ELSTE Data science

Some concept of Python coding and statistical inference

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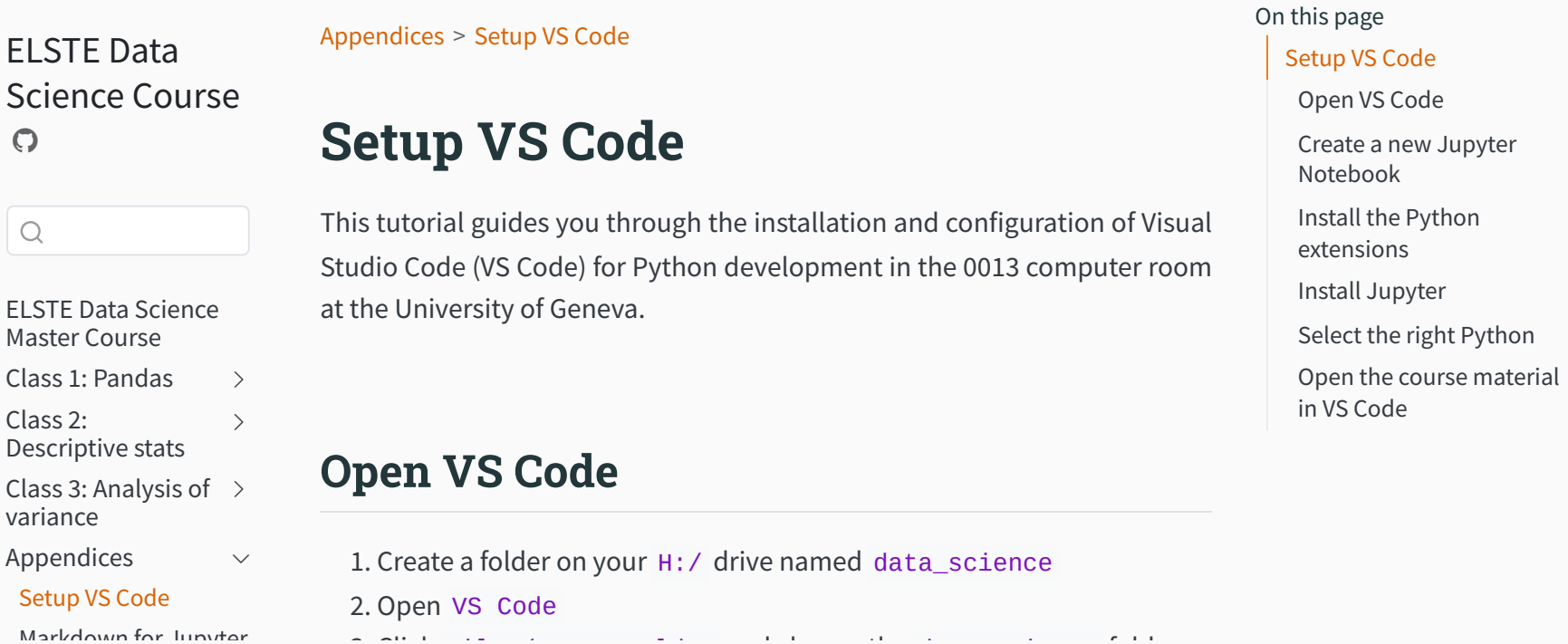
October 15, 2025

