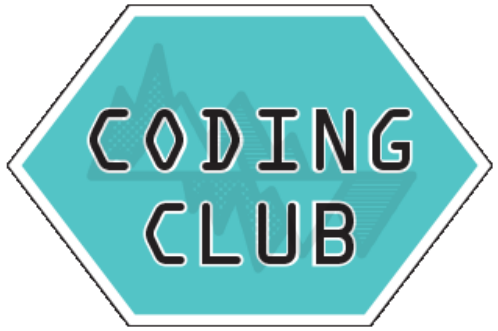
https://ourcodingclub.github.io/



Programming and your research

A whirlwind tour of coding tools with a significant Python bias

James Fulton

Expectations

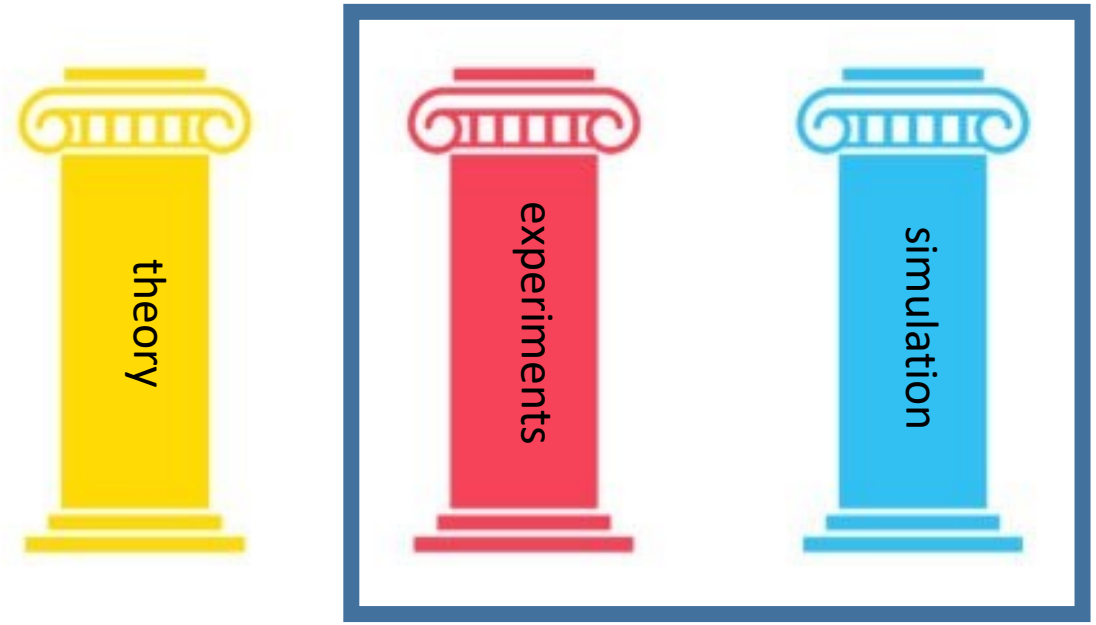
This talk is

- Overview and examples of research focused coding
- Quick comparison of different languages and making your choice
- A spin round the neighbourhood of common python libraries
- Some resources you can use to teach yourself easily

