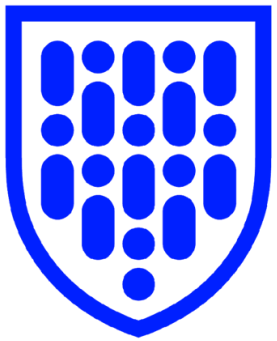

Institute of Data

2021

Data Science and AI

Module 1
Part 2:

Python for Data Science

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Agenda: Module 1 Part 2

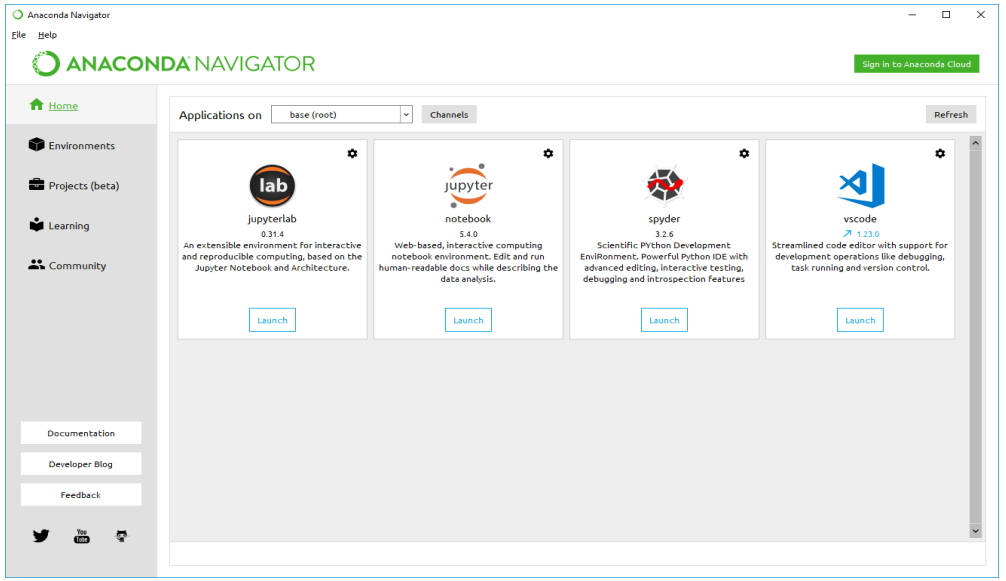
- Python Fundamentals
- Software Engineering Best Practices
- Using Git & GitHub for Version Control

Python versions: 2.7 vs 3.x

- version 2.x
  - large code base
  - last version = 2.7 (no more releases!)
- version 3.x
  - *print* is a function
  - raising & catching exceptions
  - integer division (2.x truncates; 3.x converts to float)
  - short → long integers
  - octal constants: 0*nnn* → 0o*nnn*
  - unicode strings
  - …

