

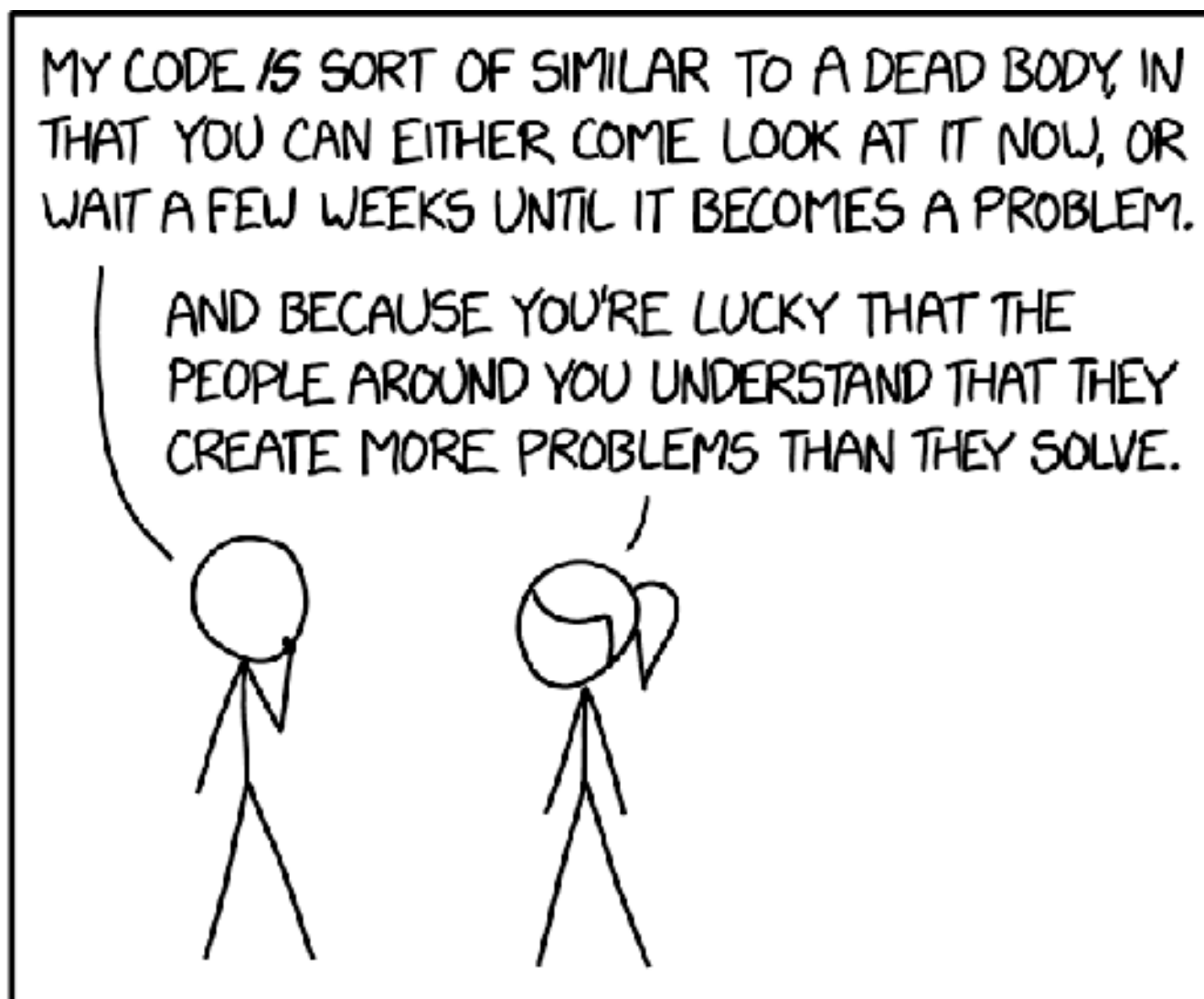
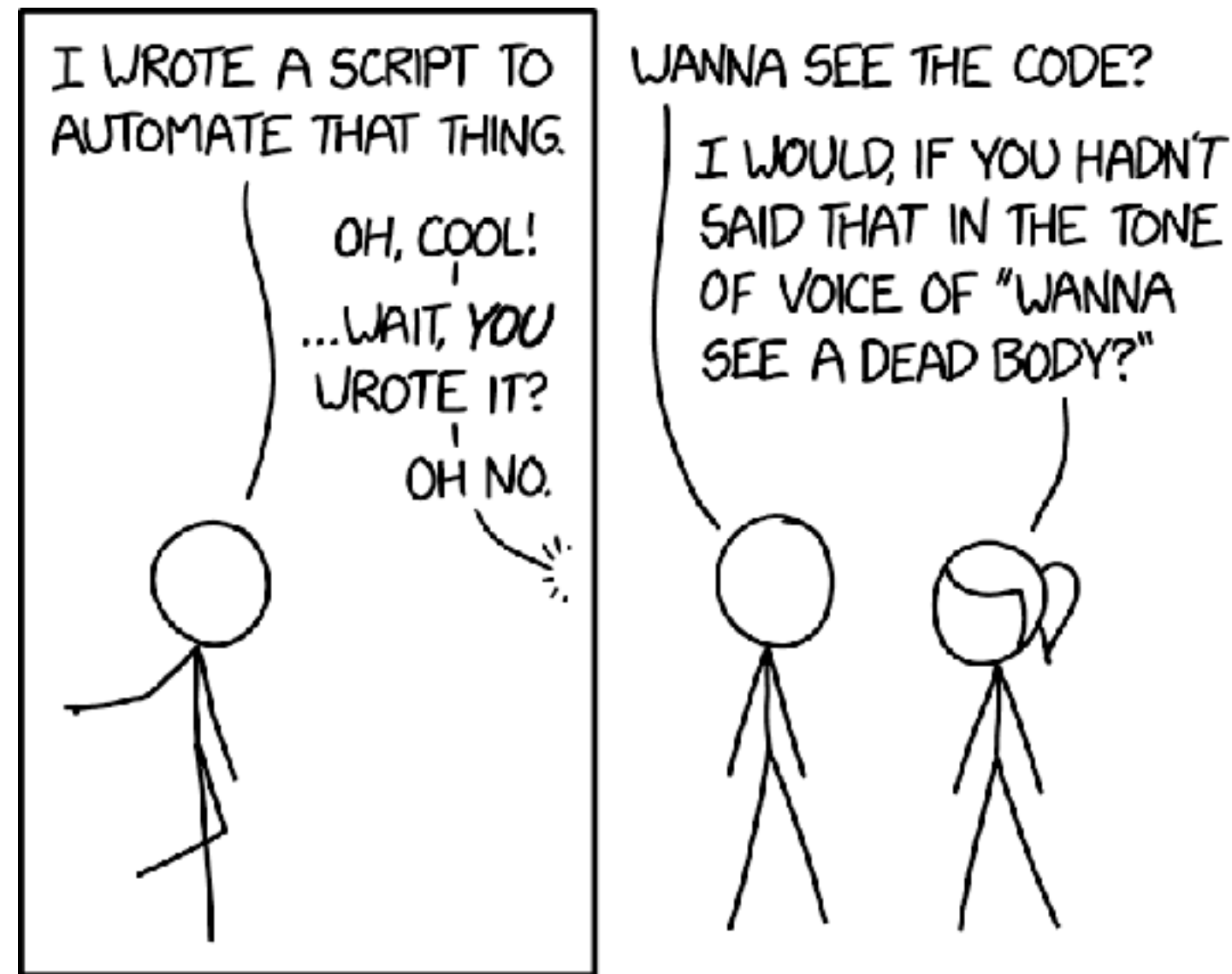
Scientific Computing in Astrophysics