This talk isn't

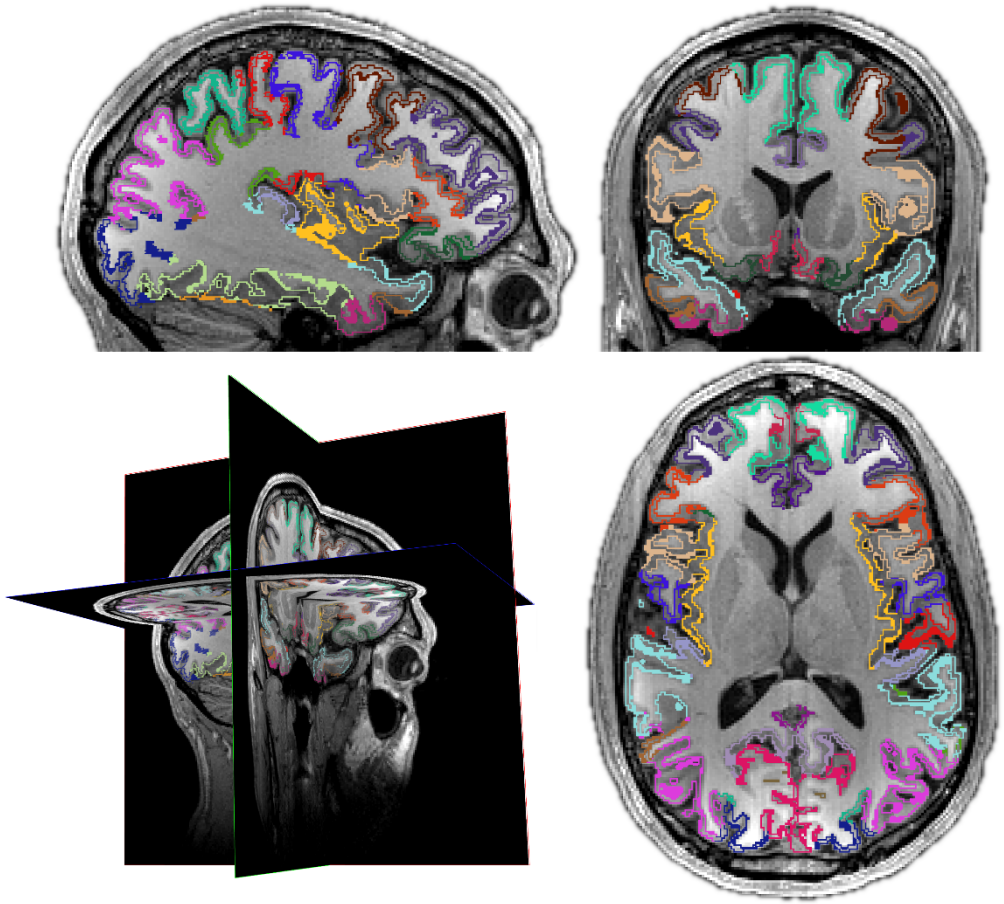
- A tutorial

Research software



https://physicsworld.com/a/the-third-pillar-of-science/

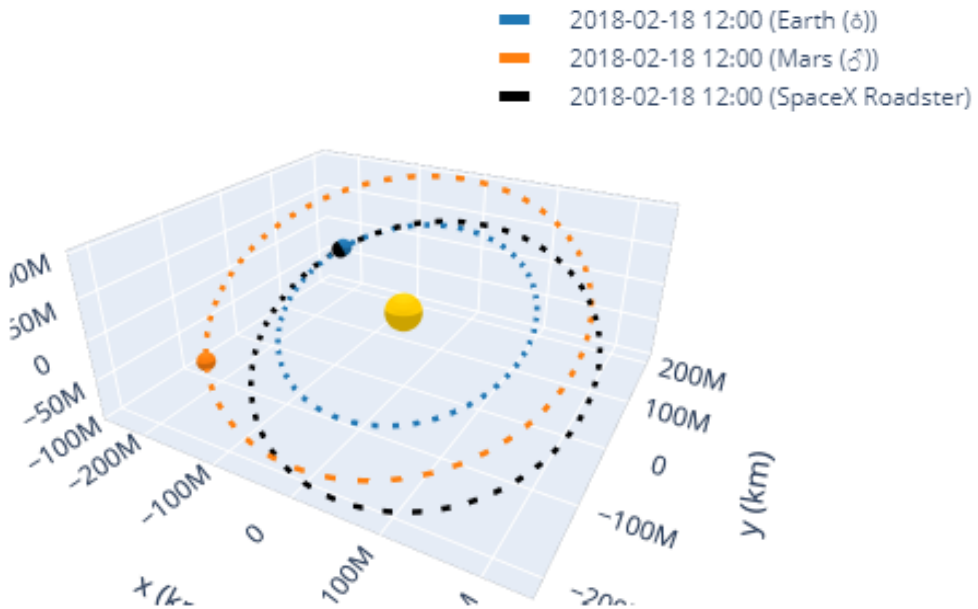
Data analysis



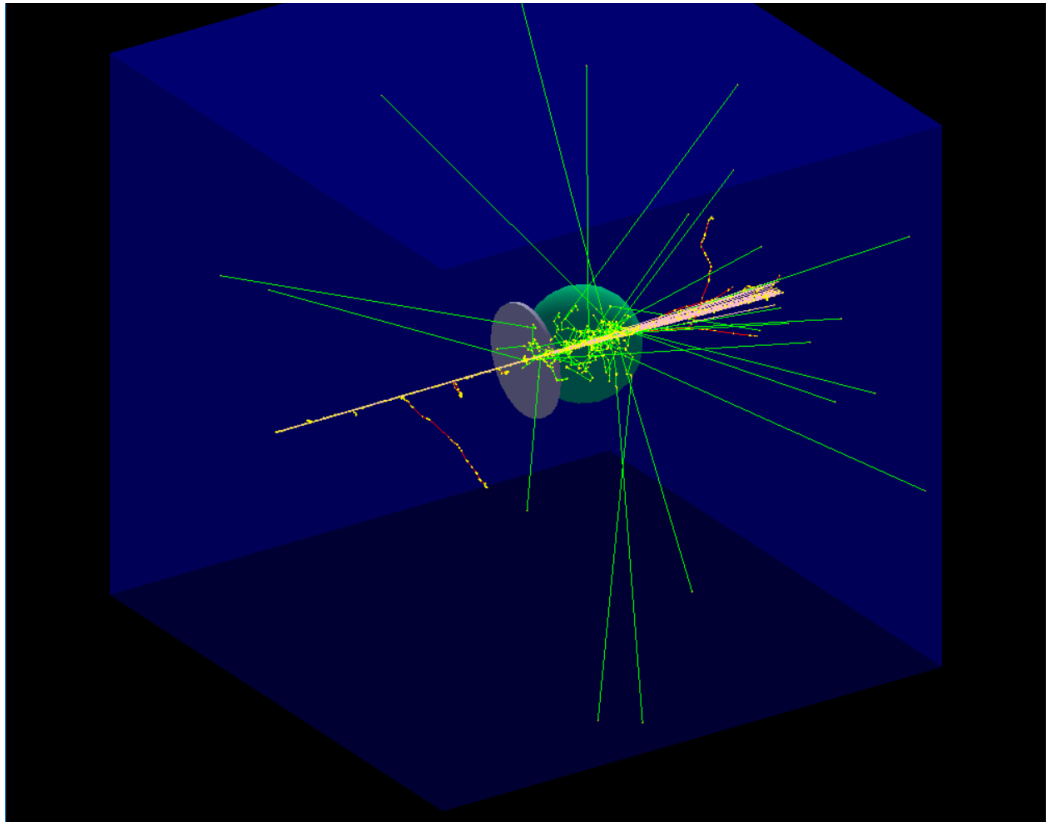
Average cortical thickness per brain region
- Created with Mindboggle

