The Alan Turing Institute

Python (or R) for Open and Reproducible Science

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erc European Research Council
Established by the European Commission

My background

PhD Student, University College London

My research – Soundscape Indices (SSID)

- Soundscape attempts to describe urban sound environments in terms of **how they are perceived**
- We describe soundscapes in terms of their pleasantness and eventfulness, telling us if they are vibrant, or calm, or chaotic, etc.
- SSID is a project to make this approach practical, through a model which can predict these perceptions based on physical inputs

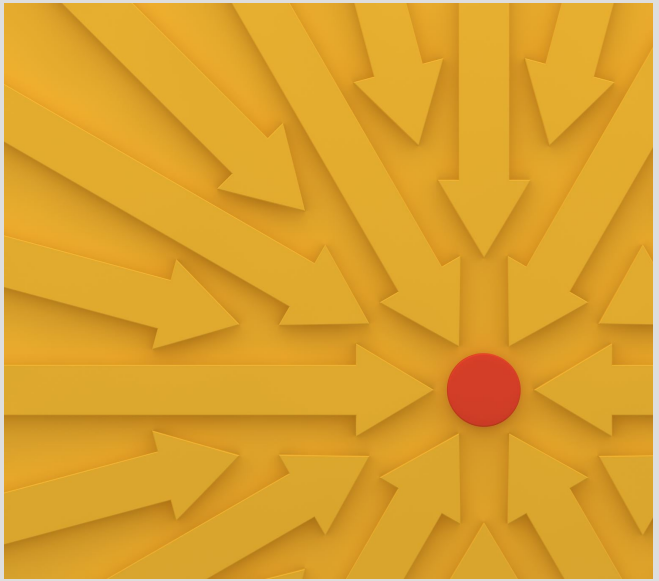
Case study sites

- Over 30 sites surveyed so far in the UK, Italy, Spain, and China covering a variety of acoustic environments and non-auditory factors
- 3000+ individual responses collected so far

Goals

To show how Python can help make your science more open and reproducible

- NOT to teach you how to write code
- To introduce tools and workflows to improve your work
- To give real examples from my own work



Part 1: Open Science

- What is Open and Reproducible Science?
- How does Python (or R) help?