Fall 2021

Imad Pasha & Marla Geha

Course Overview

Developing a Programming Toolkit



- The **goal** of this course is to practice the fundamental algorithmic underpinnings of astronomy-oriented tasks, and to introduce a set of techniques and packages you can add to your tool box when carrying out research.
- Good research skills include
 - Quickly installing and learning new tools
 - Knowing how to build nested, complex, yet reproducible and robust code
 - Knowing how to debug your code and parse errors (and find the relevant solutions)

Developing a Programming Toolkit



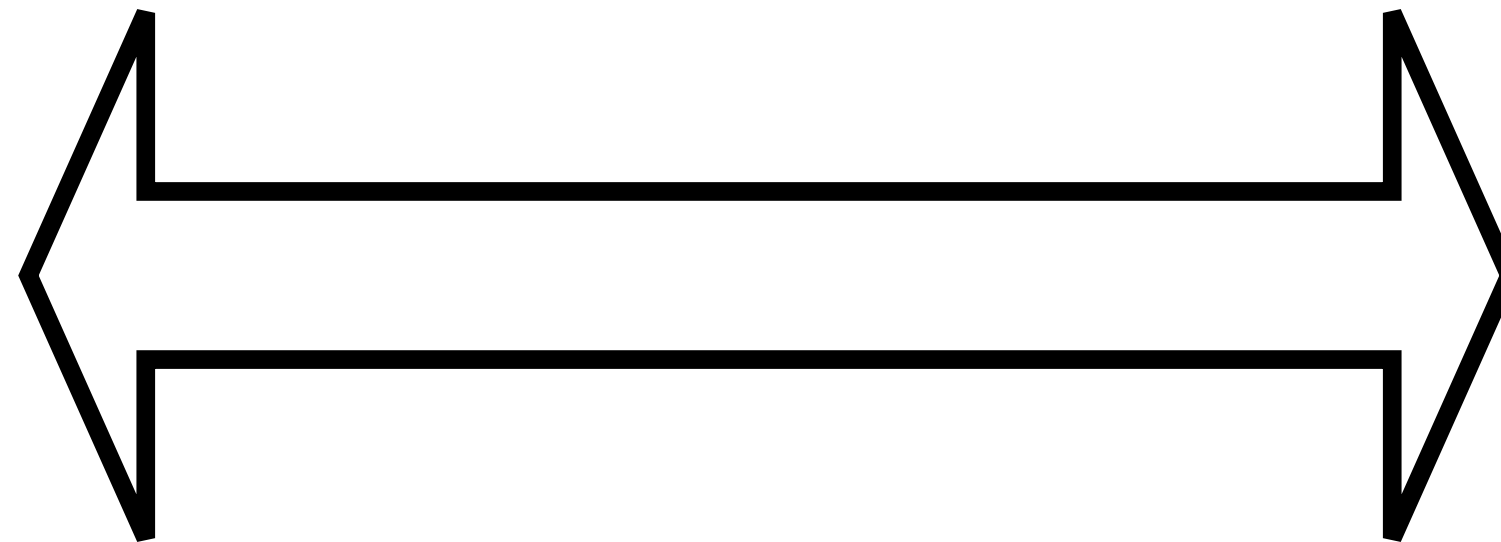
What We'll Cover

- **The System.** Developing comfort with UNIX, bash_profiles, environment variables, paths, PYTHONPATHs, installing code (beyond pip), compiling code from FORTRAN/C.
- **The Programming.** Your actual code. Structure. Objects and Classes. Functions. Writing modules.
- **Maintenance and Distribution.** Version control (git), hosting (github), installing your own modules (pip/PyPI)

Synergy between Coding and Science

{Programming Principles}

- Functional code
- Object oriented code
- Modules and packages
- Efficient / vectorized code
- Special libraries



Scientific Needs

- Image analysis
- Multidimensional data
- Simulation Data
- Spectroscopy
- Large catalogs

Course Structure

Course Structure

Lectures
(1.5 / week)

*Introduce course concepts
Pair coding exercises*

Lab
(1/week)

*Involved programming
assignment, started in-class*

Guest Lectures
(1/week)

Talks by experts in the field

Hack Day
(1 / semester)

