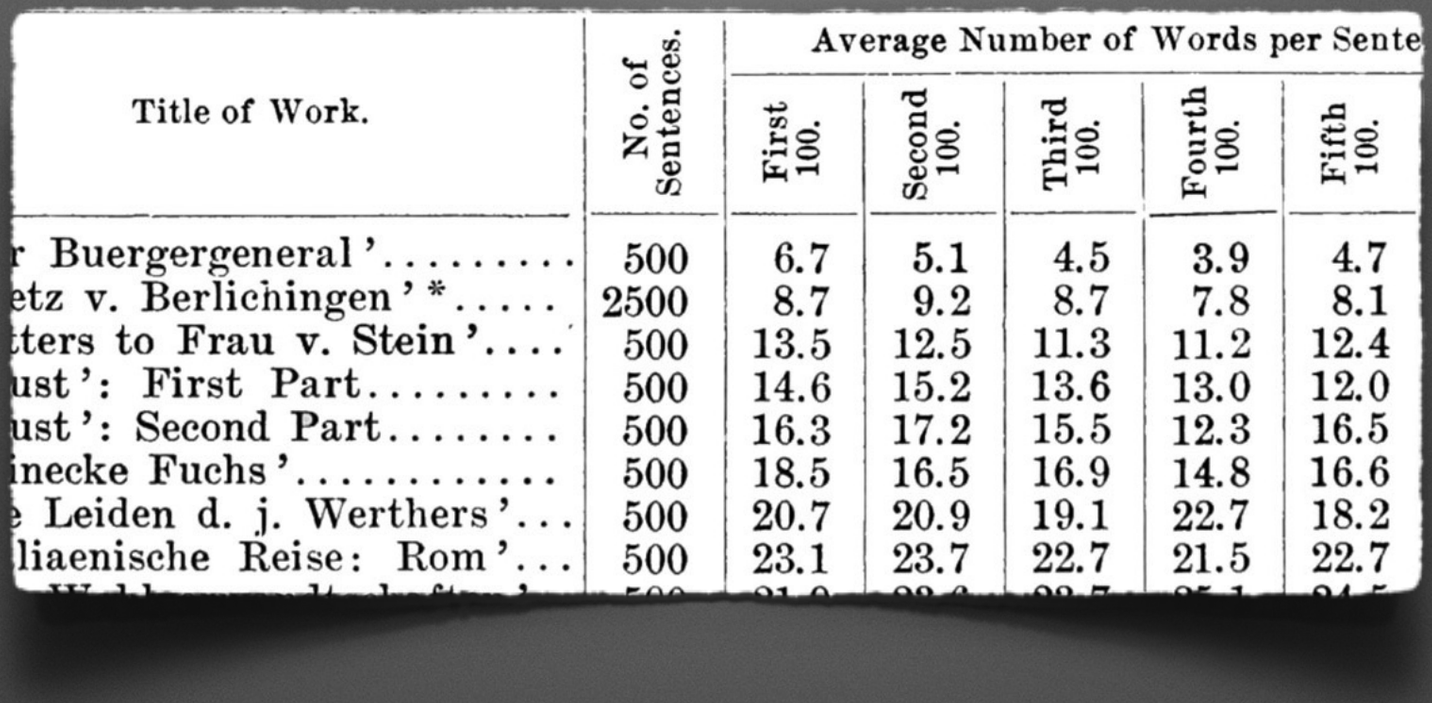

Title of Work.	No. of Sentences.	Average Number of Words per Sente				
		First 100.	Second 100.	Third 100.	Fourth 100.	Fifth 100.
r Buergergeneral'.....	500	6.7	5.1	4.5	3.9	4.7
etz v. Berlichingen'*.....	2500	8.7	9.2	8.7	7.8	8.1
tters to Frau v. Stein'....	500	13.5	12.5	11.3	11.2	12.4
ust': First Part.....	500	14.6	15.2	13.6	13.0	12.0
ust': Second Part.....	500	16.3	17.2	15.5	12.3	16.5
inecke Fuchs'.....	500	18.5	16.5	16.9	14.8	16.6
e Leiden d. j. Werthers'...	500	20.7	20.9	19.1	22.7	18.2
liaenische Reise: Rom'...	500	23.1	23.7	22.7	21.5	22.7

Introduction to Data Analysis with Python

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Introduction to Data Analysis with Python

Syllabus

Data Science Steps & Python Data Science Stack

Data Science Plumbing & Agile Data Science

Why Python?

What is IPython/Jupyter?

Data Science Steps

What do I want?
Does it have sense?

Question

What are my data sources? How reliable are they?

Acquire

How do I develop an understanding of the content of my data?

Describe

What are the key relationships in my data?

Discover

How do I develop an understanding of the content of my data?

Analyze

What are the likely future outcomes?

Predict

Are my expectations fulfilled?

Evaluate

Acquire: How do I get my data?
- Web Scraping.
- Data Base queries.
- Access to bulk data stores.

Processing: How I do clean and separate my data?
- Identification: filter data.
- Outliers.
- Imputation: missing value processing.
- Reduction: dimensionality reduction.
- Normalization: duplicates, ranges, format, coordinates, units, etc.
- Feature extraction.

Aggregation: How do I collect and summarize my data?
- Basic Statistics: mean, std, box plots, scatter plots, counts, etc.
- Distribution fitting.
- Feature aggregation.

Enrichment: How do I add more information to my data?
- Feature engineering.
- Search for additional data sources.

Discover: What are the key relationships in my data?
- Clustering (How do I segment the data to find natural groupings?)
- Visualization (Are there unexpected relationships?)

