Introduction to Python

EECS 4415

Big Data Systems

Tilemachos Pechlivanoglou

tipech@eecs.yorku.ca

Background

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Why Python?

- "Scripting language"
- Very easy to learn
- Interactive front-end for C/C++ code
- Object-oriented
- Lots of libraries
  - *including tools for **data analysis***
- Powerful, scalable
  - *supporting tools that handle **very large datasets***

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Pseudocode

```
if grade equals 60 and assignment in assignments list
    print "passed"
else
    print "failed"
```


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Python code

```
if grade == 60 and assignment in assignments_list:
    print("passed")
else:
    print("failed")
```


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Python syntax

- Much of it is similar to C syntax
- Exceptions:
  - *missing operators: ++, --*
  - *no { } for blocks*
    - only whitespace and indentation
  - *different keywords*
  - *no type declarations!*
  - *lots of extra features*

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Starting and exiting Python

```
% python
Python 3.5.2 …
>>> print("hello")
hello
>>> ^D
%
```


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Running a Python file

Contents of file.py:

```
print (“hello world”)
```

Executing it in terminal:

```
% python file.py
hello world
%
```


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Simple data types

- Numbers
  - *integer*
  - *floating-point*
  - *complex!*
- Strings
  - *characters are strings of length 1*
- Booleans are `0`/`1` (or `False`/`True`)

- Comments with **#**

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Simple data types: operators

- `+ - * / %` (like C)
- `+= -= etc.` (no `++` or `--`)
- Assignment using =
  - *but semantics are different!*

```
a = 1
a = "foo" # OK
```

- Can also use `+` to concatenate strings

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Python Script

Contents of file.py:

```
print (“hello world”)
```

Executing it in terminal:

```
% python file.py
hello world
%
```


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Compound data types (1)

- Lists:

```
a = [1, 2, 3, 4, 5]
print (a[1]) # 2
some_list = []
some_list.append("foo")
some_list.append(12)
print (len(some_list)) # 2
```


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Compound data types (2)

- Tuples:

```
a = (1, 2, 3, 4, 5)
print (a[1]) # 2
empty_tuple = ()
```

- Difference between lists and tuples:
  - *lists are mutable; tuples are immutable*
  - *lists can expand, tuples can't*
  - *tuples are slightly faster*

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Compound data types (3)

- Dictionaries:

```
a = {“age”: 18, “b”: “123a”, 3: True}
print (a[3]) # True
print (a[“age”]) # 18
```

- Key-Value pairs
  - *key can be number or string*
  - *value can be anything, including another sub-dictionary*

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Compound data types (4)

- Objects:

```
class Thingy:
    # methods and properties
t = Thingy()
t.method()
print (t.field)
```

- Built-in data structures (lists, dictionaries) also objects
  - *though internal representation is different*

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Control flow (1)

- `if`, `if/else`, `if/elif/else`

```
if a == 0:
    print ("zero!")
elif a < 0:
    print ("negative!")
else:
    print ("positive!")
```

- Notes:
  - *blocks delimited by indentation!*
  - *colon (`:`) used at end of* control flow keywords

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Control flow (2)

- `while` loops

```
a = 10
while a > 0:
    print (a)
    a -= 1
```


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Control flow (3)

- `for` loops

```
for a in range(10):
    print (a)
```

- Really a "foreach" loop
- Common `for` idiom:

```
a = [3, 1, 4, 1, 5, 9]
for i in range(len(a)):
    print (a[i])
```


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Control flow (4)

- `pass` keyword

```
if a == 0:
    pass # do nothing
else:
    # whatever
```

- `continue` statement similar to C

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File access

- `for..in` loops

```
f = open("some_file", "r")
for line in f:
    # do something with line...
```

- Files normally end in .py

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Functions

- Definition

```
def foo(x):
    y = 10 * x + 2
    return y
```

- Execution

```
print (foo(10)) # 102
```

- All variables are local unless specified as `global`
- Arguments passed by value

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Modules (1)

- Access other code by importing modules:

```
import math
print (math.sqrt(2.0))
```

- or

```
from math import sqrt
print (sqrt(2.0))
```

- or

```
from math import *
import sys, string, math
```


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Modules (2)

- Try to avoid `from some_module import *`
  - *dumps all names from `some_module` into local namespace*
  - *easy to get name conflicts this way*

- Code you write in file `foo.py` is part of module `"foo"`

```
from foo import my_function
import bar
```


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Strings and formatting

```
i = 10
d = 3.1415926
s = "I am a string!"
print ( "%d\t%f\t%s" % (i, d, s) )
```


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Links and other material

- Python tutorials:
  - https://www.w3schools.com/python/
  - https://www.learnpython.org/
- Python documentation:
  - https://docs.python.org/3/

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