

Introduction to Python

Parham Alvani

Amirkabir University of Technology

`parham.alvani@gmail.com`

May 14, 2015

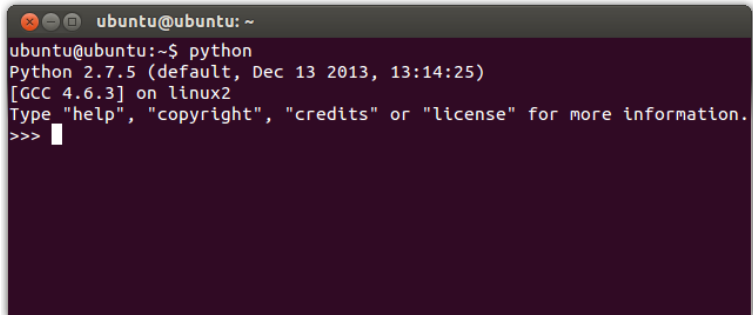


what is python...

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable..



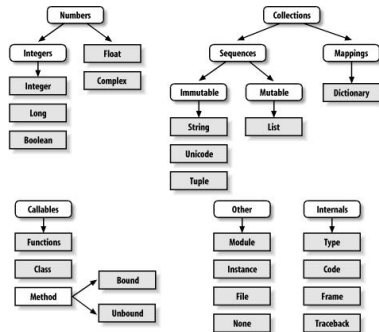
Environment

A terminal window with a dark purple background and a grey title bar. The title bar contains three window control icons (close, minimize, maximize) and the text 'ubuntu@ubuntu: ~'. The terminal text is as follows:

```
ubuntu@ubuntu:~$ python
Python 2.7.5 (default, Dec 13 2013, 13:14:25)
[GCC 4.6.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> 
```

Variable Types

- ▶ Numbers
- ▶ String
- ▶ List
- ▶ Tuple
- ▶ Dictionary



Numbers

- ▶ Number data types store numeric values.
- ▶ They are immutable data types, means that changing the value of a number data type results in a newly allocated object.

Strings

- ▶ Strings are amongst the most popular types in Python.
- ▶ We can create them simply by enclosing characters in quotes.
- ▶ Python treats single quotes the same as double quotes.

- ▶ The most basic data structure in Python is the sequence.
- ▶ Each element of a sequence is assigned a number - its position or index.
- ▶ The first index is zero, the second index is one, and so forth.

Tuples

- ▶ A tuple is a sequence of immutable Python objects.
- ▶ Tuples are sequences, just like lists.
- ▶ The differences between tuples and lists are :
 - the tuples cannot be changed unlike lists
 - tuples use parentheses, whereas lists use square brackets.

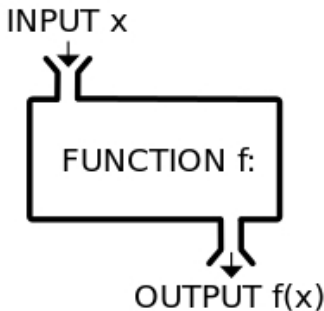
- ▶ Each key is separated from its value by a colon (:)
- ▶ the items are separated by commas
- ▶ and the whole thing is enclosed in curly braces.

- ▶ If-Then-Else
- ▶ For
- ▶ While
- ▶ Exceptions

FLOW  **CONTROL**

Functions

- ▶ Function blocks begin with the keyword `def`, followed by the function name and parentheses.
- ▶ Any input parameters or arguments should be placed within these parentheses.
- ▶ The first statement of a function can be an optional statement - the documentation string of the function or docstring.



Functions

```
def square(x):  
    return x * x
```

```
def hello():  
    return "Hello"
```

Classes

- ▶ The class statement creates a new class definition.
- ▶ The name of the class immediately follows the keyword `class` followed by a colon as follows



Classes

```
class Employee:
    """
    Common base class for all employees
    """
    empCount = 0

    def __init__(self, name, salary):
        self.name = name
        self.salary = salary
        Employee.empCount += 1

    def displayCount(self):
        print "Total Employee %d" % Employee.empCount

    def displayEmployee(self):
        print "Name : ", self.name, ", Salary: ", self.salary
```

```
emp1 = Employee("Zara", 2000)
```

Garbage Collection

- ▶ Python deletes unneeded objects automatically to free the memory space.



Inheritance

- ▶ Instead of starting from scratch, you can create a class by deriving it from a preexisting class by listing the parent class in parentheses after the new class name.



Inheritance

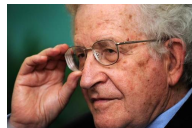
```
class SubClassName (ParentClass1[, ParentClass2, ...]):  
    """  
    Optional class documentation string  
    """  
    # class_suite
```

Big Data, the Noam Chomsky Way



Big data is a step forward. But, our problems are not lack of access to data, but understanding them. [Big data] is very useful if I want to find out something without going to the library, but I have to understand it, and that's the problem.

Big Data, the Noam Chomsky Way



Big data is a step forward. But, our problems are not lack of access to data, but understanding them. [Big data] is very useful if I want to find out something without going to the library, but I have to understand it, and that's the problem.

