# Getting started with AI

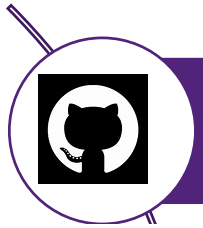
## Basic Skills & Tools

**Steffen Bollmann**
**Research Fellow**
**School of Information Technology and Electrical Engineering**

# … building AI models is easy? Right?

- Code under version control -> **basics in git**
- Most models developed in Python -> **some conda magic**
- Some models are trained in “containers” -> **docker**
- We need GPUs for training -> **Google Colab + HPC basics**

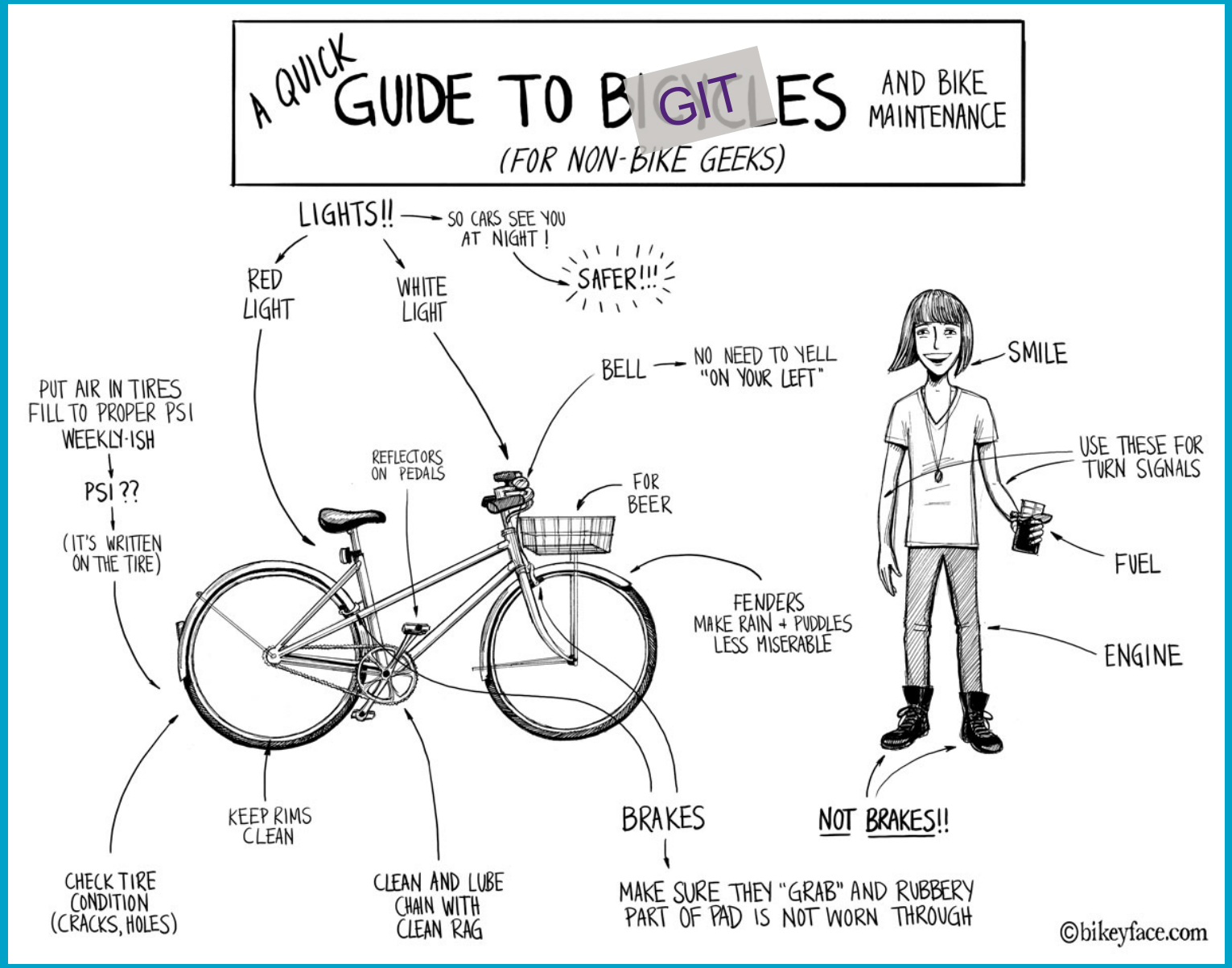
# … building AI models is easy? Right?



Code under version control -> **basics in git**

# Most git tutorials you find online:






https://bostonbiker.org/tag/comic/

1) Using code from github.com

2) Version Control for your project

Use Cases

3) Adding someone to your project

4) Contributing to a project

1) Using code from github.com

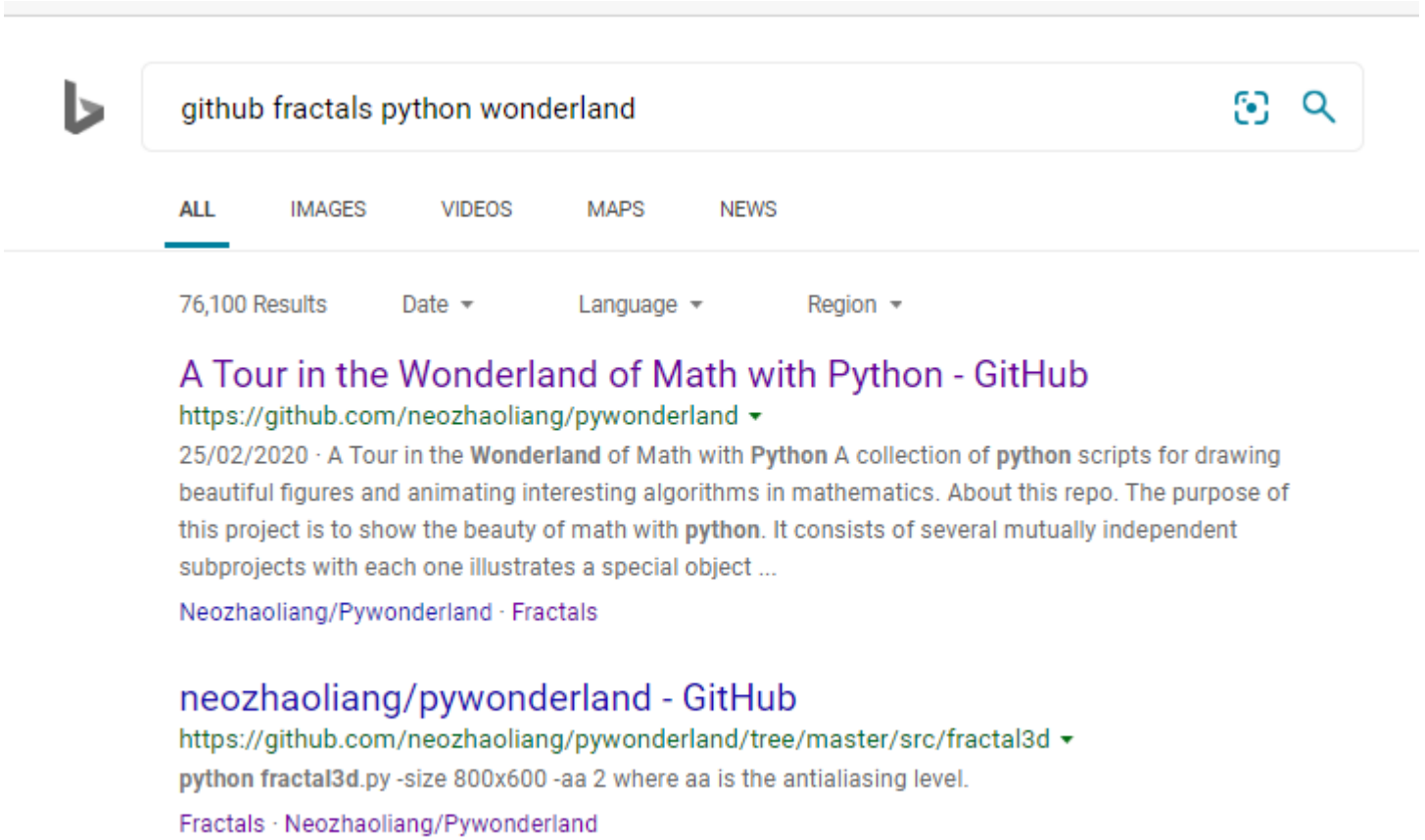
2) Version Control for your project

Use Cases

3) Adding someone to your project

4) Contributing to a project

# Example: Fractals in python



# neozhaoliang / pywonderland





A tour in the wonderland of math with python.

fractals penrose-tilings polytopes hopf-fibration reaction-diffusion coxeter-groups hopcroft domino-shuffling-algorithm coupling-from-the-past uniform-spanning-tree todd-coxeter uniform-tilings hyperbolic-tilings hyperbolic-honeycombs

396 commits 1 branch 0 packages 0 releases 5 contributors MIT



neozhaoliang update galley image — Latest commit 4437564 19 hours ago

| | | |
|---|---|---|
| src | add code for drawing vertices on coxeter planes | yesterday |
| .deepsource.toml | Add .deepsource.toml | 6 months ago |
| .gitignore | add examples for hyperbolic honeycomb code | 5 months ago |
| .travis.yml | remove python3.5 test in travis.yaml | last month |
| 120-cell.png | some minor changes | 7 months ago |
| LICENSE | delete histry commits and upload new files | 3 years ago |
| README.md | add upper half plane model | 5 days ago |
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Code Issues 0 Pull requests 0 Actions Security 0 Insights

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Branch: master New pull request Find file Clone or download

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A tour in the wonderland of math with python.

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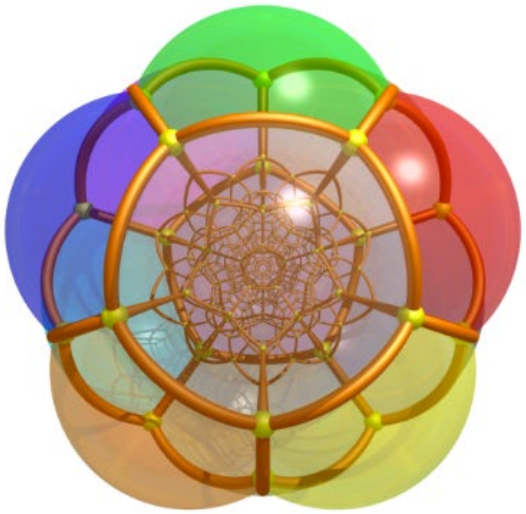
# pywonderland

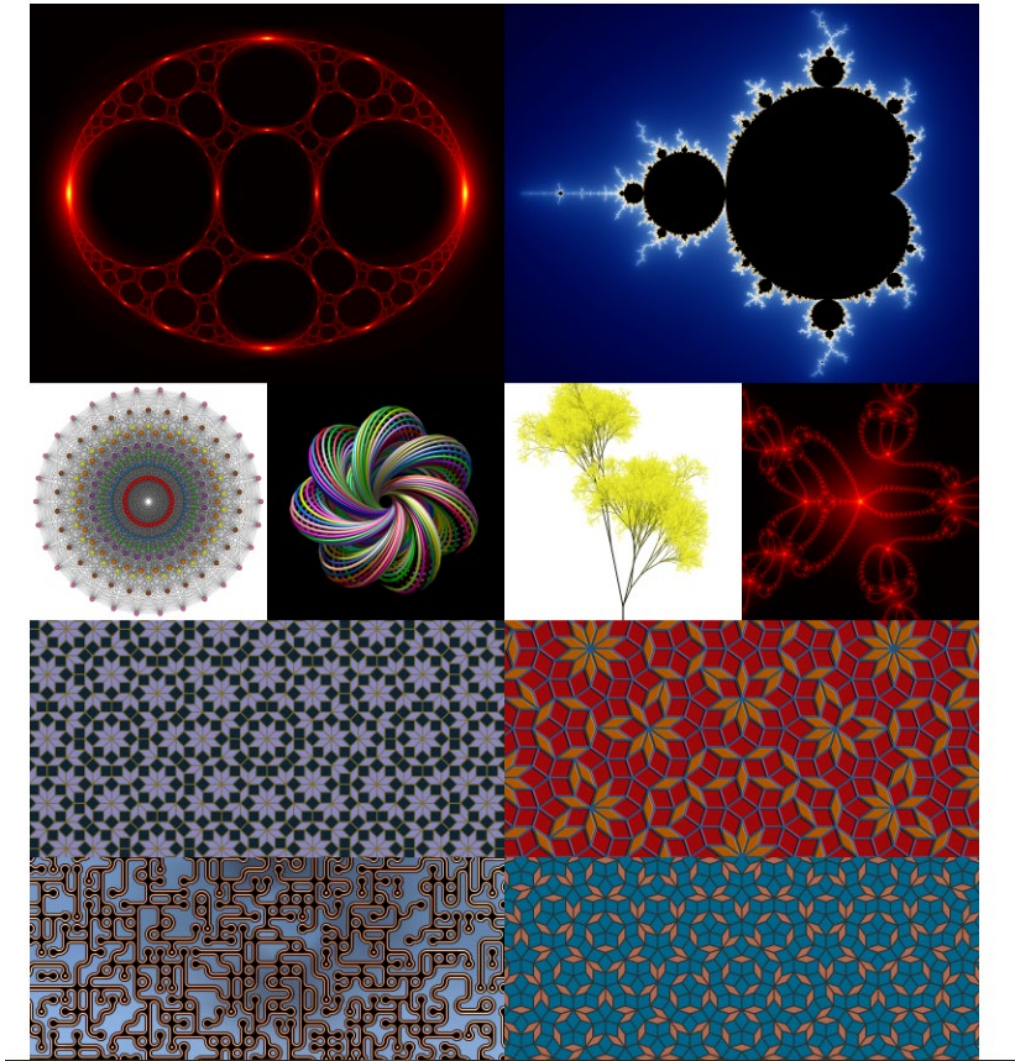
README.md



## A Tour in the Wonderland of Math with Python

> A collection of python scripts for drawing beautiful figures and animating interesting algorithms in mathematics.

build passing | license MIT | python 3.5 | 3.6



# Intermezzo I

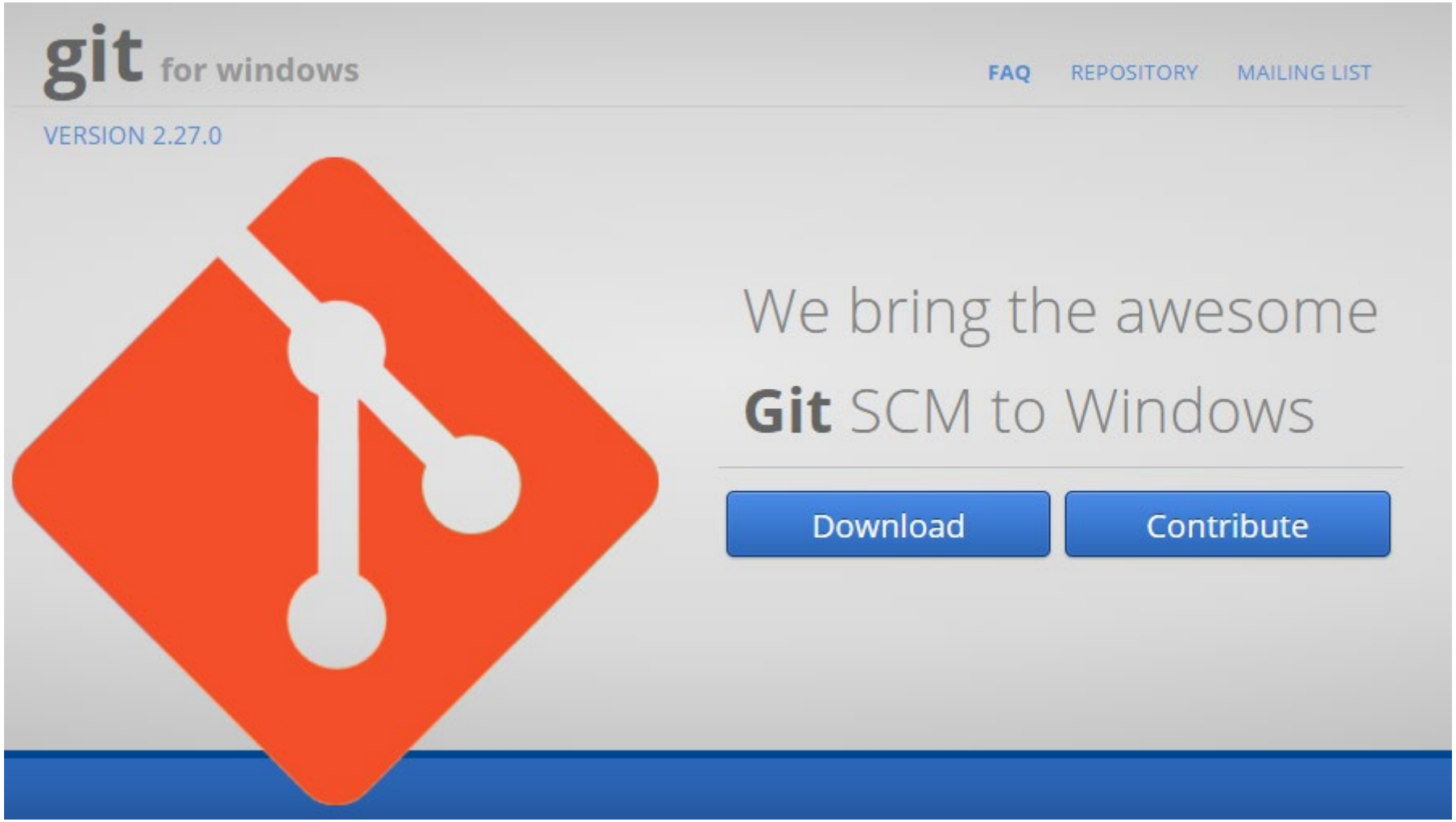
## How to install git
## (and create a nice development environment for Python)

# Ingredients for a Python IDE

- Integrated Development Environment: Visual Studio Code
- Python via miniconda
- Git

Note: Most IDEs (pycharm, matlab, RStudio) already have a git interface

# Install git (e.g. from https://gitforwindows.org/)



# Install miniconda

## Miniconda

Miniconda is a free minimal installer for conda. It is a small, bootstrap version of Anaconda that includes only conda, Python, the packages they depend on, and a small number of other useful packages, including pip, zlib and a few others. Use the `conda install command` to install 720+ additional conda packages from the Anaconda repository.