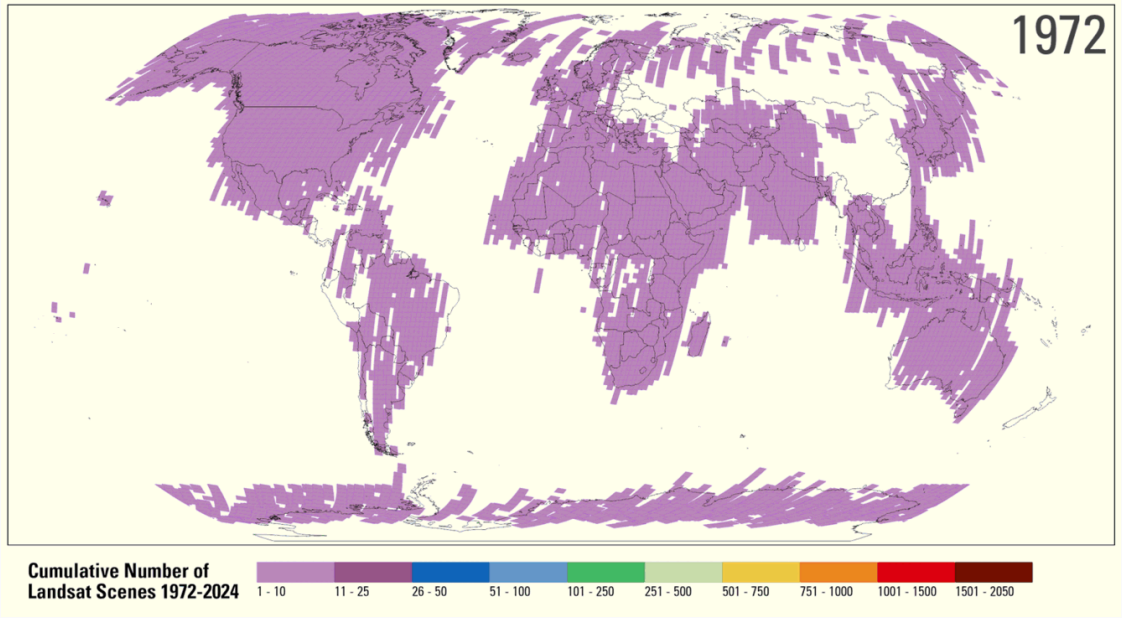
Get ready

- Go to https://elste-master.github.io/Data-Science/
  - → **Download slides:** Class 1 > Overview
  - → **Setup VS Code:** Appendices > Setup VS Code



Why this class?

Data deluge: The big EO data landscape

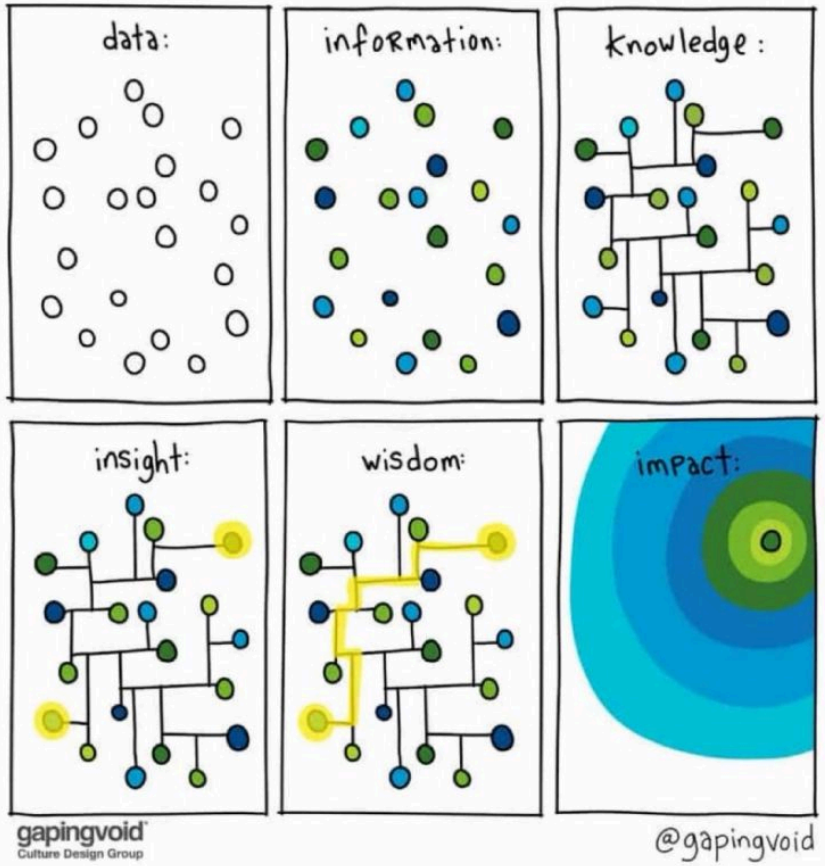


- **Landsat:**
  - → Download: 53 images/day (2001) - 220’000 images/day (2017)
  - → 5 million images of the Earth surface → > 5 PB
- **ESA Sentinel 1 & 2 →** 4.6TB /daily!

