Data Management

Introduction

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HEC Liège | ECON2306

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Welcome

Introduction: Who are we?

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Who am I?

PhD in economics from the Paris School of Economics

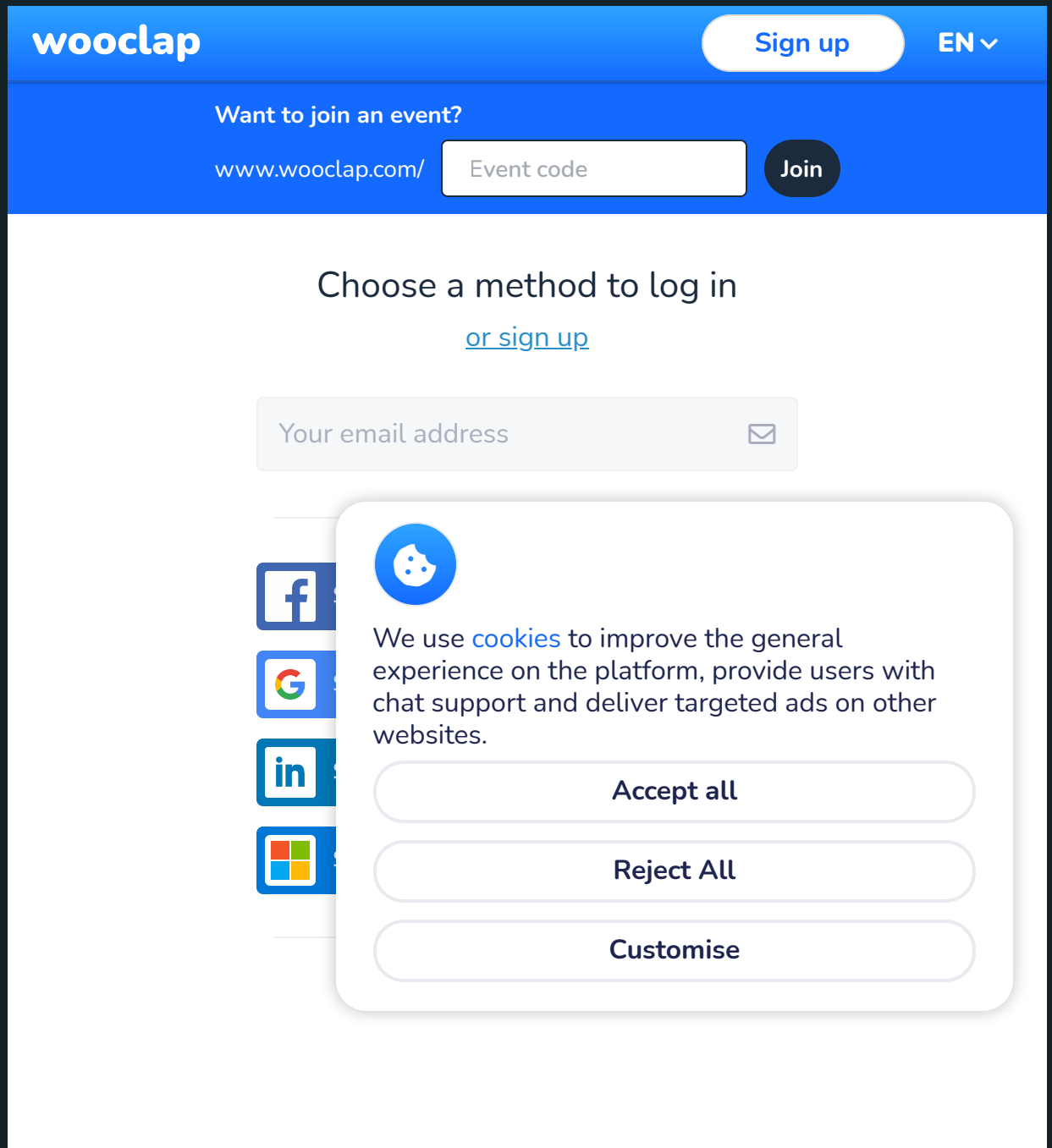
Postdoc at ETH

Assistant professor in applied micro economics at HEC Liège

Interested in **public economics** questions: inequality and taxation

Using the standard econometric toolbox + natural language processing + machine learning

