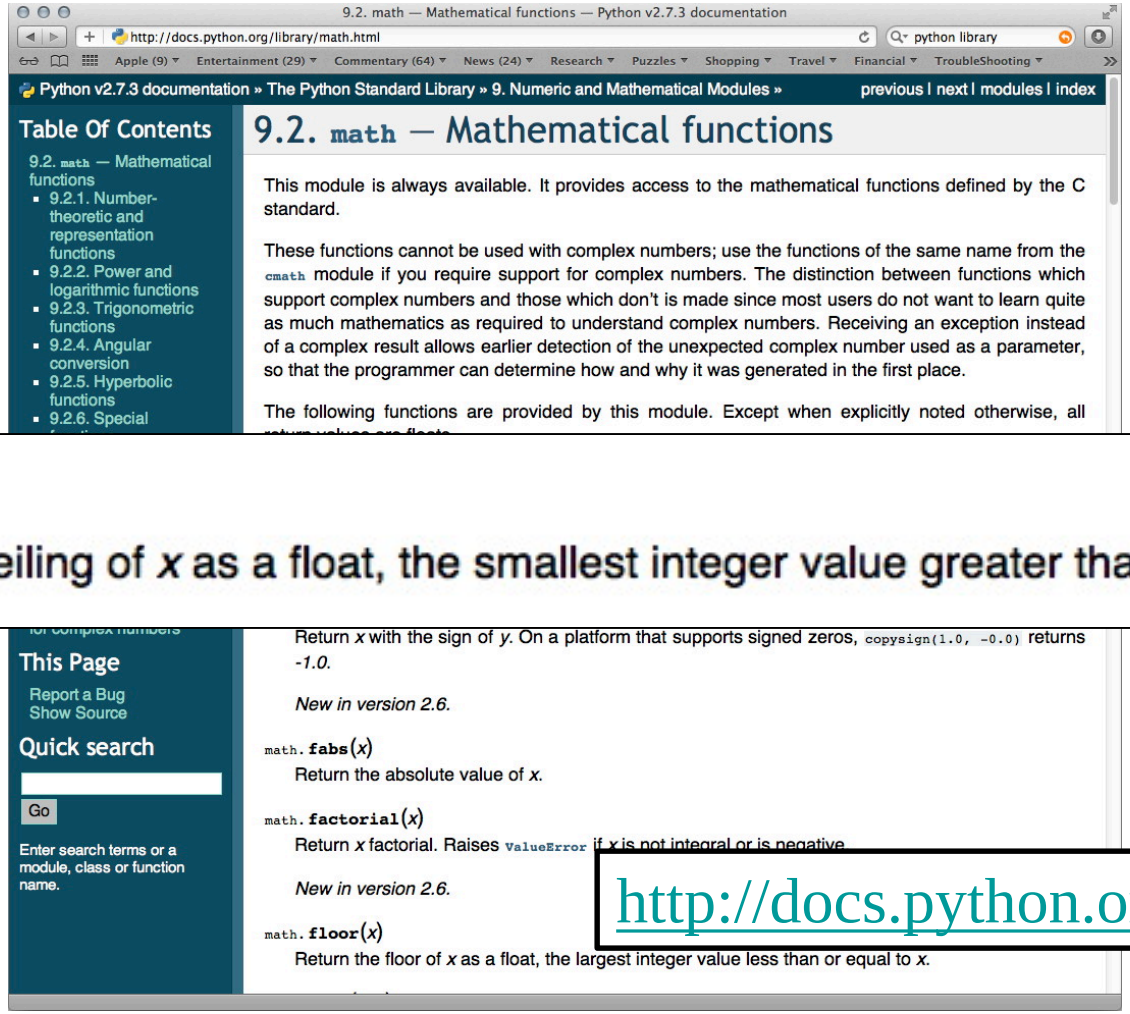
- io
  - Read/write from files
- random
  - Generate random numbers
  - Can pick any distribution
- string
  - Useful string functions
- sys
  - Information about your OS