Analyze: How do I model my data?
- Variable selection (How do I determine important variables?)
- Probabilistic modeling (How are my variables related?)

Predict: What are the likely future outcomes?
- Regression (How do I predict the future?)
- Classification (How do I predict a category?)
- Recommendation (How do I predict relevant conditions?)

Evaluate: Are the outcomes generic and robust?
- Statistical Testing.
- Model performance.

Python Data Stack

Scrapy
PyDB
PyMongo
Numpy
Pandas
SciPy
SciKit Learn
MatplotLib
SymPy
IPython
Cython
Bokeh
Blaze
PySpark
StatsModels
Shogun
PyMC
seaborn
PyTables
cvskit
sqlite3
plotly
NetworkX
nltk
gensim
twython

Data Science Plumbing

Agile Development & Model Deployment

Logs from servers, sensors, transactions, etc. Events must be **serialized** in a common format.

Events

Events are collected from different sources and **aggregated** to bulk storage.

Collector

This is a **filesystem** capable of parallel access by concurrent processes.

Bulk Storage

Data processing with scripting languages with **out-of-core** processing capabilities.

Batch Processing

These are multinode stores to **publish data** for consumption by web apps.

Distributed Store

Web application server.

Application Server

Presentation of the data as an **interactive experience** + **story telling**.

Browser

Why Python?

- Python is a modern, open source, **object-oriented programming** language, created by a Dutch programmer, Guido van Rossum, in 1991.
- Officially, it is an **interpreted scripting language**. There are several implementations, being the most used the one implemented in C.
- It offers the power and flexibility of lower level (i.e. compiled) languages, without the steep learning curve, and without most of the associated debugging pitfalls.
- The language is very **clean and readable**, and it is available for almost every modern computing platform.
- It is widely used: Google, DropBox, Deutsche Borse, NASA, etc.

Why Python?

In Data Science, **programming is mostly about discovering solutions by writing code and using a language to express them**.

Python offers a number of advantages to data scientists:

- Powerful and easy to use.
- Anything that can be coded in C, FORTRAN, or Java can be done in Python, almost always in fewer lines of code, and with fewer debugging headaches.
- Its standard library is extremely rich, including modules for string manipulation, regular expressions, file compression, mathematics, scientific programming, profiling and debugging.
- Unnecessary language constructs, such as END statements and brackets are absent, making the code efficient and easy to read.
- Python is object-oriented, which allows data structures to be abstracted in a natural way.

Why Python?

- It is interactive
  - Python may be run interactively on the command line. Commands may entered serially followed by the Return key.
  - This is useful for exploratory programming.
- It is extensible
  - Python is often referred to as a “glue” language, meaning that it is a useful in a mixed-language environment. C or FORTRAN code can be compiled directly into Python programs.
  - Sometimes, it can be slow relative to compiled languages. In many cases this performance deficit is due to a short loop of code that runs thousands or millions of times. Such bottlenecks may be easily removed by coding a function in C or Cython that can be compiled into a Python module.

Why Python?

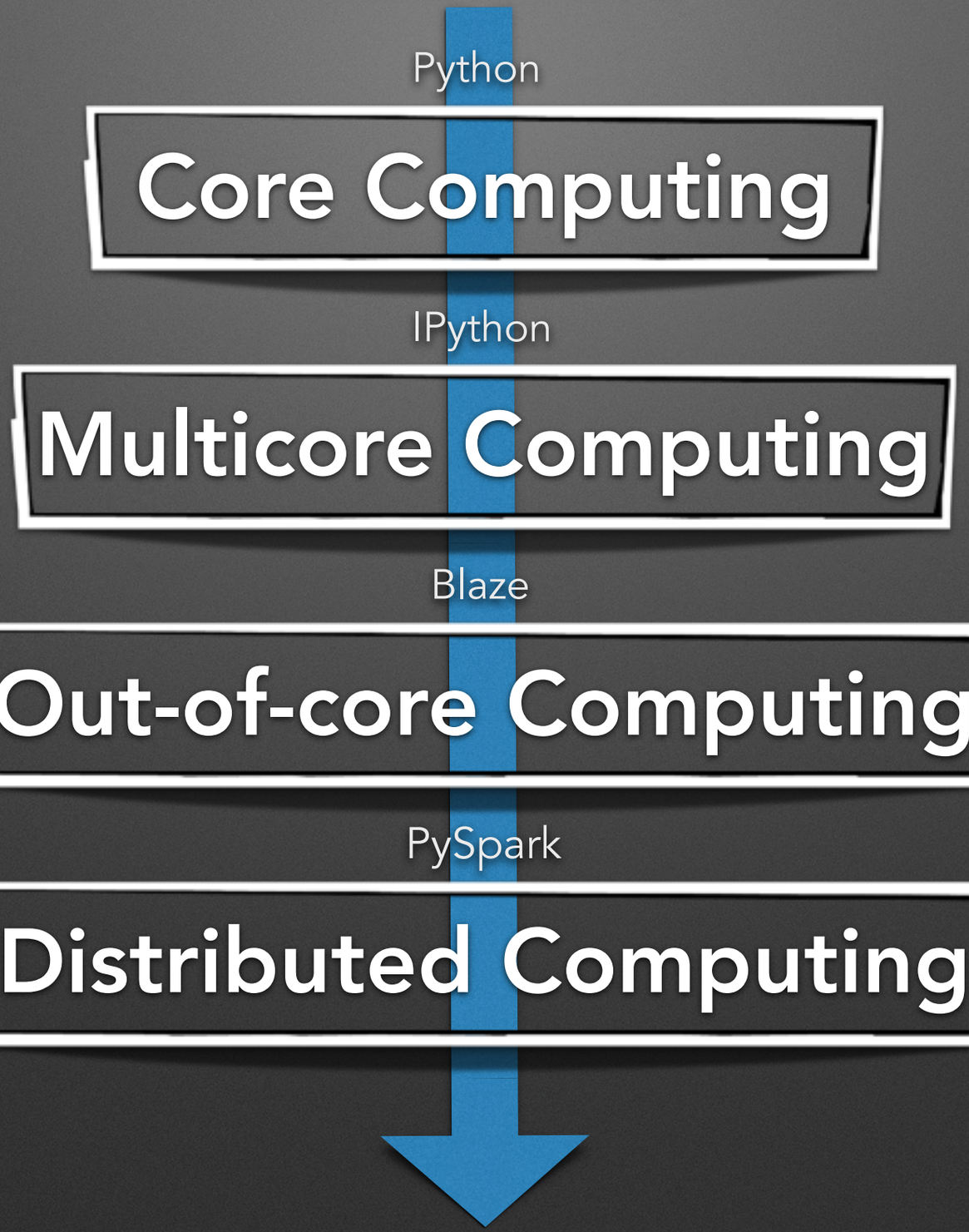
- There is a vast body of Python third party modules:
  - **NumPy**: Numerical Python (NumPy) is a set of extensions that provides the ability to specify and manipulate array data structures.
  - **SciPy**: An open source library of scientific tools for Python, SciPy supplements the NumPy module. SciPy includes modules for graphics and plotting, optimization, integration, special functions, signal and image processing, genetic algorithms, ODE solvers, and others.
  - **Matplotlib**: Matplotlib is a python 2D plotting library which produces publication-quality figures.
  - **pandas**: A module that provides high-performance, easy-to-use data structures and data analysis tools. In particular, the DataFrame class is useful for spreadsheet-like representation and mannipulation of data.
  - **IPython**: An enhanced Python shell, designed to increase the efficiency and usability of coding, testing and debugging Python.