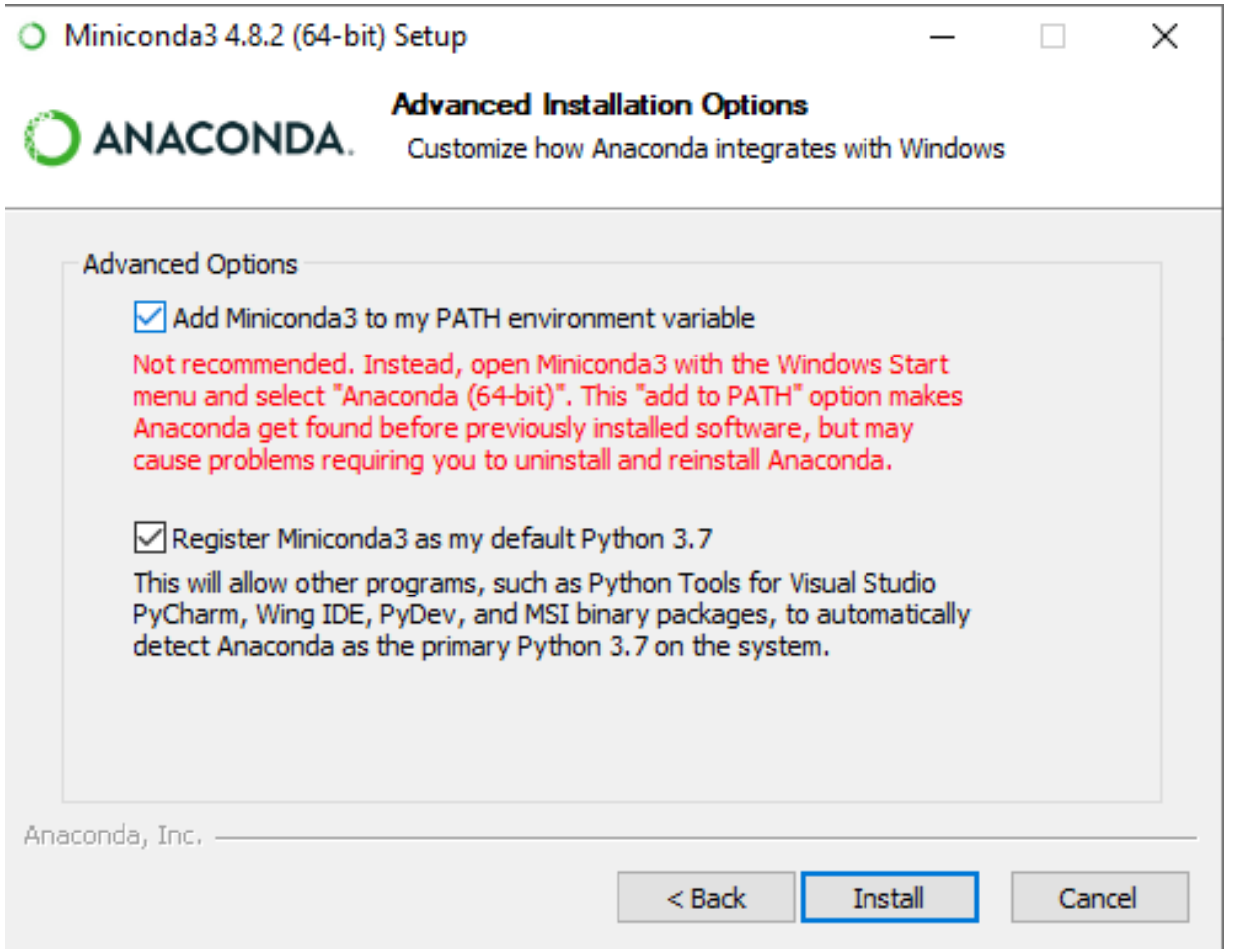
See if Miniconda is right for you.

### Windows installers

*Windows*

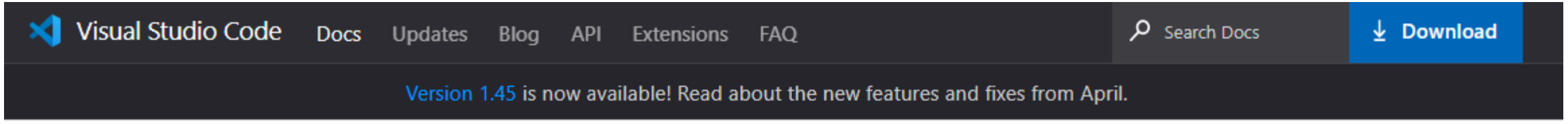
| Python version | Name | Size | SHA256 hash |
|---|---|---|---|
| Python 3.7 | Miniconda3 Windows 64-bit | 51.6 MiB | `1701955cd637d1dad5a84958fd470649b79de973d1570541eb52857664b5056c` |
| | Miniconda3 Windows 32-bit | 52.2 MiB | `ca74cb6eb0731db2b972c0fb512e29661a84c3f01ac6133121b4372eb1c41f46` |
| Python 2.7 | Miniconda2 Windows 64-bit | 50.9 MiB | `8647c54058f11842c37854edeff4d20bc1fbdad8b88d9d34d76fda1630e64846` |
| | Miniconda2 Windows 32-bit | 48.7 MiB | `0d106228d6a4610b599df965dd6d9bb659329a17e3d693e3274b20291a7c6f94` |

# Add to system path



# Install Visual Studio Code (portable version if no admin privileges)

https://code.visualstudio.com/docs/editor/portable




Overview

SETUP

GET STARTED

USER GUIDE

- Basic Editing
- Extension Marketplace
- IntelliSense
- Code Navigation
- Refactoring
- Debugging
- Version Control
- Working with GitHub
- Integrated Terminal

## Portable Mode

Edit

Visual Studio Code supports Portable mode. This mode enables all data created and maintained by VS Code to live near itself, so it can be moved around across environments.

This mode also provides a way to set the installation folder location for VS Code extensions, useful for corporate environments that prevent extensions from being installed in the Windows AppData folder.

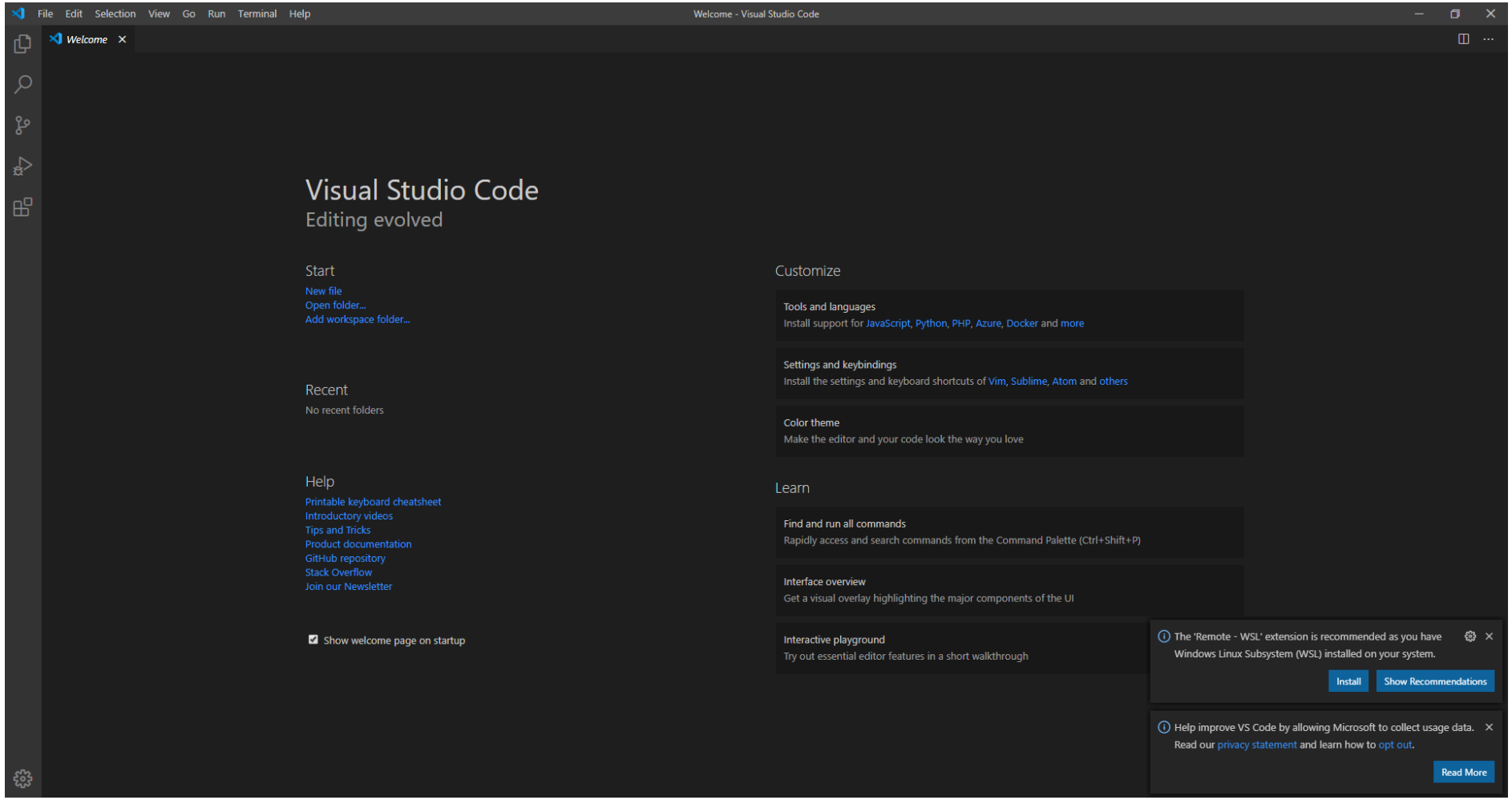
Portable mode is supported on the ZIP download for Windows, and the TAR.GZ download for Linux, as well as the regular Application download for macOS. See the Download page to find the correct `.zip` / `.tar.gz` file for your platform.

> **Note:** Do not attempt to configure portable mode on an installation from the **Windows User or System installers**. Portable mode is only supported on the Windows ZIP (`.zip`) archive. Note as well that the Windows ZIP archive does not support auto update.

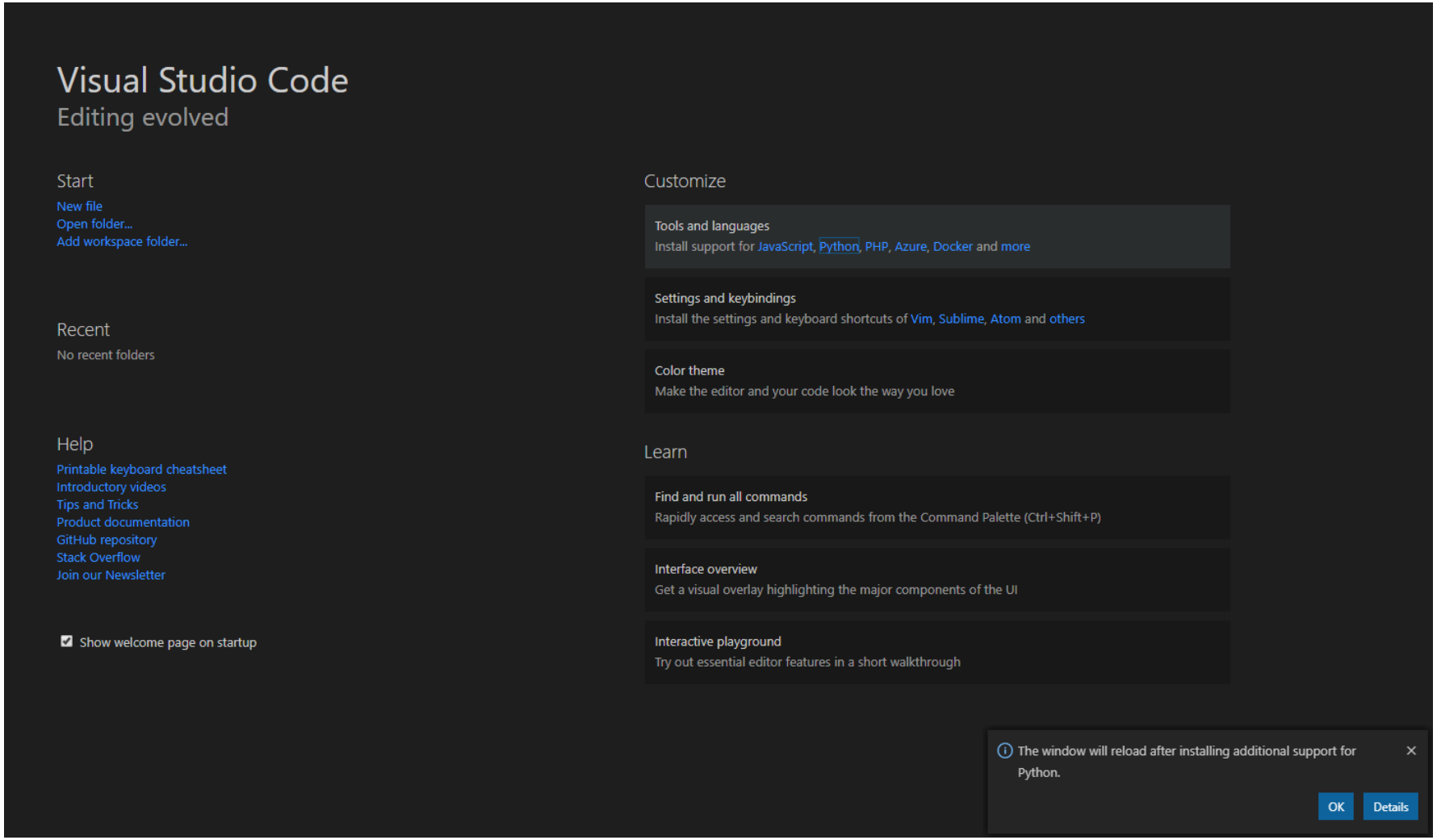
IN THIS ARTICLE

- Enable Portable mode
- Update Portable VS Code
- Migrate to Portable mode
- TMP directory

# Open Visual Studio Code



# Enable Python Connection



# Add libraries


```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\uqsboll2\projects\fractal> conda activate base
PS C:\Users\uqsboll2\projects\fractal> & conda install --name base pylint -y
Collecting package metadata (current_repodata.json): done
Solving environment: done

## Package Plan ##

  environment location: C:\Users\uqsboll2\Miniconda3

  added / updated specs:
    - pylint
```