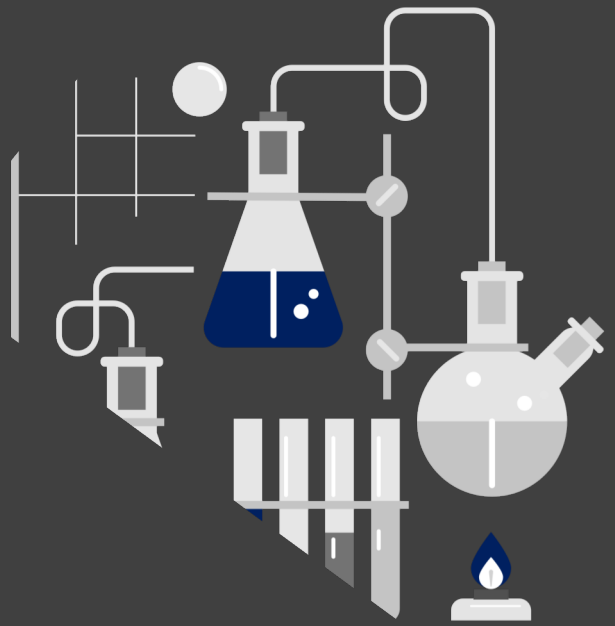
Part 2: Practical Python

- Data Processing
- Data Analysis
- Interactive Code
- Sharing and Collaborating

Part 3: An Example

- Soundscapy
- Sharing Data
- Sharing Code
- Making it accessible

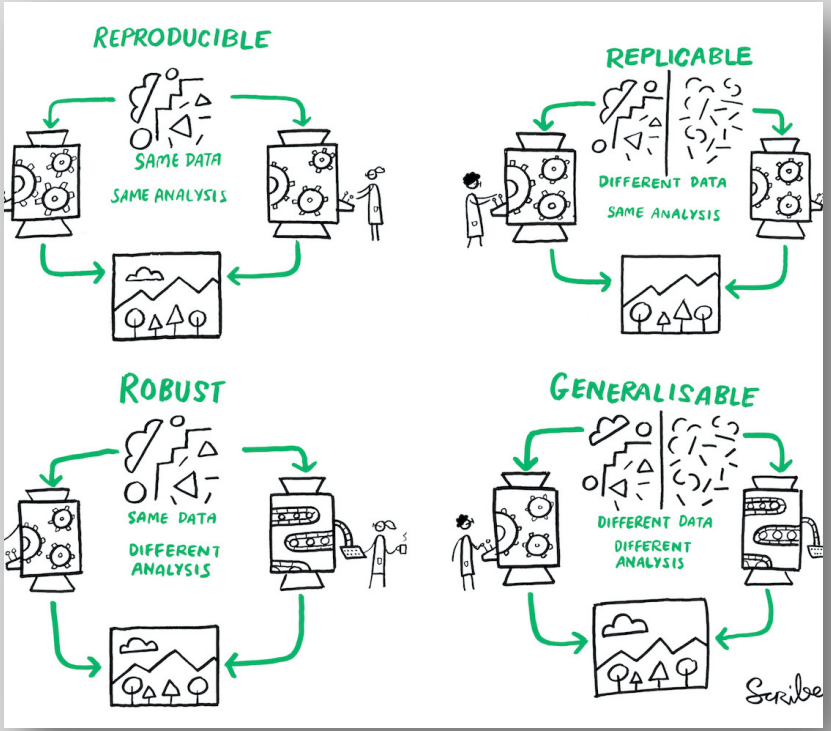
Part 1 – Open Science



What is Open and Reproducible Science?

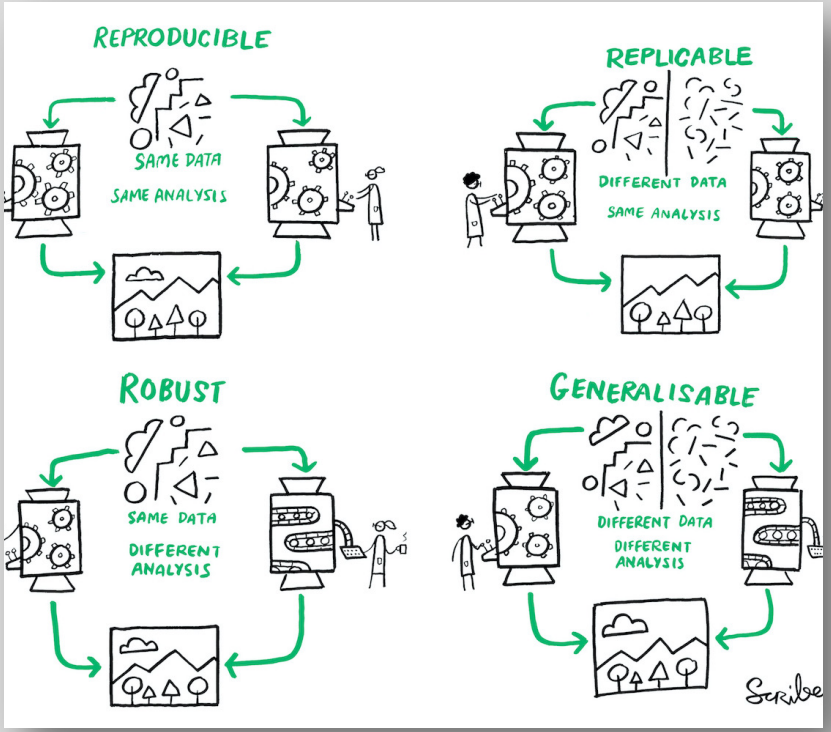
Reproducible

Authors provide all the necessary data and the computer codes to run the analysis again, re-creating the results



Replicable

A study that arrives at the same scientific findings as another study, collecting new data (possibly with different methods) and completing new analyses.