Reading the Python Documentation



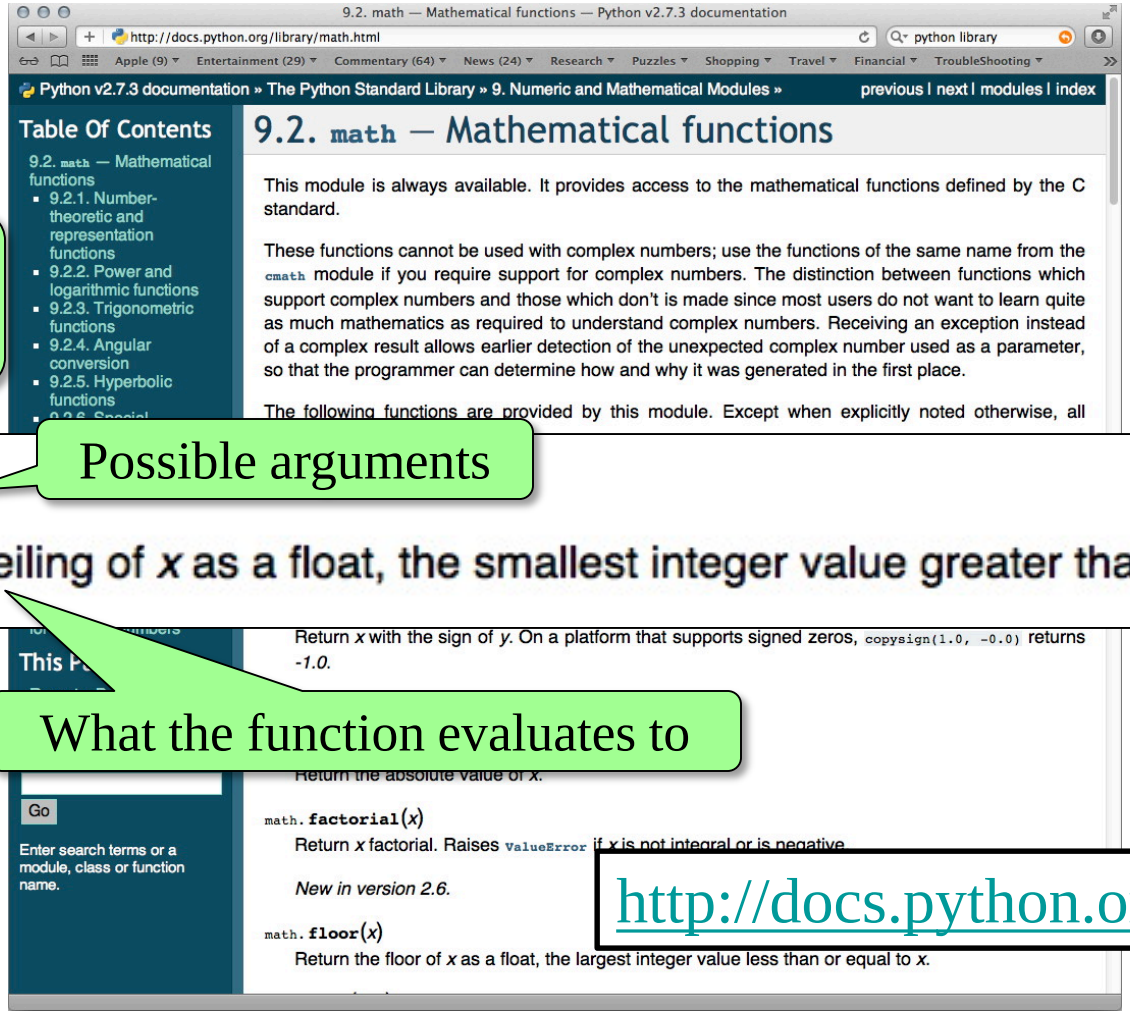
http://docs.python.org/library

Reading the Python Documentation



http://docs.python.org/library

Reading the Python Documentation



Function name

Possible arguments

`math.ceil(x)`

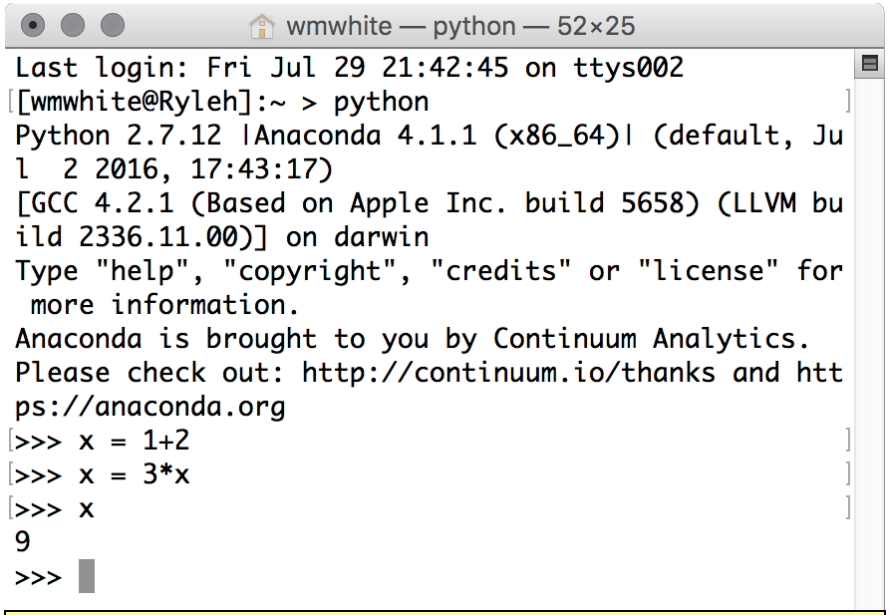
Return the ceiling of *x* as a float, the smallest integer value greater than or equal to *x*.

Module

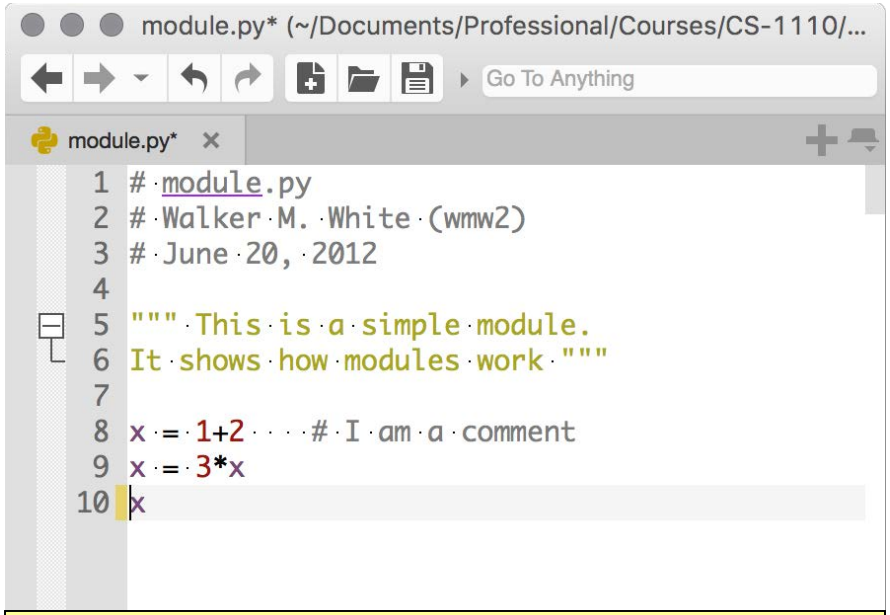
What the function evaluates to

http://docs.python.org/library

Interactive Shell vs. Modules



- Launch in command line
- Type each line separately
- Python executes as you type



- **Write in a text editor**
  - We use Komodo Edit
  - But anything will work
- Load module with import

Using a Module

Module Contents

```
# module.py

""" This is a simple module.
It shows how modules
work"""

x = 1+2
x = 3*x
x
```

Using a Module

Module Contents

```
# module.py
```

Single line comment
(not executed)

```
""" This is a simple module.
It shows how modules
work"""

x = 1+2
x = 3*x
x
```

Using a Module

Module Contents

```
# module.py
```

Single line comment
(not executed)

```
""" This is a simple module.
It shows how modules
work"""
```

Docstring (note the Triple Quotes)
Acts as a multiple-line comment
Useful for *code documentation*

```
x = 1+2
x = 3*x
x
```

