# Introduction to Python Programming

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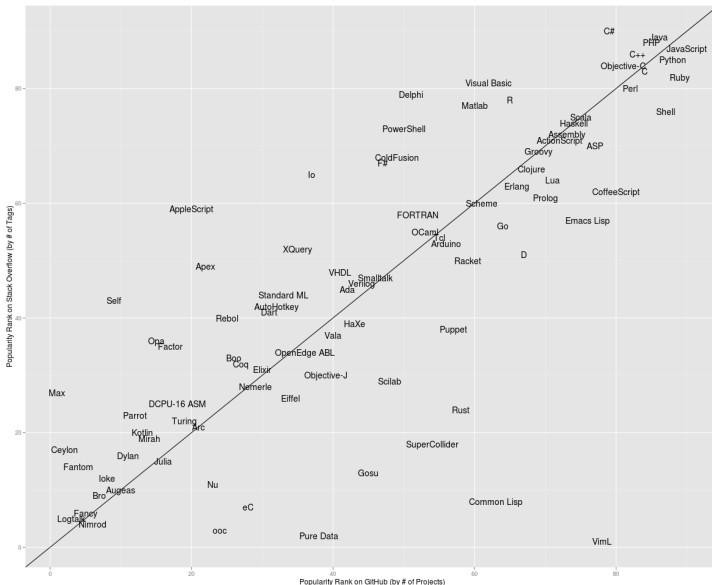
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EMBL

Let's digress for a moment discussing the language...

# Python Language History
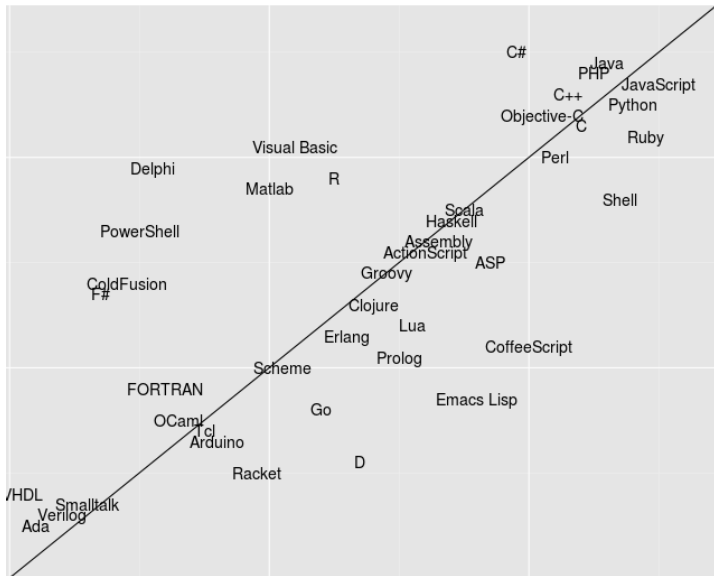
## History

- Python was started in the late 80's.
- It was intended to be both easy to teach and industrial strength.
- It is (has always been) open-source.
- In the last 10 years, it has become one of the most widely used languages (top 10).

# Python Versions

## Python Versions

- The current versions of Python are 2.7 and 3.4
- This class assumes you have 2.6–2.7
- There are some small differences when compared to version 3.x

# What is a Computer?

1. Memory
2. Processor
3. Magic

# Python Model

1. Objects
2. Operations on objects
3. Magic

# Python Example

```python
print "Hello World"
```

## Running Python

1. From a file
2. Interactively

# Computer Program

### helloword.py

```python
print 'Hello World'
```

Let me show you a demonstration...

# More Complex Example

What is 25 times 5?

