GENERAL ASSEMBLY

INTRO TO DATA SCIENCE

LECTURE 3: DATABASES, PYTHON AND PANDAS

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11/02/2015

LAST TIME:

I. WHAT ARE DATABASES?

II. WHY ARE THEY NEEDED?

III. WHAT ARE RELATIONAL DATABASES?

IV. WHAT IS SQL?

DATA STORAGE:

I. NOSQL DATABASES

PYTHON:

II: INTRO TO PYTHON

HANDS-ON: PYTHON EXERCISES

III: INTRO TO PANDAS

HANDS-ON: PANDAS EXERCISES

- What are No-SQL databases?
- What are the differences between relational and non-relational databases?
  - When is one preferred to the other?
- What are some beneficial characteristics of Python?
- What is Pandas?

I. NO-SQL DATABASES

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Most importantly, they often attempt to minimize the need for **JOIN** *operations*

Memcached

Apache HBase

Cassandra

MongoDB

Memcached	::	*LiveJournal*
Apache HBase	::	*Google BigTable*
Cassandra	::	*Amazon Dynamo*
MongoDB		

Memcached was:

- developed by LiveJournal

- distributed key-value store (HashMap or Python Dict)

- Support two operations:

get *and* **set**

Memcached was:

- *developed by LiveJournal*
- *distributed key-value store (HashMap or Python Dict)*
- *Support two* **very fast** *operations:*
  - **get** *and* **set**

Cassandra was

- *developed by Facebook*
- *Messages application and Inbox Search*
- *Key-Value* **(-ish)**
  - *supports query by key or value range*
- *Very fast writing speeds*
- *Useful for record keeping, logging*

Modeled after Google's BigTable

Scalable **Key-Value** *Store*

Built into most **Hadoop** *distributions*

Column-based *for quick Range scans*

Very fast **point retrieval/update**

Example Use Case: User Profiles

Other examples?

Key Takeaways:

- *Each Database has it's strengths*
- *Choose the right one for* **your use case**

DISCUSSION – DATABASES

II. INTRO TO PYTHON

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open source*: free! (both binaries and source files)*
high-level*: interpreted (not compiled)*
dynamic*: things that would typically happen at compile time happen at runtime instead (eg, dynamic typing)*

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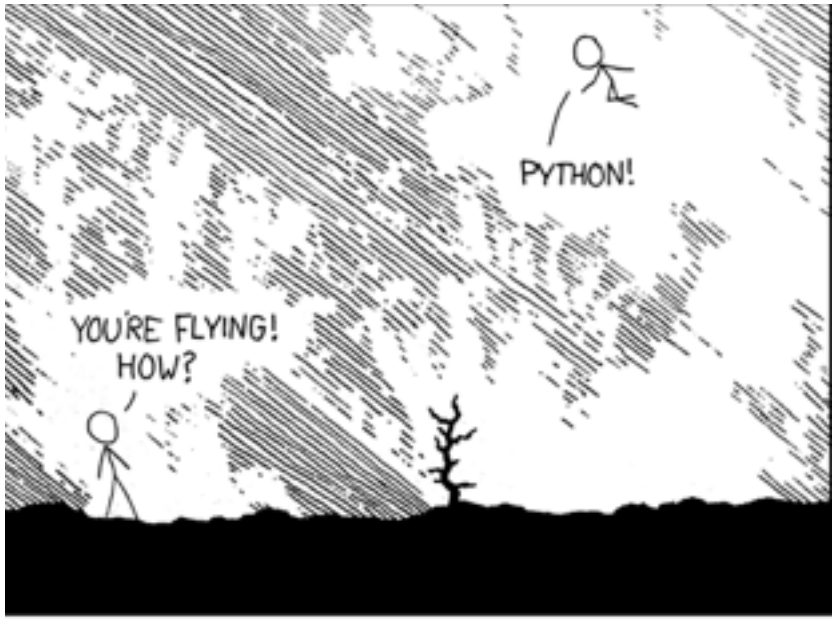
- Currently on version 3 ...
  - but most still use 2.7+

WHY PYTHON?


PYTHON!
YOU'RE FLYING!
HOW?


I LEARNED IT LAST NIGHT! EVERYTHING IS SO SIMPLE!
HELLO WORLD IS JUST print "Hello, world!"
I DUNNO... DYNAMIC TYPING? WHITESPACE?
COME JOIN US! PROGRAMMING IS FUN AGAIN! IT'S A WHOLE NEW WORLD UP HERE!
BUT HOW ARE YOU FLYING?
I JUST TYPED import antigravity
THAT'S IT?
... I ALSO SAMPLED EVERYTHING IN THE MEDICINE CABINET FOR COMPARISON.
BUT I THINK THIS IS THE PYTHON.