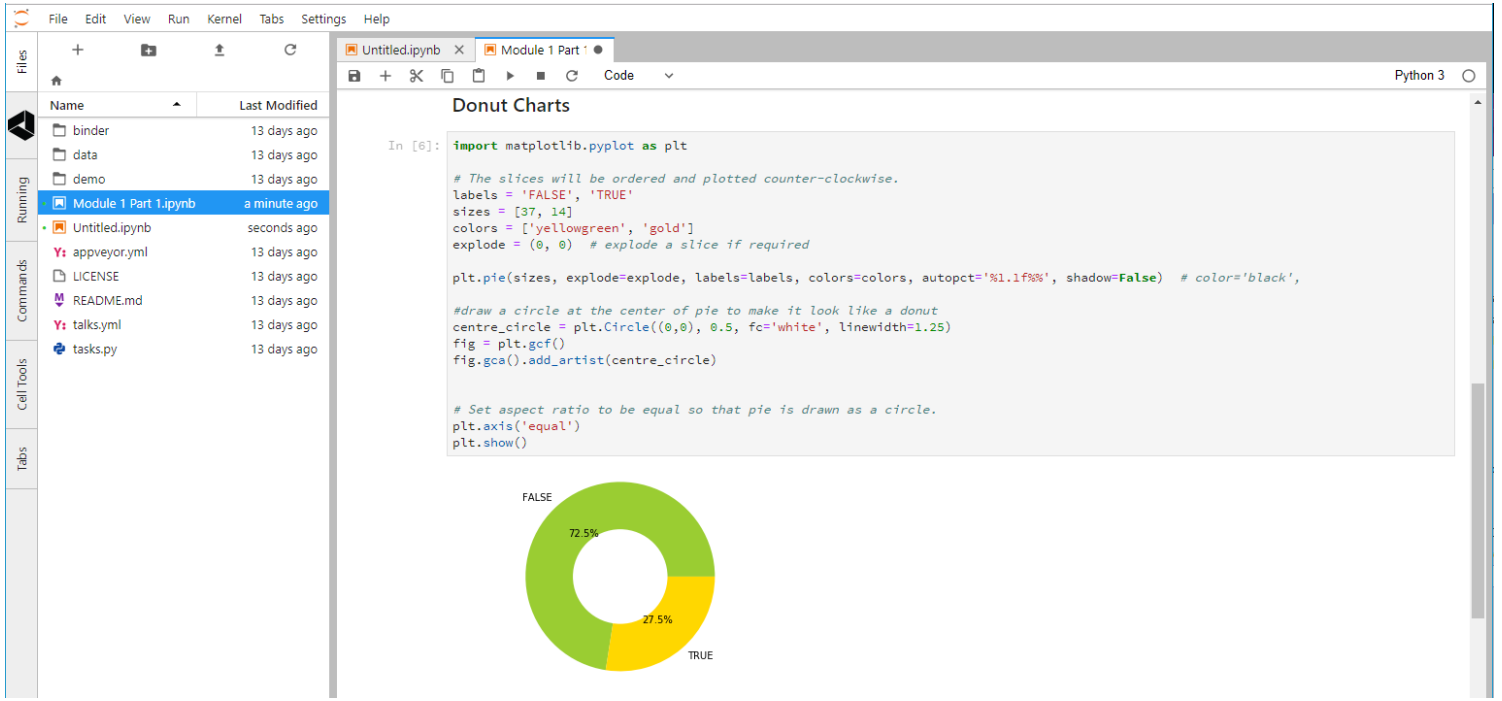
Developing and running Python

- Jupyter notebook
- Visual Studio Code (VSC)
  - VSC now has built-in Jupyter notebook support
- Jupyter Lab
- Command prompt
- Anaconda
  - Anaconda distribution is **the recommended way** to configure and manage your Python development and running environment(s).



Jupyter Notebooks

- shareable
- environment-based
- interactive or batch execution
- > 40 languages
  - Python, R, Scala, …
- Big Data support
  - Spark



Generic Data Types

Numeric	Text	Other
integer • signed, unsigned	character • unicode	Boolean • true, false Binary • 2^n
floating-point (‘float’) • double = 2 x float	string • character array • 0-based *or* 1-based • null-terminated *or* length-encoded • usually immutable in OOP	unassigned • null • NA undefined • NA • +, – infinity
complex • 2 x double (real, imaginary)	document • key-value pairs (JSON strings)	BLOB • images, video • signals

Classes

```
class phasor:
    def __init__(self, r=0, p=0):
        self.r = r
        self.p = p
    def real(self):
        return (self.r * math.cos(self.p))
    def imag(self):
        return (self.r * math.sin(self.p))

z = phasor(2.7, 0.4 * math.pi)
```

- 2 underscores before/after init
- the **self** parameter is not explicitly mapped to the function call