Why this class?

As scientists, we are exposed to:

- Increasing computational power/facilities
- Increasing amount of data



What is data science

Wikipedia

> Data science is an interdisciplinary academic field that uses statistics, scientific computing, scientific methods, processing, scientific visualization, algorithms and systems to extract or extrapolate knowledge from [...] data.

Class schedule

- **Fall part at UNIGE**: 6 × 3-h long sessions
- **Assistants**: Simon Thivet, Filippo Salmaso, Lionel Voirol
- **Format**: Theory, live coding and exercises

October 15 and 22

- **Seb** → Intro to data science libraries for Python → `Pandas`, `seaborn`

October 29 and November 5

- **Stéphane** → Intro to statistical method for data inference

November 12 and 19

- Flexible as a function of how we progress
- Exam format to be defined

Class objectives

- Scientific coding and stats often appear daunting
- True, there can be a steep learning curve

Get involved!!!

We want this class to be useful for your research!

Try to contextualise the course material to **your research**:

- Do you already have your own datasets you could bring to class?
- Can you use the course to formulate new research questions?
- Do you know any open-access datasets relevant to your fields?
  - → If not, can you find some for the next weeks?

Why coding?

Motivations

- **Example**: A common - but unnecessarily complicated - workflow of many specialised softwares

Motivations

Motivation 1: Automation

Cotopaxi volcano

- Reconstructing eruption source parameters (ESP) from tephra deposits

  → *How do different measurement methods influence ESP estimates?*

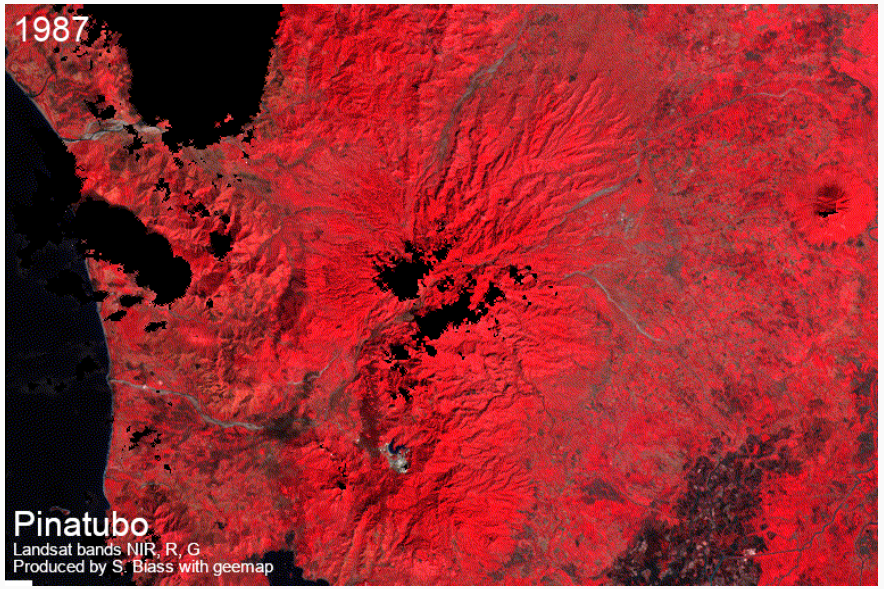
Motivations

Motivation 2: Data analysis

Example 1: Exploit catalogues of big Earth Observation data

- **Revisit big EO catalogues to infer new knowledge**

  → *What controls the impact and recovery of vegetation following eruptions?*



Motivations

Motivation 2: Data analysis

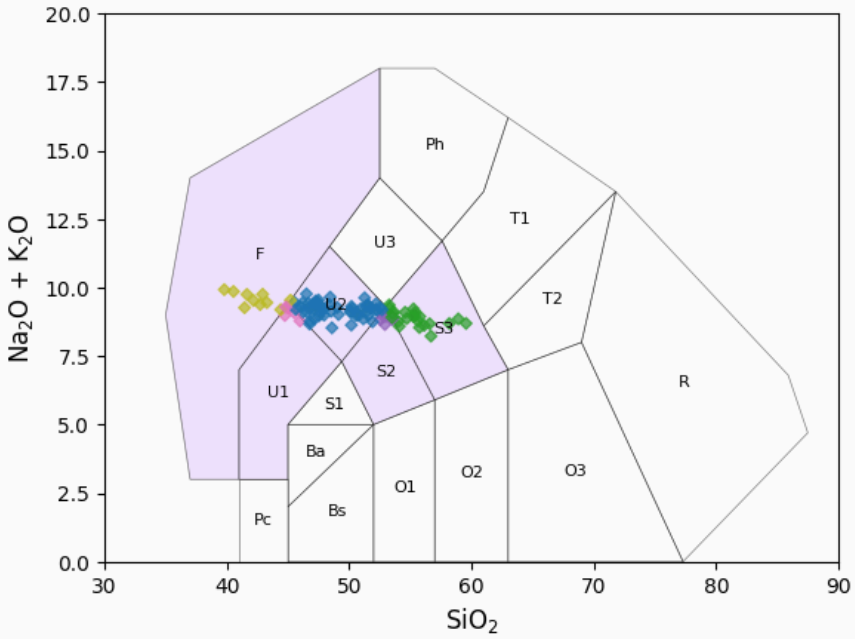
Example 2: Streamline global geochemical analyses

- **Access global databases**

  → e.g., *Georock* database

- **Automatic dedicated analyses/plots**

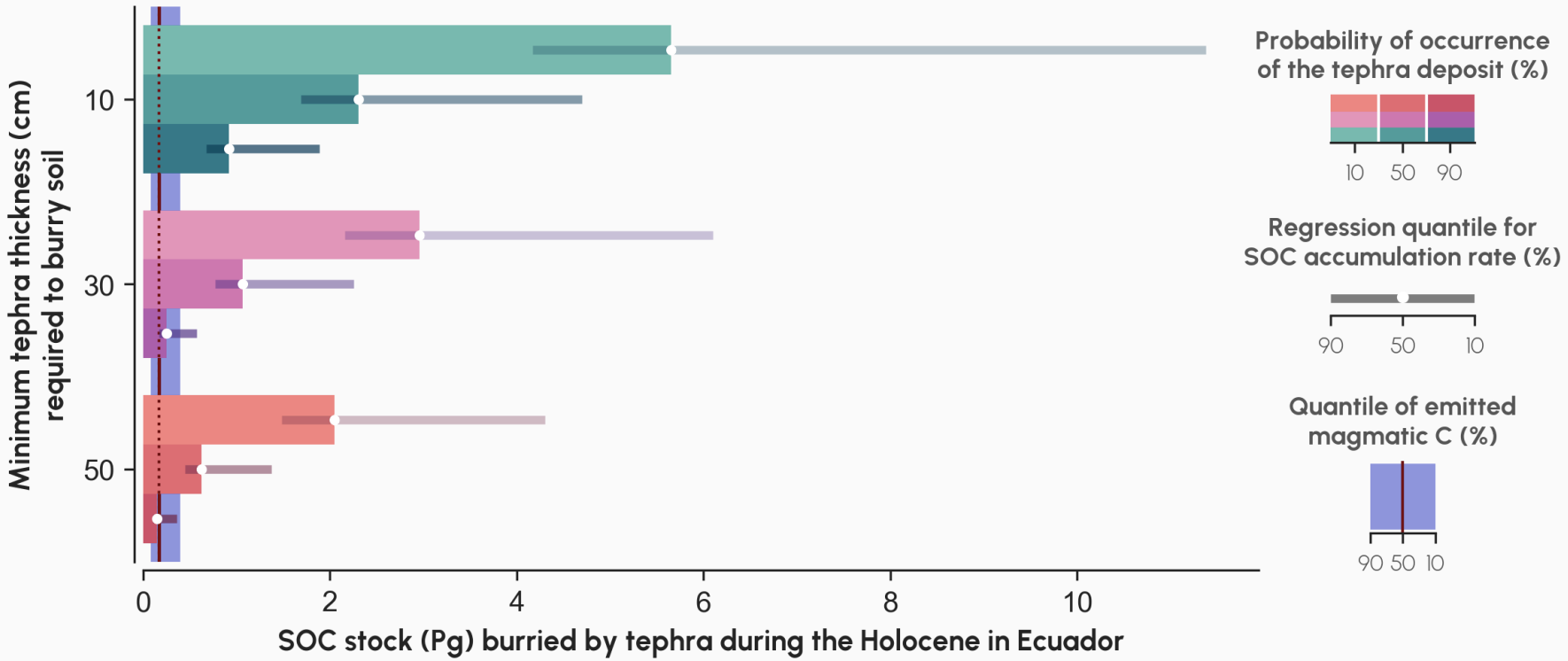
  → e.g., *TAS* diagrams and classification using `pyrolite`