# Add more libraries

```
PS C:\Users\uqsboll2\projects\fractal> python -m fractal julia -0.644 --size=300x200 --depth=25 --zoom=0.6 --show
Traceback (most recent call last):
  File "C:\Users\uqsboll2\Miniconda3\lib\runpy.py", line 193, in _run_module_as_main
    "__main__", mod_spec)
  File "C:\Users\uqsboll2\Miniconda3\lib\runpy.py", line 85, in _run_code
    exec(code, run_globals)
  File "C:\Users\uqsboll2\projects\fractal\fractal.py", line 11, in <module>
    import pylab, argparse, collections, inspect, functools
ModuleNotFoundError: No module named 'pylab'
PS C:\Users\uqsboll2\projects\fractal> conda install pylab
```

Run program

Missing package

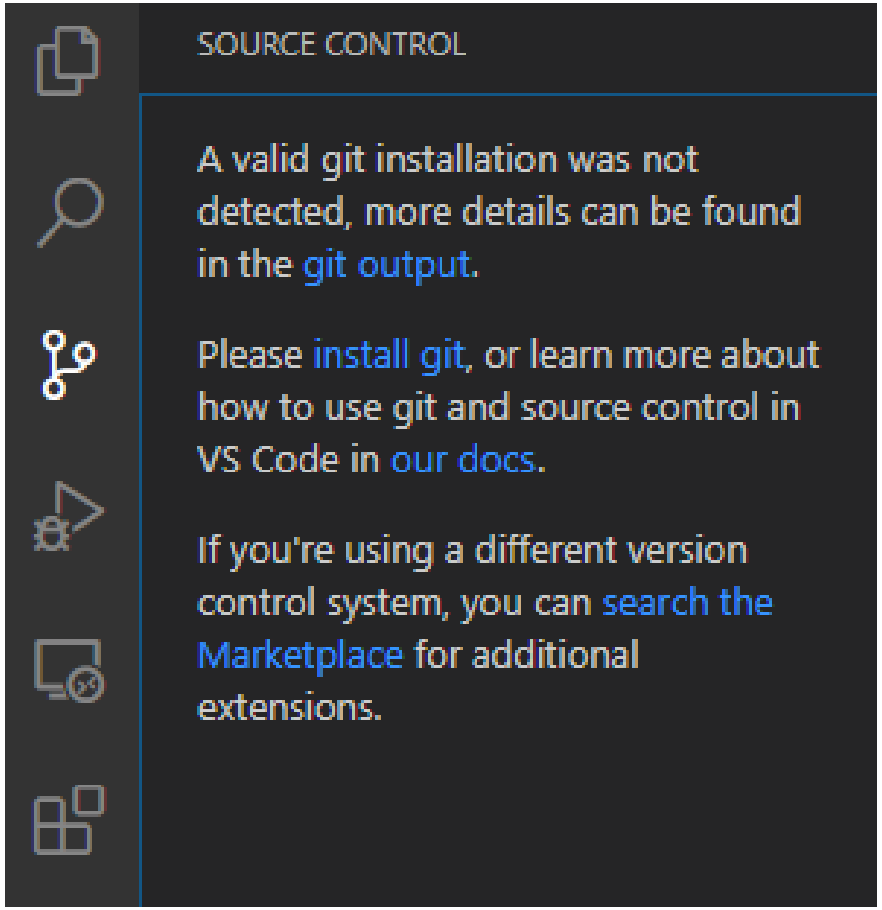
Try to get it (failed)

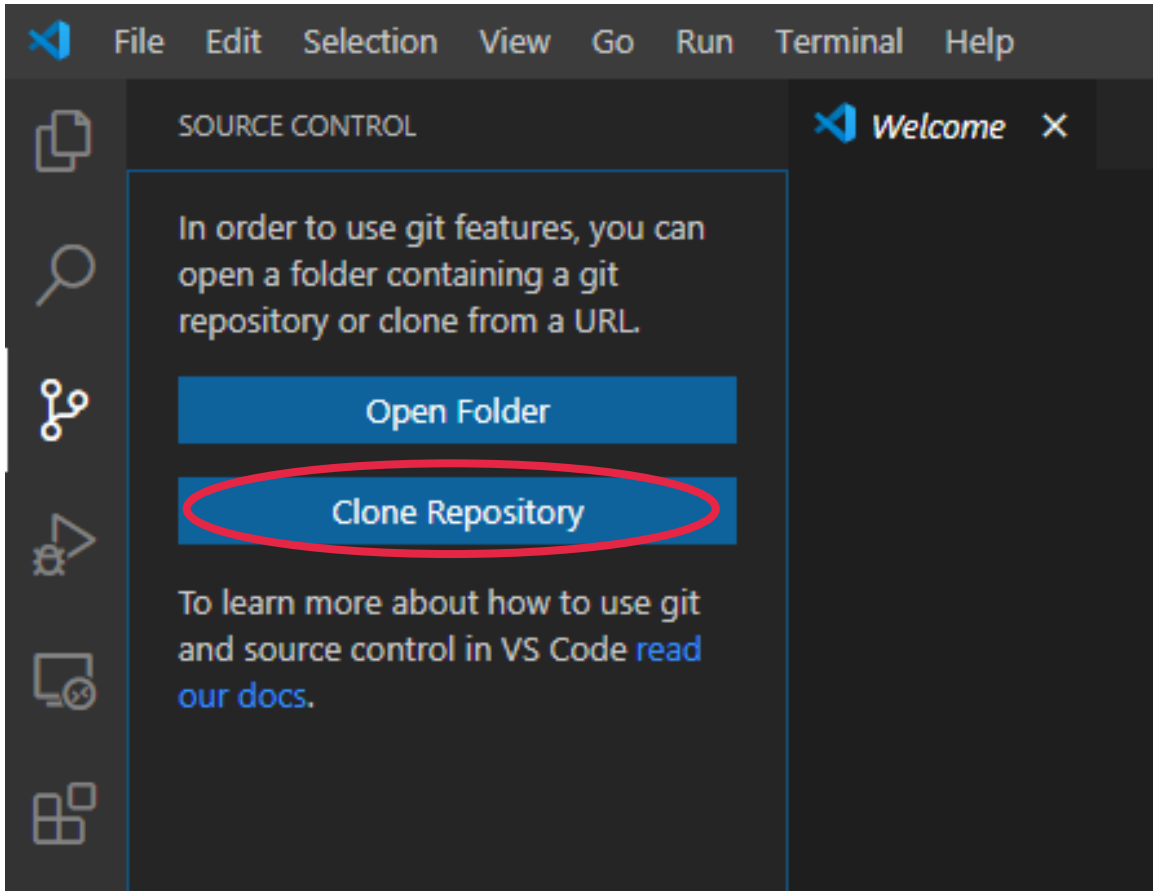
After some googling: pylab is part of matplotlib

```
PS C:\Users\uqsboll2\projects\fractal> conda install matplotlib
Collecting package metadata (current_repodata.json): done
Solving environment: done

## Package Plan ##

  environment location: C:\Users\uqsboll2\Miniconda3
```

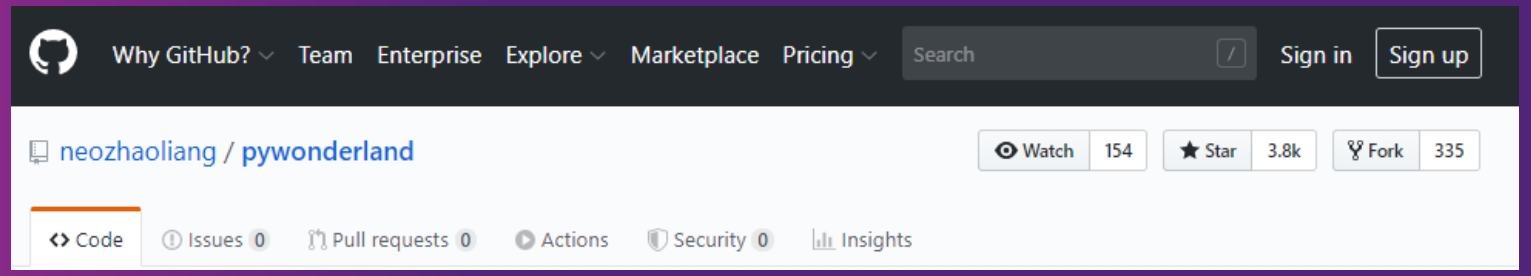
Install matplotlib via conda

# Using git in Visual Studio Code



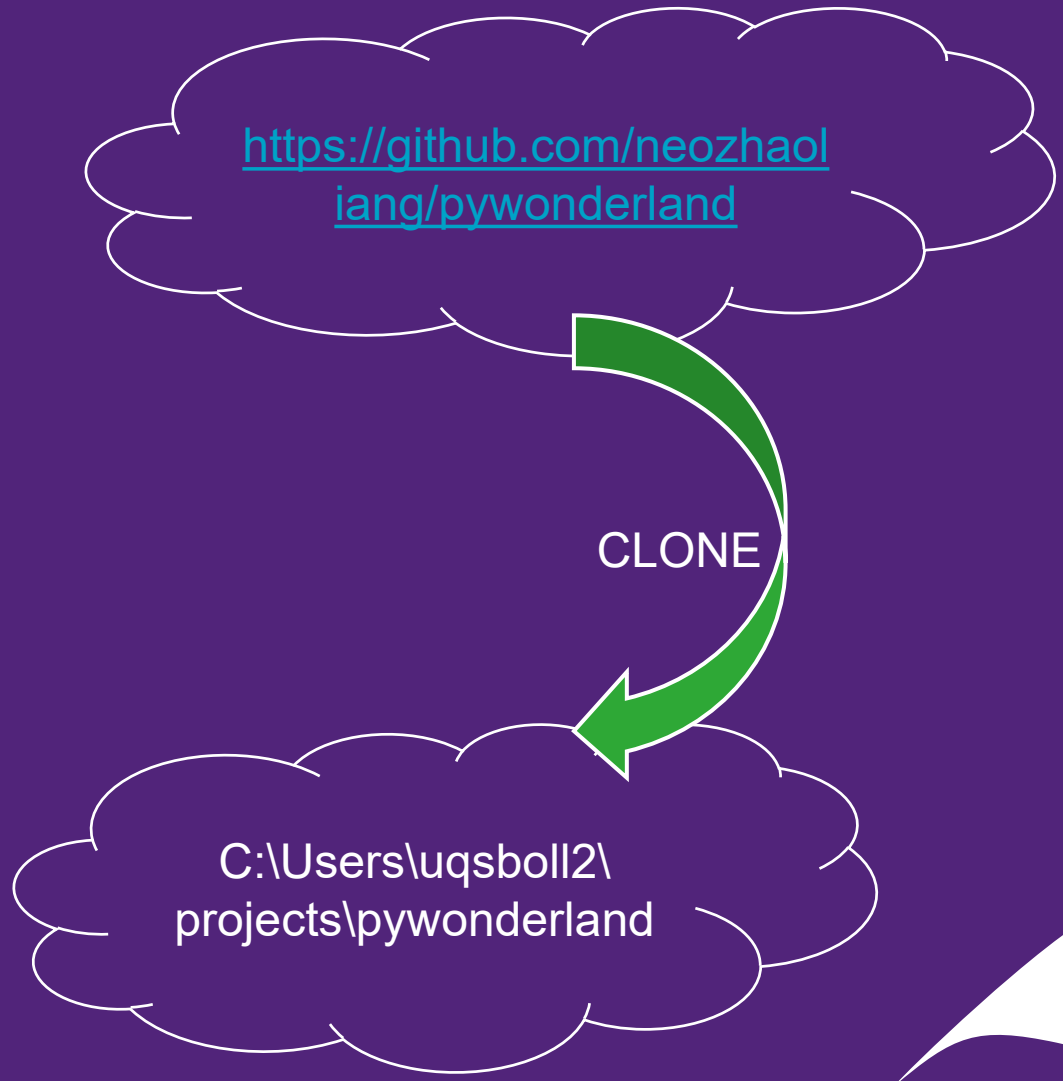

Visual Studio Code will tell you if you forgot to install git



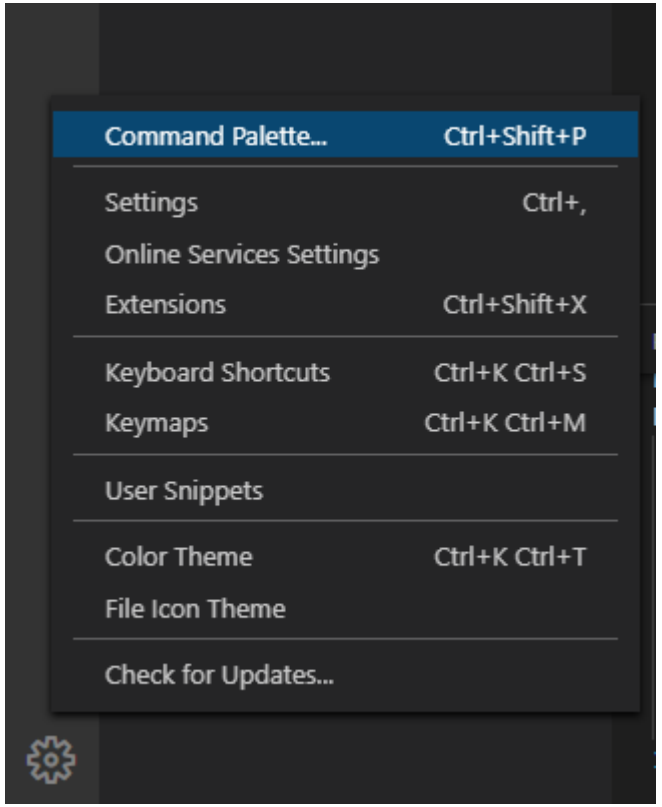


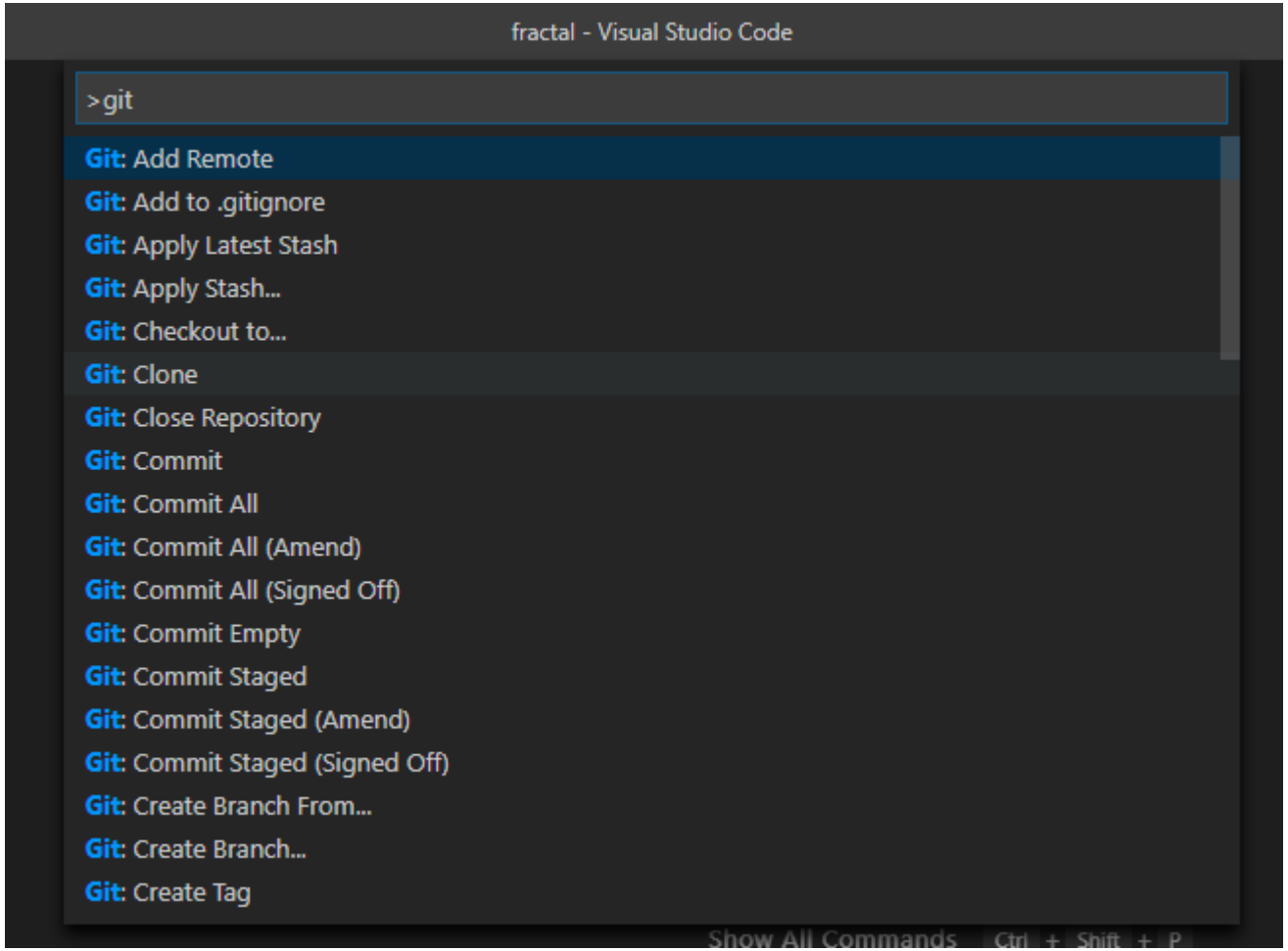

# Clone Repository

make a copy of a repository from a central server to your own computer (for the first time)