WHAT ARE THE ADVANTAGES TO PYTHON?

- Batteries Included: Large collection of built in libraries
- Multi-paradigm: many different programming methodologies apply
- Simple and clean syntax

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- Simple and clean syntax - *but we have to pay attention to whitespace*

WHAT ARE THE ADVANTAGES TO PYTHON?

- BATTERIES INCLUDED

- Lots of tools built-in to the standard library

- Easy to install new package: pip, easy_install
  - Try
    - > *pip install oauth*
    - > *pip install django*

WHAT ARE THE ADVANTAGES TO PYTHON?

- MULTI-PARADIGM

- Scripting language
- Functional programming
- Object oriented programming

WHAT ARE THE ADVANTAGES TO PYTHON?

- CLEAN SYNTAX

- Java
  - public static void main(String [ ] args)

  {

  System.out.println(“Hello world”);

  }

WHAT ARE THE ADVANTAGES TO PYTHON?

- CLEAN SYNTAX

- Python:
  - print “Hello World”

WHAT SETS PYTHON APART?

- Type system:
  - Dynamic typing!

WHAT IS TYPING?

- Need to tell the program WHAT something is:
  - C, Java: double pi = 3.14...
- Can lead to hard to read to code
- But also means safer code

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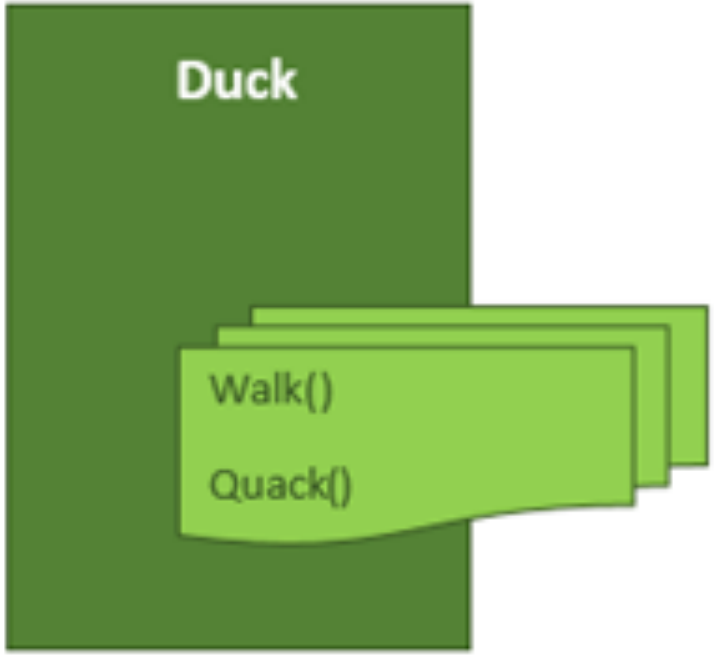

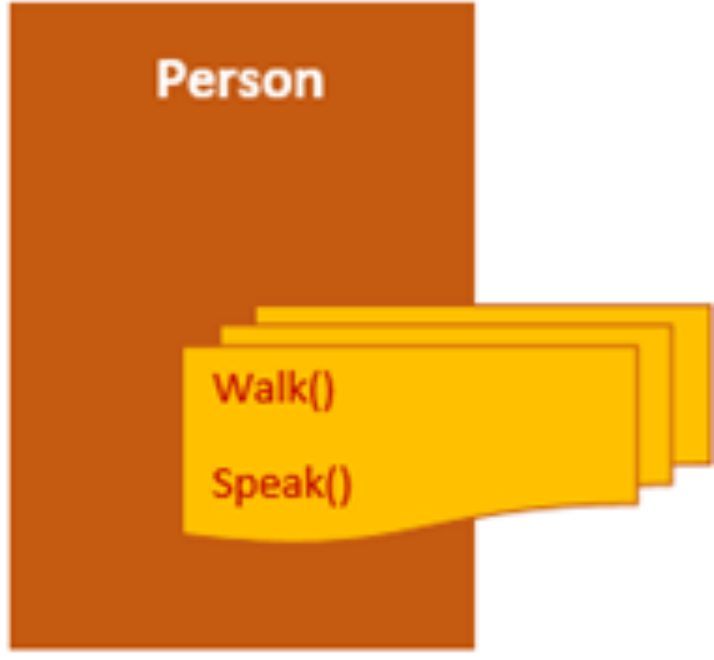

WHAT SETS PYTHON APART?