Motivations

Motivation 3: Visualisation

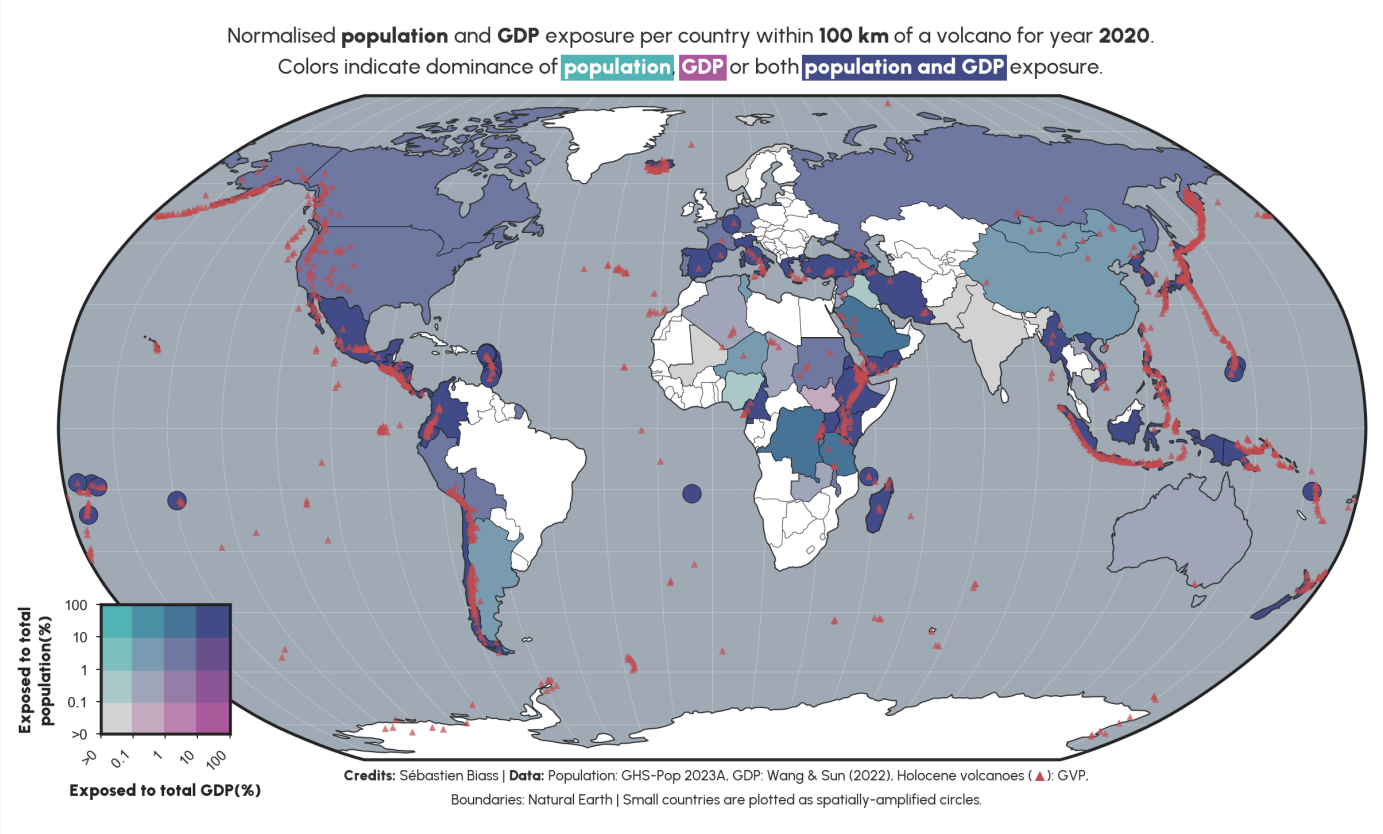
Example 1: In volcanically-active regions, soil burial after explosive eruptions capture more carbon that they emit.