Citation: Klein A, Ghosh SS, Bao FS, Giard J, Häme Y, Stavsky E, et al. (2017) Mindboggling morphometry of human brains. PLoS Comput Biol 13(2): e1005350. https://doi.org/10.1371/journal.pcbi.1005350

Physical simulation

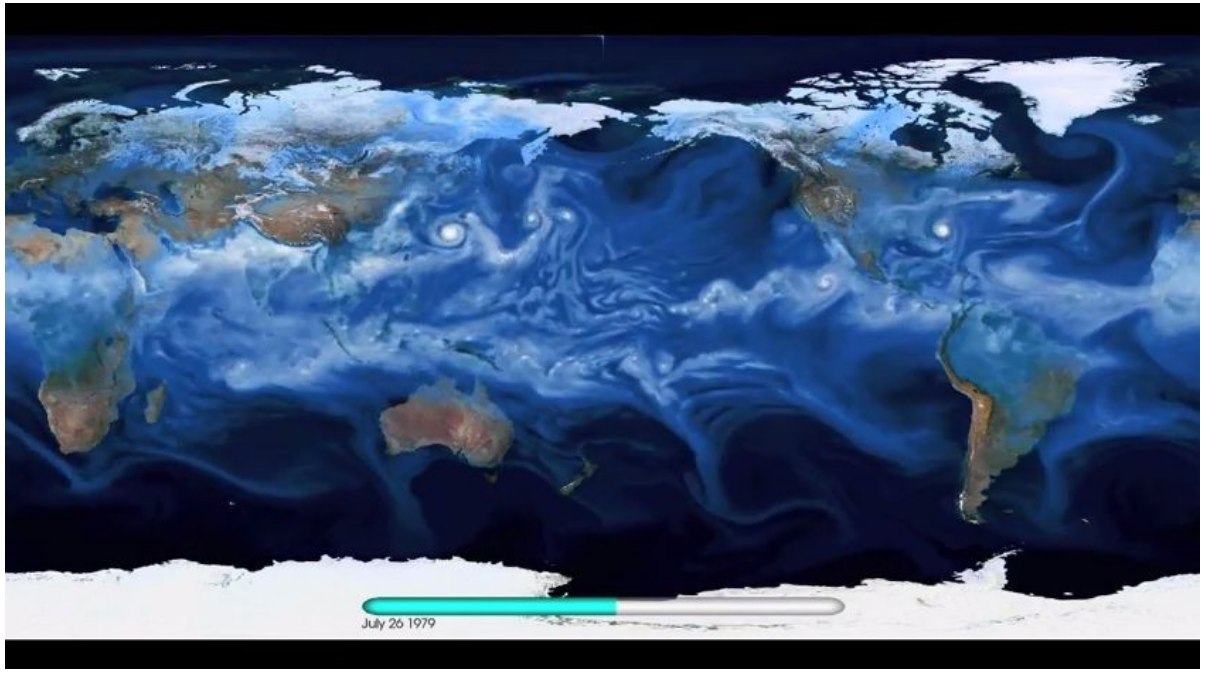


Calculating the orbital path of the SpaceX Roadster
- Created using Poliastro (Python)