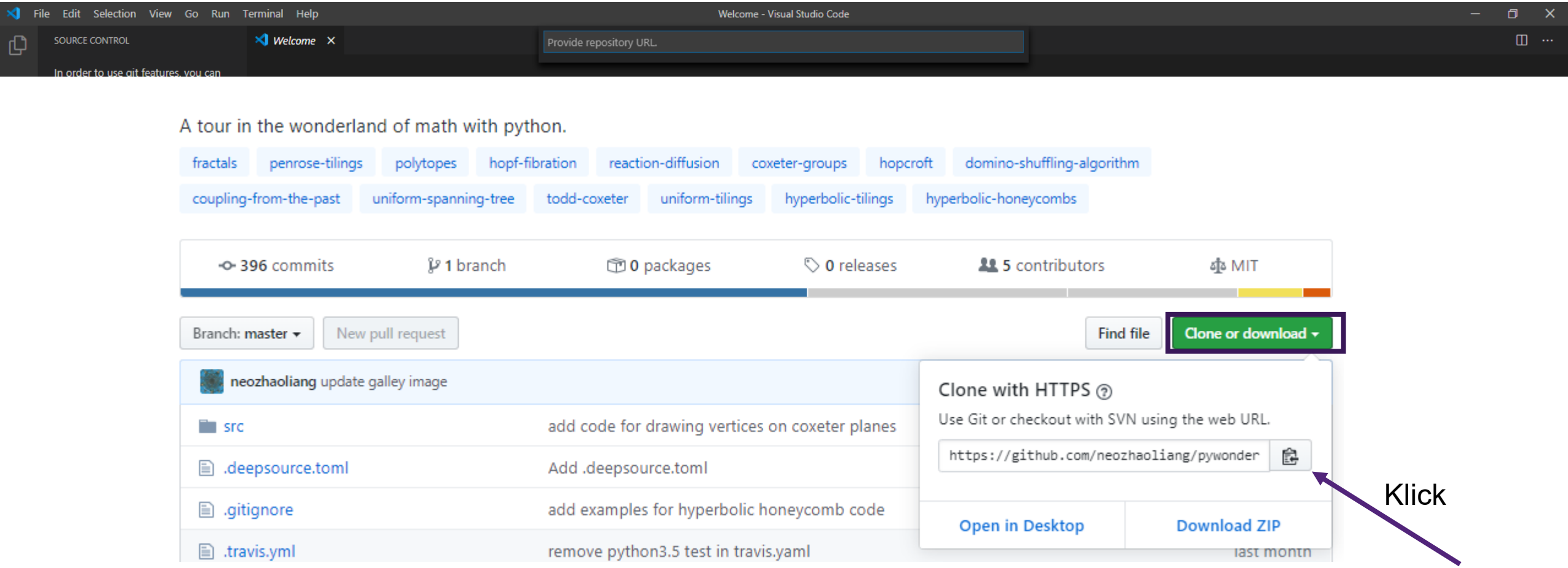


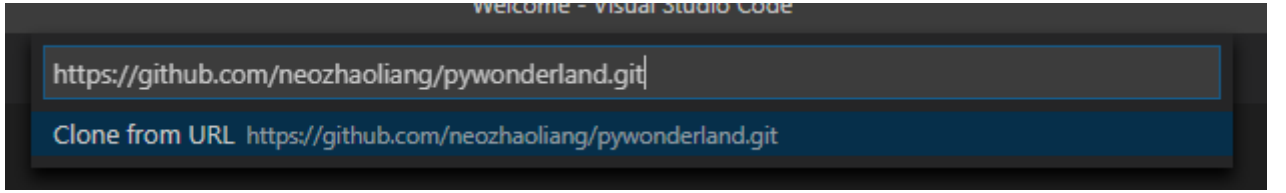
# Git Clone via command palette

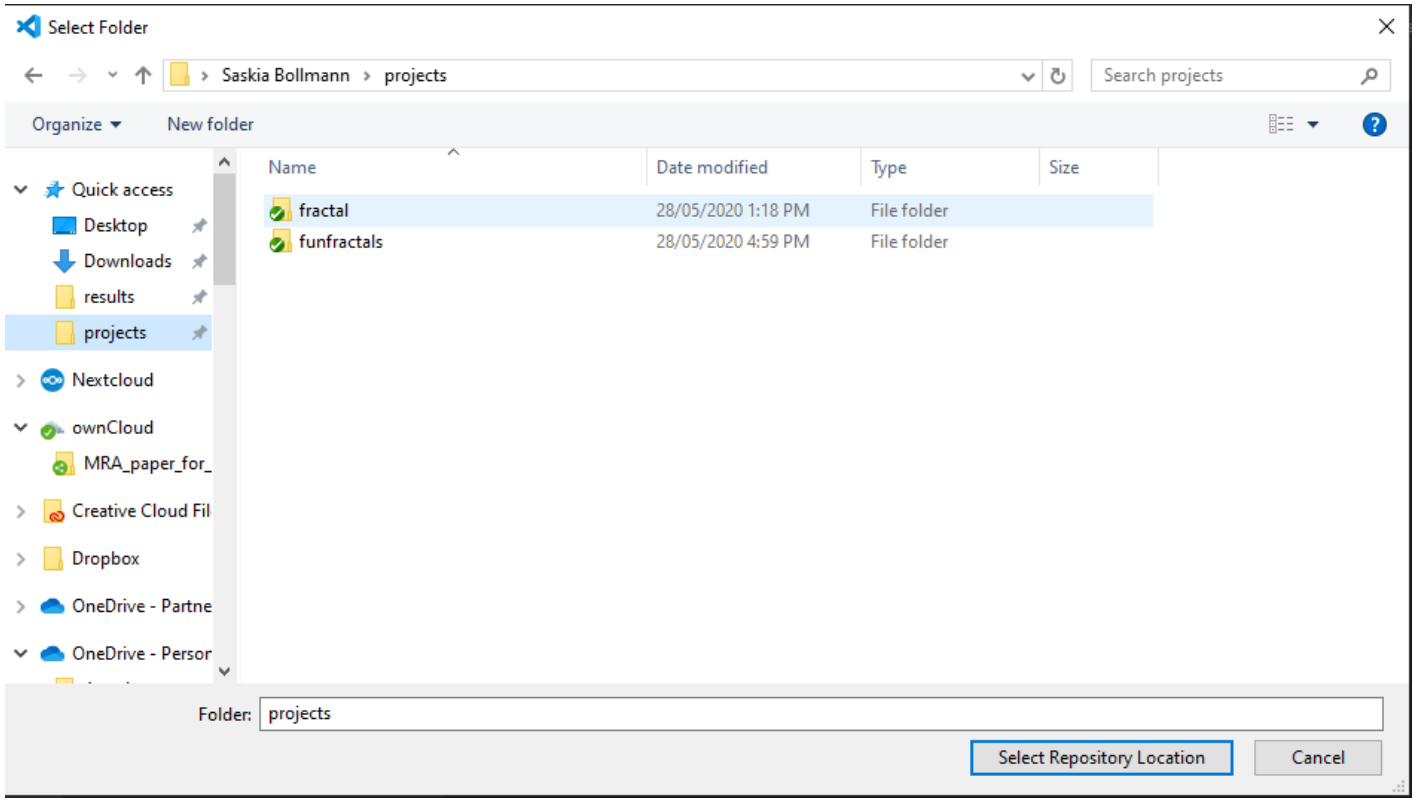


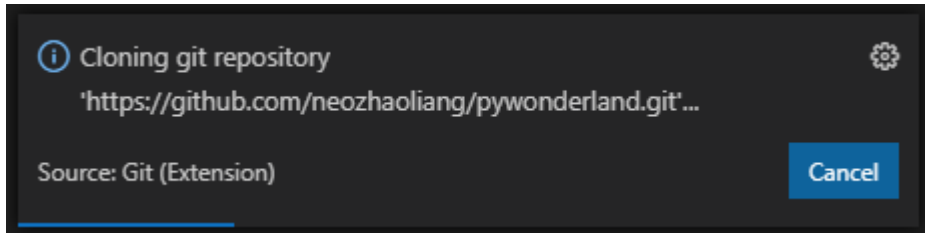



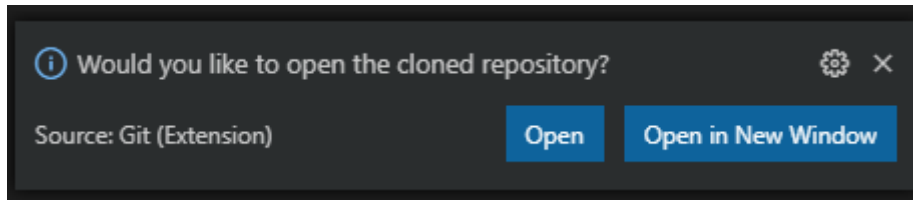
# Repository URL

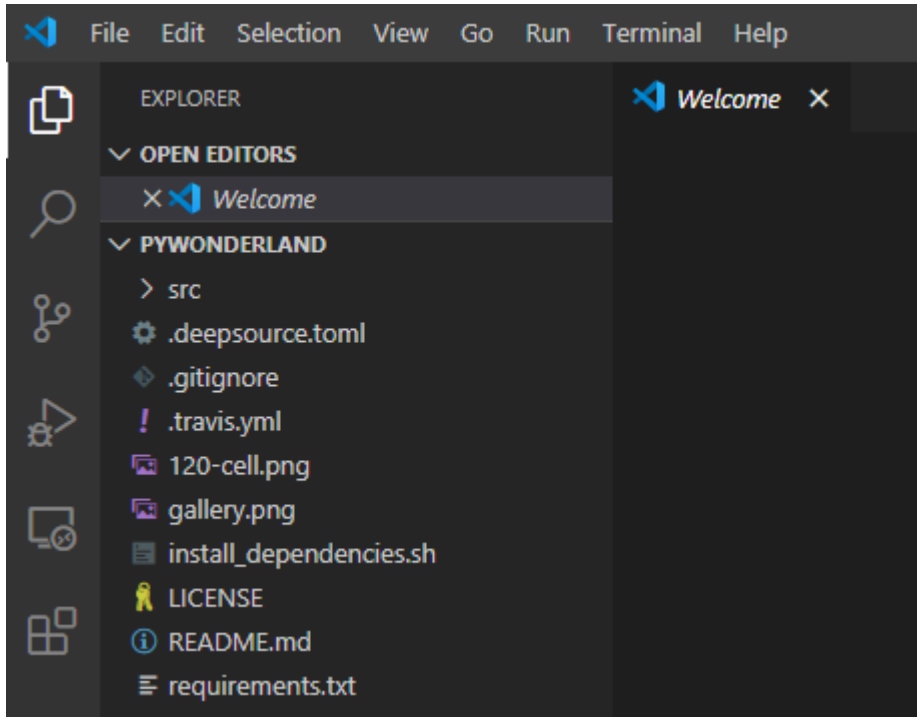



Welcome - Visual Studio Code
https://github.com/neozhaoliang/pywonderland.git
Clone from URL https://github.com/neozhaoliang/pywonderland.git


Select Folder
Saskia Bollmann › projects
Search projects
Organize
New folder
Quick access
Desktop
Downloads
results
projects
Nextcloud
ownCloud
MRA_paper_for_
Creative Cloud Fil
Dropbox
OneDrive - Partne
OneDrive - Persor
Name
Date modified
Type
Size
fractal
28/05/2020 1:18 PM
File folder
funfractals
28/05/2020 4:59 PM
File folder
Folder:
projects
Select Repository Location
Cancel

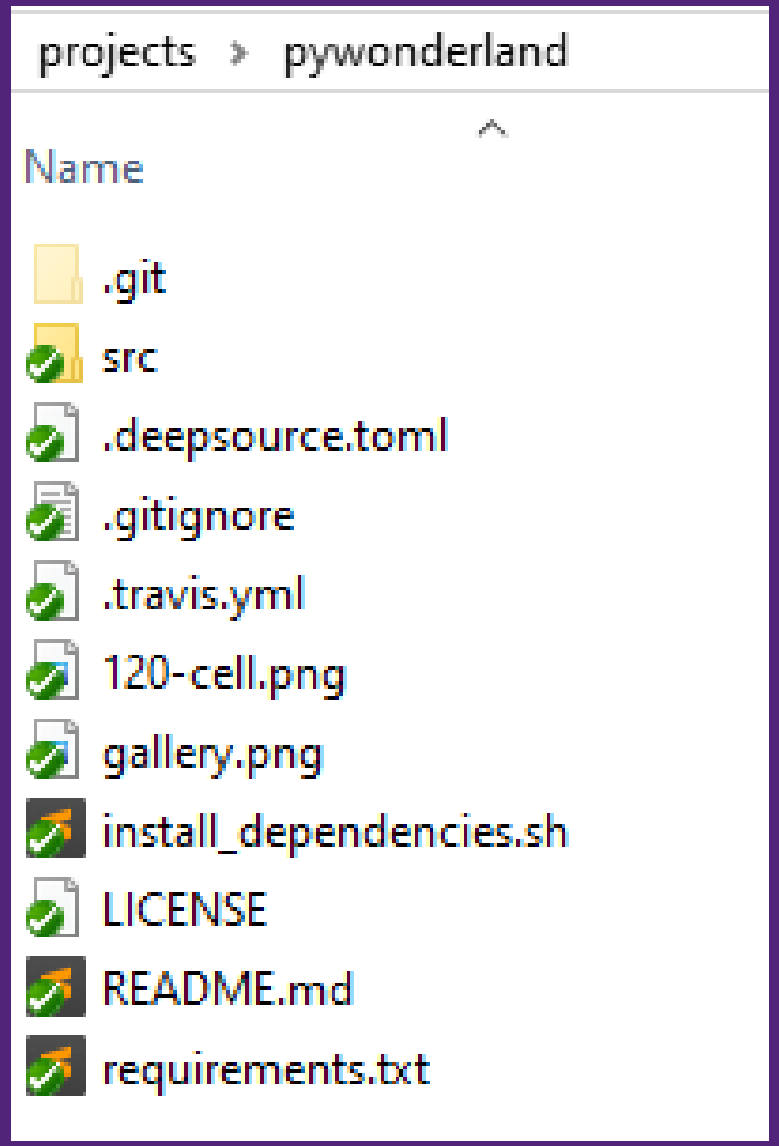

Cloning git repository
'https://github.com/neozhaoliang/pywonderland.git'...
Source: Git (Extension)
Cancel

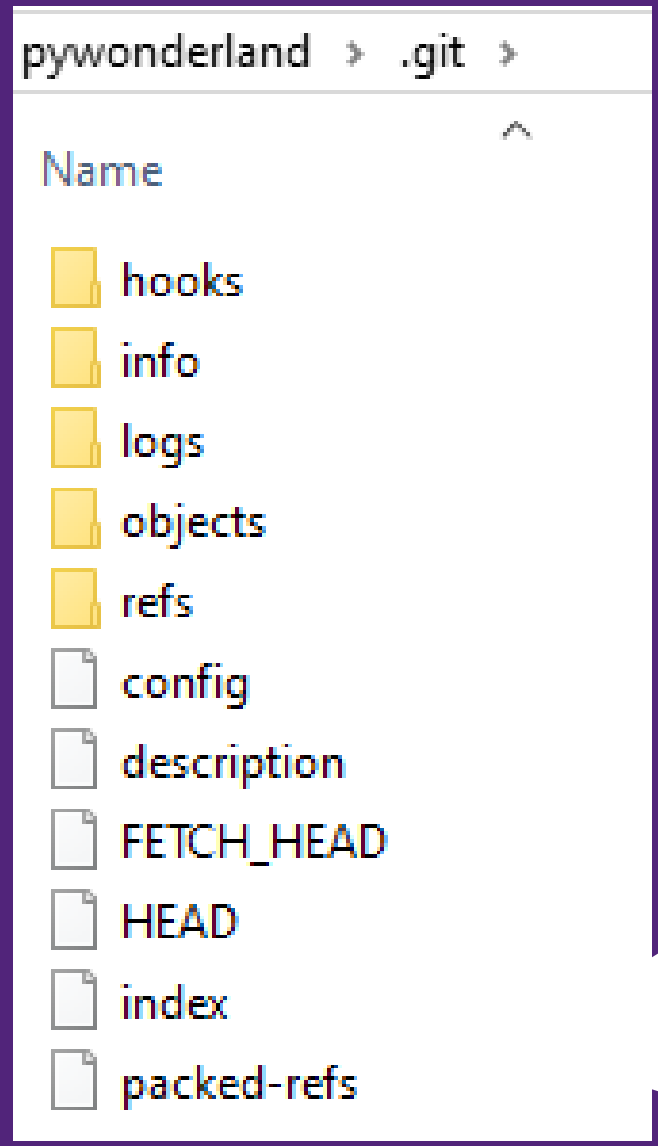

Would you like to open the cloned repository?
Source: Git (Extension)
Open
Open in New Window