Why Python?

- Strong points:
  - Viable alternative to SAS/Matlab/R/…
  - Uptake in the financial sector.
  - Upcoming generation of programmers with Python as a first language.
  - Python communities in HPC/Scientific Computing.

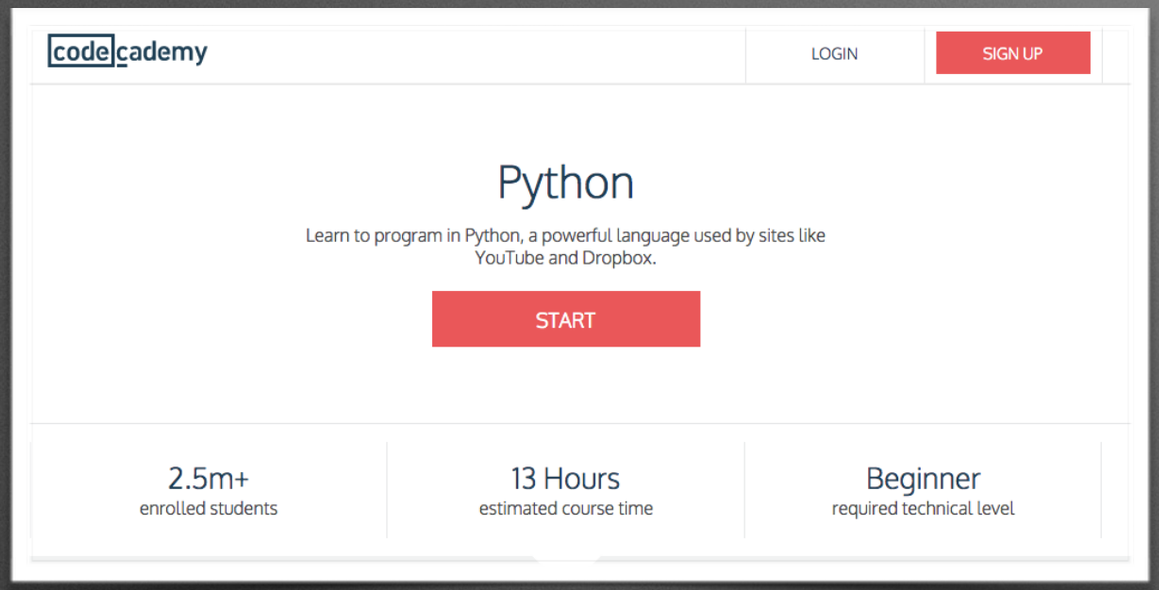
- Weak points
  - No (public) great success story.
  - Weak support.

Why Python?

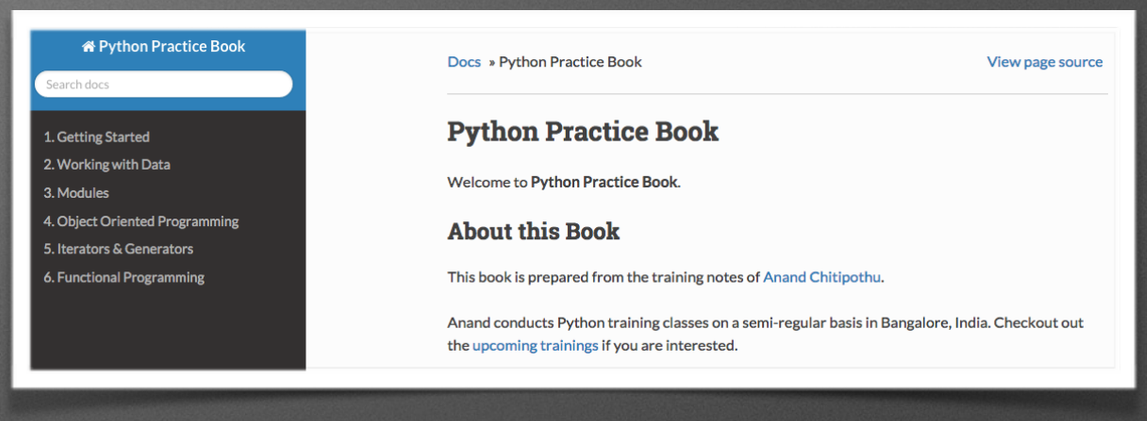

Python
Core Computing
IPython
Multicore Computing
Blaze
Out-of-core Computing
PySpark
Distributed Computing

