

Introduction to Python

Adapted with gratitude from Brad Dayley's "Python Phrasebook" and CSE 391 slides at UPenn

What is Python?

- Powerful open source scripting language.
- Developed by Guido van Rossum in early 90s.
- Named after Monty Python.
- Maintained at:

www.python.org



Why Python?

- **Portability**
 - Interpreters available on almost any platform.
- **Integration**
 - Can contain C/C++ code. Can run on Java.
- **Ease of use**
 - Clear and readable syntax. Intuitive data types.
- **Power**
 - Powerful extensions added all the time.
- **Dynamic**
 - Flexible language that supports creative solutions.
- **Open Source**
 - Free to use and distribute.

Who Uses Python?

- **Examples:**
 - Google
 - Industrial Light and Magic
 - United Space Alliance
 - Disney (Panda 3D)
 - CCP Games (EVE Online)
 - Sid Meier (Civilization IV)
 - etc.

Invoking The Interpreter

- If the python executable (python.exe on PCs) is in your execution path, just type:
`python`
in any shell to invoke the interpreter in interactive mode.
- The command:
`>>> execfile("scriptfile.py")`
will interpret the contents of this script.
- Quicker to invoke the interpreter with a script parameter:
`python scriptfile.py`

Types

- Built-in object types. Type guessed at assignment time. Can determine later whether object is of a specific type:
`>>> s = "A Simple String"`
`>>> print isinstance(s, basestring)`
True
`>>> print isinstance(s, dict)`
False
`>>>`

Types

- Built-in object types:
 - General `object, type`
 - Null `Types.NoneType`
 - Numbers `bool, int, long, complex`
 - Sets `set, frozenset`
 - Sequences `str, list, tuple, xrange`
 - Maps `dict`
 - Files `file`
 - Callable `types.FunctionType, types.MethodType`

Types

- Numbers
 - **bool** is either `True` or `False`
`>>> x = True`
 - **int** is 32 bit whole numbers while long is only limited by machine memory.
`>>> x = 4`
 - **float** is 64 bit floating-point numbers.
`>>> x = 4.3`
 - **complex** is a pair of floats.
`>>> x = 1.5+0.5j`
`>>> print x.real, x.imag`
`1.5 0.5`

Types

- Sets
 - An unordered collection of unique items.
 - Mutable sets (`set`) can be modified.
 - Immutable sets (`frozenset`) cannot be changed after creation!

Types

- Sequences
 - Ordered items, indexed by integers.
 - Can be made up of almost any Python object.
 - **strings** and **tuples** are immutable.


```
>>> mystring = "hello"
>>> mytuple = (1, mystring, 3.5)
```
 - **lists** are mutable.


```
>>> mylist = [1, "hello", 3.5]
>>> mylist[1] = "bye"
```

Types

- Sequences: Indexing
 - Typical array notation starting with 0, also negative indexing from right starting with -1.

```
>>> mystring[4]
'o'
>>> mystring[-1]
'o'
```

Types

- Sequences: Slicing
 - Returning a copy with a subset of original sequence. Start copying at first index and stop copying before second index.

```
>>> mystring[2:4]
'll'
>>> mytuple[0:-1]
(1, 'hello')
```

Types

- **Maps** (i.e. Dictionary, Hash tables, Associative Arrays)
 - A collection of key objects that index the second collection of value objects.
 - The key object must be of an immutable type.
 - The value object can be almost any Python object.

```
>>> trans = {'epli':'apple', 'appelsína':'orange'}
>>> trans['epli']
'apple'
```

Types

- **Files**
 - Object representing an open file.
 - Used to read and write filesystem data.
- **Callables**
 - Objects of this type can be called as a function.
 - For example built-in functions, user-defined functions and method instances.

