The Python Language

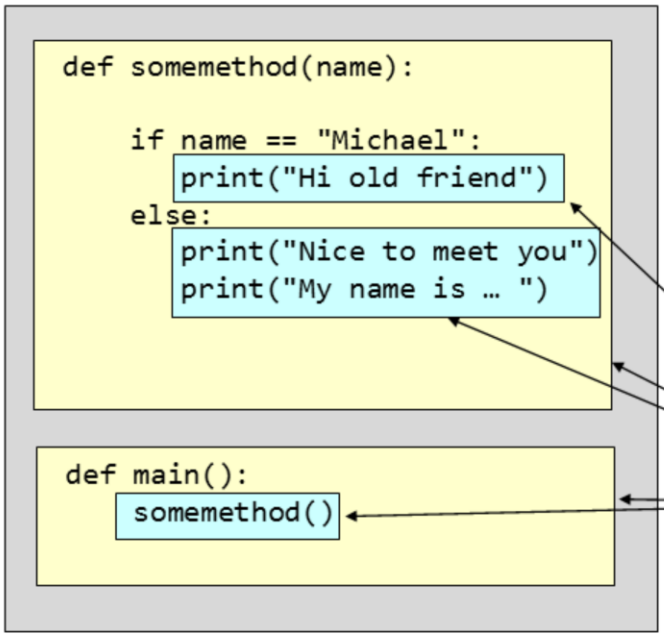
Global Knowledge®

Objectives

- Learn the basics of the Python language
- Define code blocks
- Work with variables
- Test for true / false using various conditionals
- Write loops to work with sets of data
- Consume external code via packages and modules
- Create isolated development environments
- Use deterministic clean up for recovering resources

The 'shape' of a Python program

- Python defines code blocks (known as **suites** in Python) using whitespace and colons.



Things to note:

- No semicolons
- Code blocks start with ':'
- Whitespace really really matters
- There are no braces
- There are no parentheses
- Tabs are not your friend

Code suites

Variables

- Declaring variables is no-nonsense

```
name = "Jeff"
print( "Hi there " + name )
name = 42
print( name )
```

Note:

- You do not declare the type
- Variables are not strongly-typed (but types are)
- Discover current type via **`type(var)`**
- Compare references with **`id(var)`** and **`var1 is var2`**
- Compare values with **`var1 == var2`**

Variables [scope]

- Variable scope
  - Python does not have strict block scope like many C-based languages
  - Not restricted to the declaring scope
  - Scope is global or function level
    - Initialize first => function scope
    - Use first => global scope (must be explicit)

```
num1 = 40

if num1 > 10:
    num2 = 2
    print("Num from if: " + str(num2))

print("Looks like the number is " + str(num1 + num2))

# prints 'Looks like the number is 42'
```

http://docs.python.org/3.3/faq/programming.html

What are the rules for local and global variables in Python?
In Python, variables that are only referenced inside a function are implicitly global. If a variable is assigned a new value anywhere within the function's body, it's assumed to be a local. If a variable is ever assigned a new value inside the function, the variable is implicitly local, and you need to explicitly declare it as 'global'.
Though a bit surprising at first, a moment's consideration explains this. On one hand, requiring global for assigned variables provides a bar against unintended side-effects. On the other hand, if global was required for all global references, you'd be using global all the time. You'd have to declare as global every reference to a built-in function or to a component of an imported module. This clutter would defeat the usefulness of the global declaration for identifying side-effects.

Variables [global scope]

- Variable scope
  - **global** keyword can promote scope
  - **nonlocal** keyword can allows us to share scopes (for closures)

```
sharedVal = 3

def method1():
    global sharedVal
    if sharedVal == 3:
        sharedVal = 7

    sharedVal += 1

method1()
print( sharedVal ) # prints 8
```

Nonlocal is only in Python 3, not 2.