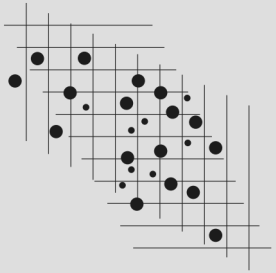
Open Research

Aims to transform research by making it more reproducible, transparent, reusable, collaborative, accountable, and accessible to society

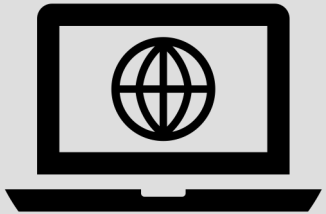
- Be publicly available
- Be reusable
- Be transparent

From *The Turing Way,* “Open Research” https://the-turing-way.netlify.app/reproducible-research/open.html

Open Research



Open Data



Open Source Software

Open Access

Open Notebooks

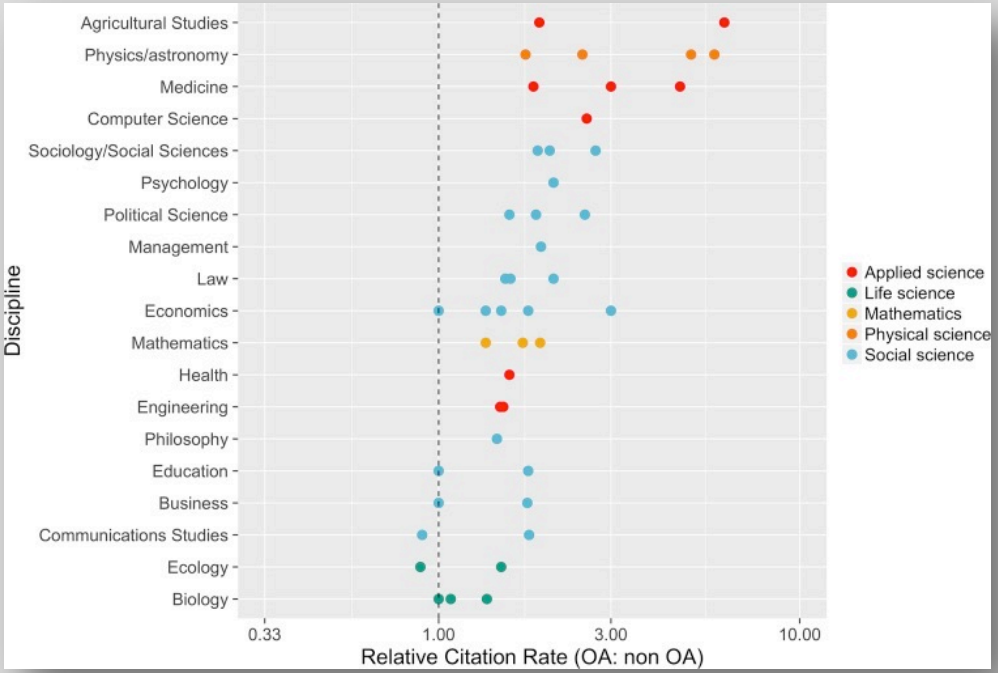
From *The Turing Way,* “Open Research” https://the-turing-way.netlify.app/reproducible-research/open.html

Five selfish reasons to work reproducibly

1. Reproducibility helps to avoid disaster
2. Reproducibility makes it easier to write papers
3. Reproducibility helps reviewers see it your way
4. Reproducibility enables continuity of your work
5. Reproducibility helps to build your reputation