# More Complex Example

What is 25 times 5?

```
print 25 * 5
```

# More Complex Example

```
a = 2
b = 3
c = a + b
d = 5
print a + d
```

# Blackboard demonstration

# Conditionals

```python
if <condition>:
    <statement 1>
    <statement 2>
else:
    <statement 3>
```

# Conditionals (Example)

```
print 'Before testing. . .'
if 3.3*9.2 > 30:
    print 'Greater than 30'
else:
    print 'Smaller or equal'
print 'After'
```

# Conditionals (Example)

```
print 'Before testing. . .'
if 3.3*9.2 > 31:
    print 'Greater than 31'
elif 3.3*9.2 > 30:
    print 'Greater than 30'
else:
    print 'Smaller or equal'
print 'After'
```

```
print 'Before testing...'
v = 3.3*9.2
if v > 31:
    print 'Greater than 31'
elif v > 30:
    print 'Greater than 30'
else:
    print 'Smaller or equal'
print 'After'
```

# Lists

```python
students = ['Luis','Mark','Rita']

print students[0]
print students[1]
print students[2]
```

# Loops

```
students = ['Luis', 'Mark', 'Rita', ...]

for st in students:
    print st
```

# Example

```
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]
```

## Example

```
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

sum = 0
for v in values:
    sum = sum + v
print sum
```

- How do you obtain the number of elements in a list?
- Use this to compute the mean of a list of numbers

# Example

```
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

sum = 0.0
sum2 = 0.0
for v in values:
    sum = sum + v
    sum2 = sum2 + v * v

mu = sum/len(values)
mu2 = sum2/len(values)
print 'Average: {0}'.format(mu)
print 'Std Dev: {0}'.format(mu2 - mu*mu)
```

# Example

```python
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

sum = 0.0
sum2 = 0.0
for v in values:
    sum += v
    sum2 += v * v

mu = sum/len(values)
mu2 = sum2/len(values)
print 'Average: {0}'.format(mu)
print 'Std Dev: {0}'.format(mu2 - mu*mu)
```

# Example

```
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

mu = 0.0
mu2 = 0.0
for v in values:
    mu += v
    mu2 += v * v

mu /= len(values)
mu2 /= len(values)
print 'Average: {0}'.format(mu)
print 'Std Dev: {0}'.format(mu2 - mu*mu)
```

# Example

```python
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

mu = 0.0
mu2 = 0.0
for v in values:
    mu += v
    mu2 += v * v

mu /= len(values)
mu2 /= len(values)
print 'Average: {0}'.format(mu)
print 'Std Dev: {0}'.format(mu2 - mu*mu)
```

Adapt the code to ignore negative numbers.

# Exercise

Adapt the code to ignore negative numbers.

```python
values = [0.11, -0.23, -0.16, 0.18, 0.23, 0.19]

mu = 0.0
mu2 = 0.0
n = 0.0
for v in values:
    if v >= 0.0:
        mu += v
        mu2 += v * v
        n += 1

mu /= n
mu2 /= n
print 'Average: {0}'.format(mu)
print 'Std Dev: {0}'.format(mu2 - mu*mu)
```

## Greatest Common Divisor (Euclid's Method)

$$\gcd(a, b) = \begin{cases} a & \text{if } b = a \\ \gcd(a - b, b) & \text{if } a > b \\ \gcd(a, b - a) & \text{o.w.} \end{cases}$$

# Loops (II)

### Greatest Common Divisor (Euclid's Method)

$$\gcd(a,b) = \begin{cases} a & \text{if } b = a \\ \gcd(a-b, b) & \text{if } a > b \\ \gcd(a, b-a) & \text{o.w.} \end{cases}$$

```python
a = 9344
b = 6497

while a != b:
    if a > b:
        a, b = a-b, b
    else:
        a, b = a, b-a
print a
```

# Python So Far

## Python

1. Basic types: int, float, list
2. Control flow: for, while, if, else, elif

# List Indexing

```
students = ['Luis','Rita','Sabah','Grace']
print students[0]
print students[1:2]
print students[1:]
print students[-1]
print students[-2]
```

# Tuples (I)

```
A = (0,1,2)
B = (1,)

print A[0]
print len(B)
```

Tuples are like immutable lists.

# Dictionaries

- Dictionaries are associative arrays.

```
gene2ensembl = {}
gene2ensembl['SMAD9'] = 'ENSG00000120693'
gene2ensembl['ZNF670'] = 'ENSG00000135747'

print gene2ensembl['SMAD9']
```

# Dictionary Methods

```python
gene2expression = {
    'SMAD9' : 12.3,
    'ZNF670' : 4.3,
}

print len(gene2expression)
print gene2ensembl.keys()
```