Pandas

- high-performance, easy-to-use data structures and data analysis tools
  - DataFrame class
  - IO tools
  - data alignment
  - handling of missing data
  - manipulating data sets
    - reshaping, pivoting
    - slicing, dicing, subsetting
    - merging, joining

```
import pandas as pd
```

https://pandas.pydata.org/

Scikit-learn

- biggest library of ML functions for Python
  - classification
  - regression
  - clustering
  - dimensional reduction
  - model selection & tuning
  - preprocessing

$ pip install -U scikit-learn

or

$ conda install scikit-learn

http://scikit-learn.org/stable/

Other Python Packages for Data Science

- statsmodels
  - statistical modelling & testing
  - R-style formulae

```
import statsmodels.api as sm
import statsmodels.formula.api as smf
```

- BeautifulSoup
  - reading & parsing XML & HTML data

```
from bs4 import BeautifulSoup
```

- Natural Language Toolkit
  - tokenising, tagging, analysing text

```
import nltk
```

Lab 1.2.1: Numpy

1. Explain the following NumPy methods and create working examples in Jupyter notebook using the data created for you in the beginning of the Lab notebook:

2. Structure your code using functions (prepare to discuss the value of using functions).

- ndim
- shape
- Size
- itemsize
- data
- linspace
- mean
- min

- max
- cumsum
- std
- sum

...

3. Stretch exercise. Use matplotlib to explore the data

Lab 1.2.2: Pandas

1. Explore and download Employee Attrition file from Kaggle (https://www.kaggle.com/HRAnalyticRepository/employee-attrition-data)
2. Explain the following Pandas methods and create working examples in the lab Jupyter notebook.
3. Structure your code using functions (prepare to discuss the value of using functions.

- read_csv
- describe
- loc
- iloc
- index
- sort_index
- set_index
- sample
- …

4. Stretch exercise. Use matplot to explore some of the data in the data frame

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Software Engineering Best Practices

- Object-Oriented Programming
- Refactoring
- Coding for readability
- Coding for testability
- Documenting

Object-Oriented Programming

- an *object* encapsulates
  - data (*attributes*)
  - procedures (*methods*)
- a *class* is a prototype for an object
  - *instantiation*: creating an object (in memory) from a class definition

def: **encapsulation**

- attributes of the class should only be accessible by methods of the class
  - get()
  - set()

Creating and Using a Class in Python

```
class myclass:
    def __init__(self, param1, …):
        # initialise class attributes

    def method1(self, ):
        # do something
        return (method1result)


obj1 = myclass(arg1, …)
```

- define class by name
  - initialisation code
    - only **self** is mandatory
    - may use arguments passed from caller
  - define methods
    - only **self** is mandatory
    - may use arguments passed from caller
    - may use attributes
    - may return a value

- invoke class name in assignment to instantiate an object
    - omit **self**

Other OOP Concepts

def: **abstraction**

- data and procedures that do not need to be accessible to the caller should be hidden within the class

def: **inheritance**

- new classes can be based on and extend an existing class

def: **polymorphism**

- a class can implement multiple methods with the same name and function, but which operate on different parameters (type and/or number)

Refactoring

def: Restructuring existing code without changing its behaviour

Examples

- abstract reused code to functions
  - generalise functions (polymorphism?)
- use get, set methods
- simplify structure of nested loops, logic
- minimise use of global variables
  - in Python, this includes all variables defined in main program

Coding for Readability (Maintainability)

Examples

- indent blocks
  - mandatory in Python
- white space
  - between groups of lines
  - between symbols
- comments: inline (to explain logic, return values, etc.)
  - sectional (to explain functional blocks)
  - header (to explain program or module)
    - purpose, authors, date
    - dependences, assumptions

- comments are for coders
  - maintaining or extending your code
- documentation is for users
  - explaining what the application is for and how to use it

Coding for Testability

Examples

- avoid side-effects in functions
- enable testing via compiler flags

```
##define TEST_MODE
#if TEST_MODE
print("test mode activated")
#endif
```

- write tests *before* functions
  - specify return type(s) supported
  - test return type(s), validity
  - pass sample data as arguments
  - print result

- test *frequently*
  - avoid marathon coding sessions
- code top-down
  - create wireframe code to test logic, structures
  - fill in the details later

pytest

https://docs.pytest.org/en/latest/

Questions?