More on Python

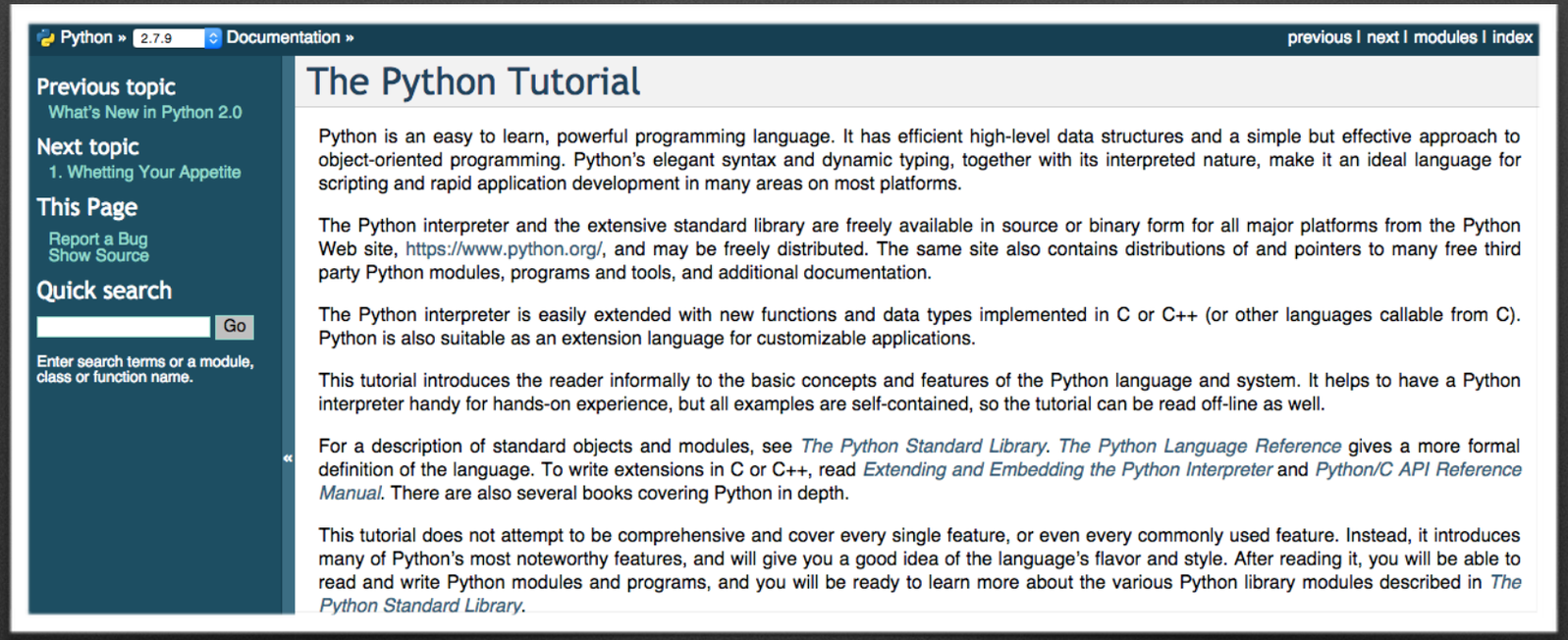
www.codecademy.com



http://anandology.com/python-practice-book/



www.python.org



What is Jupyter?

In this class, we will use **Jupyter notebooks** for teaching and programming assignments.