Wooclap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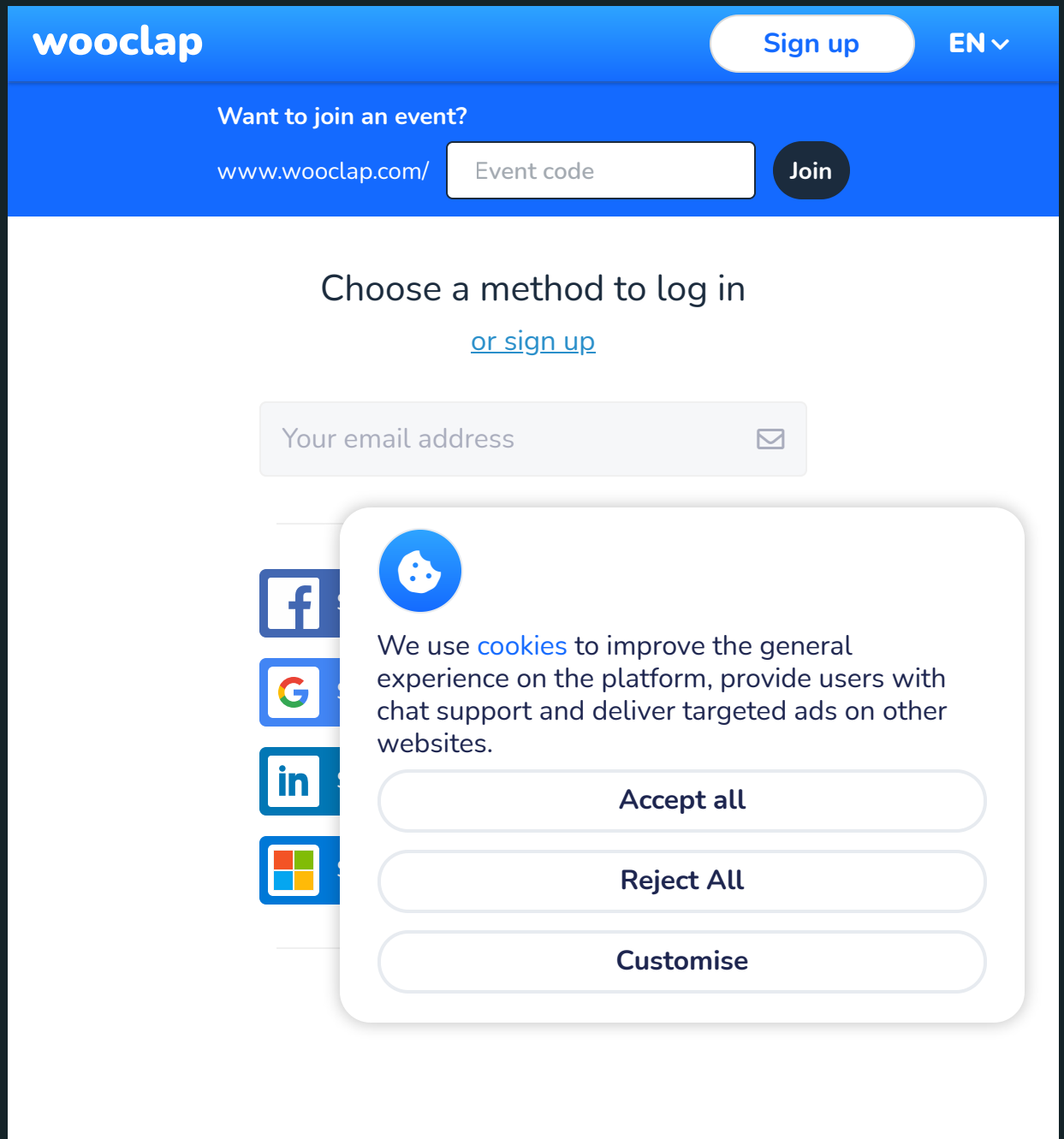
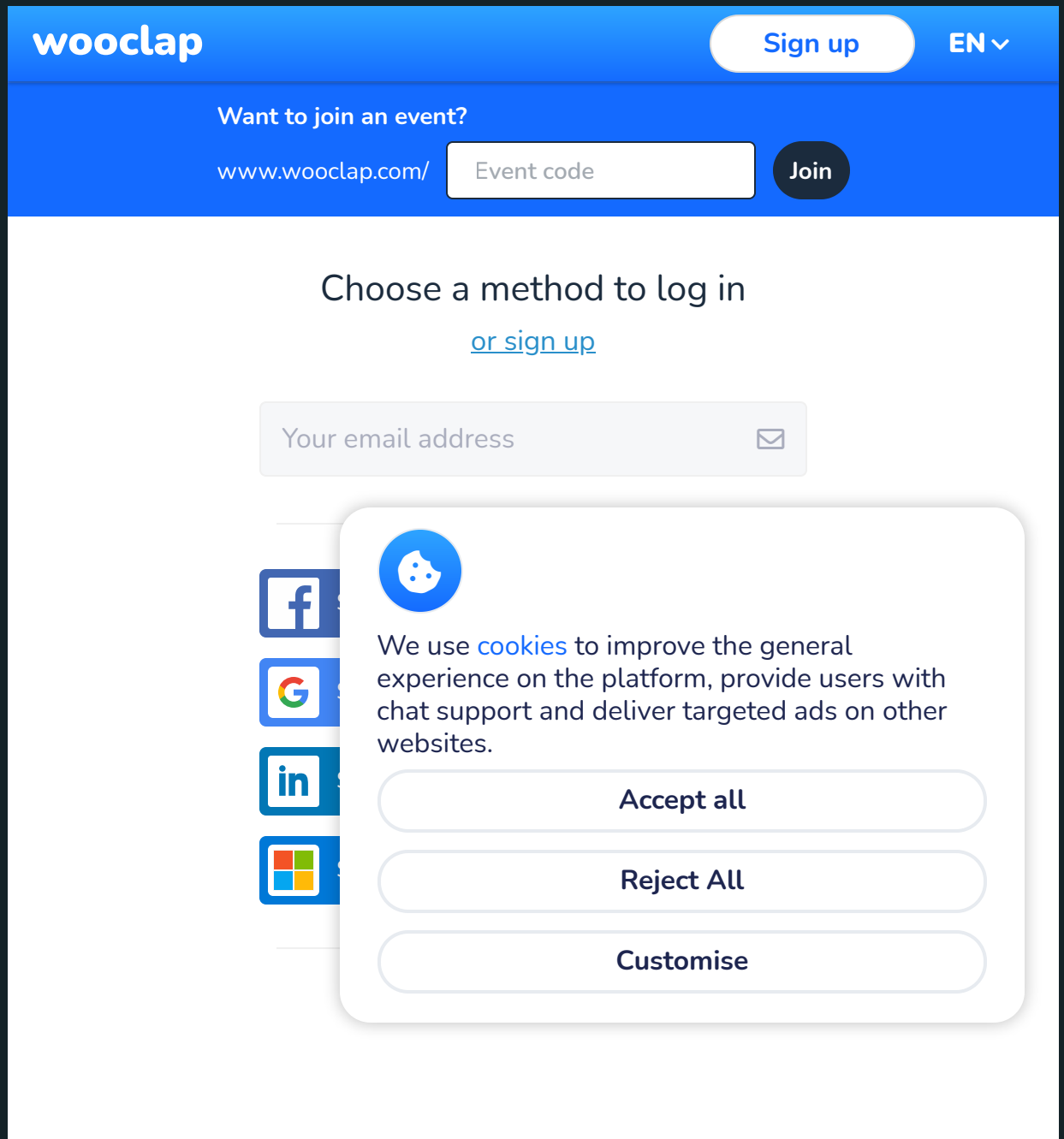
Introduction: Who are you ?



