

INTRODUCTION TO PYTHON PROGRAMMING

LET'S MEET



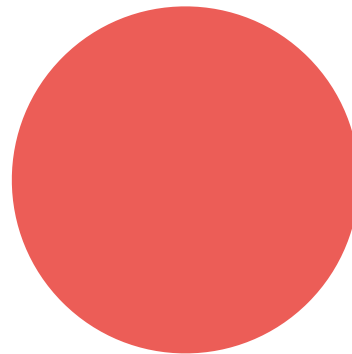
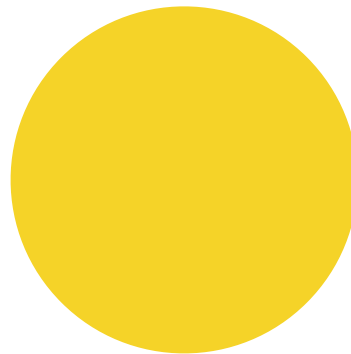
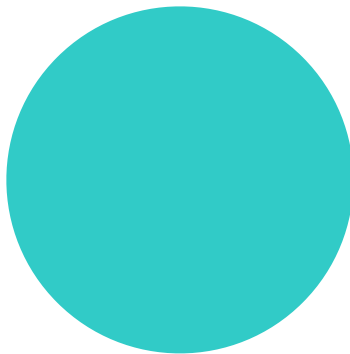
ABOUT YOUR PRODUCER!



Chris Wright

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Classes & Workshops Lead



ABOUT YOUR INSTRUCTOR!



Ruben Naeff

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Data Science Instructor

**DATA SCIENTIST
AT KNEWTON**

**MUSIC COMPOSER
STRATEGY CONSULTANT
ECONOMIC RESEARCHER
MATH TEACHER**

**AMSTERDAM, NL
BROOKLYN, NY**

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**

Clone or download ▾

Clone with HTTPS ?

Use SSH

Use Git or checkout with SVN using the web URL.

`https://github.com/rubennaeff/intro_to_`



Open in Desktop

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. IPYTHON & JUPYTER NOTEBOOKS

- **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 COMFORTABLE WITH JUPYTER / IPYTHON NOTEBOOKS**
- **BE ABLE TO WRITE, SAVE, AND RUN SCRIPTS**
- **BE ABLE TO INSTALL AND IMPORT PACKAGES**
- **KNOW WHERE TO LOOK FOR FURTHER STUDY**

PYTHON

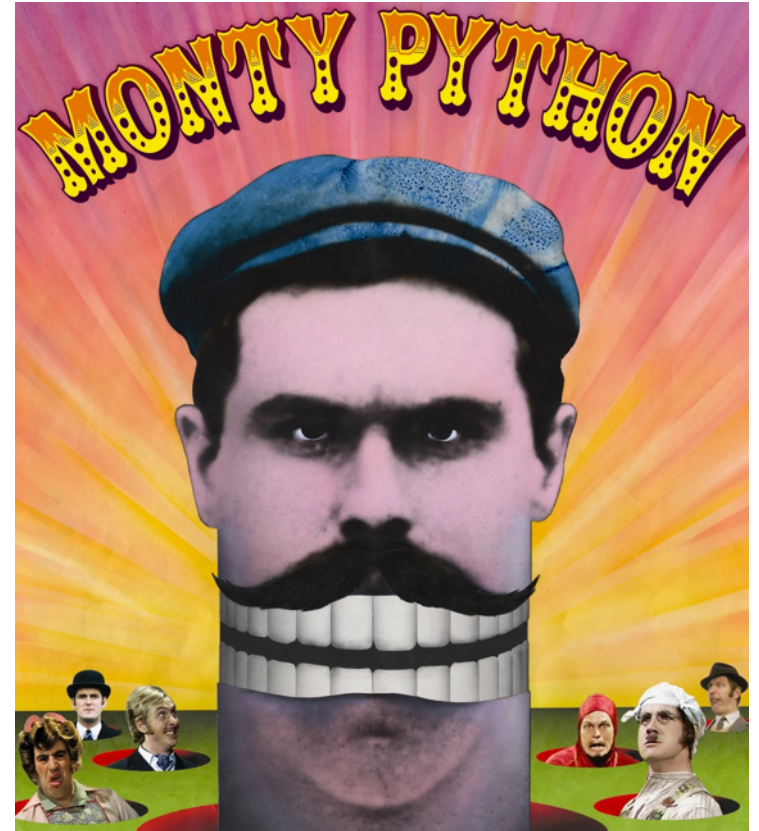
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 - but most still use 2.7+



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- Currently on version 3 ...
 - but most still use 2.7+
- 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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- ▶ Batteries included: lots of built-in functionality

PYTHON IS FREE

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

PYTHON IS EASY

Java

```
public static void main( String args []) {  
    System.out.println("Hello world");  
}
```