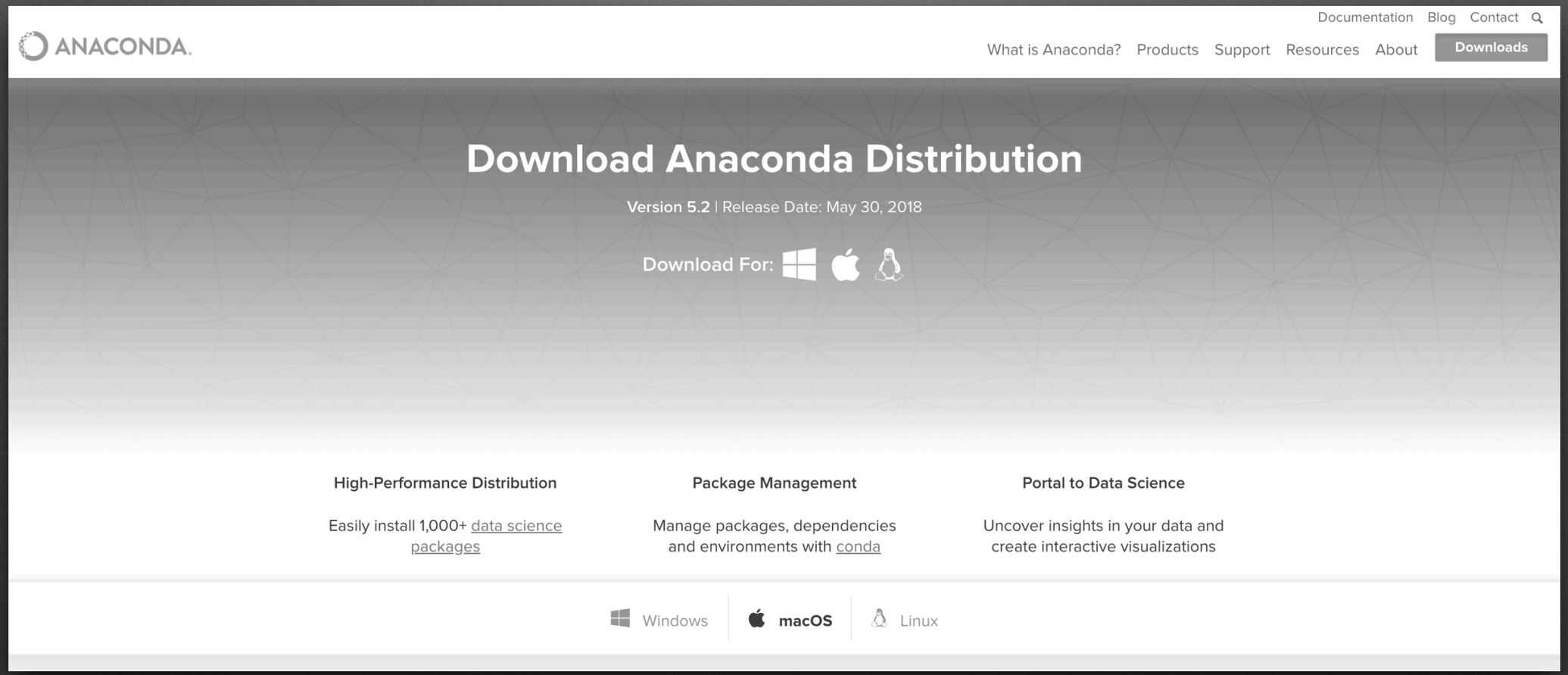
A Jupyter notebook lets you write and execute Python code in your web browser.

Jupyter notebooks make it very easy to tinker with code and execute it in bits and pieces; for this reason Jupyter notebooks are widely used in scientific computing.

Anaconda

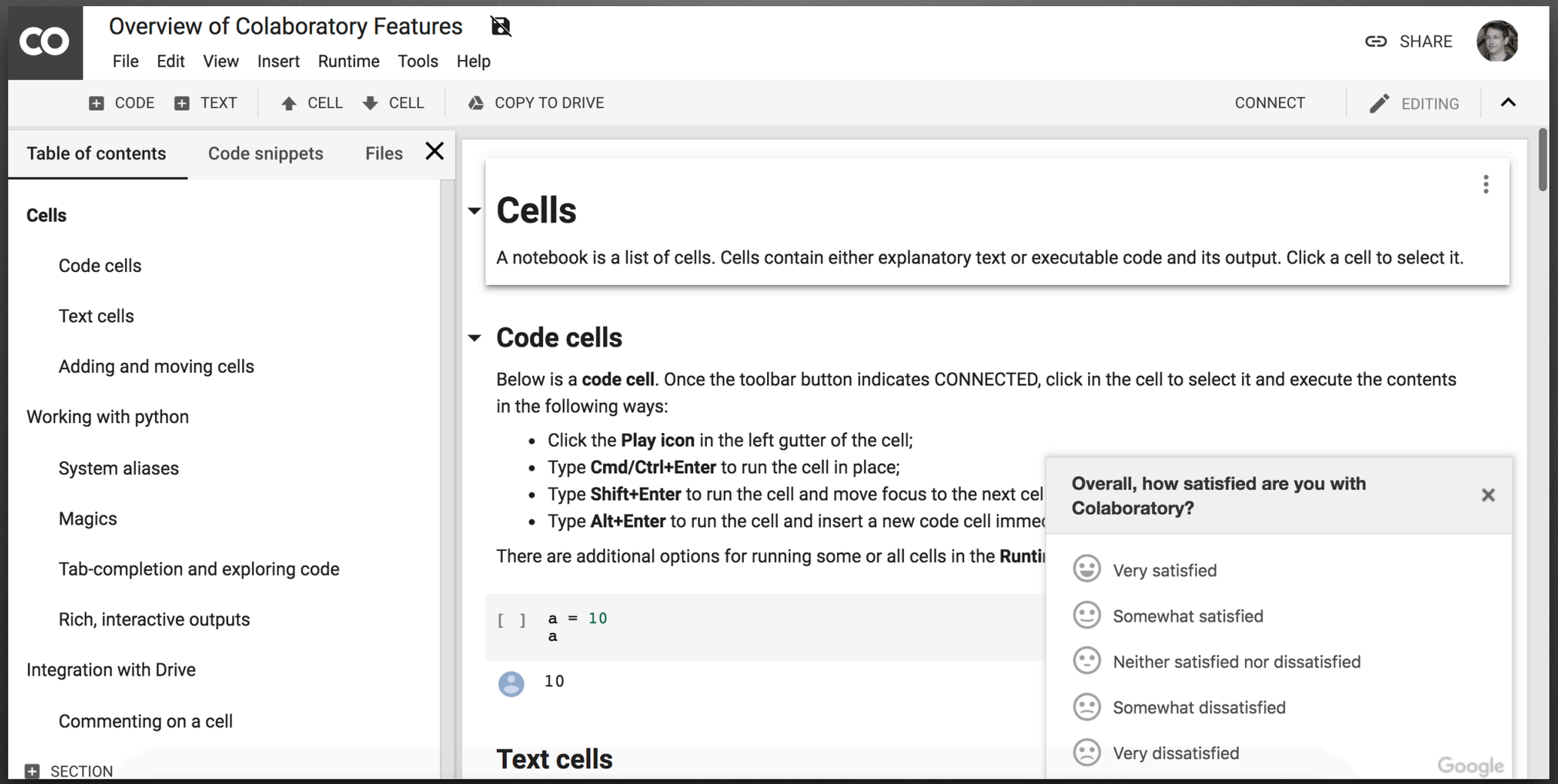
For new users who want to get up and running with minimal effort, we suggest you to download and install Anaconda (http://www.anaconda.com) which provide a setup based on Python 3.7

Anaconda is a free collection of powerful packages for Python that enables large-scale data management, analysis, and visualization for Business Intelligence, Scientific Analysis, Engineering, Machine Learning, and more.