*Build a short project
from scratch*

Class Projects
(~several / semester)

*Contribute to a class-wide
collaborative code project*

Final Projects

*Build a substantive piece of code
and present it to the class*

Course Structure

Monday

Lectures
(1.5 / week)

*Introduce course concepts
Pair coding exercises*

Wednesday

Lab
(1/week)

*Involved programming
assignment, started in-class*

Psets Due

Friday*

Guest Lectures
(1/week)

Talks by experts in the field

*Lecture/lab for first
few weeks

Talks held on zoom

Problem Sets (labs)

- We will use (and re-use) a lot of data throughout the semester. You don't want to be pushing those hunky data files to GitHub or copying them around from directory to directory.
- Therefore, we suggest you organize your code something like the following

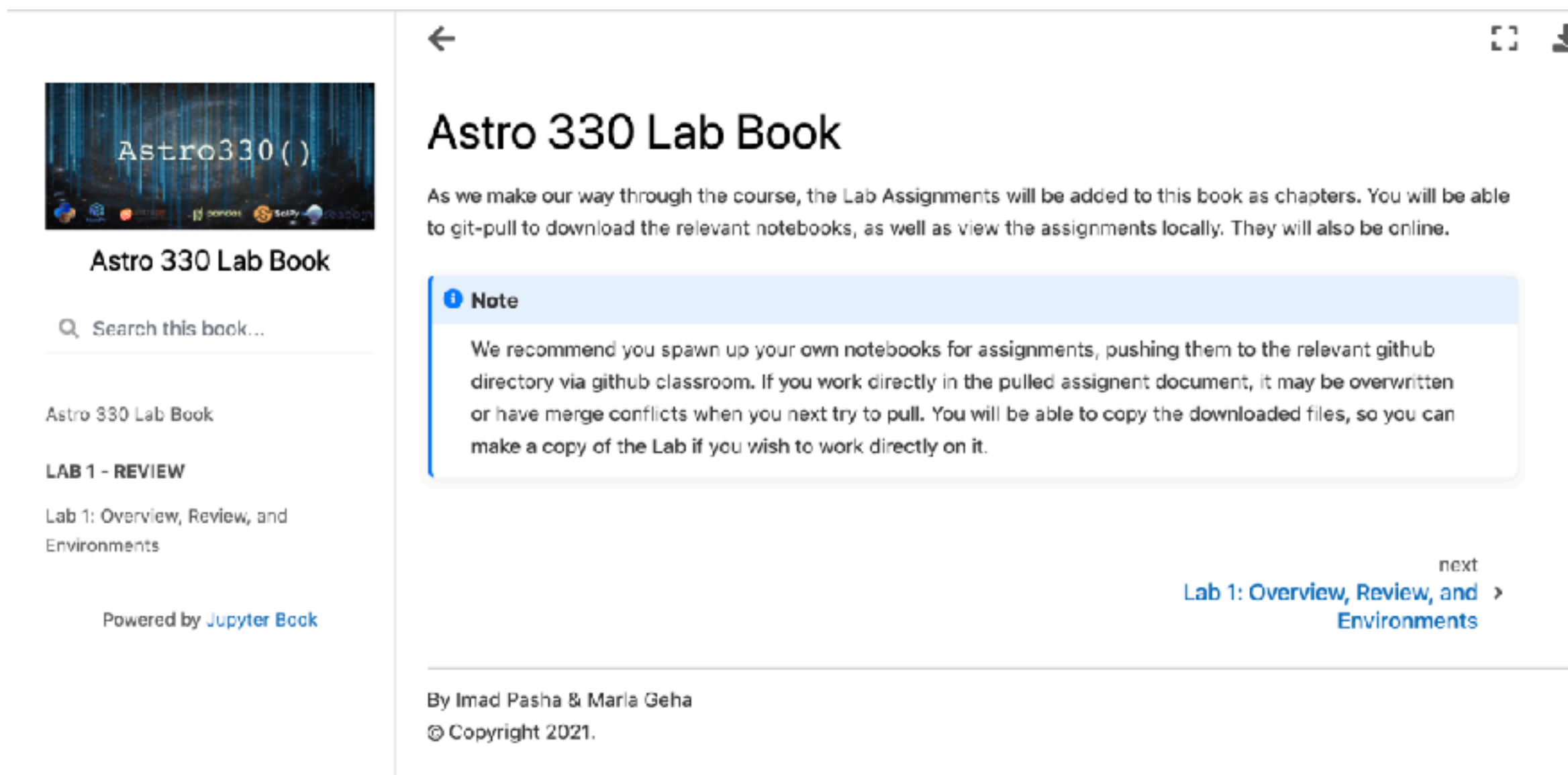
```
User@computer:ls
```

```
|—Astro330_code/  
|   |—ps1/  
|   |—ps2/  
|—Astro330_data/  
|   |—HST/  
|   |—Kepler/
```

You will git pull assignments within the `Astro330_code/` folder, work on them, and push/submit them. Meanwhile, you can point your code to `../..Astro330_data/` to use relevant data in your assignments. Consider setting an environment variable!

Problem Sets (labs)

- View nicely formatted lab at website



The screenshot shows the Astro 330 Lab Book website. On the left is a sidebar with a book cover titled 'Astro330()' and a search bar. The main content area is titled 'Astro 330 Lab Book' and contains a note about spawning notebooks via GitHub Classroom. At the bottom, it says 'By Imad Pasha & Marla Geha' and '© Copyright 2021.' A 'next' link points to 'Lab 1: Overview, Review, and Environments'.

Astro 330 Lab Book

Search this book...

Astro 330 Lab Book

LAB 1 - REVIEW

Lab 1: Overview, Review, and Environments

Powered by Jupyter Book

Astro 330 Lab Book

As we make our way through the course, the Lab Assignments will be added to this book as chapters. You will be able to git-pull to download the relevant notebooks, as well as view the assignments locally. They will also be online.