File
Edit
Selection
View
Go
Run
Terminal
Help
EXPLORER
OPEN EDITORS
Welcome
PYWONDERLAND
src
.deepsource.toml
.gitignore
.travis.yml
120-cell.png
gallery.png
install_dependencies.sh
LICENSE
README.md
requirements.txt
Welcome

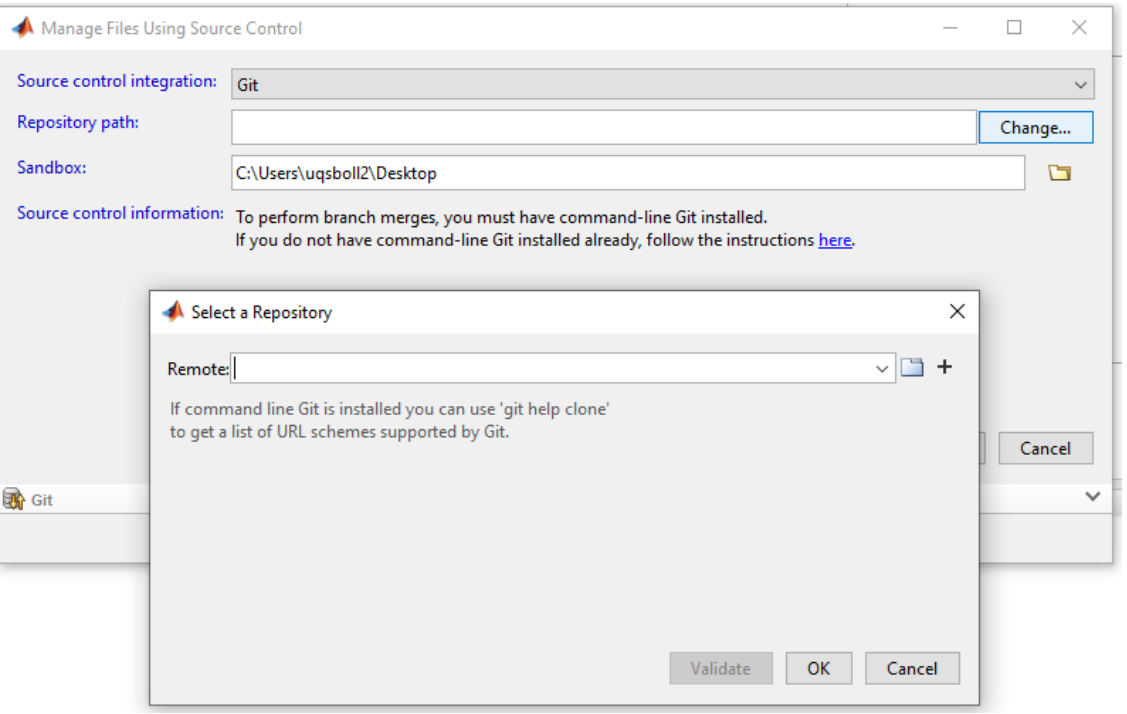
# Repository

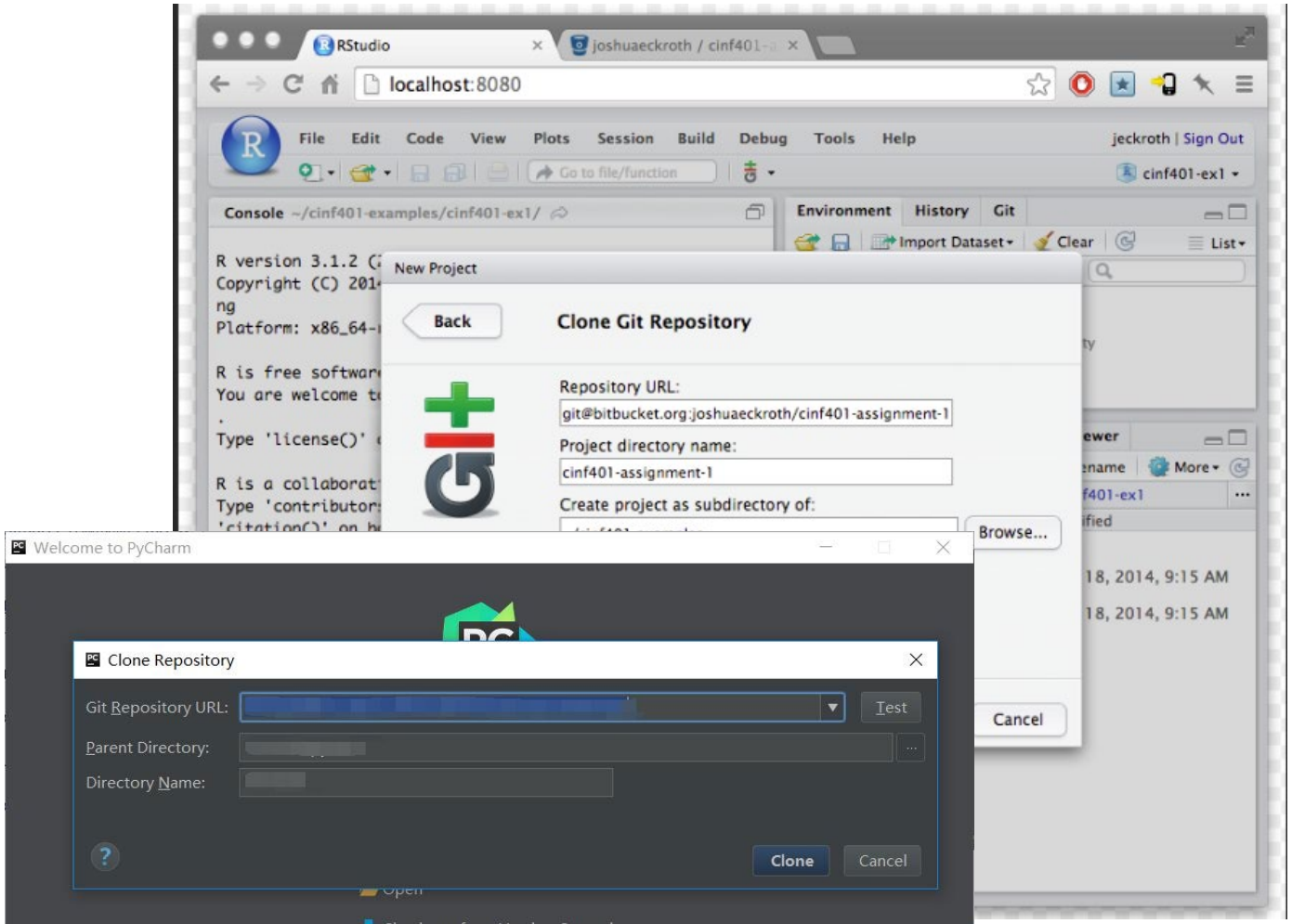
Virtual storage of project files including history



# Git in other IDEs



396 commits | 1 branch | 0 packages | 0 releases | 5 contributors | MIT

Branch: master ▾ | New pull request | Find file | Clone or download ▾

**neozhaoliang** update galley image — Latest commit 4437564 18 hours ago

| | | |
|---|---|---|
| src | add code for drawing vertices on coxeter planes | yesterday |
| .deepsource.toml | Add .deepsource.toml | 6 months ago |
| .gitignore | add examples for hyperbolic honeycomb code | 5 months ago |
| .travis.yml | remove python3.5 test in travis.yaml | last month |
| 120-cell.png | some minor changes | 7 months ago |
| LICENSE | delete histry commits and upload new files | 3 years ago |
| README.md | add upper half plane model | 5 days ago |
| gallery.png | update galley image | 18 hours ago |
| install_dependencies.sh | add upper half plane | |
| requirements.txt | add upper half plane | |

Remote

Local Repository

Saskia Bollmann › projects › pywonderland

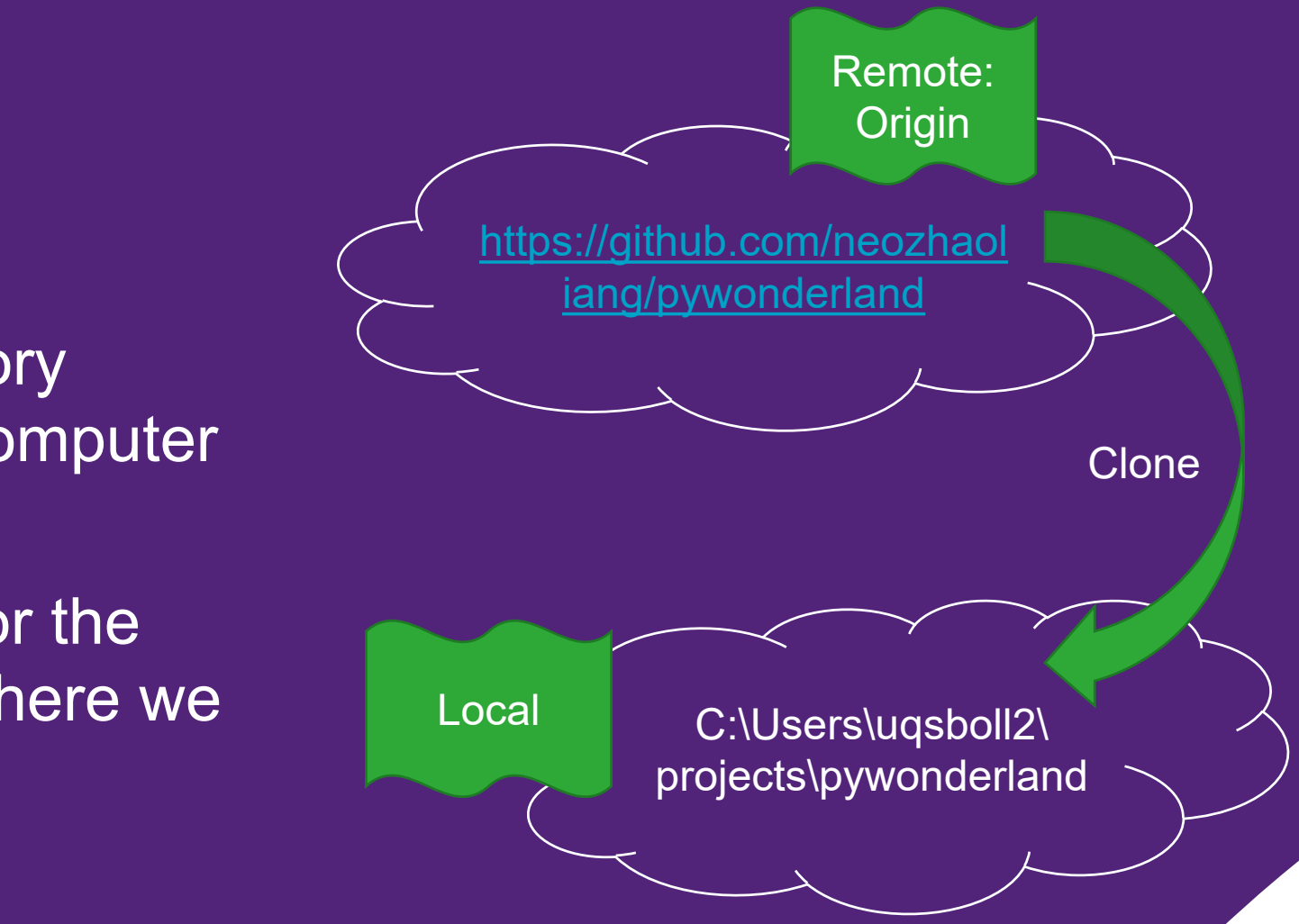
Search pywonderland

| Name | Date modified | Type |
|---|---|---|
| .git | 28/05/2020 8:05 PM | File folder |
| src | 28/05/2020 8:04 PM | File folder |
| .deepsource.toml | 28/05/2020 8:04 PM | TOML File |
| .gitignore | 28/05/2020 8:04 PM | Text Document |
| .travis.yml | 28/05/2020 8:04 PM | YML File |
| 120-cell.png | 28/05/2020 8:04 PM | PNG File |
| gallery.png | 28/05/2020 8:04 PM | PNG File |
| install_dependencies.sh | 28/05/2020 8:04 PM | SH File |
| LICENSE | 28/05/2020 8:04 PM | File |
| README.md | 28/05/2020 8:04 PM | MD File |
| requirements.txt | 28/05/2020 8:04 PM | TXT File |

# Remote

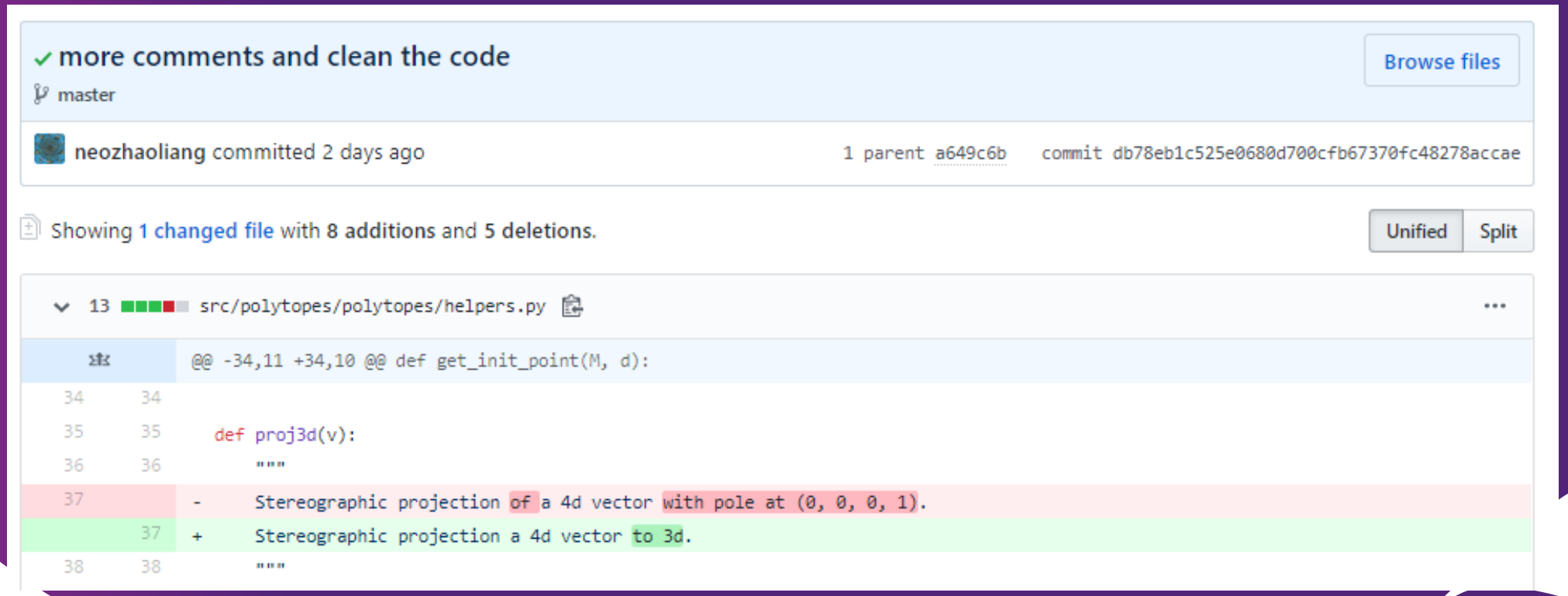
Definition: A repository stored on another computer

Origin = the name for the remote repository where we cloned from



# What is a “Commit”?

Committing a change means to create a snapshot of the project's current status. Commit often! Assign a clear message of your intention.