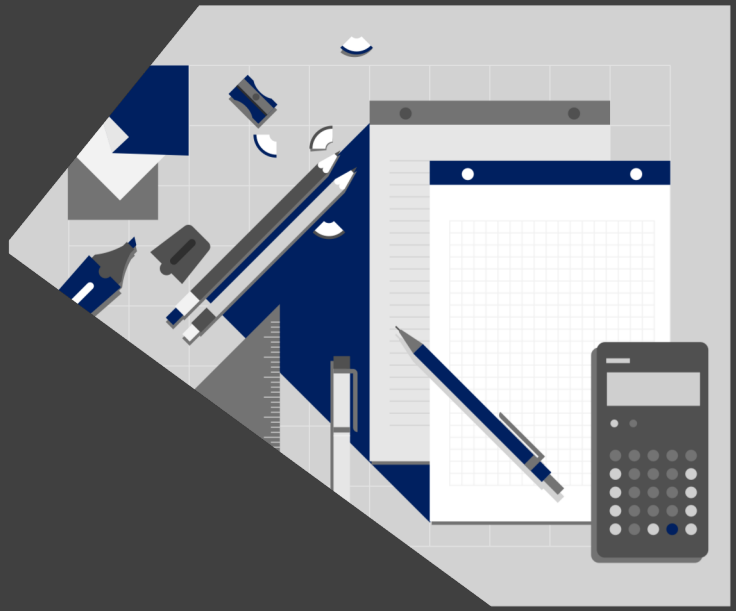
Markowetz, F. Five selfish reasons to work reproducibly. Genome Biol 16, 274 (2015). https://doi.org/10.1186/s13059-015-0850-7

Open Access research gets cited more

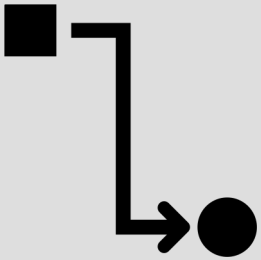


The relative citation rate (OA: non-OA) in 19 fields of research. This rate is defined as the mean citation rate of OA articles divided by the mean citation rate of non-OA articles. Multiple points for the same discipline indicate different estimates from the same study or estimates from several studies.

How does Python (or R) help?



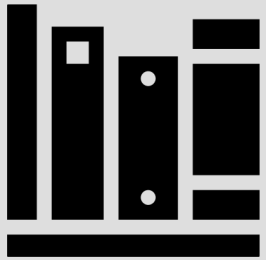
Levels of Code



Function

Script

Module



Package (or library)

Reproducible by default

– The biggest advantage is reproducibility, both for yourself and for others
– Transparent reproducibility

Iteration of Analysis

– By working in code, we can iterate and improve our analysis, without starting from scratch
– Suggestions from reviewers can be (more) easily integrated

Collaboration

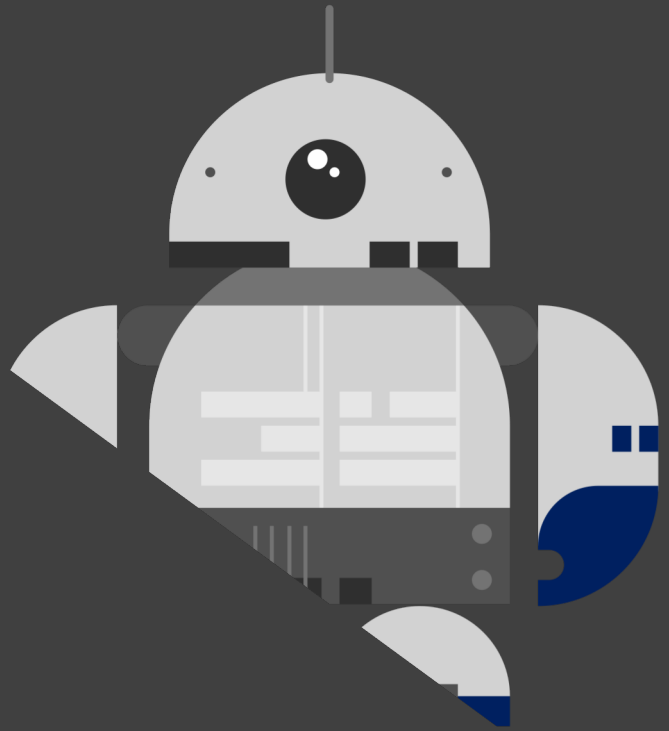
- Code is easily shared between research partners
- Using notebooks can make the process even easier
- Collaborative development and improvement is at the heart of open source software more broadly