Note

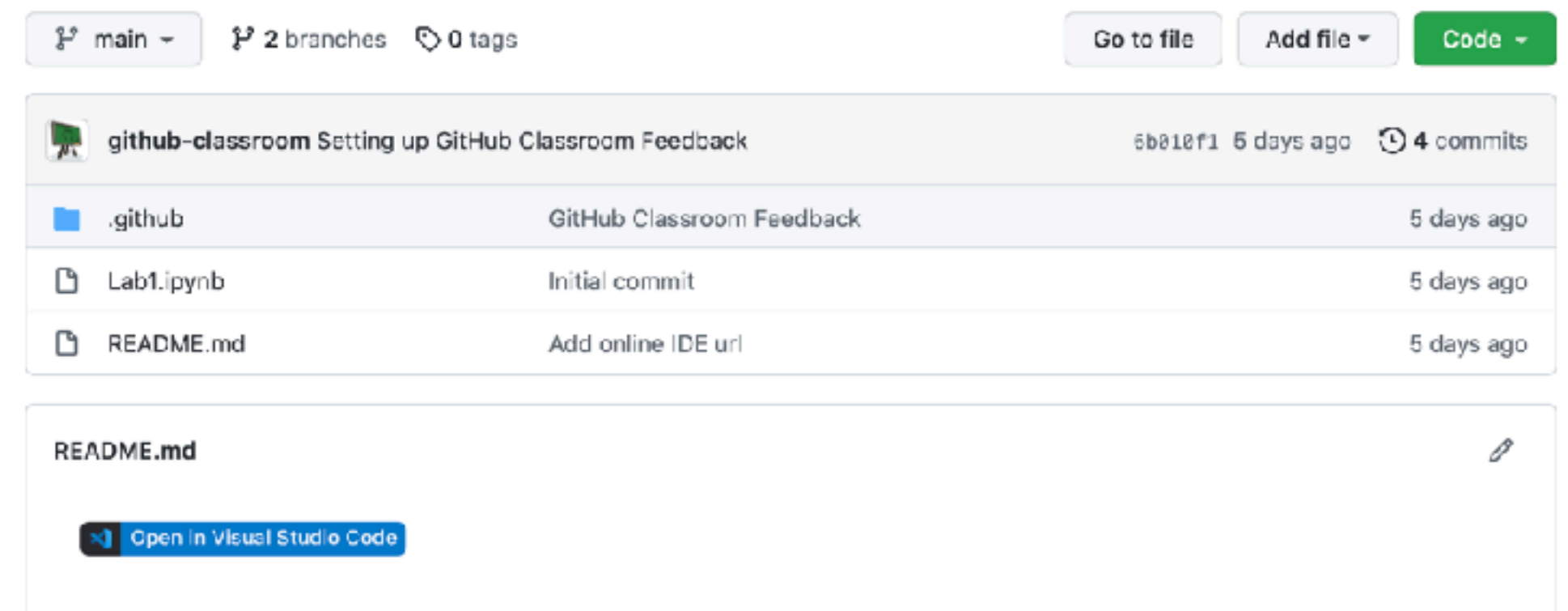
We recommend you spawn up your own notebooks for assignments, pushing them to the relevant github directory via github classroom. If you work directly in the pulled assignment document, it may be overwritten or have merge conflicts when you next try to pull. You will be able to copy the downloaded files, so you can make a copy of the Lab if you wish to work directly on it.

next
[Lab 1: Overview, Review, and Environments](#) >

By Imad Pasha & Marla Geha
© Copyright 2021.

astro-330.github.io

- Use assignment link to make lab repo, then pull > work > push back



The screenshot shows a GitHub repository for 'github-classroom'. It has 2 branches and 0 tags. The repository contains a file named 'Lab1.ipynb' and a 'README.md' file. The 'README.md' file has a button to 'Open in Visual Studio Code'.

main 2 branches 0 tags

Go to file Add file Code

github-classroom Setting up GitHub Classroom Feedback 6b810f1 5 days ago 4 commits

.github	GitHub Classroom Feedback	5 days ago
Lab1.ipynb	Initial commit	5 days ago
README.md	Add online IDE url	5 days ago