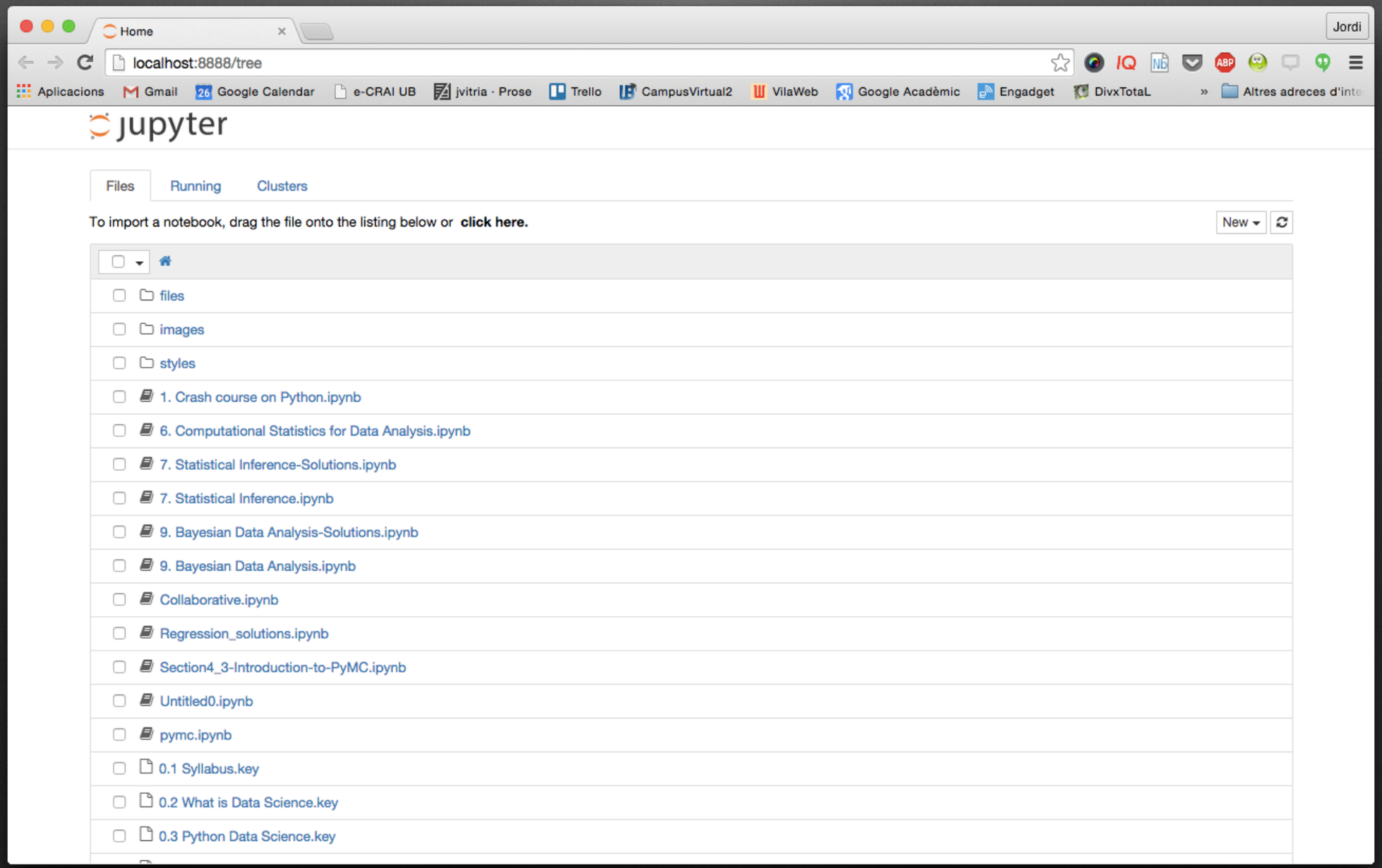
https://www.anaconda.com/distribution/

You need to install Anaconda (Python 3.7)



In some cases **Google Colab** is an interesting alternative.