- Type system:
  - Dynamic typing!

```
>>> x = 1
>>> x
1
>>> x = 'horseshoe'
>>> x
'horseshoe'
>>> _
```

WHAT SETS PYTHON APART?

- Type system:

  Dynamic typing!

- Interpreted language
  - No compilation

PYTHON SYNTAX

SETTING UP VARIABLES

- Python shell is just a complex calculator:
  - 10 * 15
  - x = 5
  - x #prints 5
  - x^2 #prints 25

The most basic data structure is the **None** *type. This is the equivalent of NULL in other languages.*

There are four basic numeric types: **int, float, bool, complex, string**

```
>>> type(1)
<type 'int'>
>>> type(2.5)
<type 'float'>
>>> type(True)
<type 'bool'>
>>> type(2+3j)
<type 'complex'>
```

DATA TYPES

- Lists:

  l = [1, 2, 3]

  l = [‘happy’, ‘sad’, ‘indifferent’]

- Dictionaries (Maps):

  Key-Value datastructure

  d = { ‘first_name’ : ‘Paul’, ‘last_name’: ‘Burkard’}

IF/ELSE STATEMENTS

- If/Else statements allow us to take different paths through depending on some condition:
- x = 5
- if x > 4:
  - print “This number was less than 4”

LOOPING

- Looping allows us to pass through some set of values and perform an operation on each

- l = [“happy”, “sad”, “don’t care”]
- for x in l:
  - print x
  - if x == ‘happy’:

FUNCTIONS

- Functions allow us to save some piece of functionality to reuse later

- def func(x):
  - if x > 4:
    - print “This number is less than 4

    - >> func(6)

Our final example of a data type is the Python **file object**. *This represents an open connection to a file (eg) on your laptop.*

```
>>> with open('output_file.txt', 'w') as f:
...   f.write(my_output)
```

These are particularly easy to use in Python, especially using the with statement context manager, which automatically closes the file handle when it goes out of scope.

Python allows you to define custom **functions** *as you would expect:*

```
>>> def x_minus_3(x):
...     return x - 3
...
>>> x_minus_3(12)
9
```

Functions can optionally return a value with a **return statement** *(as this example does).*

Functions can take a number of **arguments** *as inputs, and these arguments can be specified in two ways:*

As **positional arguments***:*

```
>>> def f(x, y):
...     return x - y
...
>>> f(4,2)
2
>>> f(2,4)
-2
```

Functions can take a number of **arguments** *as inputs, and these arguments can be specified in two ways:*

Or as **keyword arguments***:*

```
>>> def g(arg1=x, arg2=y):
...   return arg1 / float(arg2)
...
>>> g(arg1=10, arg2=5)
2.0
>>> g(arg2=100, arg1=10)
0.1
```

Python supports **classes** *with member attributes and functions:*

```
>>> class Circle():
...   def __init__(self, r=1):
...     self.radius = r
...   def area(self):
...     return 3.14 * self.radius * self.radius
...
>>> c = Circle(4)
>>> c.radius
4
>>> c.area
<bound method Circle.area of <__main__.Circle instance at 0x1060778c0>>
>>> c.area()
50.24
>>> 3.14 * 4 * 4
50.24
```

HANDS ON: PYTHON

III. INTRO TO PANDAS

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data structures: *allows for working with table-like data directly in Python - functionality is similar to R*

data analysis: *interoperates smoothly with further machine learning and visualization packages expecting NumPy-style data structures*

WHY PANDAS?

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- *A rich set of recent Python libraries provide various Machine Learning out of the box (scikitlearn, statsmodels, etc)*
  - *These packages expect NumPy arrays, which can be tough to work with*
  - *Because of this, people often switch over to R for data analysis*

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A:

- *Python has traditionally been good at raw data preparation, "data munging", and manipulation*
- *A rich set of recent Python libraries provide various Machine Learning out of the box (scikitlearn, statsmodels, etc)*
  - *These packages expect NumPy arrays, which can be tough to work with*
  - *Because of this, people often switch over to R etc. for data analysis*
- *Pandas bridges the gap by providing easy-to-use Python data structures for datasets that play nicely with these machine learning packages*

HANDS ON: PANDAS

DISCUSSION