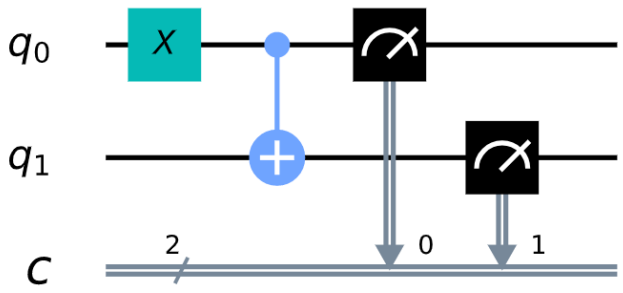
Shooting 2GeV muons at a lead shielded melon
- Created using Geant4 (C++)

Physical simulations



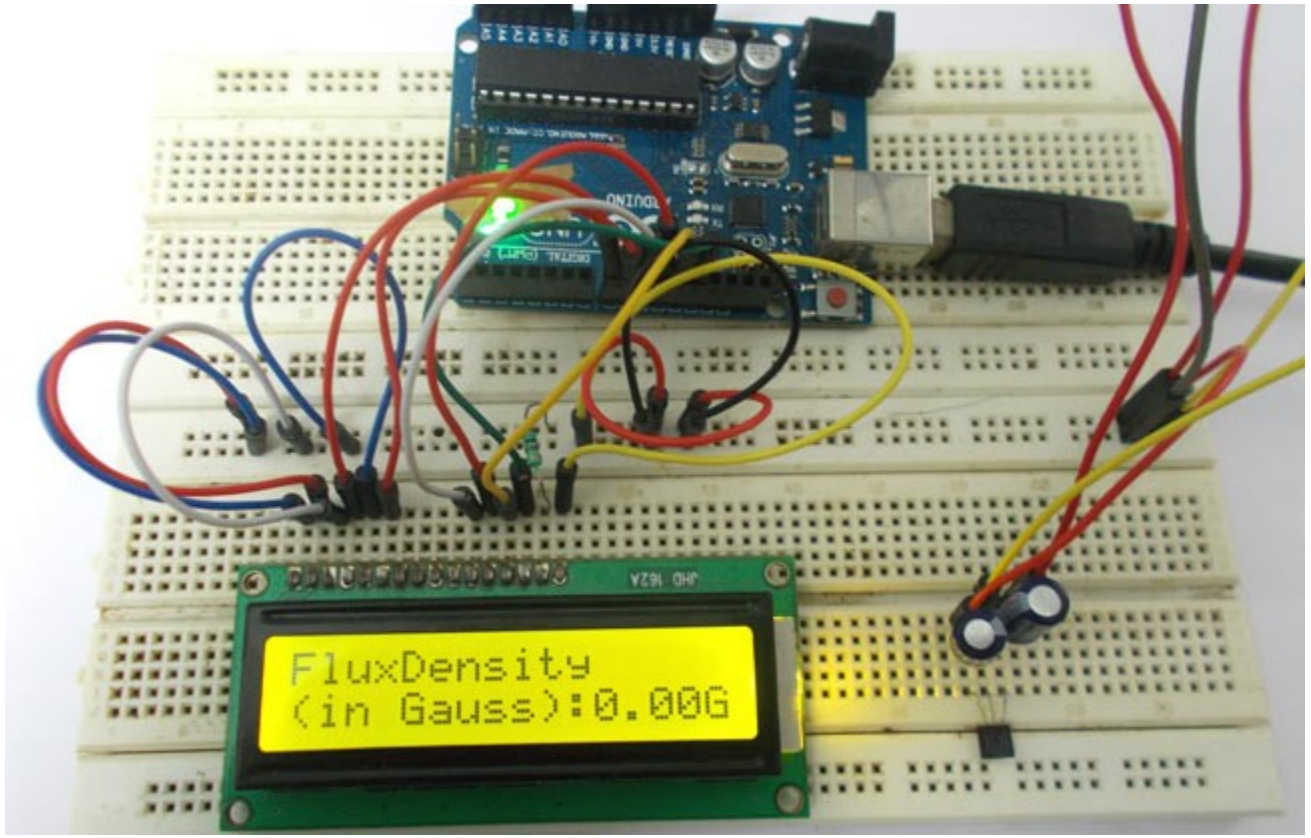
Total column water vapour
- CAM5.1 model (fortran)

```
qc = QuantumCircuit(2,2)
qc.x(0)
qc.cx(0,1)
qc.measure(0,0)
qc.measure(1,1)
qc.draw(output='mpl')
```