Notebooks


Home
Jordi
localhost:8888/tree
Aplicacions
Gmail
Google Calendar
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Trello
CampusVirtual2
VilaWeb
Google Acadèmic
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DivxTotaL
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Files
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To import a notebook, drag the file onto the listing below or click here.
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1. Crash course on Python.ipynb
6. Computational Statistics for Data Analysis.ipynb
7. Statistical Inference-Solutions.ipynb
7. Statistical Inference.ipynb
9. Bayesian Data Analysis-Solutions.ipynb
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Section4_3-Introduction-to-PyMC.ipynb
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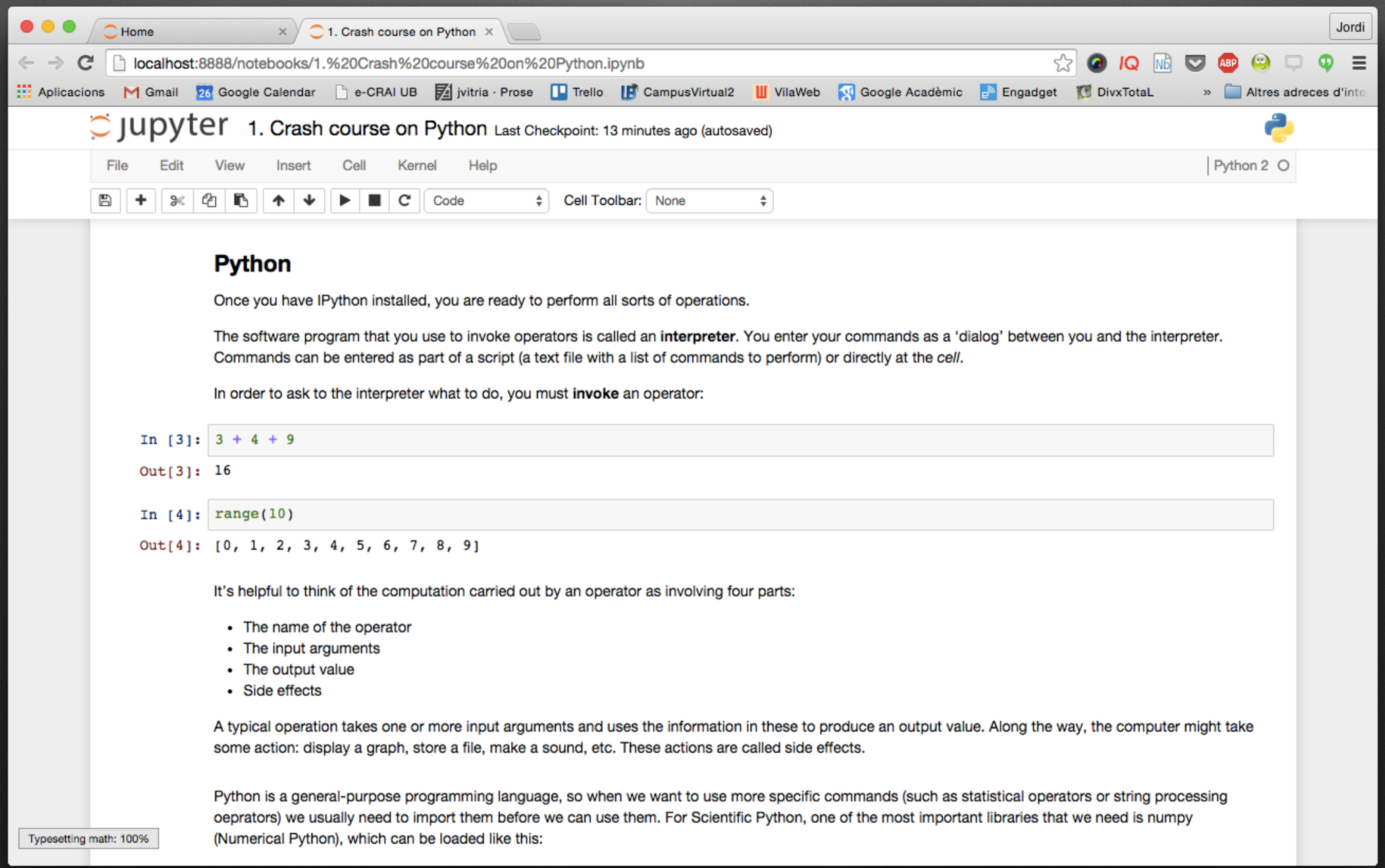
0.1 Syllabus.key
0.2 What is Data Science.key
0.3 Python Data Science.key