Using a Module

Module Contents

```
# module.py
```

Single line comment
(not executed)

```
""" This is a simple module.
It shows how modules
work"""
```

Docstring (note the Triple Quotes)
Acts as a multiple-line comment
Useful for *code documentation*

```
x = 1+2
x = 3*x
x
```

Commands
Executed on import

Using a Module

Module Contents

```
# module.py
```

Single line comment
(not executed)

```
""" This is a simple module.
It shows how modules
work"""
```

Docstring (note the Triple Quotes)
Acts as a multiple-line comment
Useful for *code documentation*

```
x = 1+2
x = 3*x
x
```

Commands
Executed on import

Not a command.
import **ignores this**

Using a Module

Module Contents

```
# module.py

""" This is a simple module.
It shows how modules
work"""

x = 1+2
x = 3*x
x
```

Python Shell

```
>>> import module
>>>x
```

Using a Module

Module Contents

```
# module.py


""" This is a simple module.
It shows how modules
work"""


x = 1+2
x = 3*x
x
```

Python Shell

```
>>> import module
>>>x
Traceback (most recent call
last):
  File "<stdin>", line 1, in
<module>
NameError: name 'x' is not
defined
```

Using a Module

Module Contents

```
# module.py

""" This is a simple module.
It shows how modules
work"""

x = 1+2
x = 3*x
x
```

"**Module data**" must be prefixed by module name

Python Shell

```
>>> import module
>>>x
Traceback (most recent call
last):
  File "<stdin>", line 1, in
<module>
NameError: name 'x' is not
defined
>>>
9
```

module.x

Using a Module

Module Contents

```
# module.py

""" This is a simple module.
It shows how modules
work"""

x = 1+2
x = 3*x
x
```

"**Module data**" must be prefixed by module name

Prints **docstring** and module contents

Python Shell

```
>>> import module
>>>x
Traceback (most recent call
last):
  File "<stdin>", line 1, in
<module>
NameError: name 'x' is not
defined
>>>help(module)
9
>>>
```

module.x

Using the from Keyword

```
>>> import math
>>> math.pi
3.141592653589793
>>> from math import pi
>>> pi
3.141592653589793
>>> from math import *
>>> cos(pi)
-1.0
```