Motivations

Motivation 3: Visualisation

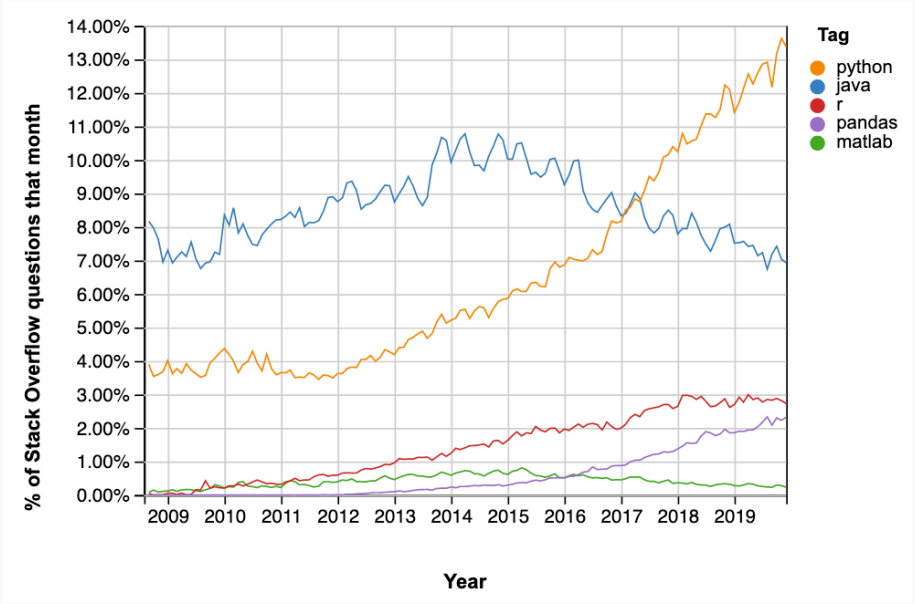
Example 2: In Small Island States, ≥90% of population and GDP is exposed to volcanic hazards.



Why Python?

Python's advantages [1]

1. **Free**
2. **Open source**
   - Not dependent on any company
   - Large online community
3. **Old** → stable (started in 1991)
4. **Very** popular in science
5. Relatively easy to learn



1. Inspired by the School of Oceanography at University of Washington

What is Python

High-level computing language

- Compiled → doesn't directly speak to the computer, but is *interpreted* by another language
  - → Usually slower, but much, much easier to use!

An example of packages, modules and functions

In the code below, we first load the necessary packages and libraries:

- `matplotlib` is the main **visualisation** package used in Python
- `pyplot` is a module of `matplotlib` that provides easy-to-use functions for **plotting** data
- `figure` is a function of `pyplot` and is the main function to prepare a plot

```
# Import the packages and modules
from matplotlib import pyplot as plt
# Set up a figure for plotting
plt.figure(...)
```

How to use Python

Option 1: Your own computer

- Requires some setup
- No internet connection required
- Slow if computer is slow
- All data stored on your own computer

> **Environment manager!**
>
> Make sure to install an **environment manager** → e.g. Miniconda

How to run Python

3 main ways to run Python…

1. Run Python `.py` scripts from the command line → *deprecated*
2. Run blocks of code from within a Python `.py` script using `ipykernel` → **similar behaviour to R/Matlab** = ❤️
3. Use **Jupyter Notebooks** in `.ipynb` files

Start coding!

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