What do you expect to learn during the class?



Data management: why, how?

What is data management about?

All processes, tools, and techniques that have to do with **working with data** :

- Data management plan
- Research data archiving
- Metadata :
  - = structured information that describes, explains, locates, and otherwise represents something else [data].

→ Allows data to be found and interpreted

- *Bottom line*: data should be valid, shared and contextualized within (research) communities

The Data Management Plan (DMP)

Supports Transparency and openness, by indicating:

- how data will be made discoverable, accessible, and reusable

Important in the context of open science / governemnts:

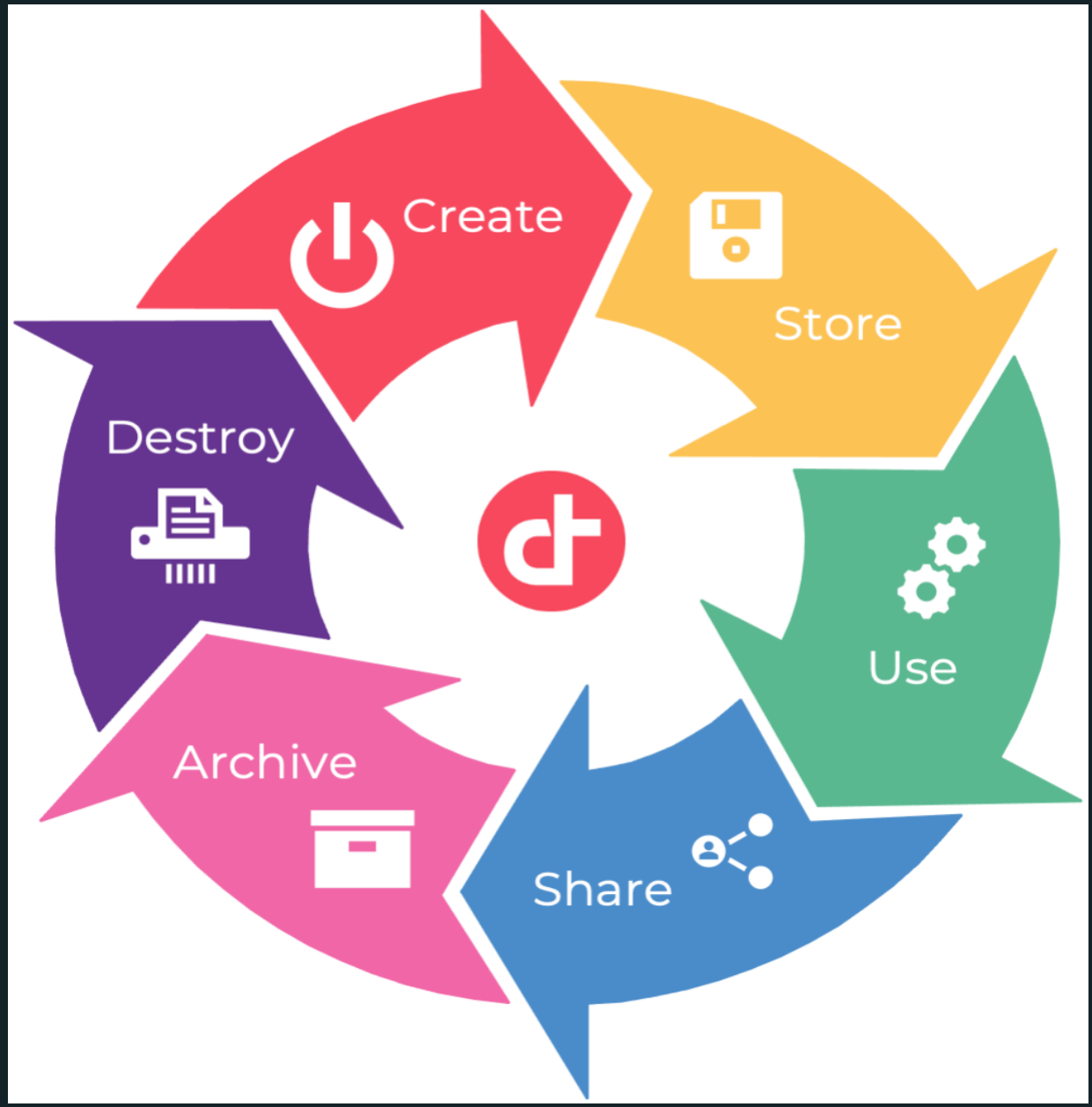
- So that **public investments** are transferable

But also in the context of a firm:

- Long-term investments are key for sustainability

Document that helps you manage the data lifecylce

The data lifecycle



This class: from acquisition of data to data analysis

The class focuses concepts & skills related to the management of data, that are central for the **exploitation** of data.