Appendices

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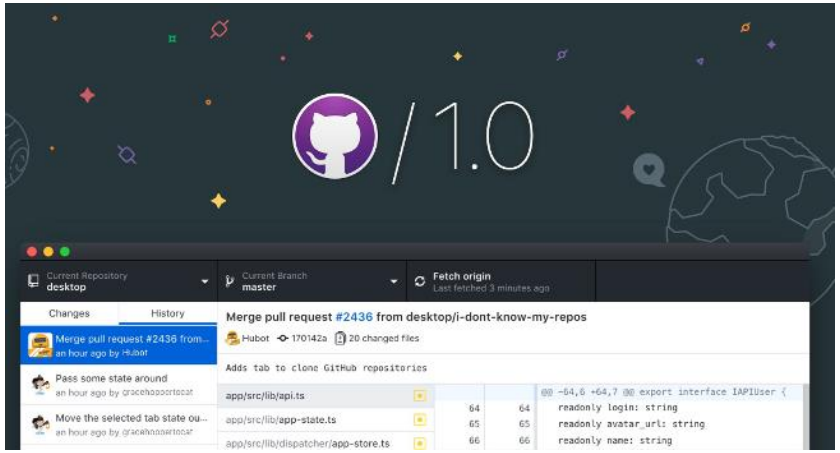
Version Control with Git & GitHub

- Forking
- Cloning
- Communicating issues
- Managing notifications
- Creating branches
- Making commits
- Introducing changes with Pull Requests

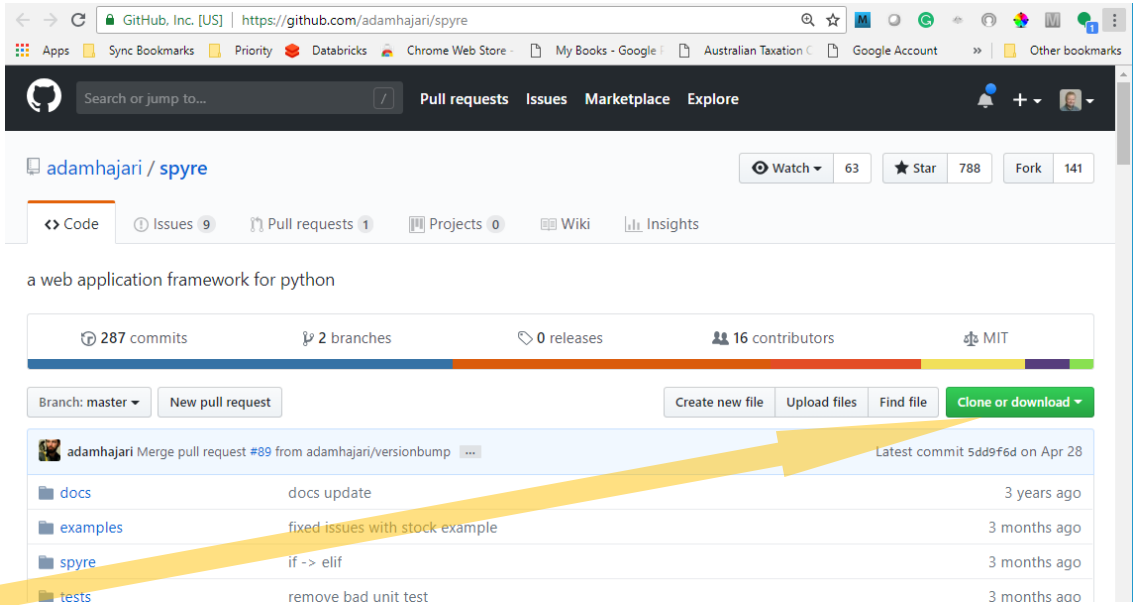
Git & GitHub

- web-based, API
- host code, data, resources
- version control
  - integrates with open-source and commercial IDE tools
- share, collaborate
  - branching
- showcase achievements
- command line & desktop versions