Comments

- Comments are indicated with the **# character**
- They last for rest of a single line
- Class / function documentation comments use an alternate syntax (details later)

```
name = "Jeff"
print( "Hi there " + name ) # use string concat
num = 42
# I wouldn't try this one!
print( "Hi there " + num) # this is an error!
```

Conditionals: Truthiness

- The following are considered **`False`**
  - **`None`**
  - **`False`**
  - zero of any numeric type, for example**`, 0, 0L, 0.0, 0j`**.
  - any empty sequence, for example, **`'', (), []`**.
  - any empty mapping, for example, **`{}`**.
  - instances of user-defined classes, if the class defines a **`__nonzero__()`** or **`__len__()`** method, which returns **`False`**
- Everything else is **`True`**

Conditionals: if statements

- **if** statements are simple suites
- Additional tests are done using **elif** (not **else if**)
- **and** and **or** are words (not symbols, e.g. **&&** and **||**)
- **else** statements can appear at the end

```
if len(name) > 5:
   print('Oh you have a long name!')
elif len(name) == 5:
   print('Let me guess, your name is Sarah?')
elif len(name) == 4 and name[0] == 'T':
   print('Let me guess, your name is Todd?')
else:
   print('Filling out forms must be quick for you!')
```

There is no switch statement in Python.

Conditionals: Ternary statements

- Ternary statements are compressed **if** / **else** suites
- They are meant to be readable rather than concise

```
name = "Jeff"
val = "short name" if len(name) < 5 else "long name"
print(val) # prints 'short name'
```

Empty code suites (blocks): Pass statement

- Sometimes you want an empty block
  - maybe you commented out some code
  - maybe you're sketching out the structure
- The **pass** keyword keeps things running

```
if len(name) > 5:
    pass
```

Empty code blocks are not allowed.

While loops

- While loops run until a condition becomes false

```
num1 = 1
num2 = 2

while num1 < 100:
    num1 = num1 * num2
    print( num1 )

# prints 2,4,8,16,32,64,128
```

For in loops

- For loops in Python fundamentally work on iterable sets
  - There is no index-based looping construct!
  - Many types are iterable
    - lists, sets, dictionaries, strings, files, classes, …

```
name = "Jeff"

for ch in name:
    print( ch, end=', ' )

# prints 'J', 'e', 'f', 'f',
```

For in loops [with indexes]

- For loops *can* use an index
  - Uses **range** function
  - But it's less Pythonic
  - range was considered harmful in Python 2.7 (it's not in 3)

```
name = "Jeff"

for i in range( len(name) ):
    print( name[i] )

# prints 'J', 'e', 'f', 'f',
```

In Python 2 range creates a (potentially large) list to iterate over. Instead, use xrange which has the same behavior as range in Python 3.

For in loops [with indexes (better)]

- Index + element for loops can be combined
  - uses **enumerate** function
  - returns tuples of (index, element)
  - more Pythonic

```
name = "Jeff"

for t in enumerate(name):
    print( t )

# prints (0, 'J'), (1, 'e'), (2, 'f'), (3, 'f')
```