README.md

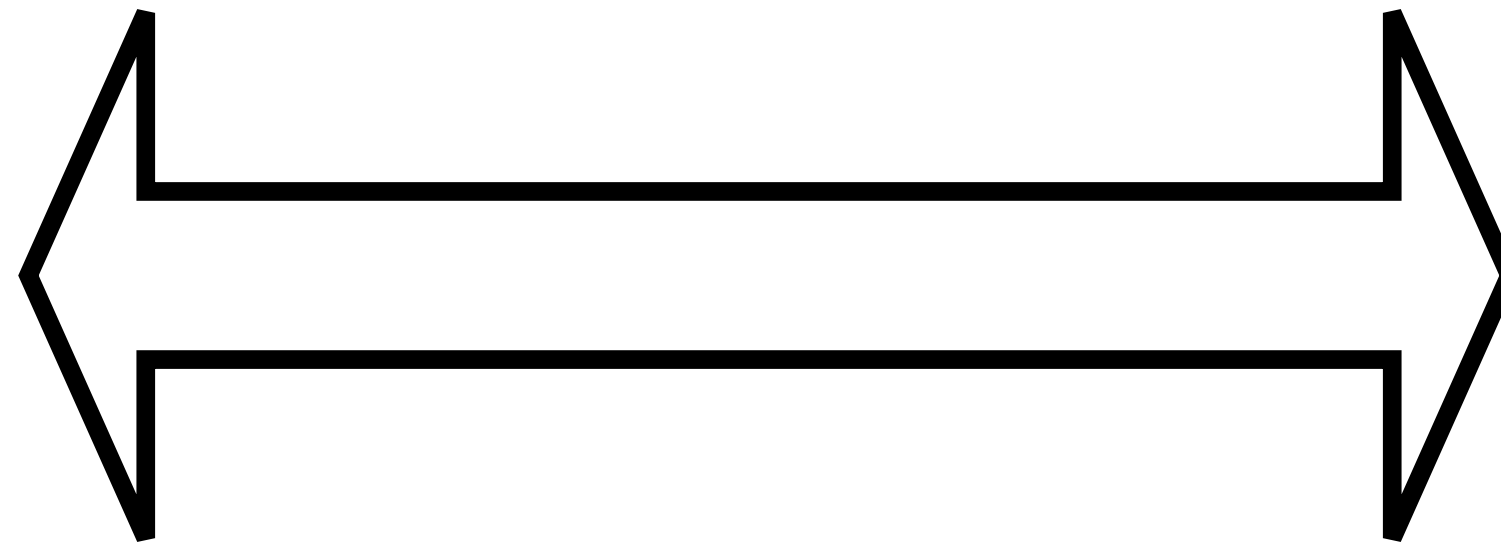
Open in Visual Studio Code

Semester Roadmap

Synergy between Coding and Science

{Programming Principles}

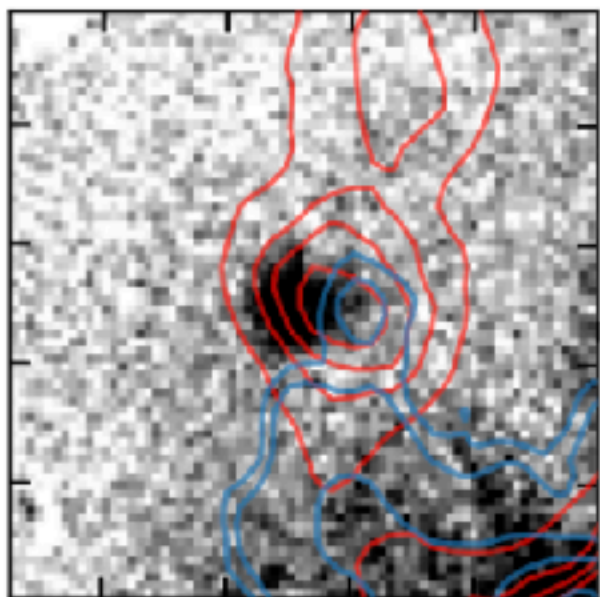
Functional code
Object oriented code
Modules and packages
Efficient / vectorized code
Special libraries



Scientific Needs

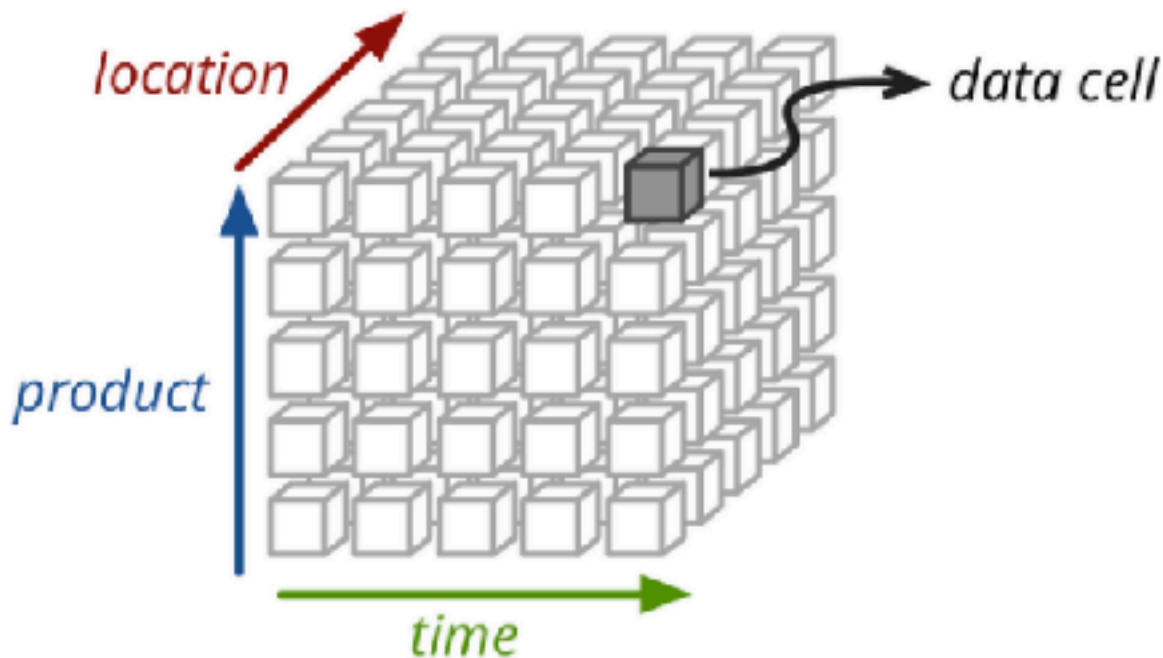
Image analysis
Multidimensional data
Simulation Data
Spectroscopy
Large catalogs

