GENERAL ASSEMBLY

INTRODUCTION TO PYTHON PROGRAMMING


LET'S MEET
GA

ABOUT YOUR PRODUCER!

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Classes & Workshops Lead

ABOUT YOUR INSTRUCTOR!

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DATA SCIENTIST
AT KNEWTON

MUSIC COMPOSER
STRATEGY CONSULTANT
ECONOMIC RESEARCHER
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ABOUT YOU!

Who
are you

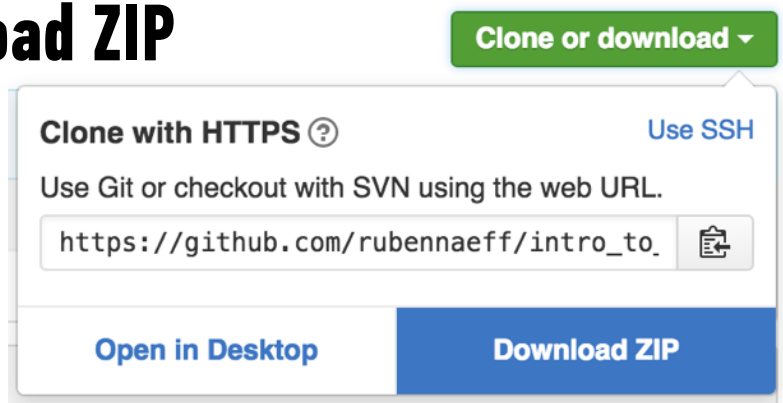
What
do you do

Why
are you here

LET'S GET SET UP

DOWNLOAD REPO TO MACHINE

- Go to **github.com/rubennaeff/intro_to_python**
- Click **Clone or download | Download ZIP**



OR

- git clone https://github.com/rubennaeff/intro_to_python

EVERYONE ALL SET WITH THE INSTALLATION?

```
python
>>> _
```

0. MEET, SETUP, TROUBLESHOOT – DONE!
I. WHY PYTHON?
II. PYTHON SYNTAX
III. WRITING A SCRIPT
IV. LIBRARIES
V. EXAMPLES

- PLAYING AROUND IN THE PYTHON SHELL
- WRITING, SAVING AND IMPORTING PYTHON SCRIPTS
- PLUGGING INTO THE WEALTH OF PYTHON LIBRARIES
- CREATING IPYTHON NOTEBOOKS
- DEVELOPING AN INTERACTIVE WEBSITE IN FLASK

THIS IS TOO MUCH FOR 3 HOURS, BUT ALL CODE IS INCLUDED.

- LEARN HOW TO GET SET UP, INSTALL PYTHON AND LIBRARIES
- FIND OUT HOW TO WRITE YOUR FIRST PYTHON SCRIPT
- FIGURE OUT WHAT TOOLS TO USE FOR YOUR PYTHON PROJECTS

- AS AN ABSOLUTE BEGINNER, GET UP TO SPEED
- EXPLAIN SUPERFICIALLY WHY PYTHON IS DIFFERENT
- BE COMFORTABLE WITH THE PYTHON SHELL
- BE ABLE TO WRITE, SAVE, AND RUN SCRIPTS
- BE ABLE TO INSTALL AND IMPORT PACKAGES
- KNOW WHERE TO LOOK FOR FURTHER STUDY

PYTHON

- Created by Guido van Rossum in 1991
- Benevolent Dictator for Life

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  - but most still use 2.7+

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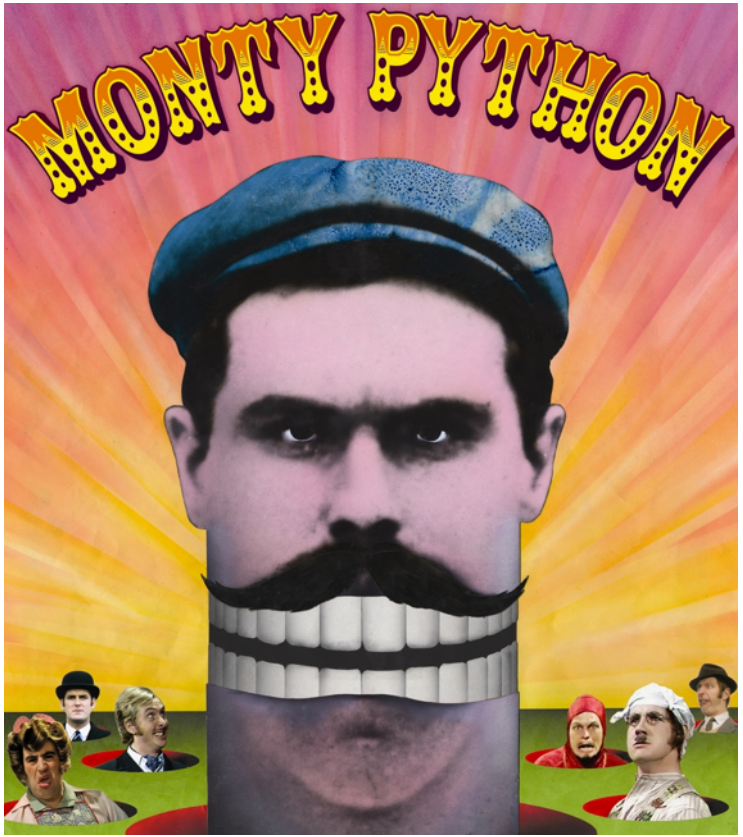
- Named after Monty Python
  - Still many references to TV show