GitHub: Forking & Cloning a Repo

- *fork:* make your own copy of someone else's repo, on GitHub
  1. click <Fork>
- *clone:* create a (working) copy of the repo on your computer

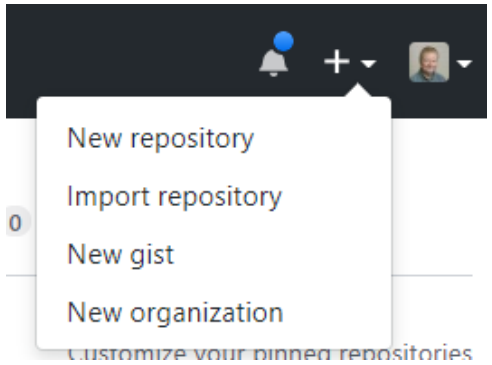


- GitHub Desktop procedure:
  1. click <Clone or download>
  2. click <Open in Desktop>
  3. navigate to target (local) folder
  4. click <Clone>

- command-line procedure:
  1. $ cd yourpath
  2. $ git clone https://github.com/yourgithubname/yourgithubrepo

GitHub: Creating a New Repo

- from your GitHub home page
  1. <New repository>
  2. clone the repo to your local drive
  3. copy files, folders into it
  4. commit changes
  5. generate a *pull* request

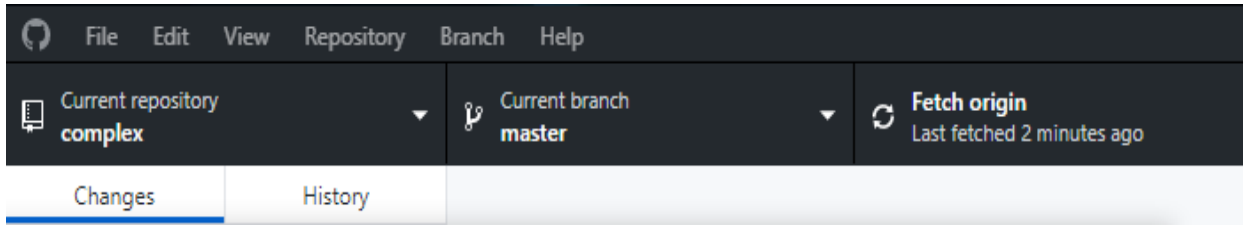


- Creating a branch
  - to allow development in isolation from source repo
    - protects your changes from changes to source
    - rejoin main branch when ready