Science Topics



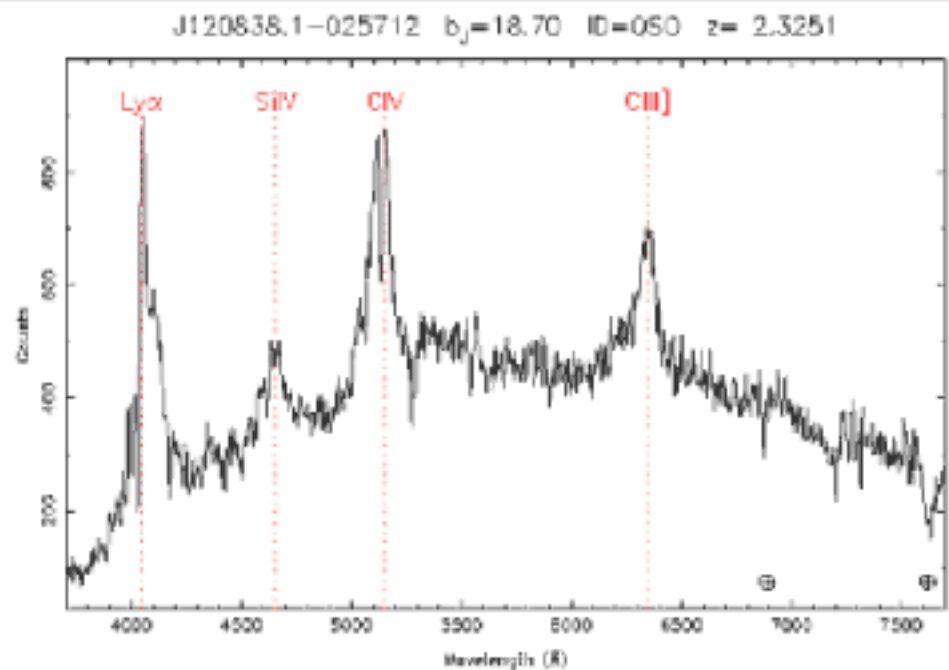
Imaging Data Analysis

Functional Programming Object Oriented Programming



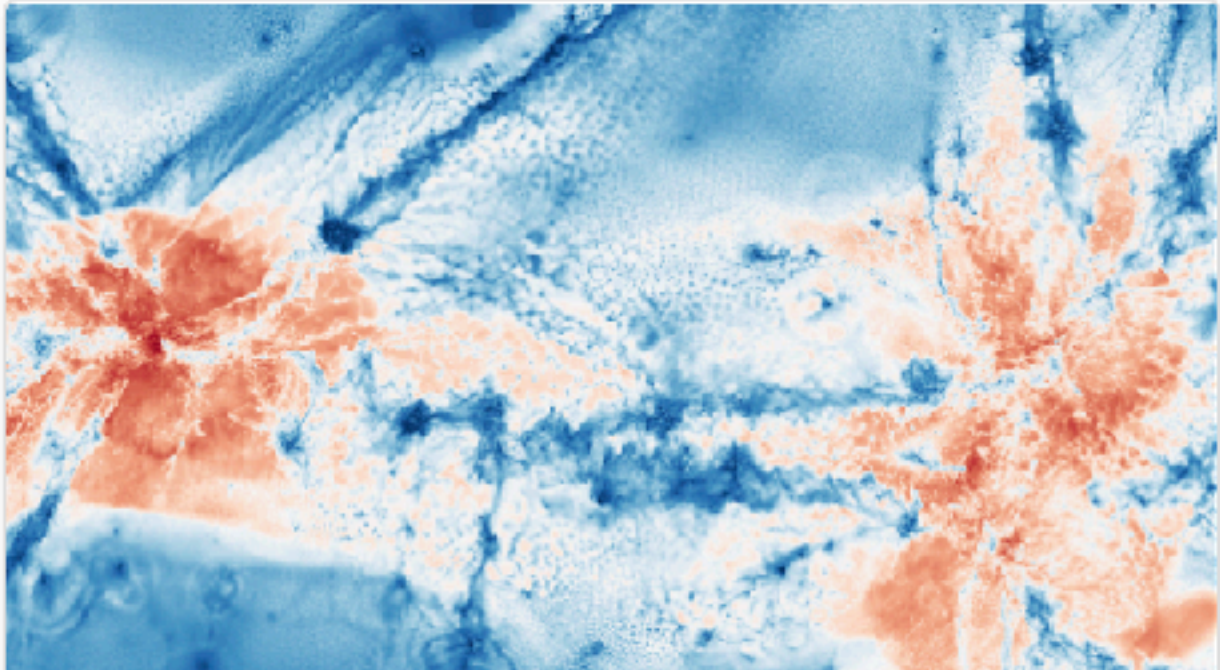
Cube Data Analysis

Functional Programming Object Oriented Programming



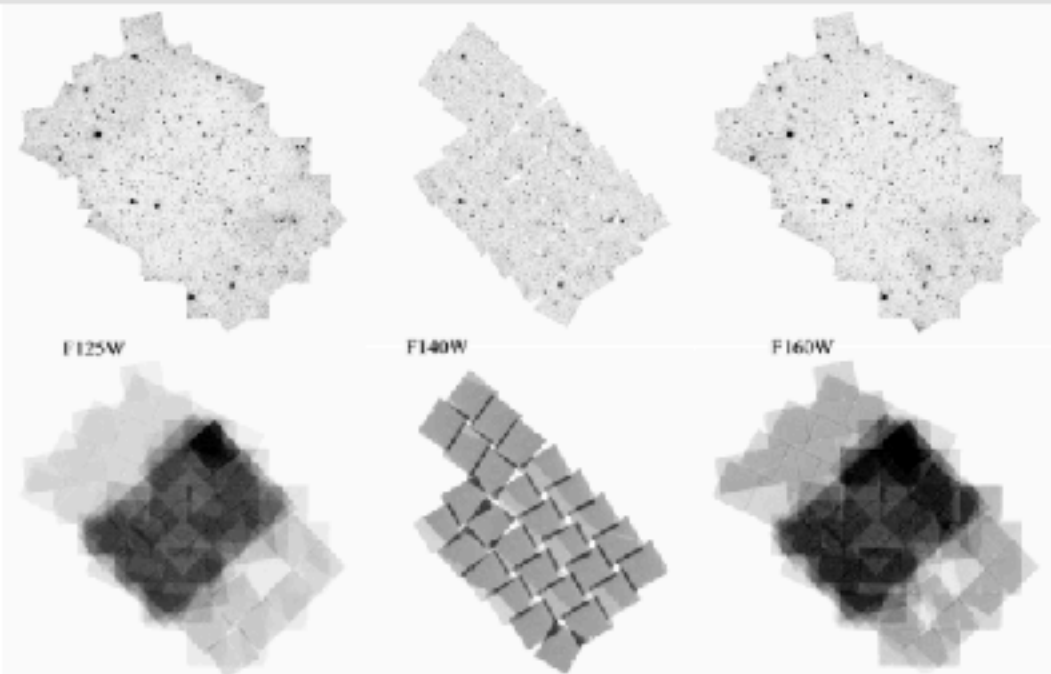