Goals:

- Equip you with the standard datascience toolkit.
- Put it to work on a real-world project.

Backbone of the class

1. The **skills**:
    - Data collection
    - Data cleaning & operation:
        - Pipelines
    - Data vizualisation
2. The **tools**:
    - python
    - git
3. The **concepts**:
    - *Project management*: documenting, sharing & managing code
    - *Reproducibility*

Public targeted: **anyone using data for projects**. For academics or non academics.

- For research
- For firms

What this course **is**, and *is not*

- **It is**:
  - **Applied** and oriented towards practice;
  - **General** overview of different techniques - what they are and how to use them.
  - **Data analysis** in general, not restricted to a research or a field (economics, political science).
  - In python.
- *It is not*:
  - **Computer science**. We're not coding up models from scratch.
  - **Mathematical statistics**. We're not deriving the functions by hand.

(Big) data

Revolution in the use of data

- **new datasets** : administrative microdata, digitization of text archives, social media
- **new methods** : causal inference, natural language processing, machine learning

⇒ New avenues in:

- research
- policy analysis
- business (costumer services)

New possibilities: exciting!

Examples of business applications

- Decision making:
  - What judges can be replaced by robots?
  - Using algorithms to help diagnose cancer / propose the most effective treatment
- Growth hacking:
  - Identify markets where the investments have the highest returns
- Forecasting:
  - Predict sales

What is (big) data?

Expert Survey (UC Berkeley, 2014)

Image by Jennifer Dutcher, [source]
{https://datascience.berkeley.edu/what-is-big-data}

What is (big) data?

- **Variety** of types/formats of data
  - Structured
  - Unstructured
- **Volume** of data
- **Velocity**: Speed of data flow/stream
- Unusual sources
  - Ready made vs. costummades