PYTHON IS EASY

Python

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

PYTHON IS EASY: INSTALLING PACKAGES

On command line, type

```
> pip install numpy
```

In python, write

```
>>> import numpy
```

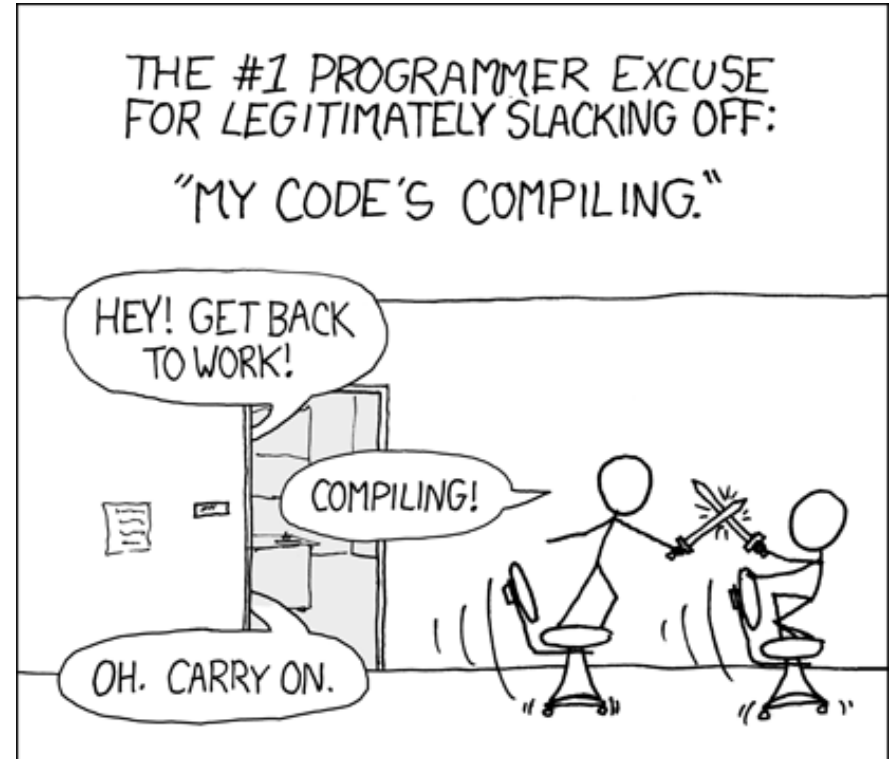
PYTHON IS DYNAMIC

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PYTHON IS DYNAMIC

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- ▶ Dynamic typing

PYTHON IS DYNAMIC

- ▶ No compiling
- ▶ 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, you type 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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- Python is slower than a lower-level language
(but keep in mind that this is a conscious tradeoff)

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```
if year == "2016":  
    print This is an election year!"
```

Missing quotation mark will only be noticed when the print command will be executed

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:
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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

- 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!"
```

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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```
def avg(lst):  
    """Compute the average of a list."""  
    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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    except ZeroDivisionError:  
        return None
```

```
>>> 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!"
```




```
#!/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
"""
```

```
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.

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

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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.

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".

```
#!/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()
```

```
#!/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

> pip install numpy

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

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In python, write

```
>>> import numpy
```

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In python, write

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


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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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```

In python, write

```
>>> from numpy.random import random
```

```
>>> random(3)
```

```
array([ 0.30807441, 0.58508608, 0.78048742])
```

Subject

Web development

Math & Science

Data Analysis

Machine Learning

Web scraping

Data visualizations

Package

flask, django, mezzanine, Jinja2

numpy, scipy

pandas, statsmodels

scikit-learn

beautifulsoup

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...

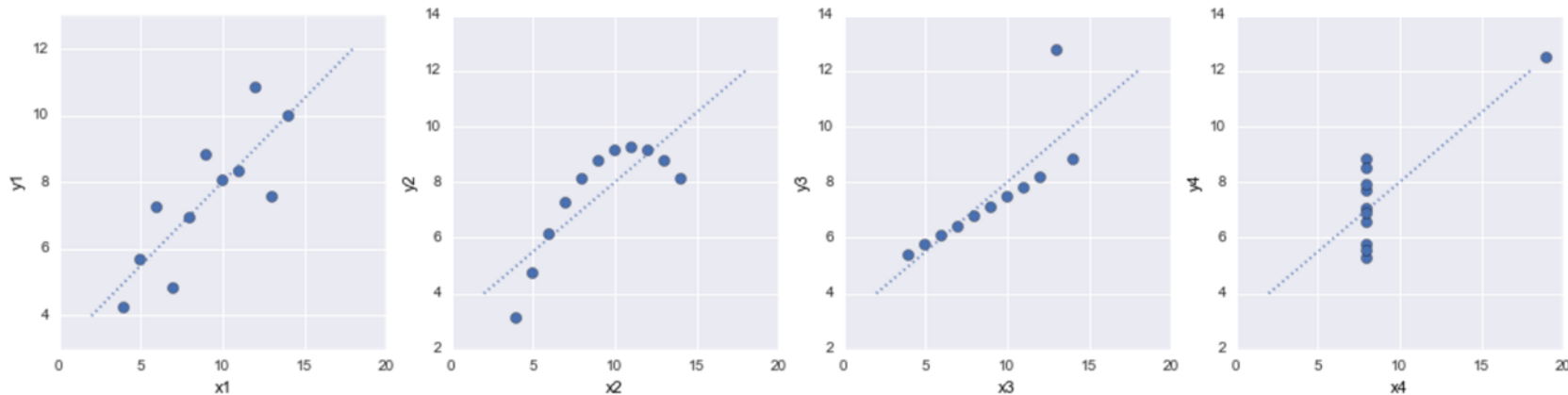
Jupyter notebook, formerly known as **IPython notebook**, lets you write python in a web browser.

- ▶ 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.