Spectroscopic Data Analysis

Functional Programming Object Oriented Programming



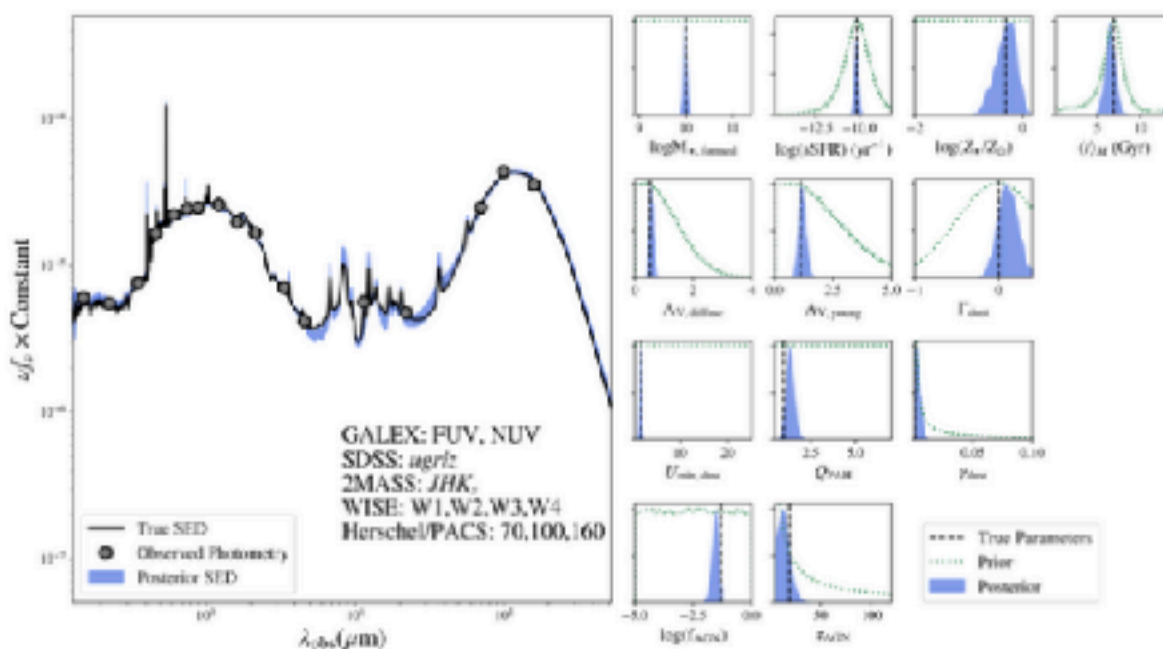
Simulation Data Analysis

Data Wrangling Functional Programming



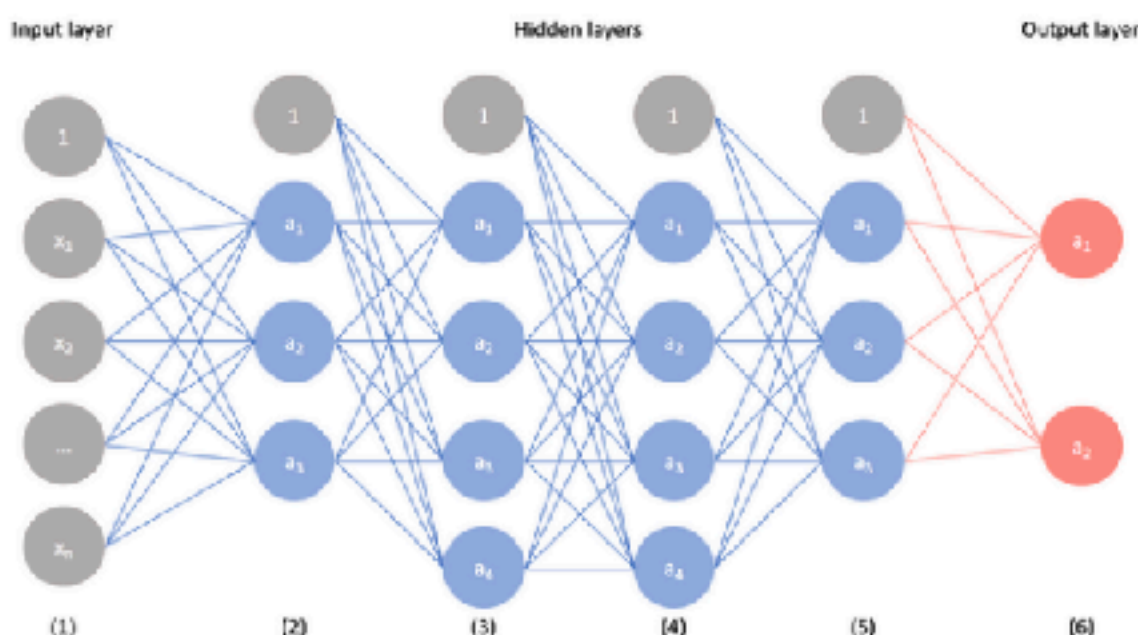
Catalog / Database Analysis