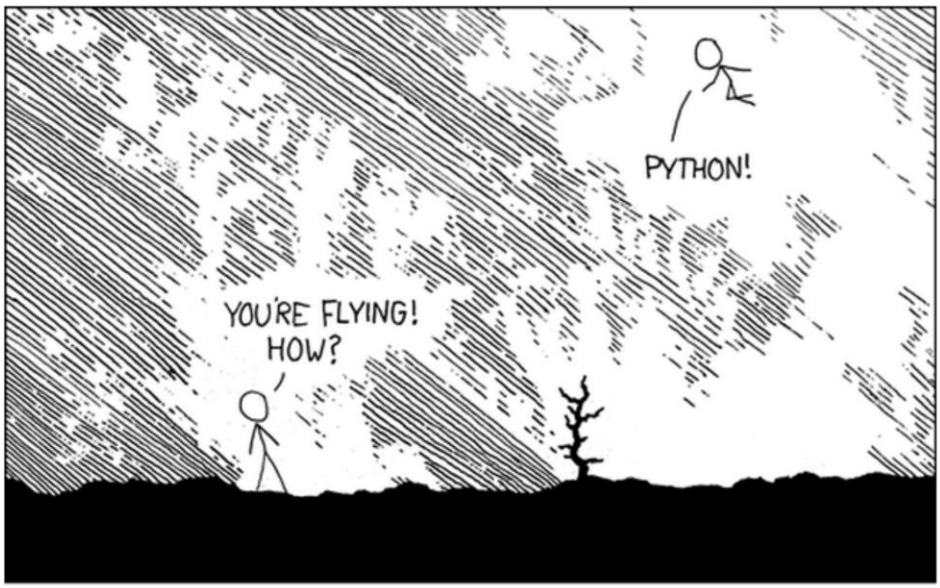
Loops and else statements

- All looping constructs support a final clause using **else**
- Only runs if
  - the loop completes **without** early breaks
  - the loop completes but never runs
- Don't forget the key line in the Zen of Python
  - "... that way may not be obvious at first unless you're Dutch."

```
print("Else loop test")
v = 7
while v < 10:
    v += 1
    print(v)
    if v == 9:
        break;
else:
    print("else v is now " + str(v))
```

Consuming libraries

- Python can access functionality from other modules, packages, and libraries using the **import** statement.



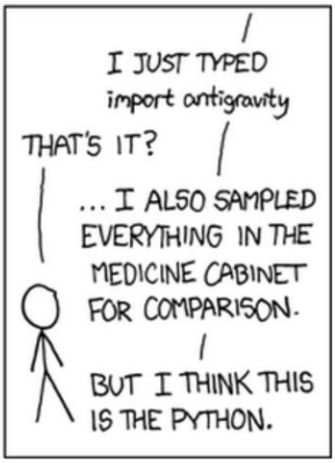


Image credit: XKCD: http://xkcd.com/353/

Consuming libraries [import keyword]

- Python can access functionality from other modules, packages, and libraries using the **import** statement.
- Import gives you access to
  - other scripts you have written
  - modules and packages from third parties
  - components of the standard library

Consuming libraries [standard library]

- Accessing the standard library

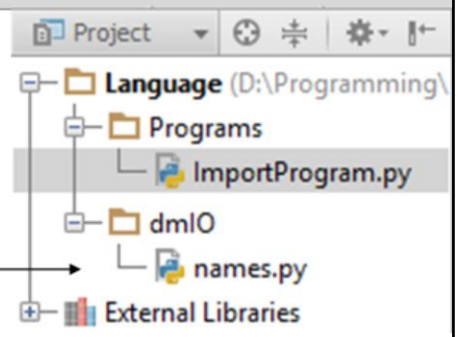
```
import sys

print("Please enter your name: ", end='')
sys.stdout.flush()
name = sys.stdin.readline()

print("Nice to meet you " + name)
```

Consuming libraries [other scripts]

- Accessing other scripts



Include relative paths for working folder

```
import dmIO.names

userName = dmIO.names.queryUserForName()
print("Nice to meet you " + userName)

# Sample execution:
# Please enter your name: Jeff
# Nice to meet you Jeff
```

Consuming libraries [importing your script]

- When your scripts are imported, they may run code you did not intend to run
  - Use the **__name__** convention to test if your script is the main script.

```
if __name__ == "__main__":
    # your code here
```

Consuming libraries [import details]

- Import has several forms

```
import dmIO.names # default: keep namespace

userName = dmIO.names.queryUserForName()
print("Nice to meet you " + userName)
```

```
from dmIO.names import queryUserForName # single method / class
import

userName = queryUserForName()
print("Nice to meet you " + userName)
```

```
from dmIO.names import * # import everything, no namespaces

userName = queryUserForName()
print("Nice to meet you " + userName)
```

The last one is considered bad style because it may accidently overwrite names in your namespace.