→ Use programming and statistics to extract value

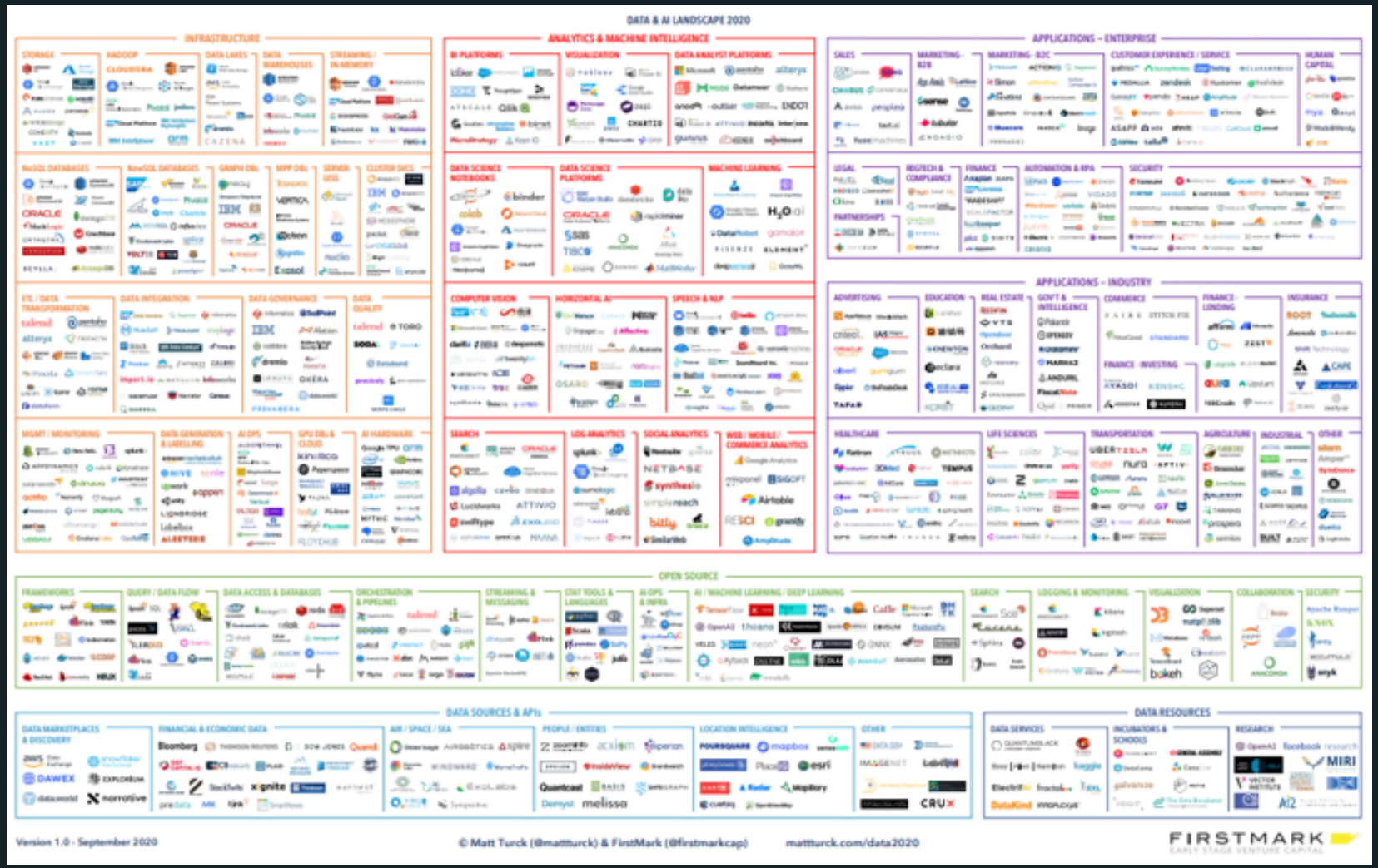
Big data in the Social sciences

- From web applications and digitization of economic and political processes
- **Volume** : can be big, but usually smaller than in natural sciences
- **Variety** and **variability**: often important and challenging
  - Various resources
  - Data generation from 'the real world'
- But usually no streaming applications (**velocity** not that much of an issue)

New tools and methods

- **Data collection** API, Webscraping
- **Analysis** text analysis, machine learning
  - Data can be tall (many observations) or **wide/fat** (many regressors) $\Rightarrow$ Machine learning helps to extract the relevant information
- **Visualization** maps, social networks, web applications

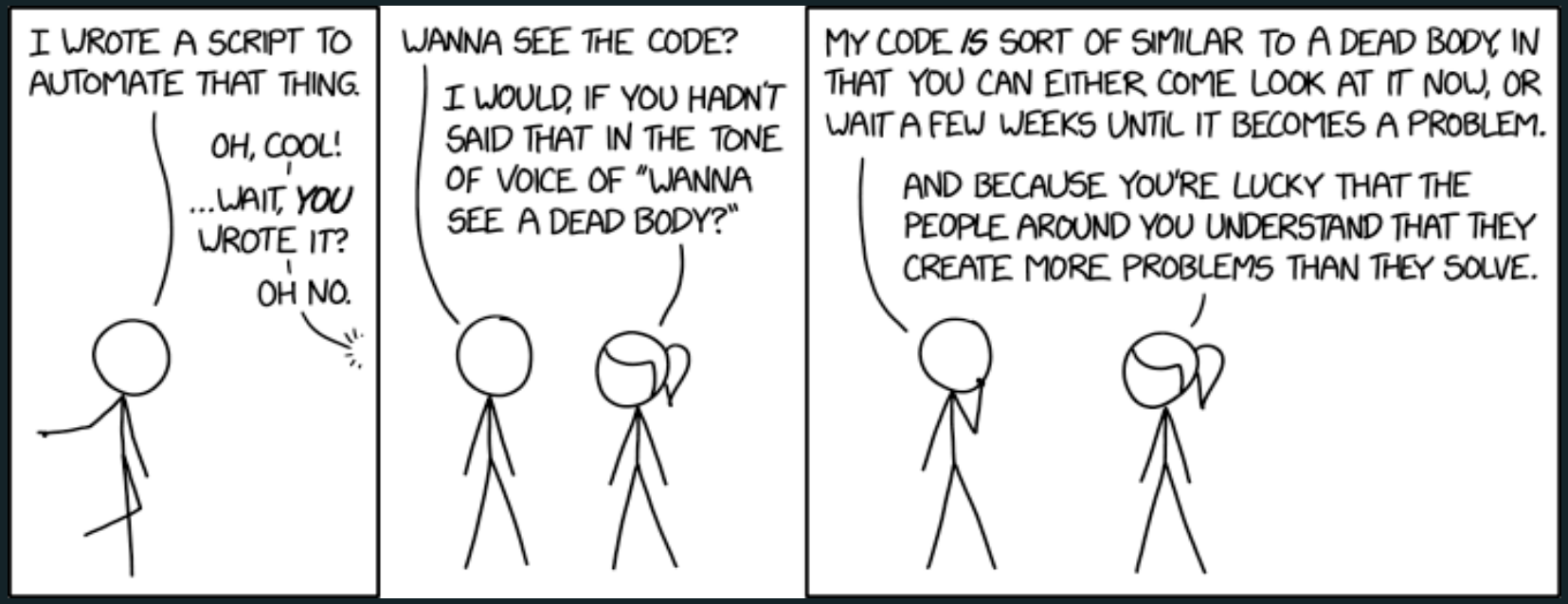
Big data ecosystem



Source: 'Big Data Landscape (2020)' from http://mattturck.com, high definition image

Managing a project with data

The importance of good coding practices



Source: xkcd 2138

Readability of the code

The **Pep 8** convention: Style guide for python code

→ makes it easier (possible) to understand a code of someone else (= you + 2 day!)