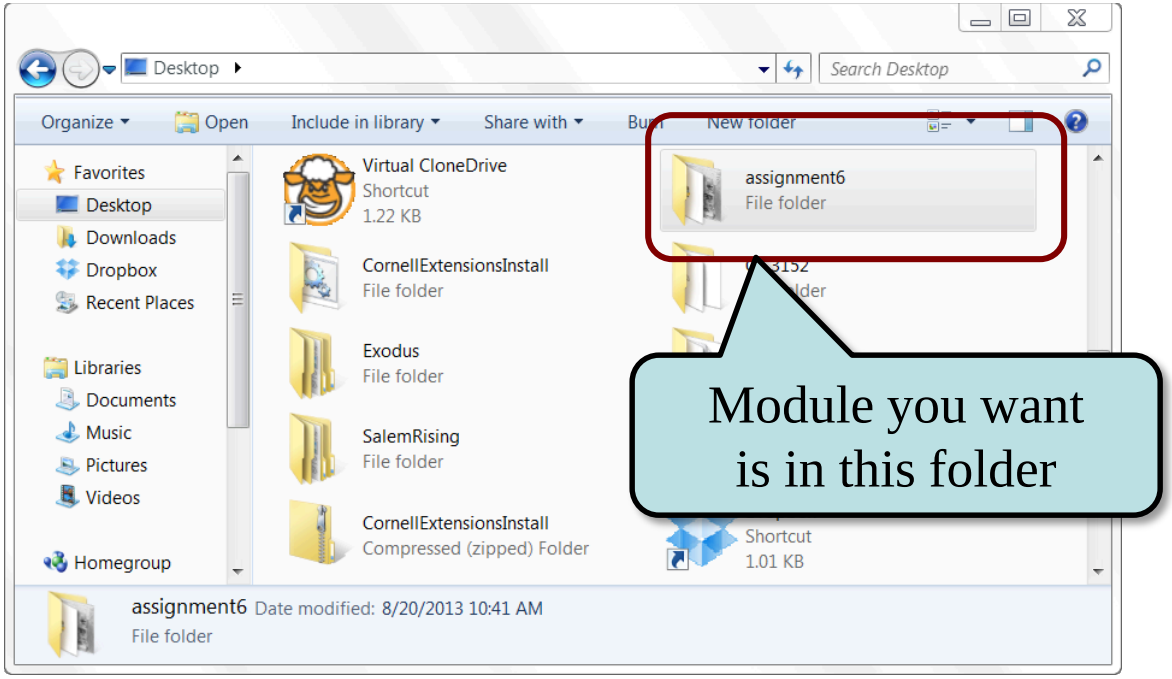
Must prefix with module name

No prefix needed for variable pi

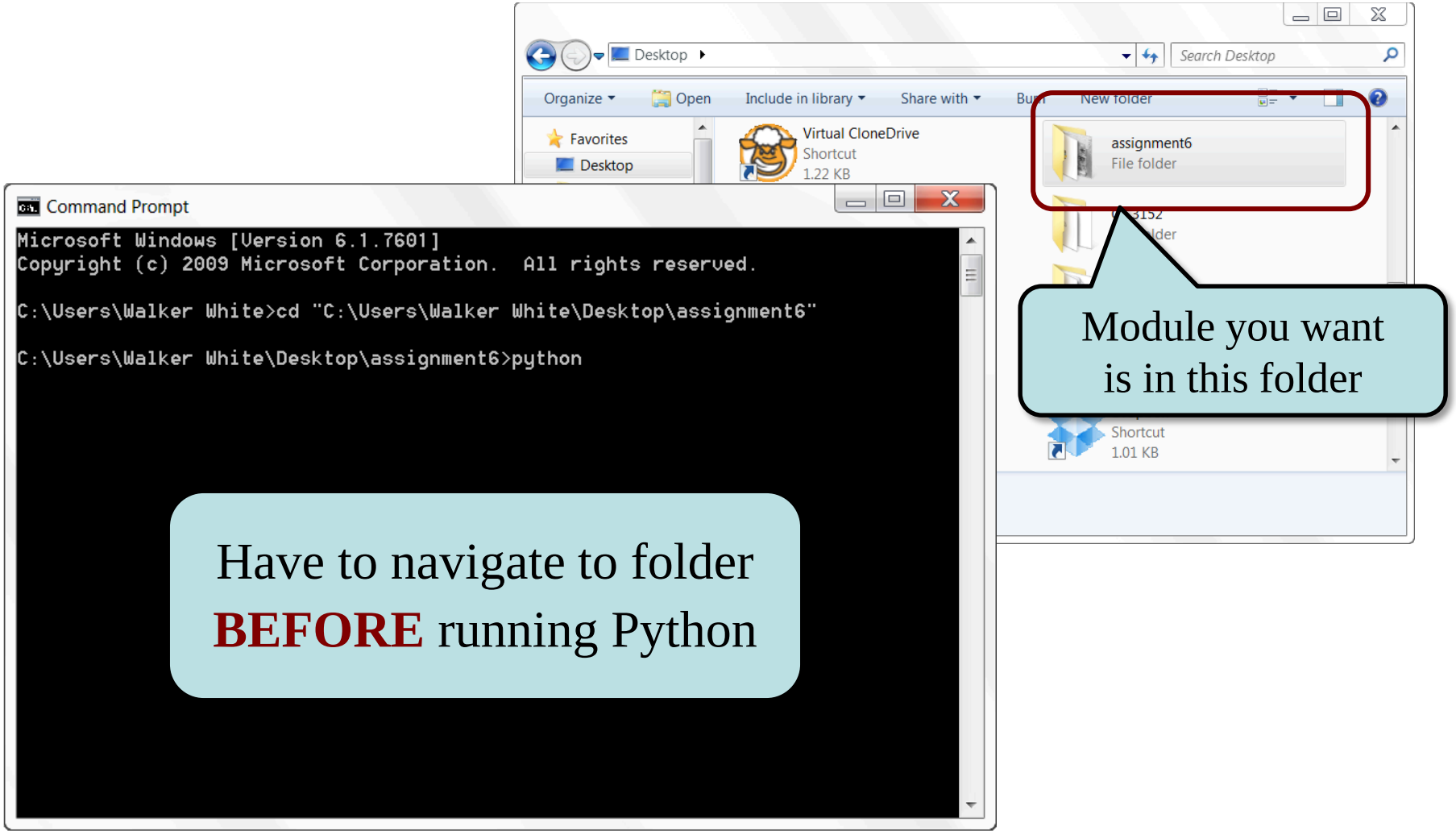
No prefix needed for anything in math

- Be careful using from!
- Using import is *safer*
  - Modules might conflict (functions w/ same name)
  - What if import both?
- **Example**: Turtles
  - Used in Assignment 4
  - 2 modules: turtle, tkturtle
  - Both have func. Turtle()

Modules Must be in Working Directory!



Modules Must be in Working Directory!



Modules vs. Scripts

Module

- Provides functions, variables
  - **Example**: temp.py
- import it into Python shell

```
>>> import temp
>>>
temp.to_fahrenheit(100)
212.0
>>>
```

Script

- Behaves like an application
  - **Example**: helloApp.py
- Run it from command line:

```
python helloApp.y
```

Modules vs. Scripts

Module

- Provides functions, variables
  - **Example**: temp.py
- import it into Python shell

```
>>> import temp
>>>
temp.to_fahrenheit(100)