WHY PYTHON?

PYTHON IS FREE

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- Open source

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- Open source
- Batteries included: lots of built-in functionality
- Many (free or open-source) third-party libraries

PYTHON IS EASY

Java

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

PYTHON IS EASY

Python

```
print "Hello, world!"
```

PYTHON IS EASY: INSTALLING PACKAGES

On command line, type

```
> pip install flask
```

In python, write

```
>>> import flask
```

PYTHON IS DYNAMIC

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PYTHON IS DYNAMIC

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- Dynamic typing

Usually, you need to define the type of your variable:

– is it text?

– is it an integer?

– is it a decimal?

```
double pi = 3.14;
```

PYTHON IS DYNAMIC

- No compiling
- Dynamic typing

In python, your types a *dynamic*.

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

WHAT ARE THE ADVANTAGES TO PYTHON?

- Easy to learn, easy to use
- Batteries Included: large collection of built-in libraries
- Simple and clean syntax

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- Easy to learn, easy to use
- Batteries Included: large collection of built-in libraries
- Simple and clean syntax – very strict indent rules

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```
if year == “2016”:
    print “Election year!” + 2016
```

TypeError will only raise if the condition is true.

Python sounds amazing! What is it bad at?

- Python is slower than a lower-level language
  (but keep in mind that this is a conscious tradeoff)
- No compilation means discovery of errors at runtime
- Dynamic typing allows for bad practice

PYTHON SYNTAX

DATA TYPES

```
x = 36  # this is an integer
x = 3.14  # a decimal number
x = True  # either True or False
x = "This is a string"
```

DATA TYPES

```
x = [1, 2, 3, 4]  # a list

# lists can contain elements of any type
x = [36, 3.14, True, "This is a string"]
x = [36, 3.14, True, "This is a string", [1, 2, 3, 4]]

# elements are numbered, starting with 0 (!)
print x[0]  # will print first element
```

DATA TYPES

```
# dictionaries (maps)
x = {'name': 'Joe', 'age': 75}  # this is a dictionary
x = dict(name='Joe', age=75)  # same as above (old syntax)

print x['name']  # will print 'Joe'
```

IF/ELSE STATEMENTS

- Allow us to take different paths through depending on some condition

```
x = 5
if x > 4:
    print "This number is greater than 4"
```

IF/ELSE STATEMENTS

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```
x = 5
if x > 4:
    print "This number is greater than 4"
else:
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```

IF/ELSE STATEMENTS

- Allow us to take different paths through depending on some condition

```
x = 5
if x > 4:
    print "This number is greater than 4"
elif x == 4:
    print "This number is equal to 4"
else:
    print "This number is smaller than 4"
```

LOOPING – FOR

- Allows us to perform the same operation on each element, one by one

```
emotions = ["happy", "sad", "¯\_(ツ)_/¯"]
for state in emotions:
    print "I feel", state
    if state == "happy":
        print "Happy is good, hooray!"
```

LOOPING – FOR

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emotions = ["happy", "sad", "¯\_(ツ)_/¯"]
for state in emotions:
    print "I feel", state
    if state == "happy":
        print "Happy is good, hooray!"
```

```
I feel happy
Happy is good, hooray!
I feel sad
I feel ¯\_(ツ)_/¯
```

LOOPING – WHILE

- Allows us to perform the same operation on each element, one by one

```
emotions = ["happy", "sad", "¯\_(ツ)_/¯"]
while len(emotions) > 0:
    state = emotions.pop()
    print "I feel", state
    if state == "happy":
        print "Happy is good, hooray!"
```

FUNCTIONS

- Allow us to save some piece of code to reuse later

```
def avg(lst):
    """Compute the average of a list."""
    return sum(lst) / float(len(lst))
```