Data Wrangling Package Creation

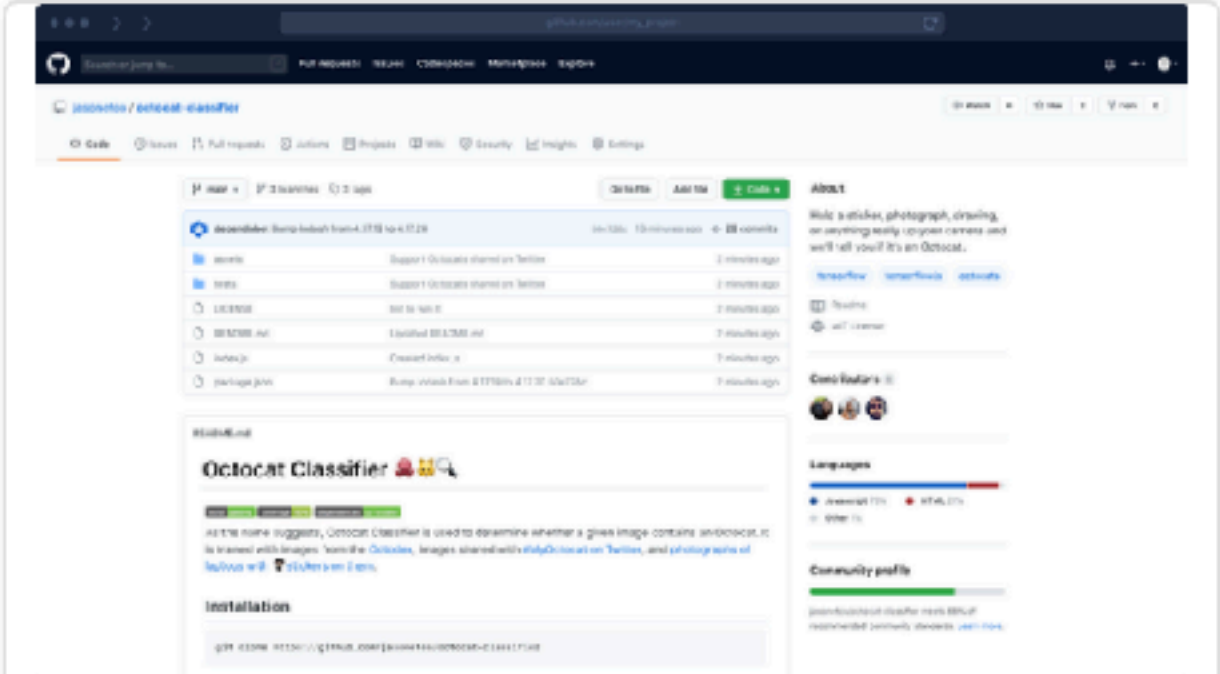


Bayesian Inference

Data Wrangling Package Creation Object Oriented

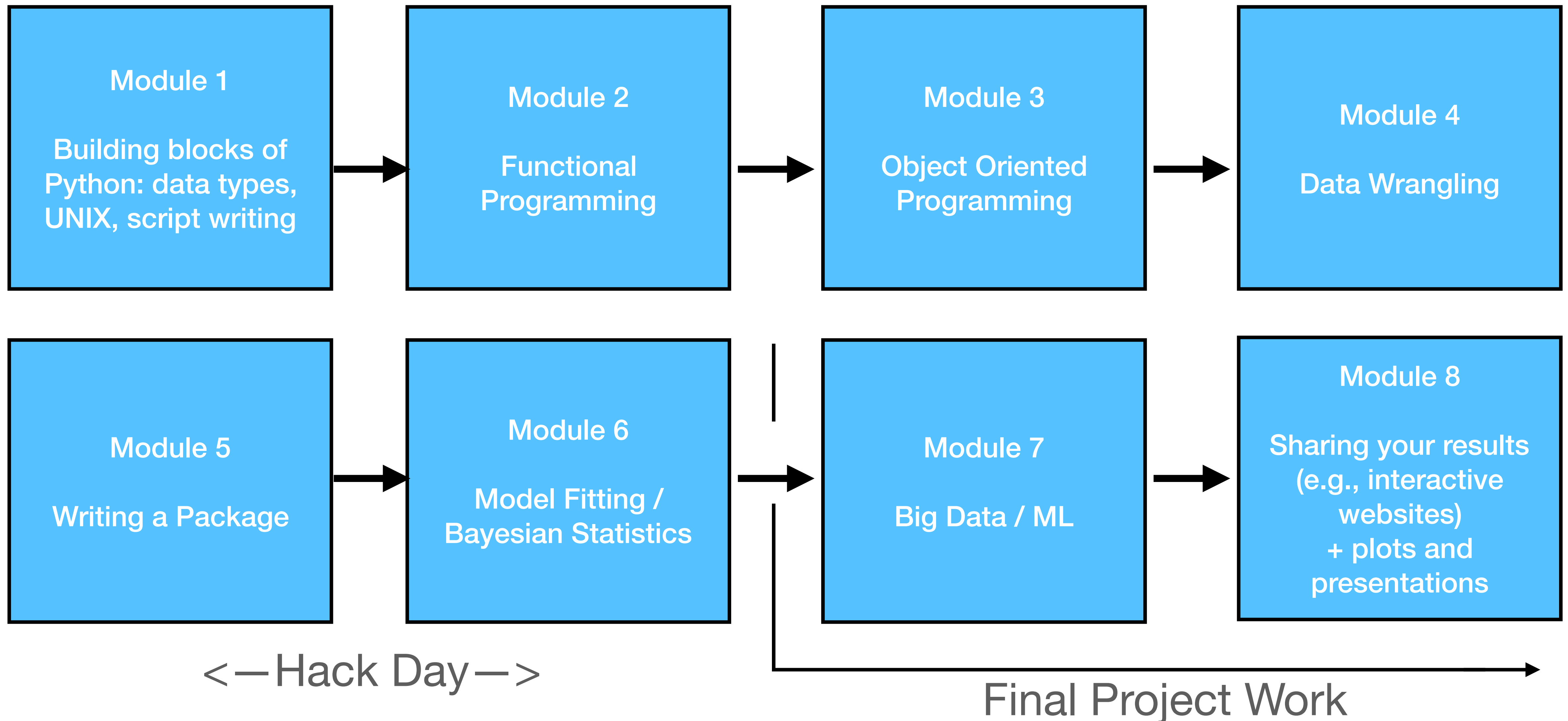


Machine Learning



Scientific Software Development

Semester Roadmap



Semester Roadmap