- **Naming**
  - Variables: underscores & small letters snake_case
  - Constants: underscores & capital letters
  - Classes CapitalizedCase
- **Code layout**
  - Blank lines
  - Maximum line length & line breaking
- **Comments**
  - Should be useful (explain code) but not obvious
  - Not on o code line
  - Documentation Strings (Using docsstrings) -> mainly for functions

Reproducibility principle

The results of the project should be *reproducible* by someone else in the future:

- this is a basic scientific principle... but too often forgotten

WANTED:

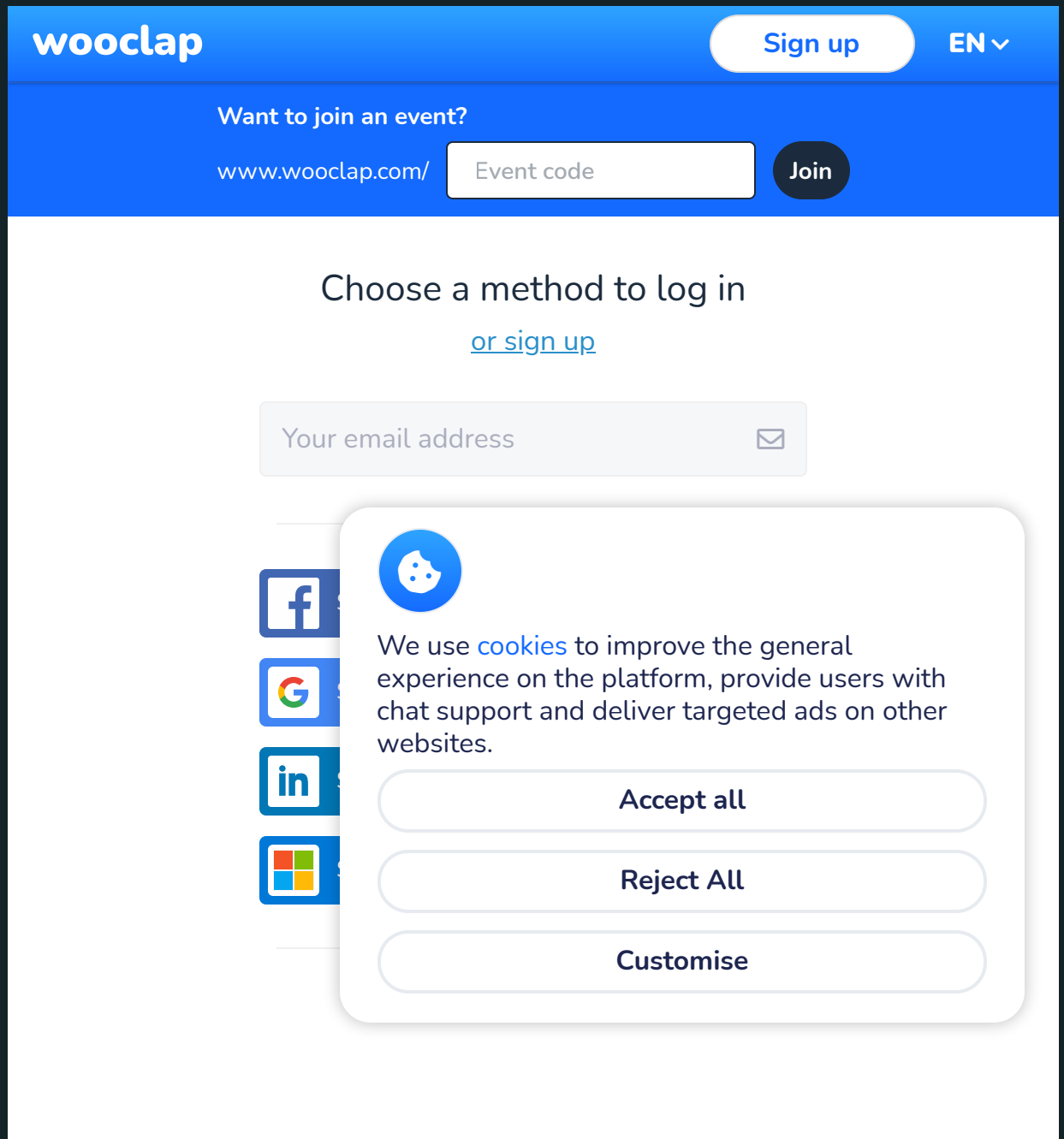
- maintaining a single master file of the data
- version control of the code
- Readme of the project
- document the code (« comments ») & the data (« metadata »)
- controlled coding environment