Consuming libraries [third-party packages]

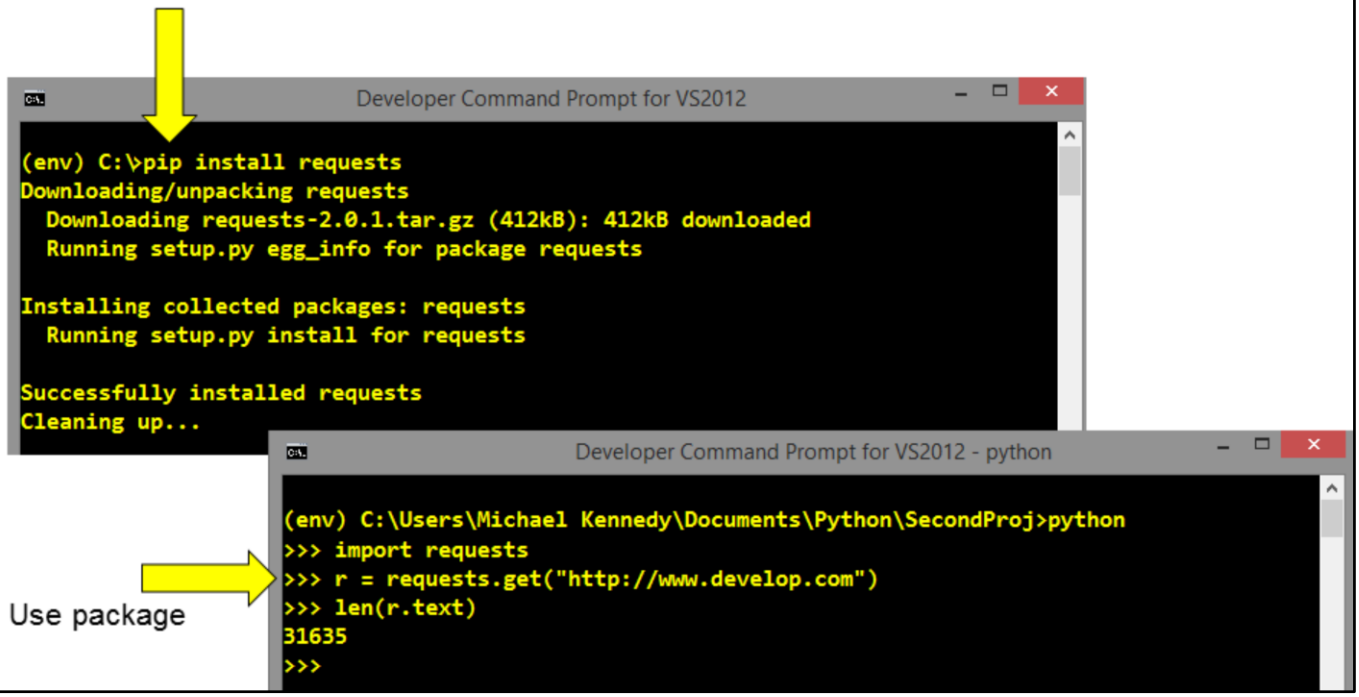
- Python has several package managers which install and upgrade third-party packages
  - **setuptools** (download and run ez_setup.py)
  - **pip** (default since 3.4, else download and run get-pip.py, requires setuptools)
- These are similar to
  - NPM from node.js [1]
  - NuGet from .NET [2]
  - Gems from Ruby [3]

Pip is now default since Python 3.4.

Consuming libraries [third-party packages]

- Installing packages
  - **`pip install <packagename>`**

Install requests package



Consuming libraries [virtual environments]

- Virtual environments allow multiple Python projects that have different (and potentially conflicting) requirements, to coexist on the same computer.
- With virtual environments you can
  - Store multiple versions of a package
  - Store packages in non-admin users folders (sudo install not required)
  - Clearly express dependencies for a deployment

Consuming libraries [using virtualenv]

- Install virtual environments
  - **`sudo pip install virtualenv`**
- Create a virtual environment in working folder
  - **`virtualenv .\env`**
- Install your packages (e.g. requests)
  - **`.\env\scripts\pip install requests`**
- Activate your terminal / cmd session
  - **`.\env\scripts\activate.bat` or `source` (on OS X)**
- Run python scripts and commands as usual
  - but will target the virtual environment
- Run 'deactivate' to turn off the virtual environment