212.0
>>>
```

Script

- Behaves like an application
  - **Example**: helloApp.py
- Run it from command line:

```
python helloApp.y
```

Files look the same. Difference is how you use them.

Scripts and Print Statements

module.py

```
# module.py

""" This is a simple module.
It shows how modules work"""

x = 1+2
x = 3*x
x
```

script.py

```
# script.py

""" This is a simple script.
It shows why we use print"""

x = 1+2
x = 3*x
print x
```

Scripts and Print Statements

module.py

```
# module.py

""" This is a simple module.
It shows how modules work"""

x = 1+2
x = 3*x
x
```

script.py

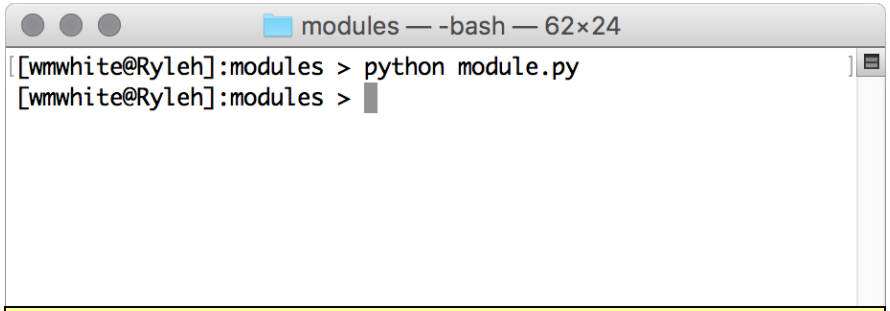
```
# script.py

""" This is a simple script.
It shows why we use print"""

x = 1+2
x = 3*x
print x
```

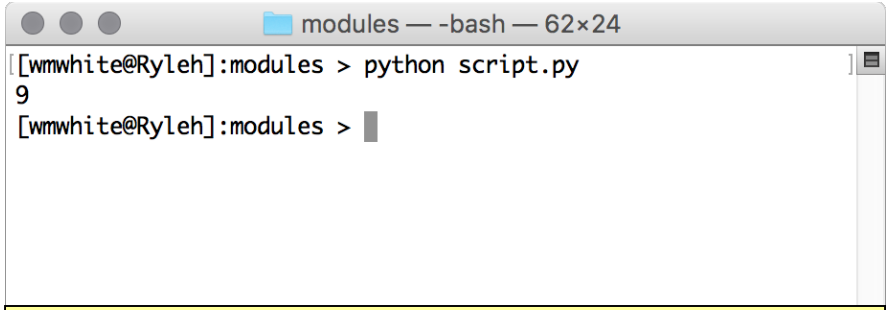
Scripts and Print Statements

module.py



- Looks like nothing happens
- Python did the following:
  - Executed the assignments
  - Skipped the last line ('x' is not a statement)