History for pywonderland / src / gifmaze / example_hilbert_curve.py

E UNIVERSITY QUEENSLAND
STRALIA

Commits on Feb 9, 2020

add many more polychora examples
neozhaoliang committed on Feb 10 ✗ — 11ca01b

Commits on Feb 11, 2019

add wang tiling animation
neozhaoliang committed on Feb 11, 2019 ✓ — 4637b14

Commits on Feb 3, 2019

remove unused import in gifmaze code
neozhaoliang committed on Feb 3, 2019 ✓ — c8d1f26

Commits on Dec 4, 2018

rewrite gifmaze project, added new features: 1. can draw grid lines 2... ...
neozhaoliang committed on Dec 4, 2018 — ef89878

Commits on Nov 20, 2018

better code formatting
neozhaoliang committed on Nov 21, 2018 — f52d599

fix some errors in hilbert curve
neozhaoliang committed on Nov 20, 2018 — caf4834

fix the color discontinuity problem in hilbert curves
neozhaoliang committed on Nov 20, 2018 — c2da2d6

add hilbert curve animation
neozhaoliang committed on Nov 20, 2018 — c91d46e

# Summary

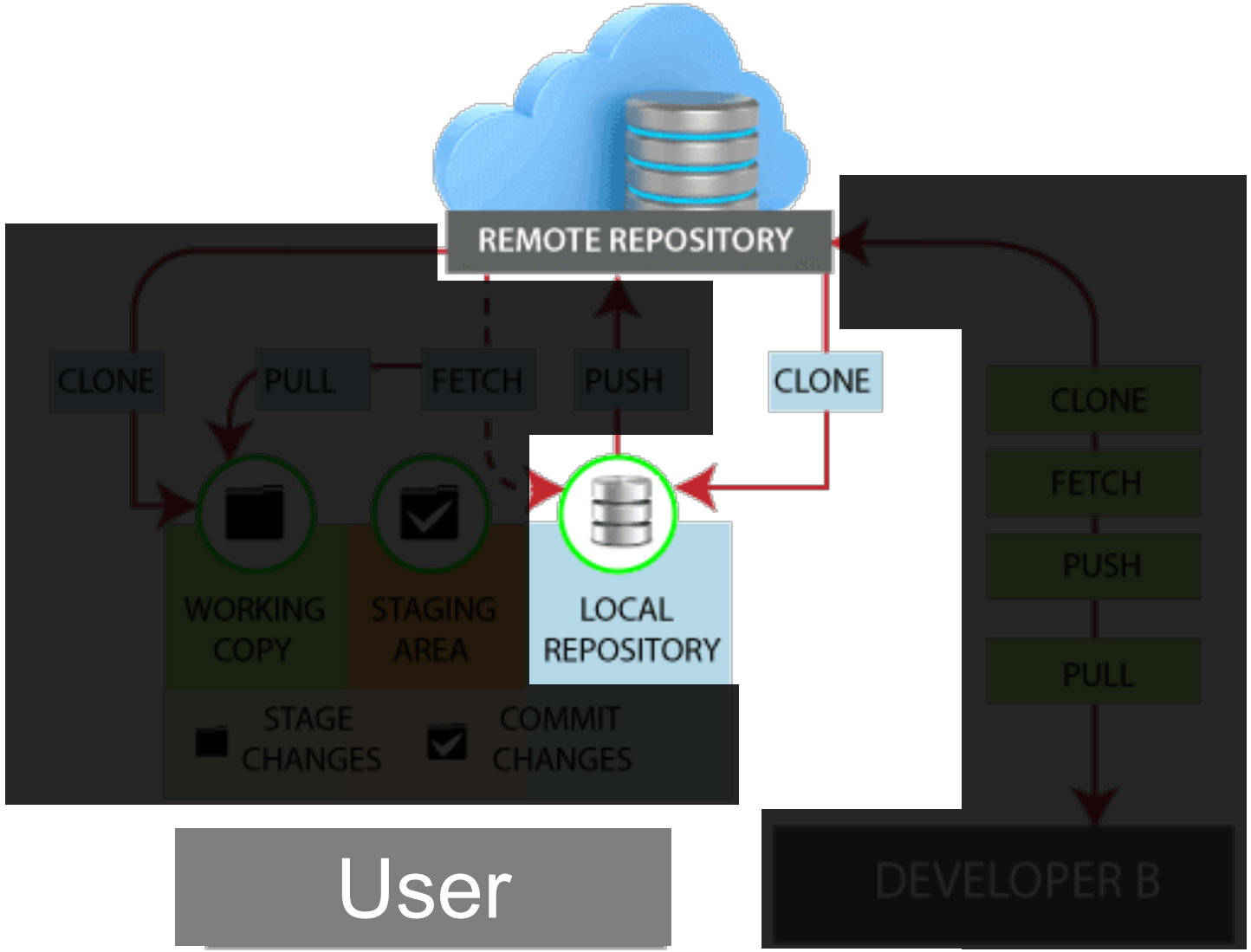
Repository

- Readme
- Commits
- History

Remote vs Local

Git commands

- Clone




https://www.javatpoint.com/git-remote

1) Using code from github.com

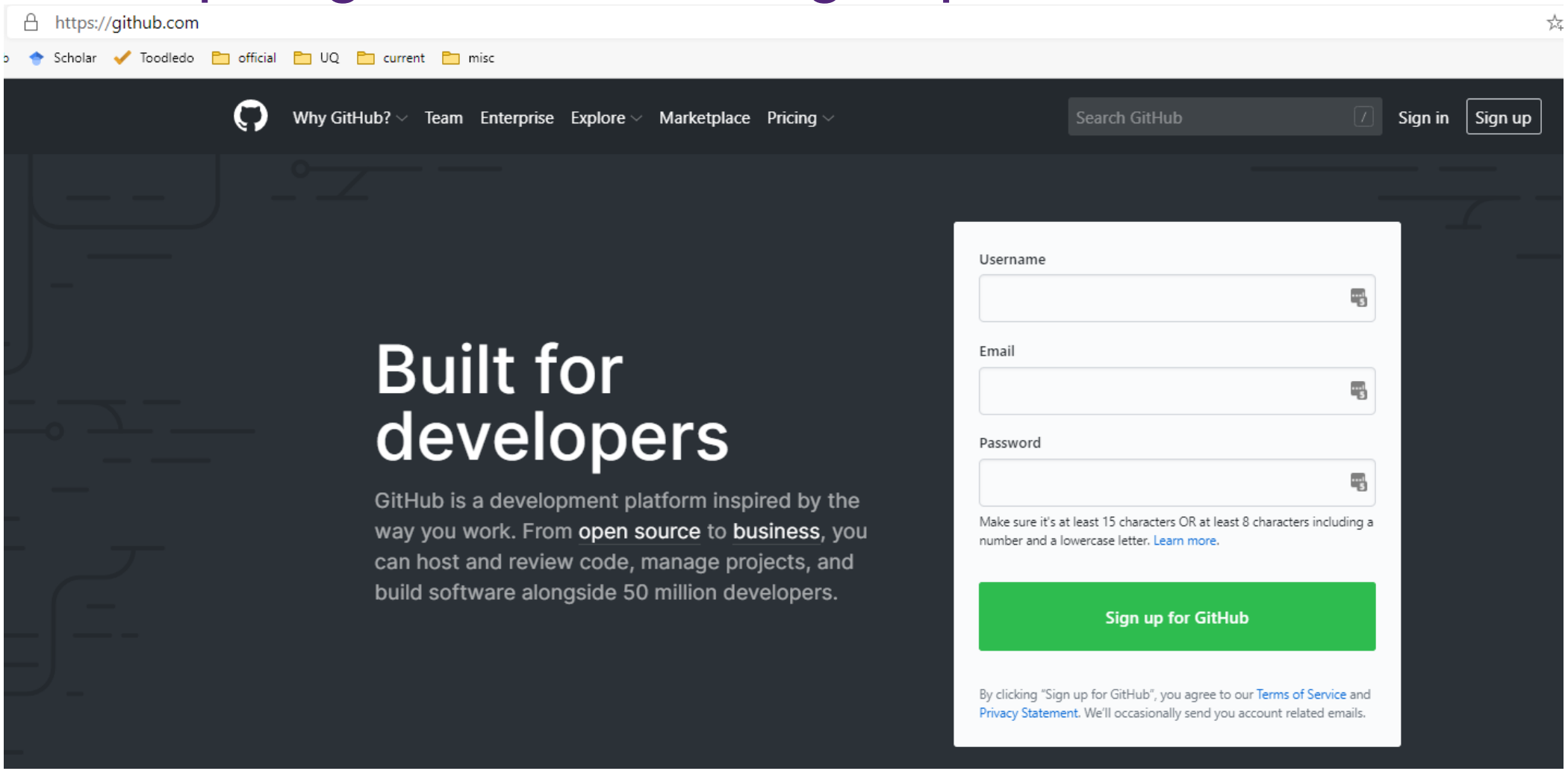
2) Version Control for your project

Use Cases

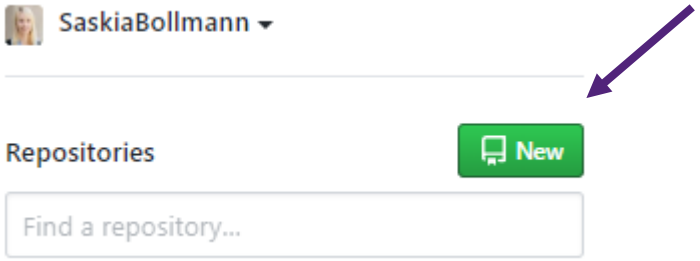
3) Adding someone to your project

4) Contributing to a project

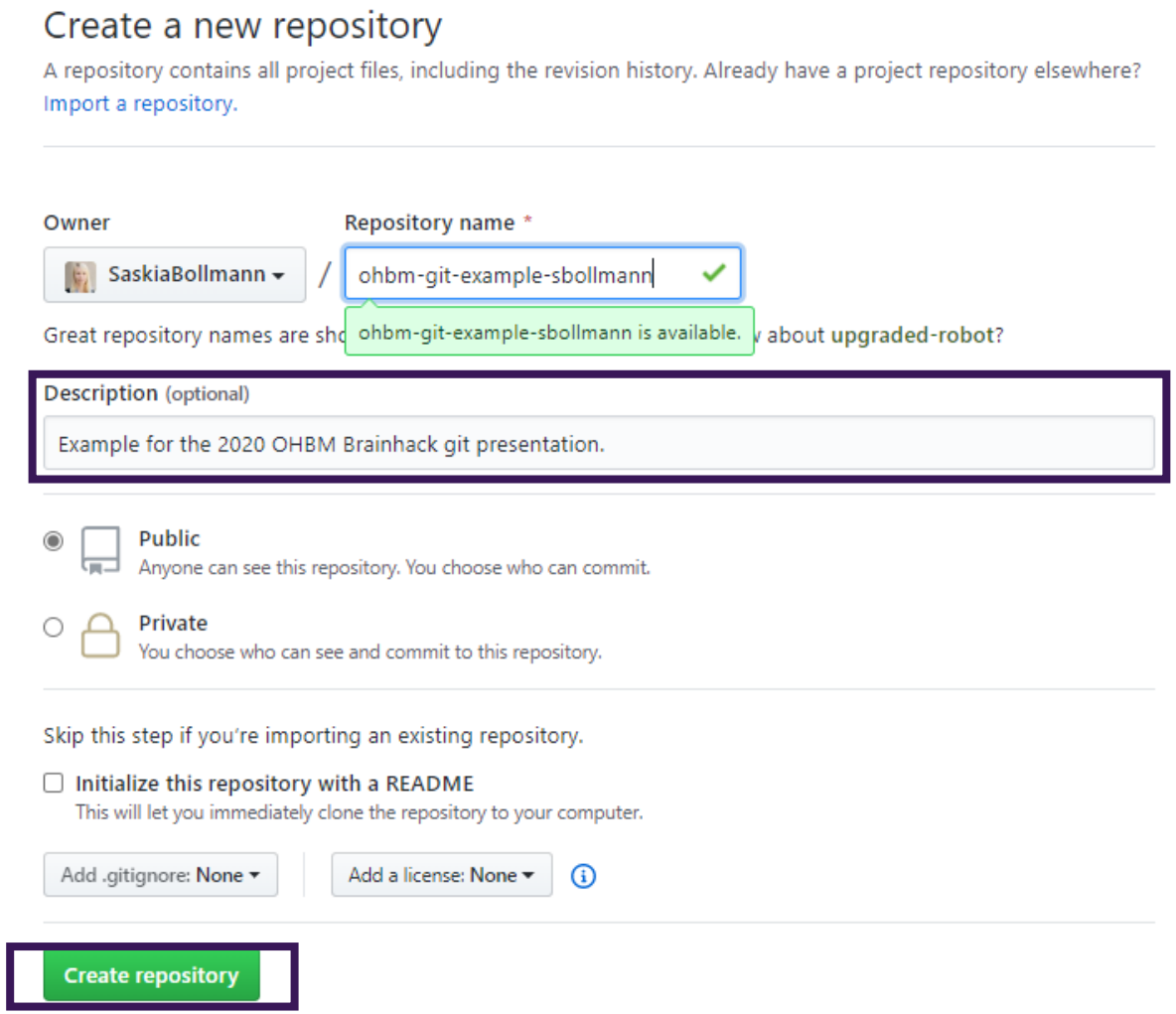
# Go to https://github.com/ & sign up



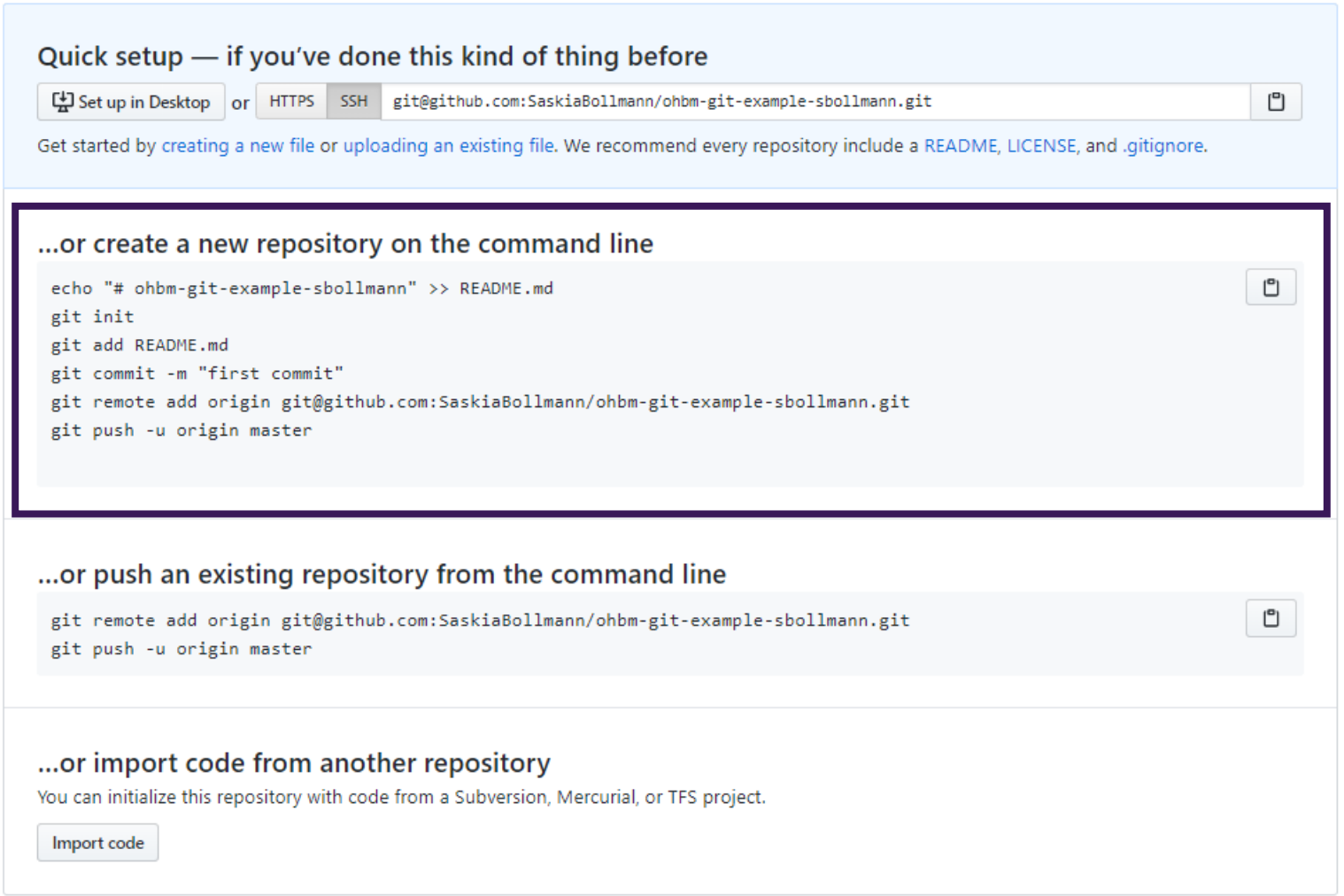
# Create a new repository



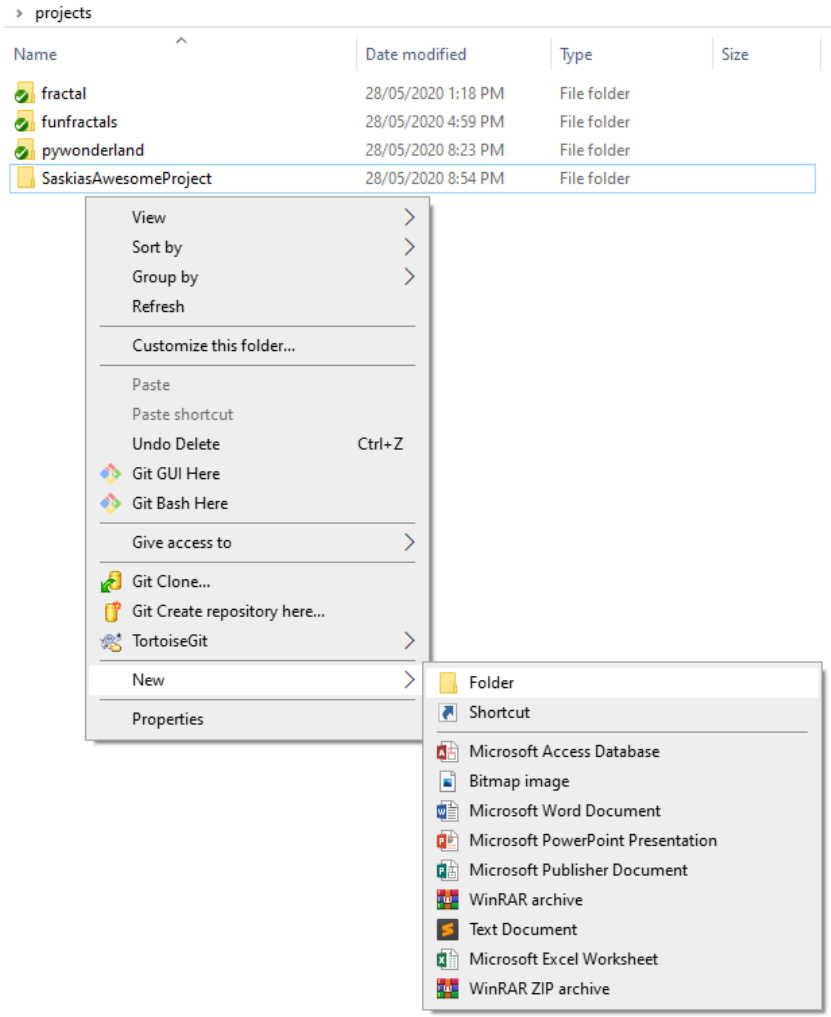
# Create a new repository

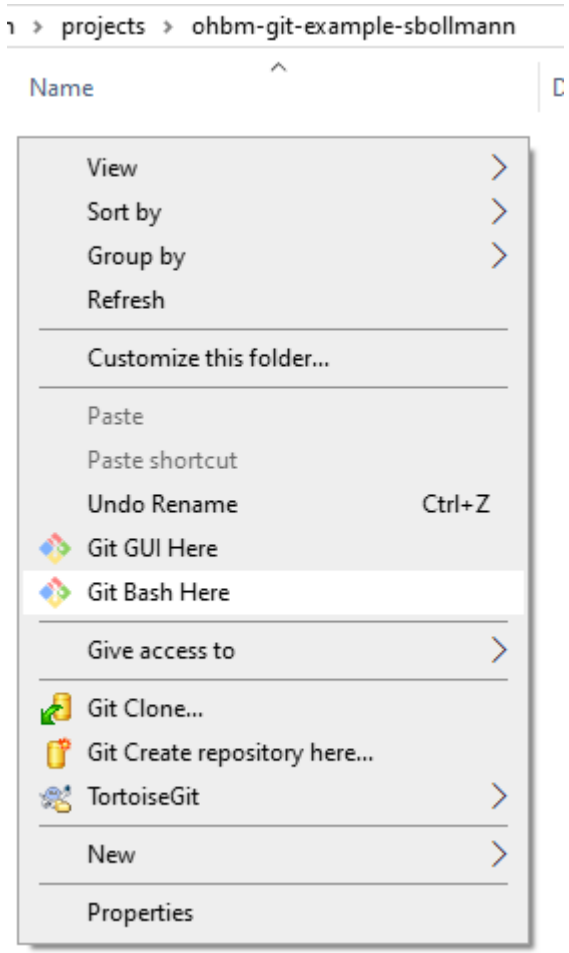


# Create a new repository



# Create local folder and open git bash



# Create README.md

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann
$ echo "# ohbm-git-example-sbollmann" >> README.md

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann
$ ls
README.md

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann
$ cat README.md
# ohbm-git-example-sbollmann
```

# Initialize new git repo locally

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann
$ git init
Initialized empty Git repository in C:/Users/uqsboll2/projects/ohbm-git-example-
sbollmann/.git/
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git status
On branch master

No commits yet

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        README.md

nothing added to commit but untracked files present (use "git add" to track)
```

# Add file to repository

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git add README.md
warning: LF will be replaced by CRLF in README.md.
The file will have its original line endings in your working directory
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git status
On branch master

No commits yet