Hmmm, not very much Chomsky-ish ..., but wait!

Big Data, the Noam Chomsky Way



Big data is a step forward. But, our problems are not lack of access to data, but understanding them. [Big data] is very useful if I want to find out something without going to the library, but I have to understand it, and that's the problem.

Hmmm, not very much Chomsky-ish ..., but wait!

We can be confident that any system of power - whether it's the state, Google, or whatever - is going to use the best available technology to control, to dominate, and to maximize their power. And they'll want to do it in secret.

Now that's sounding more like Chomsky.

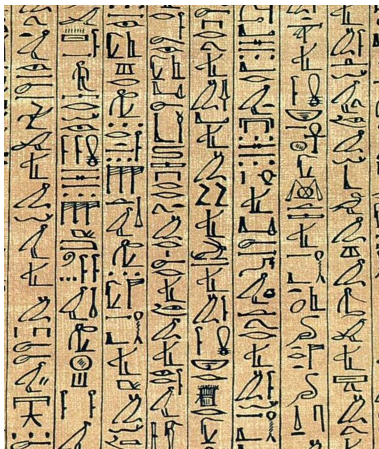
They Want to Do It In Secret ...

The truth cannot stay hidden forever!



A Brief History of Data Management!

- ▶ Manual recording
- ▶ From tablets to papyrus, to parchment, and then to paper

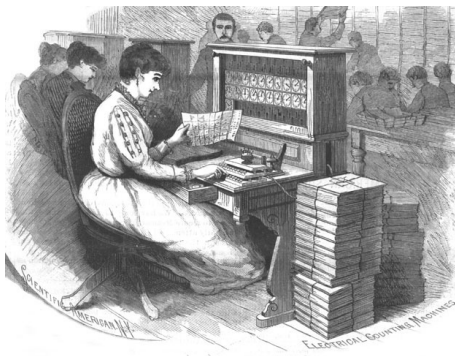


- ▶ Gutenberg's printing press



1800's - 1940's

- ▶ Punched cards (no fault-tolerance)
- ▶ Binary data
- ▶ 1890: US census
- ▶ 1911: IBM appeared



1940's - 1970's

- ▶ Magnetic tapes
- ▶ Batch transaction processing
- ▶ File-oriented record processing model (e.g., COBOL)
- ▶ Hierarchical DBMS (one-to-many)
- ▶ Network DBMS (many-to-many)



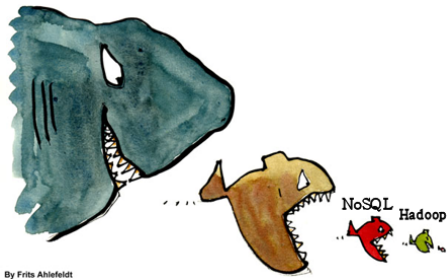
- ▶ Relational DBMS (tables) and SQL
- ▶ ACID
- ▶ Client-server computing
- ▶ Parallel processing



► The Internet...

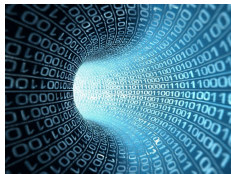


- ▶ NoSQL: BASE instead of ACID
- ▶ Big Data



Big Data

- ▶ In recent years we have witnessed a **dramatic increase** in available data.
- ▶ For example, the **number of web pages** indexed by Google, which were around **one million** in 1998, have exceeded **one trillion** in 2008, and its expansion is accelerated by appearance of the social networks.



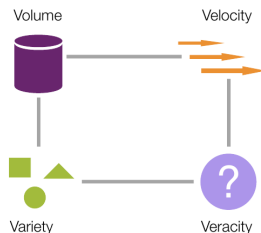
Big Data Definition

- **Big Data** refers to datasets and flows **large enough** that has outpaced our capability to **store, process, analyze, and understand**.



The Four Dimensions of Big Data

- ▶ **Volume**: data **size**
- ▶ **Velocity**: data **generation rate**
- ▶ **Variety**: data **heterogeneity**
- ▶ **Veracity**: **uncertainty** of accuracy and authenticity of data



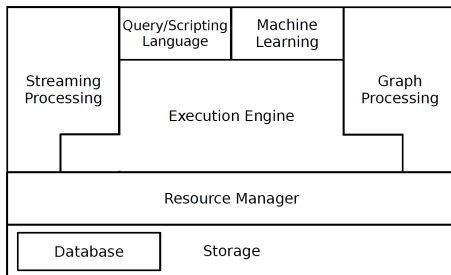
Big Data Market Driving Factors

- ▶ Mobile devices
- ▶ Internet of Things (IoT)
- ▶ Cloud computing
- ▶ Open source initiatives



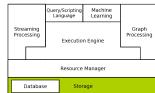
The Big Data Stack!

Big Data Analytics Stack



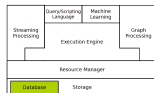
Big Data - Storage (Filesystem)

- ▶ Traditional filesystems are not well-designed for large-scale data processing systems.
- ▶ **Efficiency** has a higher priority than other features, e.g., directory service.
- ▶ Massive size of data tends to store it across **multiple machines** in a distributed way.
- ▶ HDFS, Amazon S3, ...



