School Year
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EMSI
3IIR

Python Programming
Introduction

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Introduction

What is Python?

- Compromise between shell script and C++/Java program
- Intuitive syntax
- Interpreted (sort of)
- Dynamically typed
- High-level datatypes
- Module system
- Just plain awesome

Introduction

Java

```java
public class Hello {
    public static void main(String[] args) {
        System.out.println("Hello, world!");
    }
}
```

Introduction

C++

```
#include <iostream>
int main()
{
    std::cout << "Hello World!" << std::endl;
    return 0;
}
```

Introduction

Python

```
print "hello world"
```

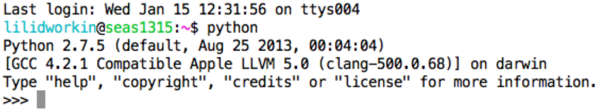
Python

- What does it mean for a language to be “interpreted?”
- Trick question – “interpreted” and “compiled” refer to implementations, not languages
- The most common Python implementation (CPython) is a mix of both
    - Compiles source code to byte code (.pyc files)
    - Then interprets the byte code directly, executing as it goes
    - No need to compile to machine language
    - Essentially, source code can be run directly

Python

How do you use it?

- Write code interactively in the interpreter



```
Last login: Wed Jan 15 12:31:56 on ttys004
lilidworkin@seas1315:~$ python
Python 2.7.5 (default, Aug 25 2013, 00:04:04)
[GCC 4.2.1 Compatible Apple LLVM 5.0 (clang-500.0.68)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 
```

- Run a file in the interpreter with `import file`
- Run a file on the command line with `python file.py`

Basics

```
>>> 1 + 1
2
>>> print "hello world"
hello world
>>> x = 1
>>> y = 2
>>> x + y
3
>>> print x
1
```

Types

What does “dynamically typed” mean?

Types

What does “dynamically typed” mean?

- Variable types are not declared
- Python figures the types out at runtime

Types

- type function:

  ```
  >>> type(x)
  <type 'int'>
  ```

- isinstance function:

  ```
  >>> isinstance(x, int)
  True
  ```

- Difference?

Types

We prefer to use “duck typing.”

“When I see a bird that walks like a duck and swims like a duck and quacks like a duck, I call that bird a duck.”

— James Whitcomb Riley

```
try:
    # assume object has desired type
except:
    # try something else
```

Types

What does “strongly typed” mean?

Types

```
>>> x = 3
>>> x = "hello"
```

- Has `x` changed type?
- No – `x` is a *name* that *points* to an object
- First we make an integer object with the value 3 and bind the name 'x' to it
- Then we make a string object with the value hello, and rebind the name 'x' to it
- Objects do not change type

Types

Interpreter keeps track of all types and doesn’t allow you to do things that are incompatible with that type:

```
>>> "hi" + 5
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: cannot concatenate 'str' and 'int' objects
```

Functions

```
def add(x,y):
    return x + y

>>> add(3,4)
7
```

- Colon (:) indicates start of a block
- Following lines are indented

Types in Functions

- Function declaration doesn't specify return type
- But all functions return a value (`None` if not specified)
- Parameter datatypes are not specified either

Style

- Blocks are denoted by whitespace
- Use spaces, not tabs
- Single line comments are denoted with `# ...`
- Multi-line comments are denoted with `""" ...  """`
- Variable and function names should be `lower_case` with underscores separating words
- Use docstrings to document what a function does:

```
def add(x,y):
   """ Adds two numbers """
   return x + y
```

Blocks in the Interpreter

```
>>> def add(x,y):
...     return x + y
...
>>>
```

- ... indicates more input is expected
- Need blank line to indicate end of block

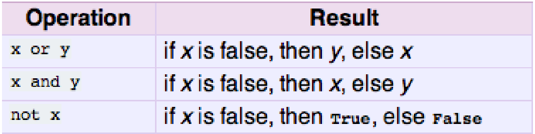
Datatypes: Overview

- `None`
- Booleans (`True`, `False`)
- Integers, Floats
- Sequences
  - Lists
  - Tuples
  - Strings
  - Dictionaries
- Classes and class instances
- Modules and packages

Booleans

- Booleans: `True`, `False`
- The following act like `False`:
    - None
    - 0
    - Empty sequences
- Everything else acts like `True`

Booleans: Operations



Operation	Result
`x or y`	if *x* is false, then *y*, else *x*
`x and y`	if *x* is false, then *x*, else *y*
`not x`	if *x* is false, then `True`, else `False`

- `and`, `or` both return one of their operands
- `and`, `or` are short-circuit operators

Booleans: Examples

```
>>> (2 + 4) or False
6
>>> not True
False
>>> not 0
True
>>> 0 and 2
0
>>> True and 7
7
```

Integers and Floats

- Numeric operators: `+ - * / % **`
- No `i++` or `++i`, but we do have `+=` and `-=`
- Ints vs. Floats

```
>>> int(5/2)
2
>>> 5/2.
2.5
>>> float(5)/2
2.5
>>> int(5.2)
5
```

Assignments

```
>>> a = b = 0
>>> a, b = 3, 5
```

Something cool:

```
>>> a, b = b, a
>>> a
5
>>> b
3
```

Comparisons

```
>>> 5 == 5
True
>>> "hello" == "hello"
True
>>> 1 != 2
True
>>> 5 > 3
True
>>> "b" > "a"
True
```

If Statements

```
if a == 0:
    print "a is 0"
elif a == 1:
    print "a is 1"
else:
    print "a is something else"
```

If Statements

- Don't need the `elif` or `else`
- Condition can be any value, not just Boolean

```
if 5:
    print "hello"

if "hello":
    print 5
```

For Loops

```
>>> range(5)
[0, 1, 2, 3, 4]
>>> for i in range(5):
...  print (i)
...
0
1
2
3
4
```

Ranges

- `range(n)` produces `[0, 1, ..., n-1]`
- `range(i, j)` produces `[i, i+1, ..., j-1]`
- `range(i, j, k)` produces `[i, i+k, ..., m]`

```
>>> range(5, 25, 3)
[5, 8, 11, 14, 17, 20, 23]
```

Break and Continue

```
>>> for i in range(5):
...   print i
...   if i < 3:
...     continue
...   break
...
0
1
2
3
```

While Loops

```
>>> i = 0
>>> while i <= 3:
...  print i
...  i += 1
...
0
1
2
3
```

Example: Factorial Function

```
5! = 5*4*3*2*1
0! = 1
```

Iterative Factorial Function

```python
def factorial(x):
```

Iterative Factorial Function

```
def factorial(x):
    ans = 1
    for i in range(2, x+1):
        ans = ans * i
    return ans
```

Recursive Factorial Function

```
def factorial(x):
```

Recursive Factorial Function

```
def factorial(x):
    if x == 0:
        return 1
    else:
        return x * factorial(x - 1)
```

Imports

```
>>> import math
>>> math.sqrt(9)
3.0
```

Python Files

```
import <>

def <>:
    ...

def <>:
    ...

def main():
    ...

if __name__ == "__main__":
    main()
```

Python Files

- `__name__` is a variable that evaluates to the name of the current module
- e.g. if your file is h1.py, `__name__ = ‘‘h1’’`
- But if your code is being run directly, via `python h1.py`, then `__name__ = ‘‘__main__’’`

Running Python Files

- In the IDLE:
  - File open hello.py
  - Run module F5
- In command line:
  - python hello.py