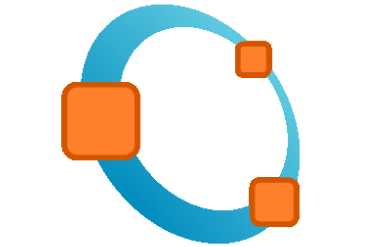
Quantum CNOT gate
- Created with Qiskit (python)

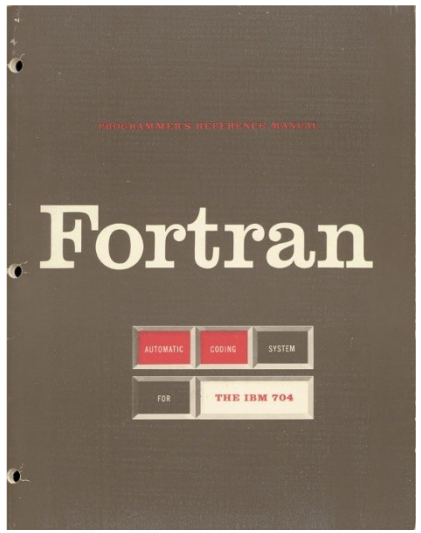
Programming devices



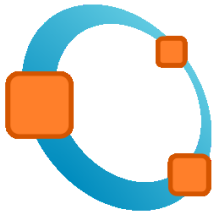
https://circuitdigest.com/microcontroller-projects/arduino-magnetic-field-measurement

Scientific programming languages





Interpreted

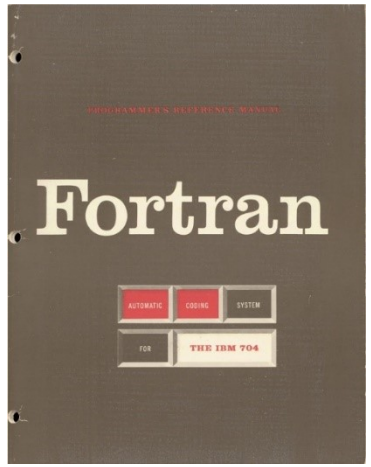


GNU Octave

IDL

Just-in-time compilation

Compiled



Interpreted

- Simple to code in
- Faster development
- Slower to run
- Adhoc analysis
- Experimentation

Just-in-time compilation

Compiled

- More complex languages
- Slower development
- Faster to run
- Large simulations
- Bottleneck processes

Choosing

1. First language -> local help
2. Research community / specialist packages

Choosing

1. First language -> local help
2. Research community / specialist packages
3. Online help
4. General packages

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1. First language -> local help
2. Research community / specialist packages
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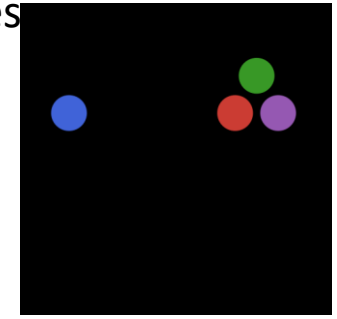
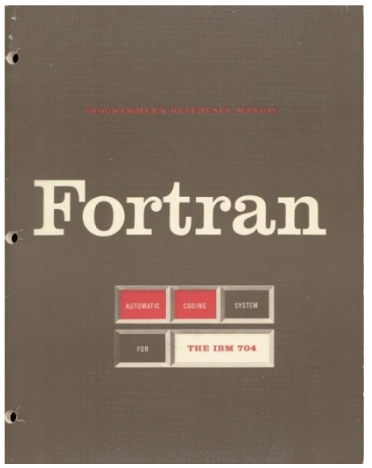
4. General packages
5. Run speed requirements





Choosing

1. First language -> local help
2. Research community / specialist packages
3. Online help
4. General packages
5. Run speed requirements
6. Cost and transferability

Jupyter

- Over to the jupyter notebook