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```
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    return sum(lst) / float(len(lst))
```

```
>>> avg([1, 2, 3])
2.0
>>>
```

EXCEPTIONS

- If code doesn't compute, an *Exception* is raised, and the script crashes

```
def avg(lst):
    """Compute the average of a list."""
    return sum(lst) / float(len(lst))
```

```
>>> avg([])
Traceback (most recent call last):
  File "<stdin>", line 3, in avg
ZeroDivisionError: float division by zero
```

EXCEPTIONS – TRY / EXCEPT

- With try/except, you can catch exceptions and save the day

```
def avg(lst):
    """Compute the average of a list."""
    try:
        return sum(lst) / float(len(lst))
    except ZeroDivisionError:
        return None
```

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```

```
>>> avg([])
>>>
```

EXCEPTIONS – TRY / EXCEPT

- With try/except, you can catch exceptions and save the day

```
def avg(lst):
    """Compute the average of a list."""
    try:
        return sum(lst) / float(len(lst))
    except ZeroDivisionError:
        return None
```

```
>>> avg(3)
TypeError: 'int' object is not iterable
```

OPERATIONS

- Python shell is just a complex calculator:

```
>>> 3 + 4
7
>>> 1 / 2
0
>>> 1 / 2.
0.5
>>> 3 ** 2
9
```

OPERATIONS

- Python shell is just a complex calculator:

```
>>> ['A', 'B'] + ['A', 'C']
['A', 'B', 'A', 'C']
>>> ['A'] * 5
['A', 'A', 'A', 'A', 'A']
>>> 'A' * 5
'AAAAA'
>>> list('ABCDEF')
['A', 'B', 'C', 'D', 'E', 'F']
```

- Let's practice!

WRITING A SCRIPT

So far, we have coded directly in the interpreter.

You can imagine that for larger-scale projects, you'd like to save your work in a file, or even build a big application containing multiple files and packages.

```
print "Hello, world!"
```

To run, type:

python hello.py

```
print "Hello, world!"
```

```python
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

```
#!/usr/bin/env python
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def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

The # indicated a comment, which will be ignored by python.

```
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

The # indicated a comment, which will be ignored by python.

In this case, however, it *is* actually some code to tell how to run this program independently.

To run, type:

./hello_world.py

```
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

On top of your file, it is good practice to include a doc string, which is a paragraph of text between triple double-quotes “”“[text]”“”, explaining the program to developers and users.

```
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

On top of your file, it is good practice to include a doc string, which is a paragraph of text between triple double-quotes “”“[text]”“”, explaining the program to developers and users.

Each function is supposed to have a doc string, too.

```
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def main():
    """Print 'Hello, world!'."""
    print "Hello, world!"


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

Python has a number of system variables, which contain information about the current application.

If the file is run as main program,

__name__ = “main”,

but if the file was imported in another program, then we’d have

__name__ = “hello_world”.

```python
#!/usr/bin/env python
"""
Simple program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""


def hello():
    """Print 'Hello, world!'."""
    print "Hello, world!"


def bye():
    """Print 'Bye, world!'."""
    print "Bye, world!"


def main():
    """Say hello and bye."""
    hello()
    bye()


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

```python
#!/usr/bin/env python
"""
Unnecessarily complicated program that prints 'Hello, world!'.

Ruben Naeff
May 2016
"""
from random import random

from meet_world import hello, bye


def main():
    """Randomly says hello or bye."""
    if random() > .5:
        hello()
    else:
        bye()


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

- Let's practice!

LIBRARIES

On command line, type

```
> pip install numpy
```

On command line, type

```
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```

You can view your installed packages with

```
> pip freeze
```

On command line, type

```
> pip install numpy
```

You can view your installed packages with

```
> pip freeze | grep numpy
```

On command line, type

```
> pip install numpy
```

On command line, type

```
> pip install numpy
```

In python, write

```
>>> import numpy
```

On command line, type

```
> pip install numpy
```

In python, write

```
>>> import numpy as np
```

On command line, type

```
> pip install numpy
```

In python, write

```
>>> import numpy as np
>>> np.random.random(3)
```

On command line, type

```
> pip install numpy
```

In python, write

```
>>> import numpy as np
>>> np.random.random(3)
array([ 0.30807441,  0.58508608,  0.78048742])
```

On command line, type

```
> pip install numpy
```

In python, write

```
>>> from numpy import random
>>> random.random(3)
array([ 0.30807441,  0.58508608,  0.78048742])
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On command line, type