Part 2 – Practical Python

A case study: Soundscape translation

- Translate a set of standardised soundscape descriptors from English into 18 different languages
- Run in the SU Sound Lab
- Need to de-randomise our survey data and standardise the layout

Data Processing



Demonstration

- Redcap Survey platform
- Data download
- Data processing and collation
- Preliminary analysis

Write it once, use it a lot

- Once a script is written, it can be run whenever and as many times as we want
- No penalty to checking data frequently
- No human or transcription errors

Python

- General Purpose
- Very flexible
- Popular outside Academia
- Learning curve is smooth
- Better extension to machine learning

Both

- Notebooks
- Lots of open-source libraries
- Readable

R

- Stats Focused
- Very popular in Academia
- Simpler to install
- Easy to start with, can get very difficult for advanced work

Interactive Code:
Jupyter Notebooks

Jupyter Notebooks (or Rmarkdown)

Analyse

- Break up code development into blocks
- Iterate your analysis strategy
- View results inline
- Easily switch out datasets while keeping the same analysis

Collaborate

- Combine rich markdown text and inline code
- Share preliminary results
- Can provide context and results to collaborators
- Share either dynamic or static versions

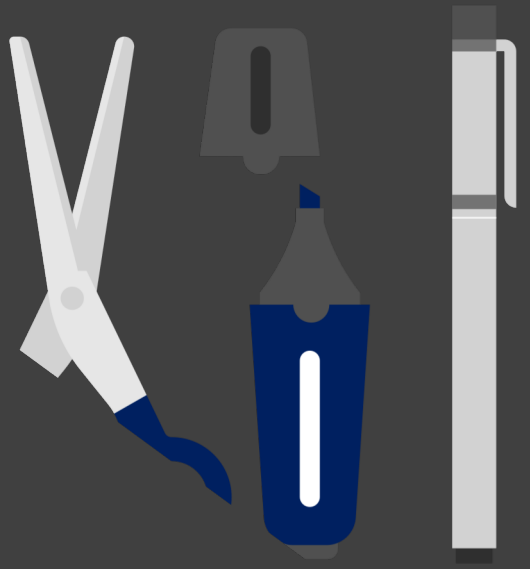
Publish

- Allow readers/reviewers to easily reproduce results
- Show the process

Real-world Examples

1. SATP Analysis notebook
2. Shared .html of modelling notebook

Part 3 – An example: Soundscapy



Home > JASA Express Letters > Volume 2, Issue 3 > 10.1121/10.0009794

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How to analyse and represent quantitative soundscape data

JASA Express Letters **2**, 037201 (2022); https://doi.org/10.1121/10.0009794

Andrew Mitchell[a], Francesco Aletta[b], *and* Jian Kang[c]

Sharing Data:	Zenodo
Sharing Notebooks:	Binder
Transition from SPSS to R:	StatsNotebook
Collaboration:	Github

Guidance and Tutorials

- The Turing Way
- Awesome Reproducible Research
- Research Software Engineering course
- Learning Statistics with R

Thank you for your attention!

The code used for demonstration was based on:

Mitchell, A., Aletta, F., & Kang, J. How to Analyse and Represent Quantitative Soundscape Data. *JASA Express Letters.* 2021. https://doi.org/10.1121/10.0009794

All of the data used is openly available at:

Mitchell, A., *et al.* The International Soundscape Database: An integrated multimedia database of urban soundscape surveys – questionnaires with acoustical and contextual information. *Zenodo [data set].* doi: 10.5281/zenodo.5654747

For more on me and my work, visit:

Website: https://andrew-mitchell.netlify.app/

And my podcast: https://www.justnoisepod.com/

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The Rest Is Just Noise