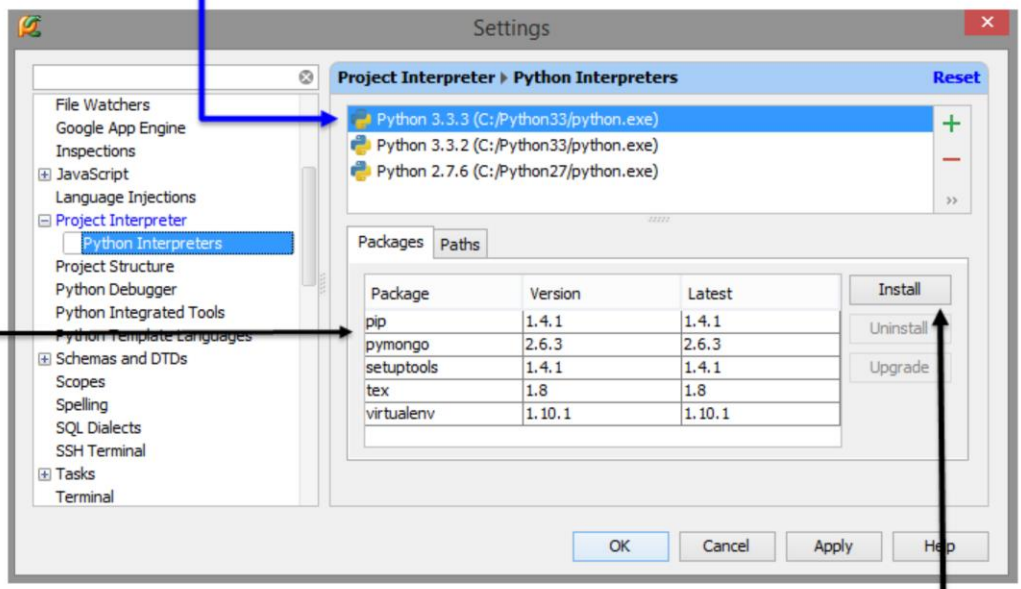
Note: Python 3.3+ includes a built-in way to do this:
http://docs.python.org/dev/library/venv.html

Use deactivate to turn off the virtualenv.
Use pyvenv for Python 3.3+

Consuming libraries [PyCharm]

- PyCharm has support for package management

For a selected interpreter or virtual environment

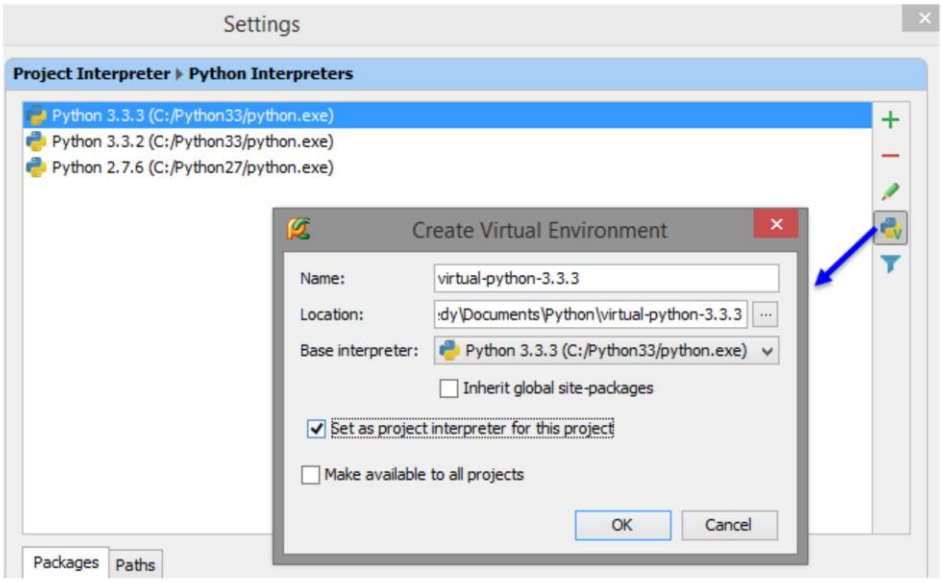


Manage / update installed packages

Install new packages

Consuming libraries [PyCharm]

- PyCharm has support for virtual environments
  - Can isolate environment
  - Can inherit global package settings