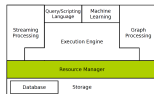
Big Data - Database

- ▶ Relational Databases Management Systems (RDMS) were **not** designed to be distributed.
- ▶ **NoSQL** databases **relax** one or more of the **ACID** properties: **BASE**
- ▶ Different data models: **key/value**, **column-family**, **graph**, **document**.
- ▶ Dynamo, Scalaris, BigTable, Hbase, Cassandra, MongoDB, Volde-mort, Riak, Neo4J, ...



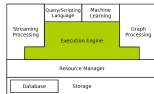
Big Data - Resource Management

- ▶ Different frameworks require different **computing resources**.
- ▶ Large organizations need the ability to **share data and resources** between multiple frameworks.
- ▶ **Resource management** share resources in a cluster between **multiple frameworks** while providing resource **isolation**.
- ▶ Mesos, YARN, Quincy, ...



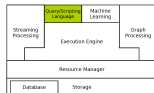
Big Data - Execution Engine

- ▶ **Scalable** and **fault tolerance** parallel data processing on clusters of unreliable machines.
- ▶ Data-parallel **programming model** for clusters of commodity machines.
- ▶ MapReduce, Spark, Stratosphere, Dryad, Hyracks, ...



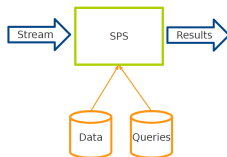
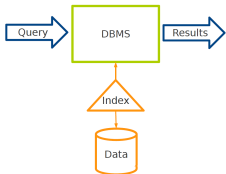
Big Data - Query/Scripting Language

- ▶ **Low-level** programming of execution engines, e.g., MapReduce, is **not** easy for end users.
- ▶ Need **high-level** language to improve the query capabilities of execution engines.
- ▶ It translates **user-defined** functions to **low-level** API of the execution engines.
- ▶ Pig, Hive, Shark, Meteor, DryadLINQ, SCOPE, ...

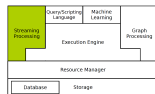


Big Data - Stream Processing

- ▶ Providing users with **fresh** and **low latency** results.
- ▶ Database Management Systems (**DBMS**) vs. Stream Processing Systems (**SPS**)

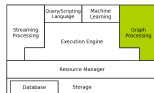


- ▶ Storm, S4, SEEP, D-Stream, Naiad, ...



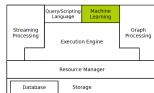
Big Data - Graph Processing

- ▶ Many problems are expressed using **graphs**: sparse **computational dependencies**, and **multiple iterations** to converge.
- ▶ Data-parallel frameworks, such as MapReduce, are not ideal for these problems: **slow**
- ▶ Graph processing frameworks are **optimized** for graph-based problems.
- ▶ Pregel, Giraph, GraphX, GraphLab, PowerGraph, GraphChi, ...

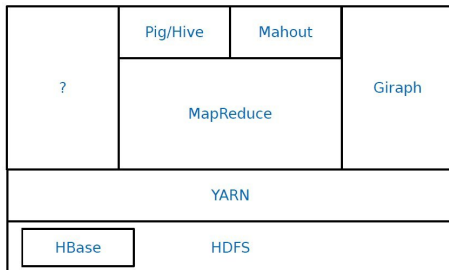


Big Data - Machine Learning

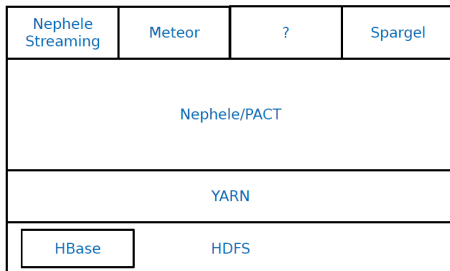
- ▶ Implementing and consuming machine learning techniques at scale are **difficult tasks** for developers and end users.
- ▶ There exist platforms that address it by providing scalable machine-learning and data mining libraries.
- ▶ Mahout, MLBase, SystemML, Ricardo, Presto, ...



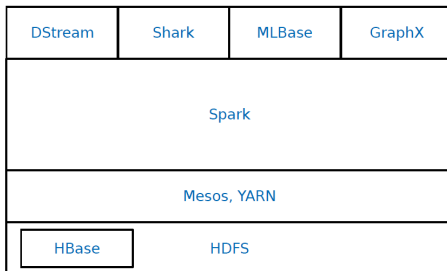
Hadoop Big Data Analytics Stack



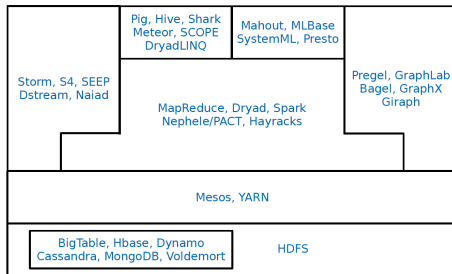
Stratosphere Big Data Analytics Stack



Spark Big Data Analytics Stack



Summary



Questions?