Next lecture

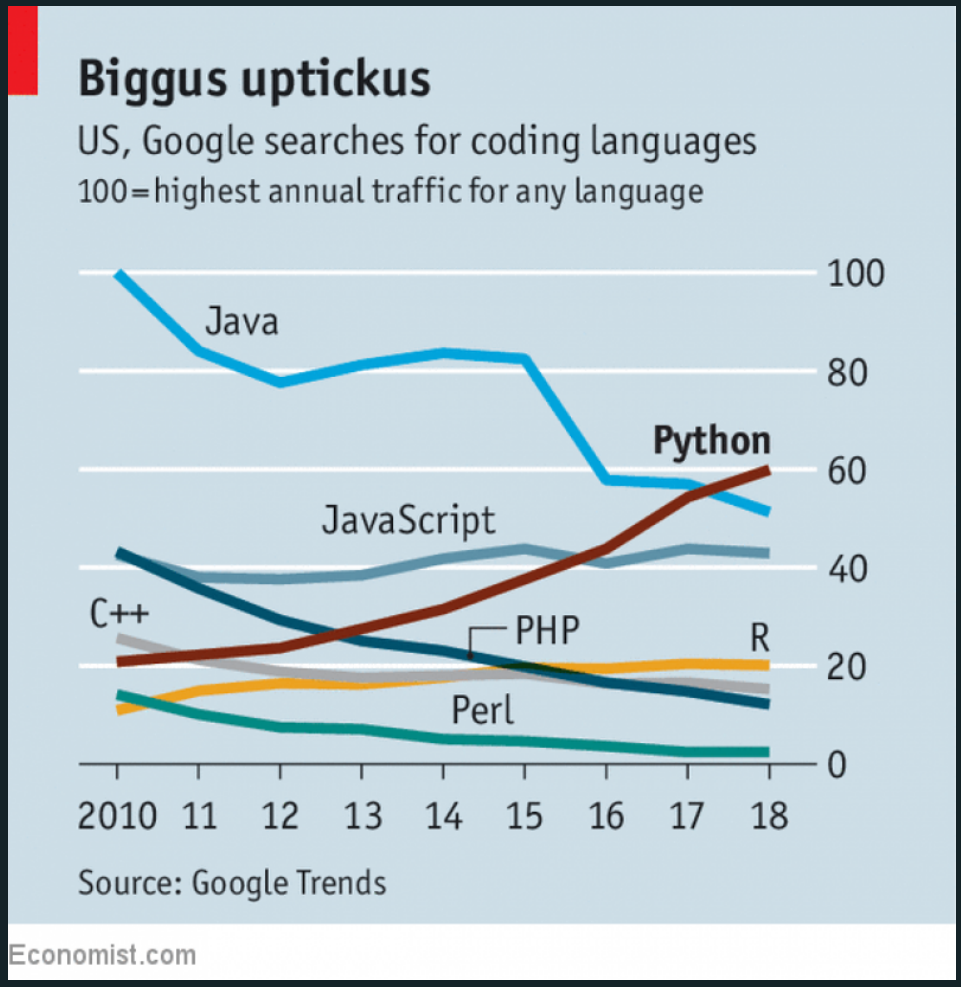
→ **The course project satisfy by the reproducibility principle**

Tools

Your programming background



Why Python?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US, Google searches for coding languages
100=highest annual traffic for any language
Java
Python
JavaScript
C++
PHP
R
Perl
100
80
60
40
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2010
11
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13
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16
17
18
Source: Google Trends
Economist.com

Why Python?

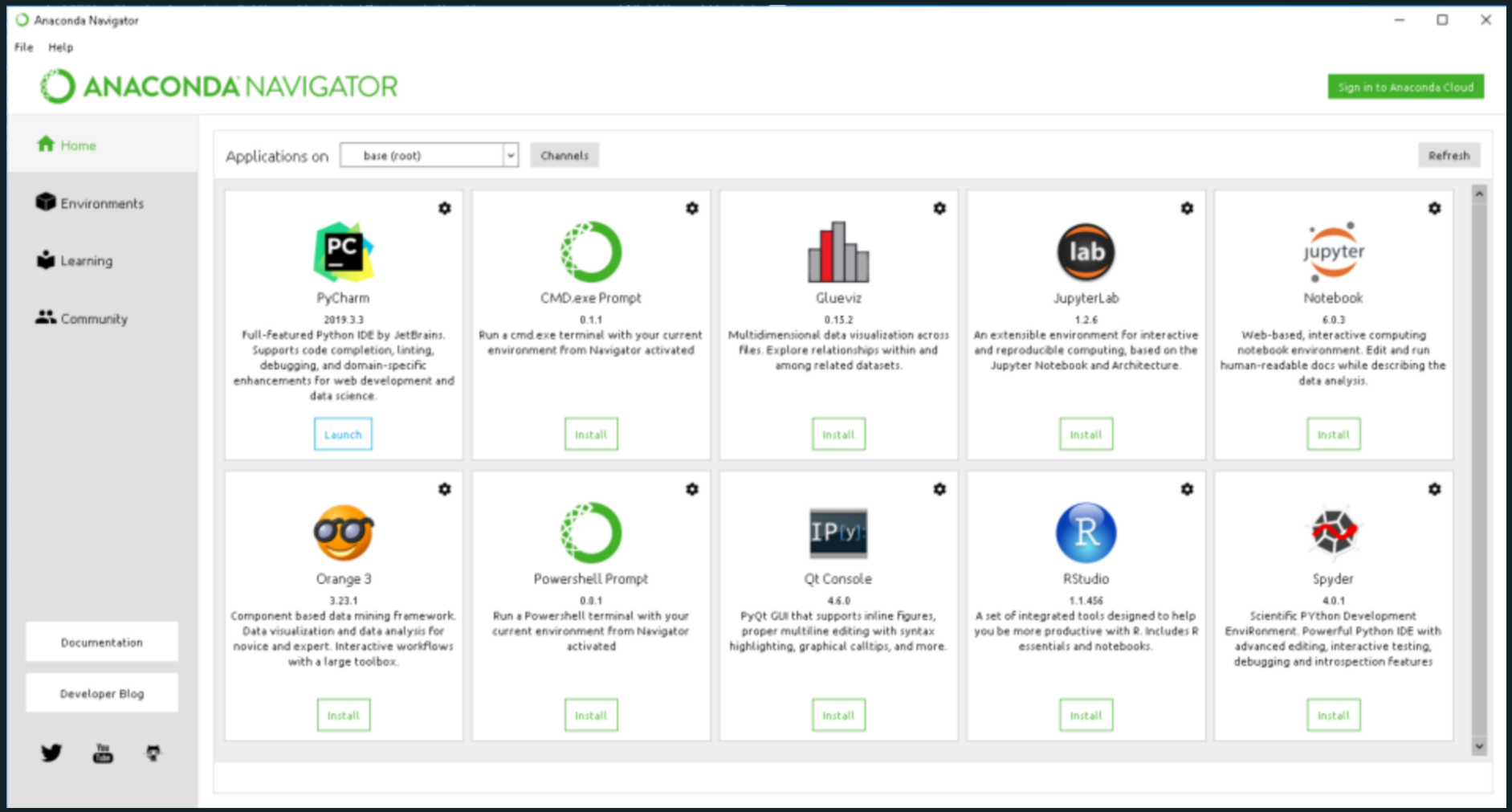
- General-purpose language
  - One of the core languages of scientific computing
- Elegant syntax
- Many useful libraries:
  - Data manipulation: Pandas
  - Machine learning: scikit-learn
  - Statistics: statsmodels
  - Natural Language Procession nltk
- Also path dependency: the language I know the best