```
> pip install numpy
```

In python, write

```
>>> from numpy.random import random
>>> random(3)
array([ 0.30807441,  0.58508608,  0.78048742])
```

Subject	Package
Web development	flask, django, mezzanine, Jinja2
Math & Science	numpy, scipy
Data Analysis	pandas, statsmodels
Machine Learning	scikit-learn
Web scraping	beautifulsoup
Data visualizations	matplotlib, seaborn, vincent

IPYTHON AND JUPYTER NOTEBOOK

IPython is an advanced shell that makes programming in python much easier.

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```
In [6]: max?
Docstring:
max(iterable[, key=func]) -> value
max(a, b, c, ...[, key=func]) -> value

With a single iterable argument, return its largest item.
With two or more arguments, return the largest argument.
Type:      builtin_function_or_method
```

IPython is an advanced shell that makes programming in python much easier.

```
>>>
>>> print max.__doc__
max(iterable[, key=func]) -> value
max(a, b, c, ...[, key=func]) -> value

With a single iterable argument, return its largest item.
With two or more arguments, return the largest argument.
>>> _
```

IPython is an advanced shell that makes programming in python much easier.

Tab completion

```
In [8]: ma
%macro      %magic      %man        %matplotlib  map         max
```

IPython is an advanced shell that makes programming in python much easier.

Cell magic

```
In [3]: %time 1 + 1
CPU times: user 4 µs, sys: 0 ns, total: 4 µs
Wall time: 9.06 µs
Out[3]: 2
```

IPython is an advanced shell that makes programming in python much easier.

Cell magic

```
In [2]: %timeit 1.23 ** 1.23
10000000 loops, best of 3: 25 ns per loop
```

IPython is an advanced shell that makes programming in python much easier.

But it even gets better...

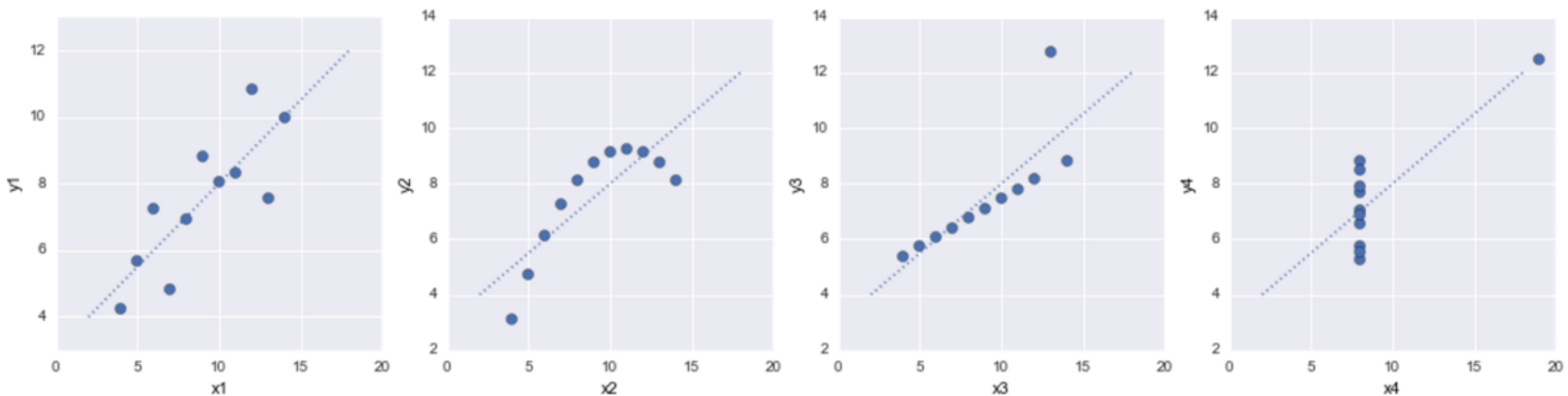
Jupyter notebook, formerly known as **IPython notebook**, lets you write python in a web browser.

- Copy and paste code like in a text editor
- Integrate graphs in the same document
- Rich markup and HTML support for beautiful layout

Basic visualizations

Plot each dataset.

In [4]:
```
fig, axes = plt.subplots(nrows=1, ncols=4, figsize=(18,4))
for i in xrange(1, 5):
    x, y = "x" + str(i), "y" + str(i)
    data.plot(kind='scatter', x=x, y=y, ax=axes[i-1], s=50)
    slope, intercept = trendlines[i - 1]
    axes[i - 1].plot([2, 18], [intercept + 2 * slope, intercept + 18 * slope], ':')
```



To install, just type on the command line

```
pip install jupyter
pip install seaborn   # this is another visual package
```

To launch, just type

```
jupyter notebook
```

- Let’s do it!

FLASK

THANK YOU.