Notebooks


Home
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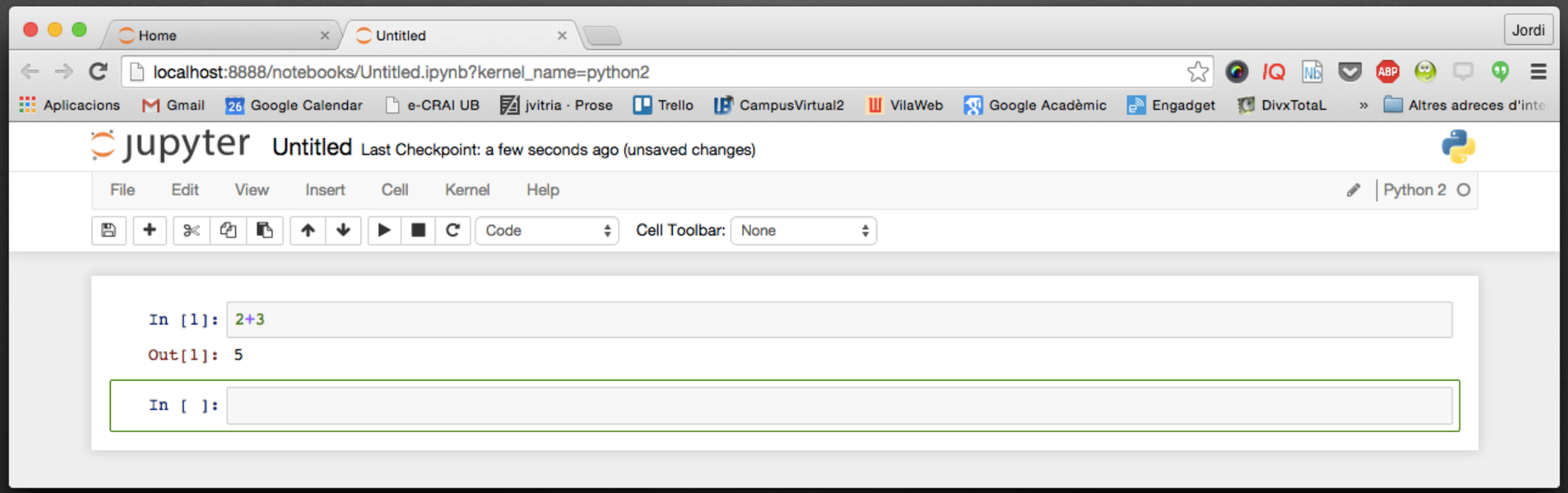
CampusVirtual2
VilaWeb
Google Acadèmic
Engadget
DivxTotaL
Altres adreces d'inte
jupyter
1. Crash course on Python
Last Checkpoint: 13 minutes ago (autosaved)
File
Edit
View
Insert
Cell
Kernel
Help
Python 2
Code
Cell Toolbar:
None
Python
Once you have IPython installed, you are ready to perform all sorts of operations.
The software program that you use to invoke operators is called an interpreter. You enter your commands as a 'dialog' between you and the interpreter. Commands can be entered as part of a script (a text file with a list of commands to perform) or directly at the cell.
In order to ask to the interpreter what to do, you must invoke an operator:
In [3]:
3 + 4 + 9
Out[3]:
16
In [4]:
range(10)
Out[4]:
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
It's helpful to think of the computation carried out by an operator as involving four parts:
The name of the operator
The input arguments
The output value
Side effects
A typical operation takes one or more input arguments and uses the information in these to produce an output value. Along the way, the computer might take some action: display a graph, store a file, make a sound, etc. These actions are called side effects.
Python is a general-purpose programming language, so when we want to use more specific commands (such as statistical operators or string processing oeprators) we usually need to import them before we can use them. For Scientific Python, one of the most important libraries that we need is numpy (Numerical Python), which can be loaded like this:
Typesetting math: 100%

Notebooks

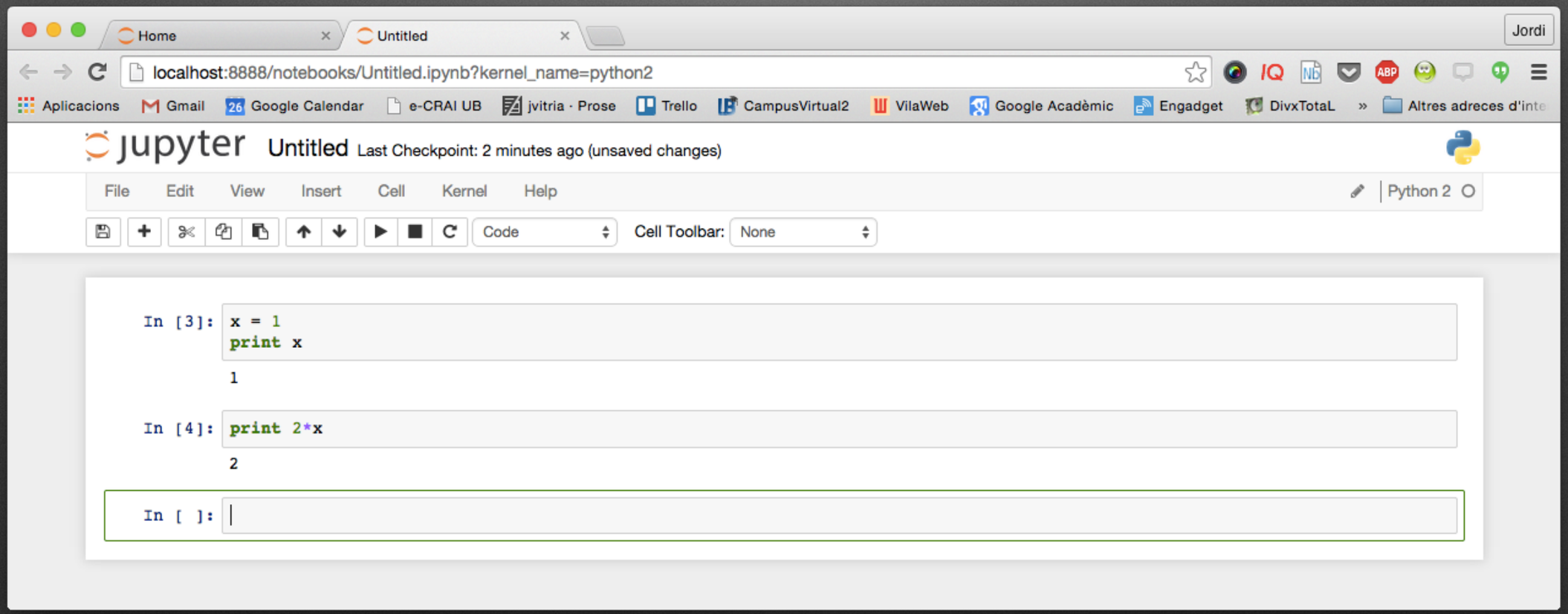
A notebook is made up of a number of cells. Each cell can contain Python code.



You can execute a cell by clicking on it and pressing Shift-Enter. When you do so, the code in the cell will run, and the output of the cell will be displayed beneath the cell.

Notebooks

Global variables are shared between cells. Executing the second cell thus gives the following result:



By convention, notebooks are expected to be run from top to bottom. Failing to execute some cells or executing cells out of order can result in errors.

Notebooks

After you have modified a notebook for one of the assignments by modifying or executing some of its cells, remember to save your changes!