Types

- **Modules**
 - Modules of code loaded with the import statement.
 - All objects within a module can be accessed using the dot syntax.

```
>>> import math
>>> print math.pi
3.14159265359
```

Syntax

- Code indentation
 - There are no { } or begin/end markers for code blocks.
 - Blocks of code are denoted by line indentation.
 - Number of spaces may vary across blocks, but never within a block!

```
if True:
    print "Good answer:"
    print "True"
else:
    print "Bad answer:"
    print "Fale"
```

Syntax

- Multiline Statements
 - Statements end with a new line.
 - Can use \ to denote the line continues.

```
Sum = x + 4 + \
    5.6 + y
```

- Statements within [], {} or () don't need this.

```
List = ['apple', 'orange',
        'lemon', 'pear']
```

Syntax

- Quotation
 - Single ('), double ("), triple ("'" or """).
 - Have to match at each end.
 - Triple quotes can span multiple lines.

```
s = 'hello'
s = "hello again 'sam'!"
s = """hello! What I meant to say was
    how are you doing?"""
```

Syntax

- Comments
 - # starts a comment to the end of the line
 - “Documentation strings” can be included as the first line of any new class or function definition

```
def foo(x, y):
    """Does foo to both x and y
    blah blah blah """
    # Now the code starts
    print x, y
```

Syntax

- Formatting strings
 - Match a list of objects to predefined format symbols within a string.

```
>>> X = ["Sam", 1]
>>> print "%s is number %03d%s" % (x[0], x[1], "!")
Sam is number 001!
```

Syntax

- Flow Control
 - **if** expression: block
 - **while** expression: block
 - **for** item **in** sequence: block
 - **else** and **elif** added to any of these.
 - **break** exits a loop (skips an else), **continue** jumps to next iteration.

Objects, Classes and Functions

- Objects
 - Every piece of data stored and used in the Python Language is an **object**.
 - Every object has
 - **Identity**: points to memory location
 - **Type**: describes object representation / interpretation
 - **Value**: the data

```
>>> x = 3
>>> print id(x), type(x), x
10115944 <type 'int'> 3
```

Objects, Classes and Functions

- Objects cont.
 - Can also have
 - **Attributes**: Other values associated with the object.
 - **Methods**: Callable functions associated with the object.
 - Those are accessed with the dot-notation.

```
>>> class foo(object):
    def p(self):
        print self.num
>>> f = foo()
>>> f.num = 3
>>> f.p()
3
```

Objects, Classes and Functions

- Classes
 - Basically a collection of attributes and methods.
 - “**class** name(*object*): block” defines a new class that derives from *object*.
 - All code contained in the block will be executed when the class is instantiated.
 - The “**__init__()**” function (method) will also be executed if defined inside the block (constructor).

Objects, Classes and Functions

- Classes cont.

```
class testClass(object):
    print "Defining a new testClass object"
    number = 5
    def __init__(self, string):
        self.string = string
    def print(self):
        print "Number=%d" % self.number
        print "String=%s" % self.string
```

```
tc = testClass("Five")
tc.print()
tc.number = 10
tc.string = "Ten"
tc.print()
```

```
OUTPUT:
Defining a new testClass object
Number = 5
String = Five
Number = 10
String = Ten
```

Objects, Classes and Functions

- Functions

- Functions are objects in Python.
- “**def** functionname(parameters): block” defines a new function.
- Parameters are not type checked!
- Parameters can be passed in a number of ways.

Objects, Classes and Functions

- Functions Cont.

```
def fun(name, location, year=2006):
    print "%s/%s/%d"%(name,location,year)
```

```
>>> fun("Teag", "San Diego")
Teag/San Diego/2006
```

Objects, Classes and Functions

- Functions Cont.

```
def fun(name, location, year=2006):  
    print "%s/%s/%d"%(name,location,year)
```

```
>>> fun(location="San Diego", name="Teag",  
        year=2004)  
Teag/San Diego/2004
```

Objects, Classes and Functions

- Functions Cont.

```
def fun(name, location, year=2006):  
    print "%s/%s/%d"%(name,location,year)
```

```
>>> fun("Teag", year=2004,  
        location="San Diego")  
Teag/San Diego/2004
```

Objects, Classes and Functions

- Functions Cont.

```
def fun(name, location, year=2006):  
    print "%s/%s/%d"%(name,location,year)
```

```
>>> tuple = ("Teag","San Diego",2004)  
>>> fun(*tuple)  
Teag/San Diego/2004
```

Objects, Classes and Functions

- Functions Cont.

```
def fun(name, location, year=2006):  
    print "%s/%s/%d"%(name,location,year)
```

```
>>> dictionary = {name="Teag",  
                  location="San Diego", year=2004}  
>>> fun(**dictionary)  
Teag/San Diego/2004
```

Objects, Classes and Functions

- Functions Cont.

- Values can be returned from functions using the **return** statement.
- If a function has no **return** statement, a **None** object is returned.

```
>>> def square(x):  
    return x*x  
>>> print square(3)  
9
```