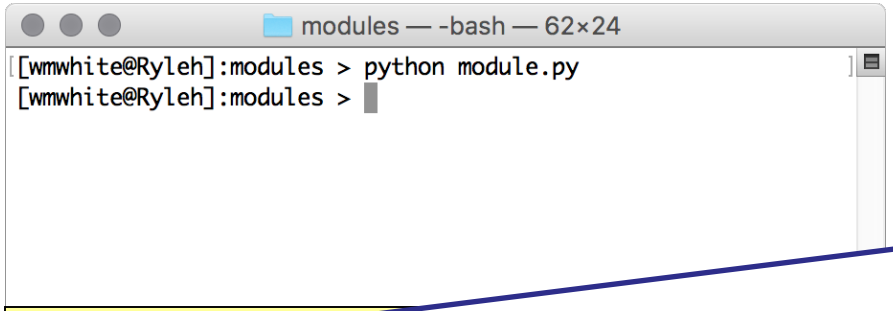
script.py



- We see something this time!
- Python did the following:
  - Executed the assignments
  - Executed the last line (Prints the contents of x)

Scripts and Print Statements

module.py



- Looks l
- Python
  - Execu assignments
  - Skipped the last line
    ('x' is not a statement)

script.py

his time!

owing:

- Executed the assignments
- Executed the last line
  (Prints the contents of x)

When you run a script,
only statements are executed

Next Time: Defining Functions

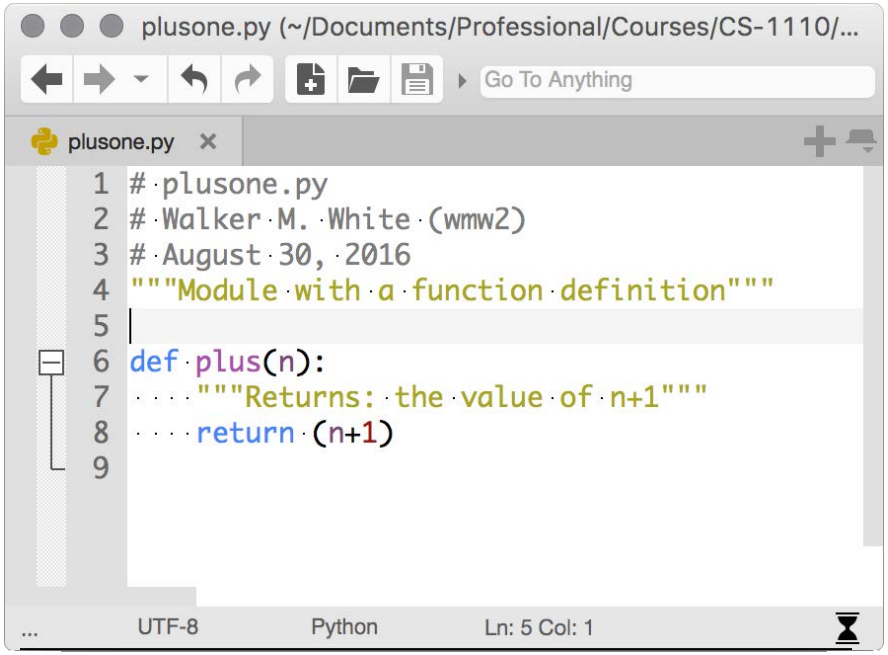
Function Call

- Command to **do** the function
- Can put it anywhere
  - In the Python shell
  - Inside another module

```
modules — python — 52×20
>>> import plusone
>>> plusone.plus(1)
2
>>> plusone.plus(2)
3
>>> plusone.plus(3)
4
>>>
```

Function Definition

- **define** the function
- Belongs inside a module



Next Time: Defining Functions

Function Call

- Command to **do** the function
- Can put it anywhere
  - In the Python shell
  - Inside another module

```
modules — python — 52×20
>>> import plusone
>>> plusone.plus(1)
2
>>> plusone.plus(2)
3
>>> plusone.plus(3)
4
>>>
```

Can **call** as many times as you want

Function Definition

- Define the function
- Belongs inside a module

plusone.py (~/Documents/Professional/Courses/CS-1110/...