Using Python

Anaconda	Jupyter notebook	Spyder
a convenient all-in-one install	for homerwork	for longer code

You are welcome to use R instead.

→ Anaconda



Spyder & Jupyter notebook are two development environments from the Anaconda set up.

Main python packages

Task	Package
Webscraping	beautiful soup
Data management	
Visualisation	
Web application	
Machine Learning	
Natural language processing	NLTK &

This class: overview & logistics

How does the class work? Spirit

Sessions are designed to be interactive

- mix of live *coding* & *exercises*
- we want to get you comfortable using your computing environment to solve problems
  - bring your laptop!
  - we expect you have completed the installation guide and have all software installed.
  - ask questions!

How does the class work? Details

- **Lectures**: 3 hours / week
  - 2 hour theory
  - 1 hour practice:
    - coding exercises
  - sometimes the frontier between theory and practice will be fuzzy.
- **Every week**
  - Thursdays
    - Theory: 9:00-10:25 (with a 10 minute break)
    - Practice: 10:35-12:00
  - Where? N1a 220 (2/20) [Liège centre - Louvrex]
  - Dates: 10.02.; 17.02.; 24.02.; 03.03.; 10.03.; 17.03.; 24.03.; 31.04.; 28.04.; 05.05.; 12.05.; 19.05.

Online Course Materials

- Syllabus
- lola:
  - Course announcement and forum
  - Giving back homerwork
- Github folder or Github page
  - **Slides**: in html, also available in PDF
    - relying on RevealJS
  - **Coding sessions**: in Jupyter Notebook
    - You can use mybinder in the beginning

[Evaluation Policy]

- **Homeworks**:
  - should be given back as jupyter notebooks in PDF format on lola.
  - $3\text{h} \times 5$ **=15%**
- **Participation in class & presentations = 5% bonus**:
- **Course project = 85%**

The homeworks are simple exercises designed to help students to “get their hands in the data & code”.

[Course project] Objectives

- The **basics**:
  - End-to-end data project using Python
    - From collection to vizualisation
  - Group project (2 people; 3 of odd no. of students)
- Use what you learn in this course to **solve a non-trivial real-world question/problem** using a graphical analysis
  - Code must be in split into meaningful sub-files
  - Solution must be submitted using GitHub
  - Web application, that should be deployed online

[Course project] Web application deployed online???

→ Some examples in various sector:

- Finance:
  - The Yield Curve
- Health
  - Opioid epidemic in the US
- Transportation:
  - Uber rides
- Energy consumption
- https://xkcd-data.herokuapp.com/
- Research project

→ Be creative, have fun!

What about you?

1 minute to think about a potential field of application.

- Present yourself
- Specify 1 or 2 domain of interest with possible data analysis
  - Can be academic: green finance, agile management
  - or not: sport, important topic

[Course project] Requirements

- Data:
  - Original data collection
- Analysis :
  - 2 tables and 2 Figures (using different commands)
- Deployment:
  - The main output should be a dash page that you develop on Herokuapp
- Submission format:
  - Invite @malkaguillot and @MichelCop to collaborate on your GitHub repository by the due date.

[Course project] Evaluation: 85% =

- Project management = 15%
  - reproducibility, github, readme
- Project relevance = 10%
  - Does the project respond to an interesting/important question?
- Quality of the visualisation = 20%
  - Choice of the graphical representations & colors
- Technical dimension = 15%
  - Is the project using advanced tools/techniques?
- Oral presentations = 25%
  - ML1: Project idea & scrapping methodology = 5%
  - ML2: Visualisation plan = 5%
  - ML3: Final presentation = 15%

Course Communication

- Us → you
  - Course communication will be done through lola's forum
- You → us
  - We will be available
    - During the breaks, after the class.
    - Michel Copée can answer questions about lectures, notebooks, assignments, and projects
  - **Personal question**:
    - face-to-face interaction > email
  - **General interest question**:
    - forum > email

References?

No general texbook. Specific references will be given when corresponding subjects are tackled.

- Introduction to python, pandas, plotting
- Stackoverflow: all the answers are there, but you have to ask the right question.

Epilogue: for next week

Python

- See installation guide on lola
- Install Anaconda, try out to run python in a Jupyter notebook and spyder
- Wait for next week's introduction by Michel !
  - Basics of python's syntax: Learn Python
    - less Classes and Objects + Modules and Packages.

Troubleshooting

- Use the course forum to share & find answers
- Let's try to make this a **fun collaborative experience** for everyone