GitHub: Refreshing Local Repo from Source

Desktop

- <Fetch origin>



Command-line

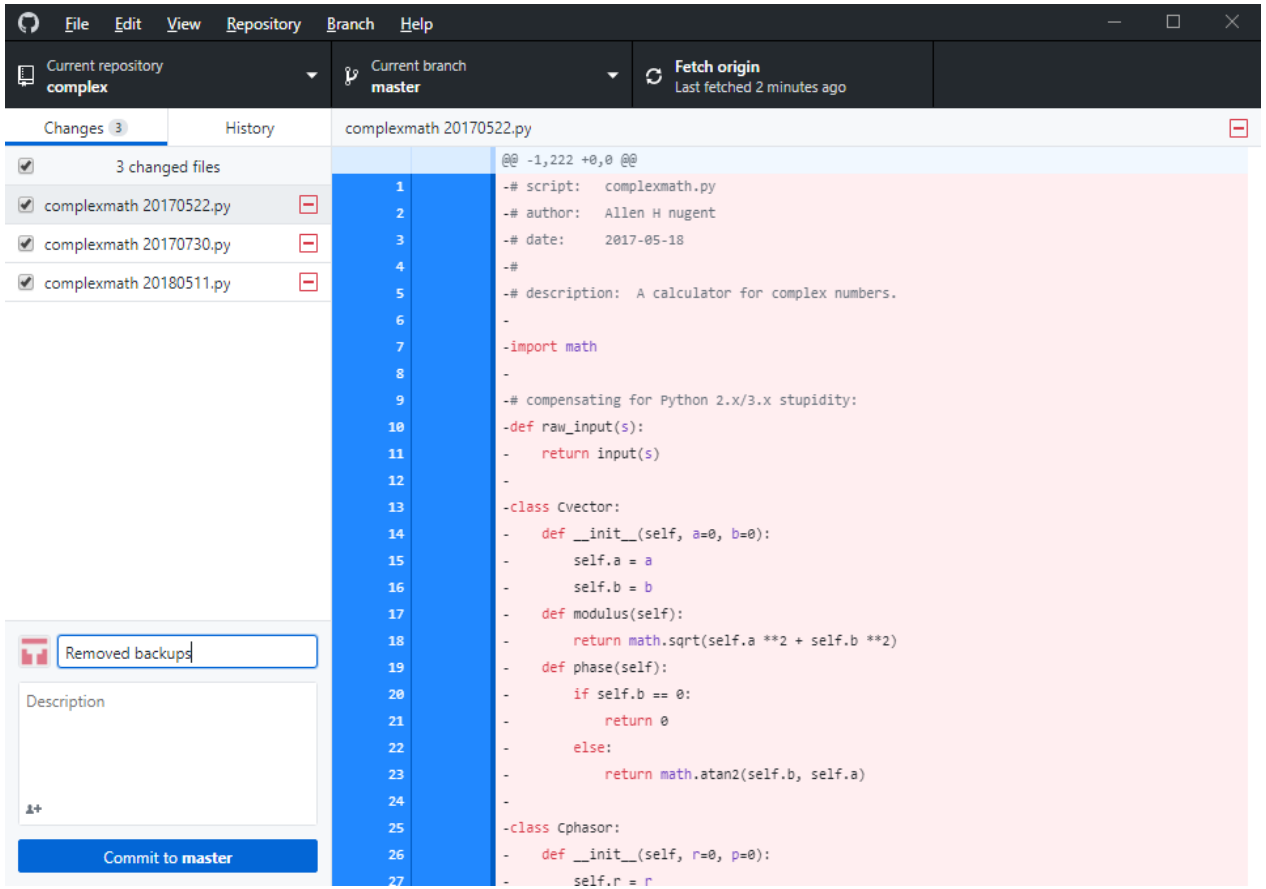
```
$ git checkout master
$ git fetch upstream
$ git merge upstream/master
```

- Ensure you're in the master branch
- Grab the latest changes from the master
- Merge the master changes with your repo

GitHub: Commit & Pull Request

Desktop

- enter comments in text box
- <Commit to master>
- Repository > Push
  or
  <Push origin>



GitHub: Commit & Pull Request

Command-line

- commit

```
$ git status
$ git add filename
$ git add .
$ git commit -m your_comments
$ git status
```