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   README.md
```

# Commit changes

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git commit -m "First commit."
[master (root-commit) 7cfb378] First commit.
 1 file changed, 1 insertion(+)
 create mode 100644 README.md

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git status
On branch master
nothing to commit, working tree clean
```

# Add remote: origin

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann
.git

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git status
On branch master
nothing to commit, working tree clean

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git remote
origin

uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git remote -v
origin  git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git (fetch)
origin  git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git (push)
```

# Push changes to remote

...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git push -u origin master
git@github.com: Permission denied (publickey).
fatal: Could not read from remote repository.

Please make sure you have the correct access rights
and the repository exists.
```

# Intermezzo III

## Creating and adding SSH keys to github.com

# Creating new ssh key

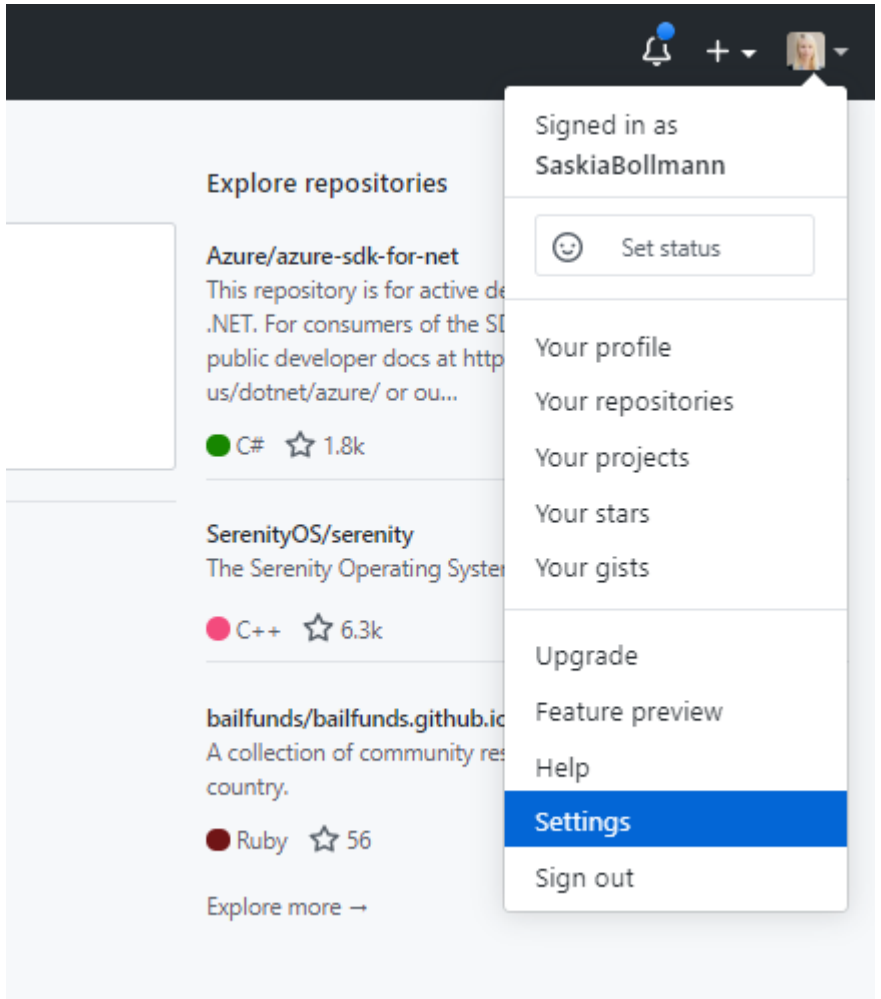
https://help.github.com/en/github/authenticating-to-github/generating-a-new-ssh-key-and-adding-it-to-the-ssh-agent

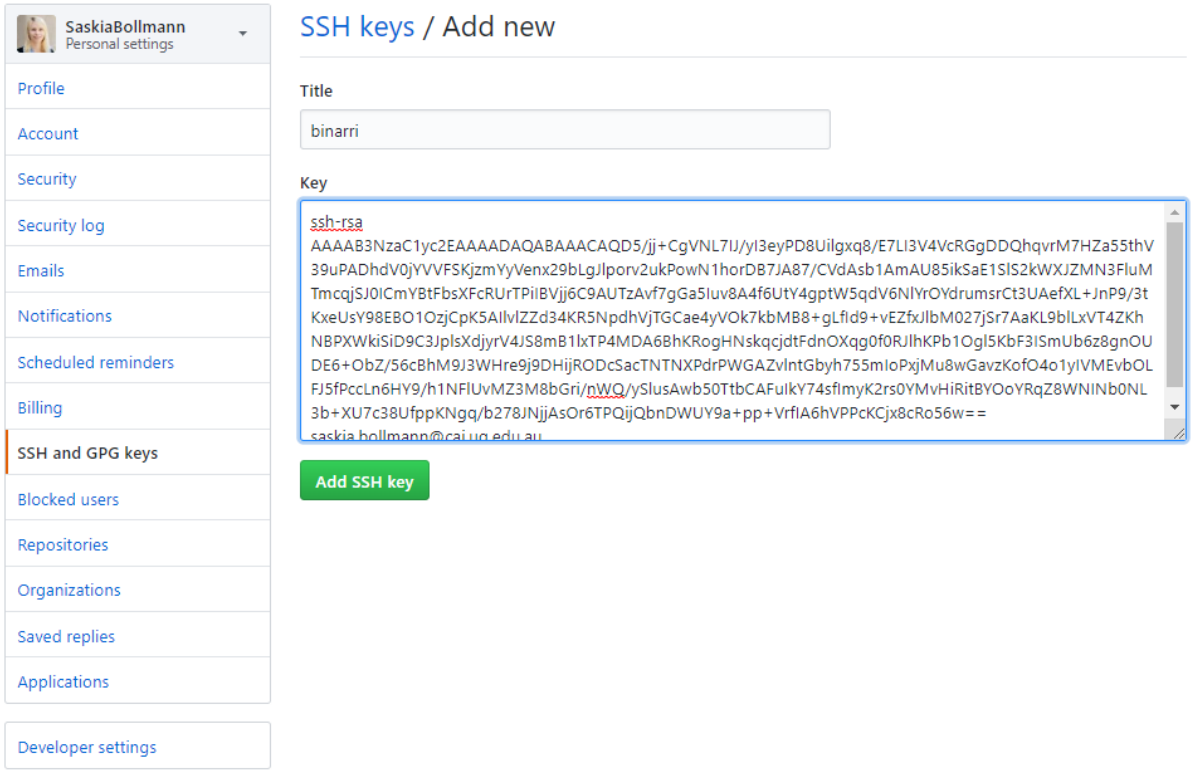
```
uqsboll2@CAI-BINNARI MINGW64 ~/projects
$ ssh-keygen -t rsa -b 4096 -C "saskia.bollmann@cai.uq.edu.au"
Generating public/private rsa key pair.
Enter file in which to save the key (/c/Users/uqsboll2/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /c/Users/uqsboll2/.ssh/id_rsa.
Your public key has been saved in /c/Users/uqsboll2/.ssh/id_rsa.pub.
```

```
$ ssh-add ~/.ssh/id_rsa
Identity added: /c/Users/uqsboll2/.ssh/id_rsa (saskia.bollmann@cai.uq.edu.au)
```

```
uqsboll2@CAI-BINNARI MINGW64 ~/projects
$ clip < ~/.ssh/id_rsa.pub
```

# Add public(!) key to github

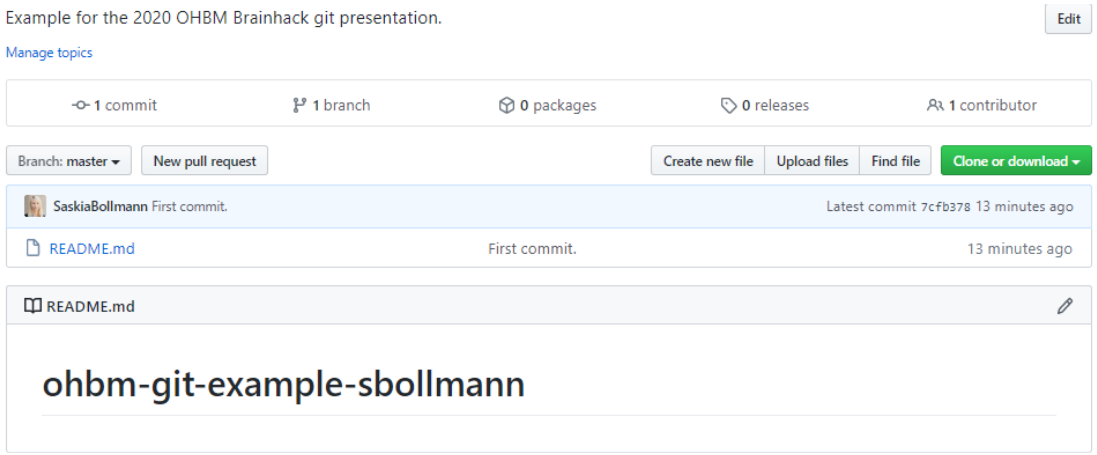


# Push changes to remote

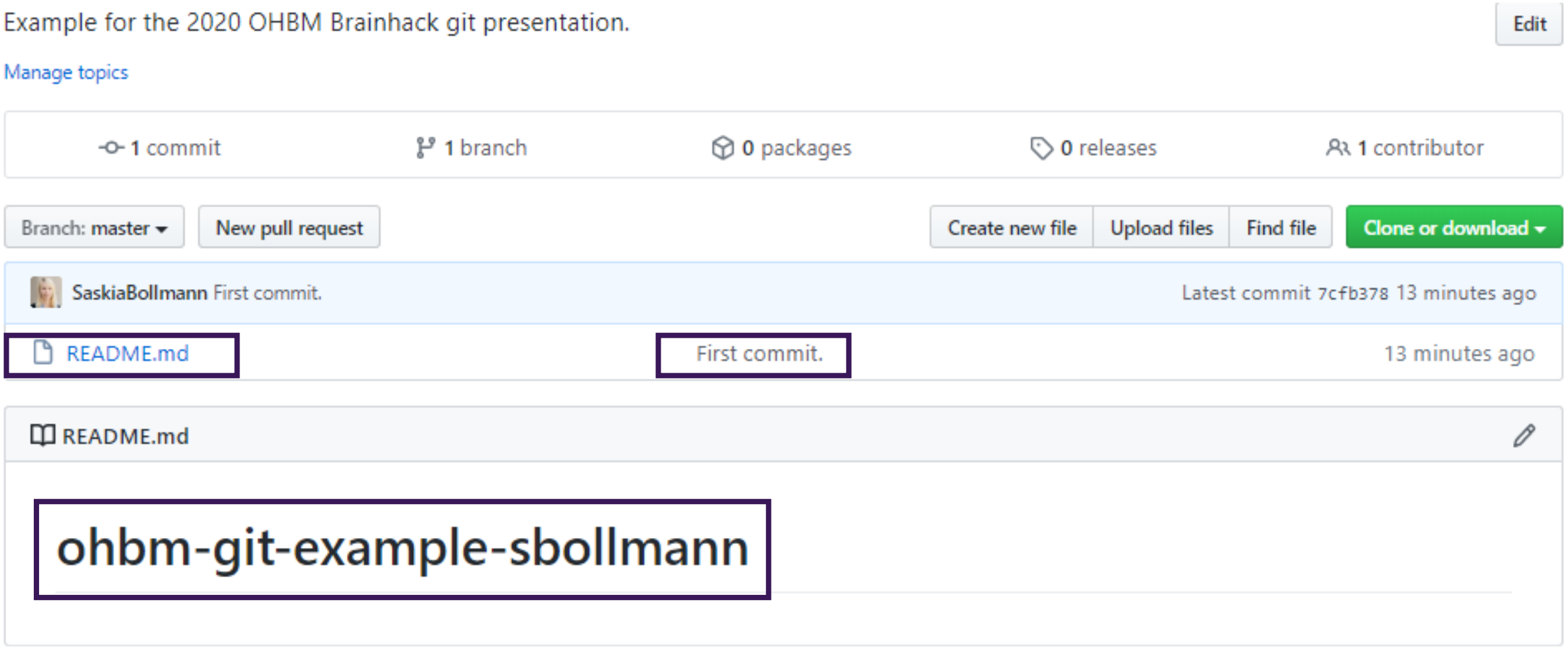
## ...or create a new repository on the command line

```
echo "# ohbm-git-example-sbollmann" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin git@github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
git push -u origin master
```




```
uqsboll2@CAI-BINNARI MINGW64 ~/projects/ohbm-git-example-sbollmann (master)
$ git push -u origin master
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Writing objects: 100% (3/3), 251 bytes | 251.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
 * [new branch]      master -> master
Branch 'master' set up to track remote branch 'master' from 'origin'.
```