Deterministic clean up

- Python memory management uses
  - Eager reference counting
  - Secondary generational garbage collector (for cycles)
- To ensure timely clean up use the **`with`** statement

```
with open('foo.txt') as fin:
    # perform some action with fin
    pass # <-- work with fin
    # cleanup happens on exit code suite
```

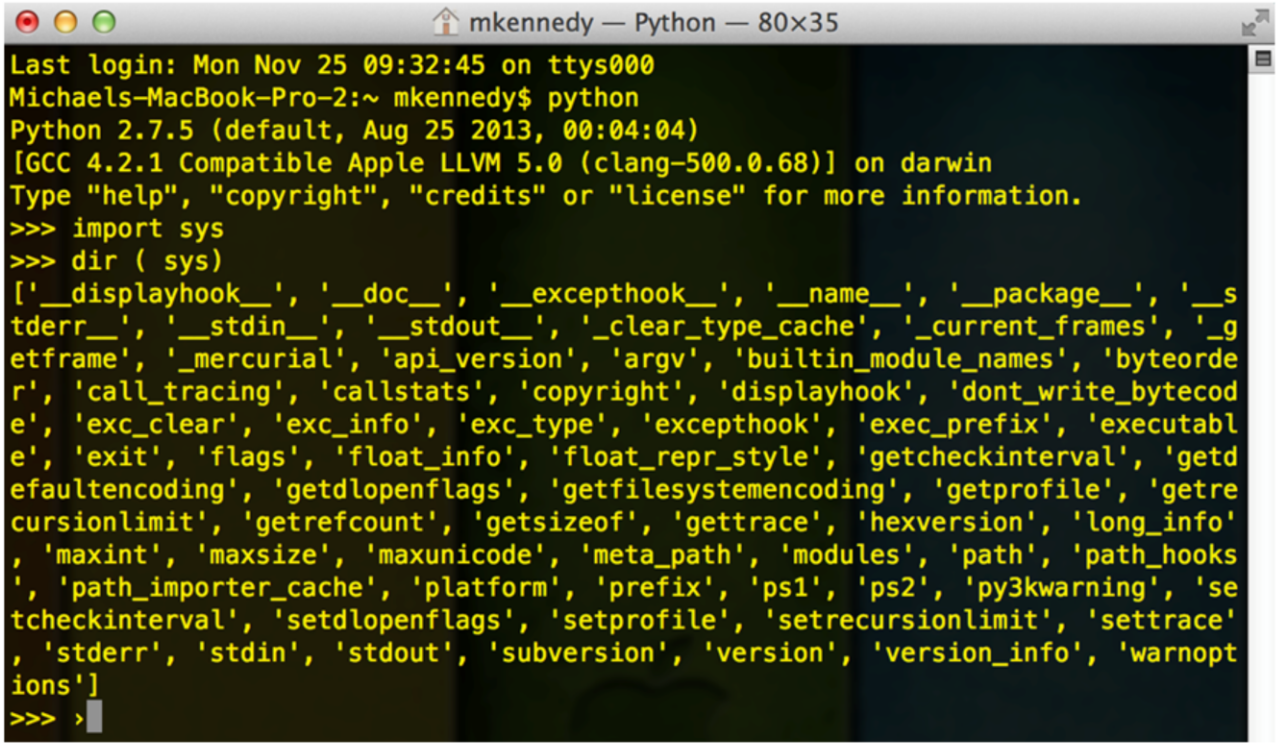
'with' uses a context manager, which is an object that supports __enter__ and __exit__

Getting help

- Python has good documentation with examples
  - Visit http://docs.python.org/3.3/contents.html
  - Just Google it (typically fastest access to docs.python.org)
  - Type **help(class)** or **help(namespace)** (hint: q to quit)

Getting help

- Not everything is documented, but you can still browse it with the **`dir(namespace)`** command.



Summary

- Python uses whitespace and colons to define blocks
- Variables do not require type definitions
- There are two types of conditionals
- Python does not have an index for loop
- Packages are imported using the import keyword
- Virtual environments allow us to work in clean envs
- With statement allows for safe use of recourse-based data