- pull request

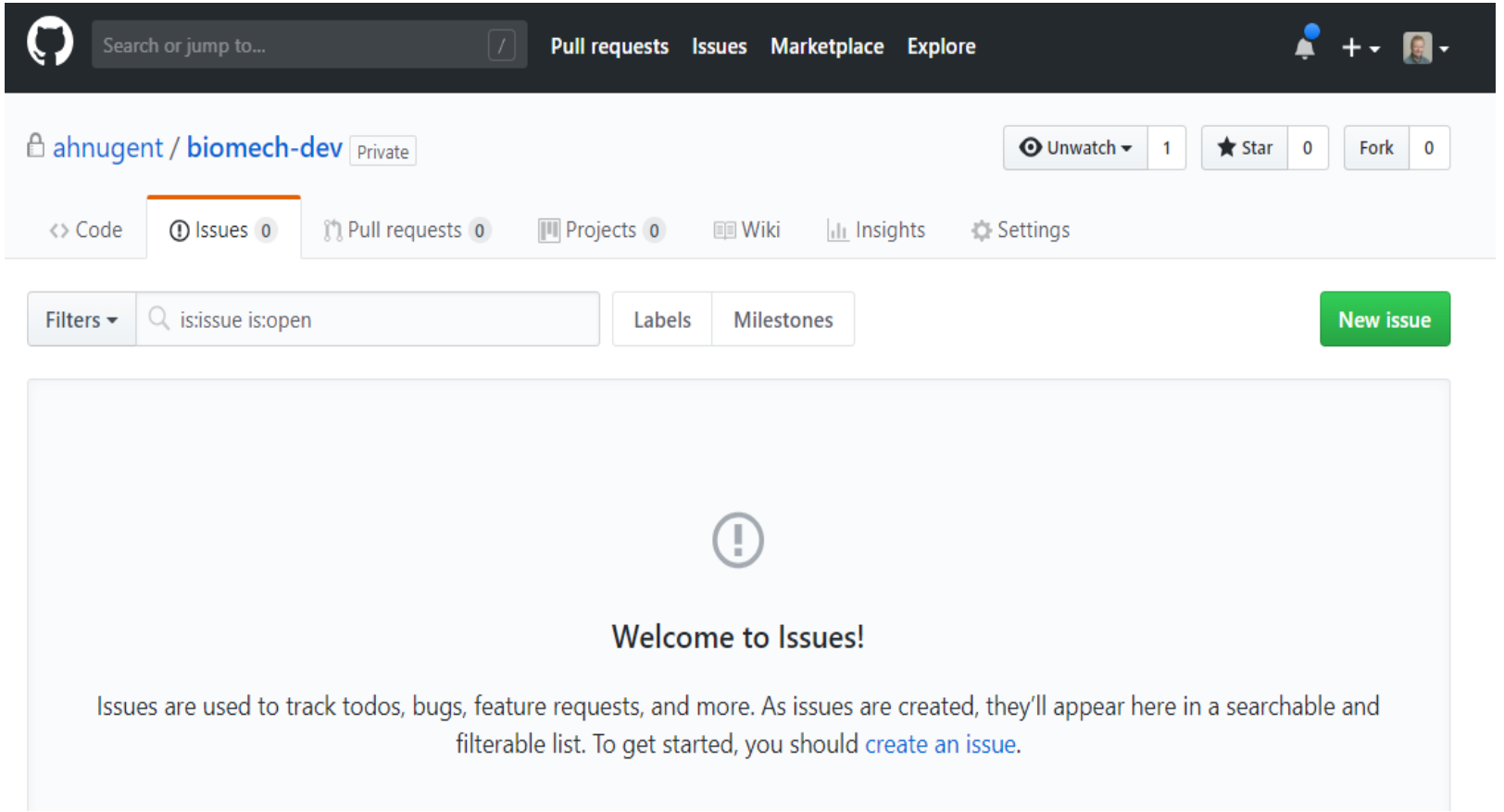
```
$ git push origin master
```

- show changes
- stage one file
- stage all change
- commit file(s), with comments

- origin = your GitHub repo (forked from source repo)
- master = source repo

GitHub: Issues

- track
  - issues / bugs
  - to-do items
  - feature requests
- search
- filter



GitHub: Notifications

Triggers

- you, a team member, or a parent team are mentioned
- you're assigned to an issue or pull request
- a comment is added in a conversation you're subscribed to
- a commit is made to a pull request you're subscribed to
- you open, comment on, or close an issue or pull request
- a review is submitted that approves or requests changes to a pull request you're subscribed to
- you or a team member are requested to review a pull request
- you or a team member are the designated owner of a file affected by a pull request
- you create or reply to a team discussion

End of Presentation!