Go To Anything

plusone.py

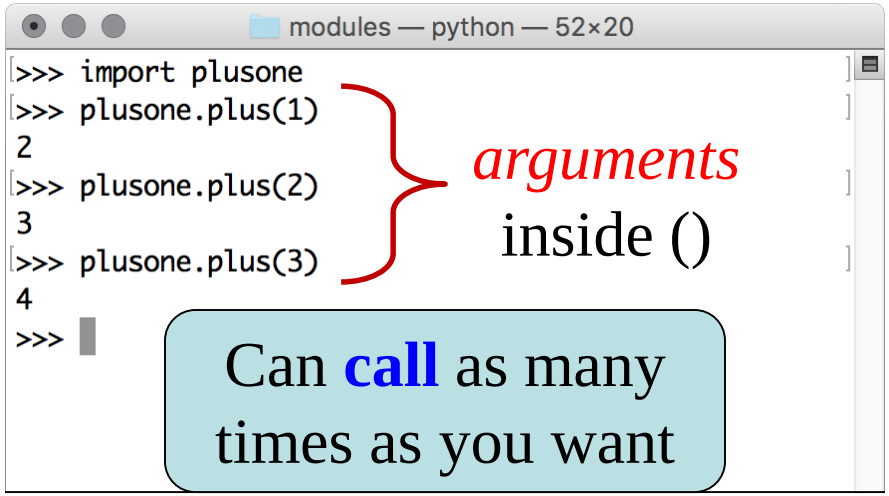
```
1 # plusone.py
2 # Walker M. White (wmw2)
3 # August 30, 2016
4 """Module with a function definition"""
5
6 def plus(n):
7     """Returns: the value of n+1"""
8     return (n+1)
9
```

But only define function **ONCE**

Next Time: Defining Functions

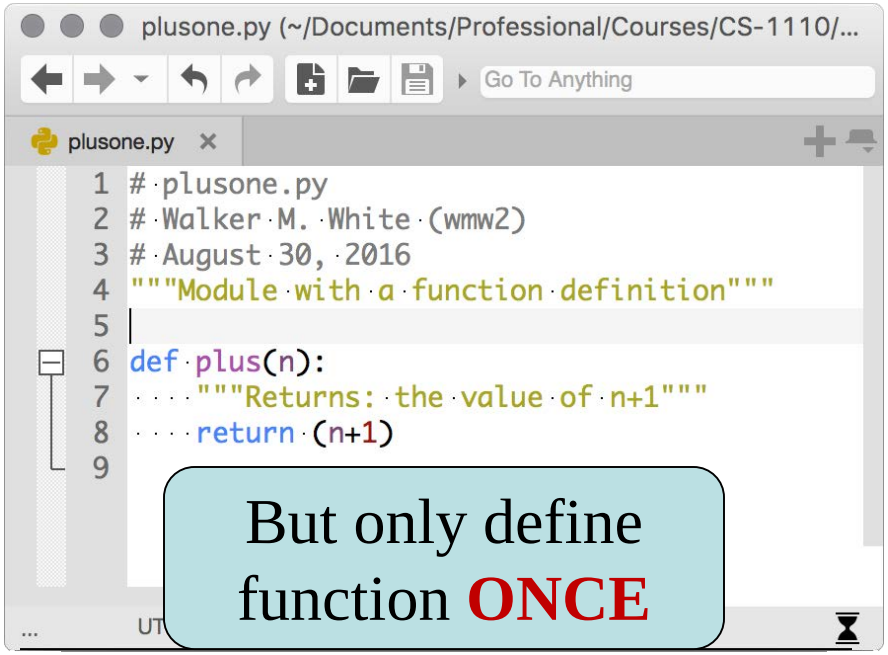
Function Call

- Command to **do** the function
- Can put it anywhere
  - In the Python shell
  - Inside another module



Function Definition

- **define** the function
- Belongs inside a module



Functions and Modules

- Purpose of modules is **function definitions**
  - Function definitions are written in module file
  - Import the module to call the functions
- Your Python workflow (right now) is

1. Write a function in a module (a .py file)
2. Open up the Terminal/Command Prompt
3. Move to the directory with this file
4. Start Python (type python)
5. Import the module
6. Try out the function