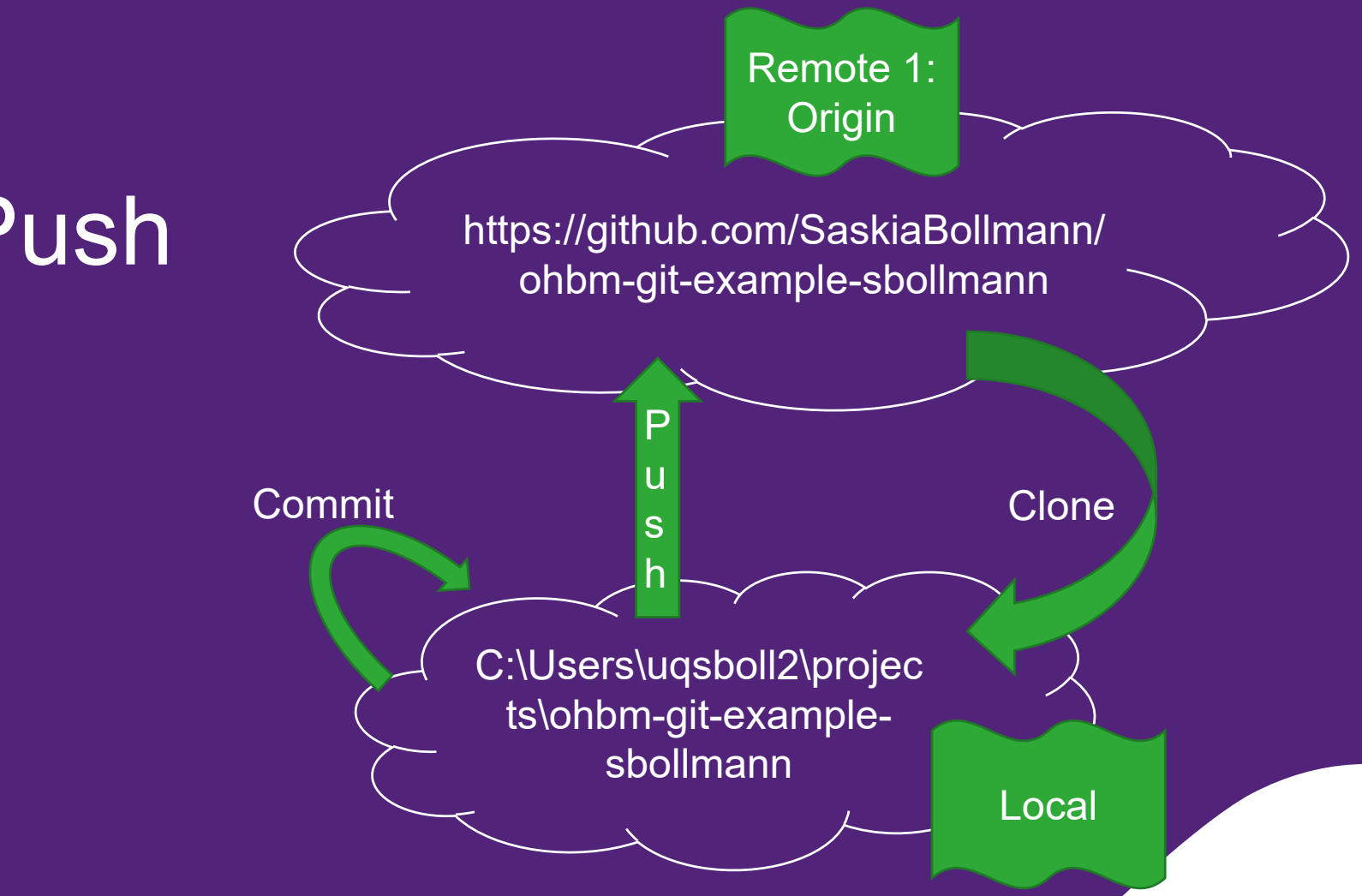
# Push changes to remote



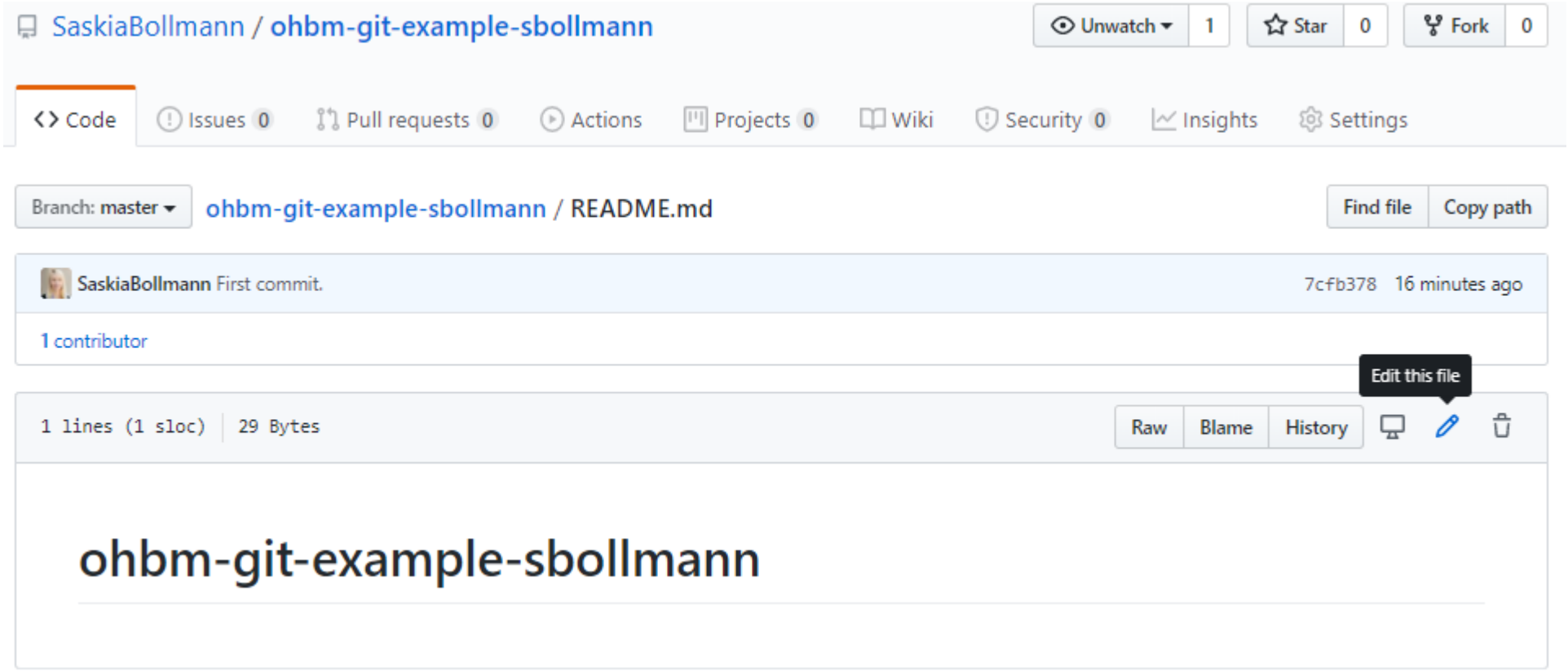
# Commit and Push

Commit = recording the status locally

Push = uploading all history to a Remote



# Making changes online



# Using Markdown

GitHub Guides

Video Guides GitHub Help GitHub.com

## Mastering Markdown

3 minute read Download PDF version

Markdown is a lightweight and easy-to-use syntax for styling all forms of writing on the GitHub platform.

**What you will learn:**

- How the Markdown format makes styled collaborative editing easy
- How Markdown differs from traditional formatting approaches
- How to use Markdown to format text
- How to leverage GitHub's automatic Markdown rendering
- How to apply GitHub's unique Markdown extensions

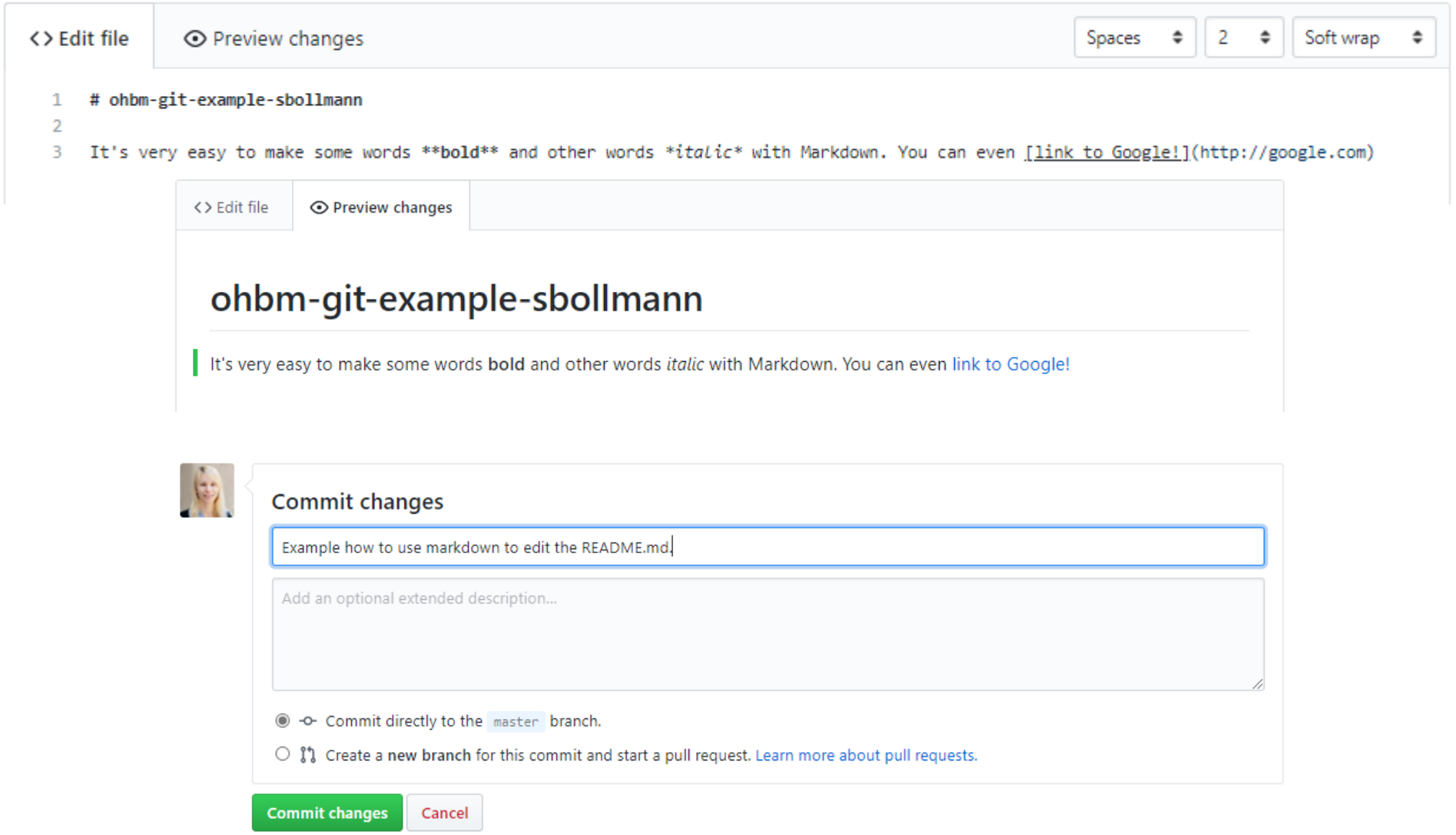
## Examples

Text Lists Images Headers & Quotes Code Extras

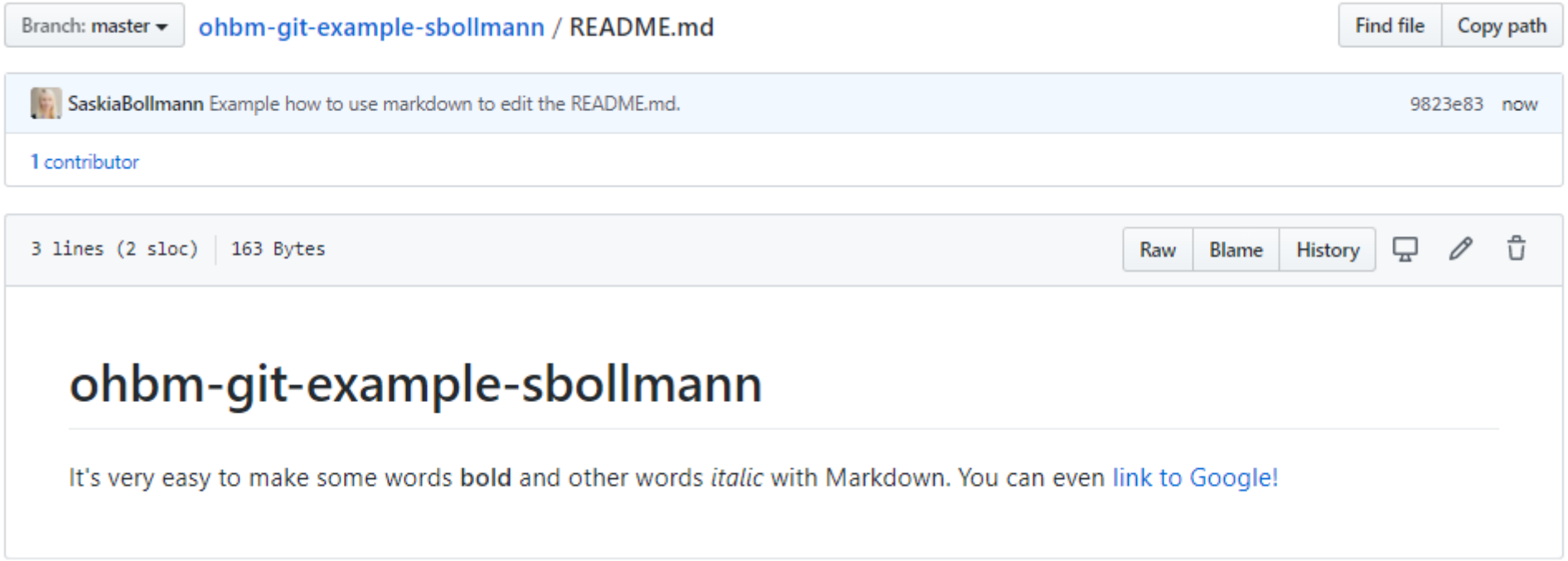
```
It's very easy to make some words **bold** and other words *italic*
with Markdown. You can even [link to Google!](http://google.com)
```

It's very easy to make some words **bold** and other words *italic* with Markdown. You can even link to Google!

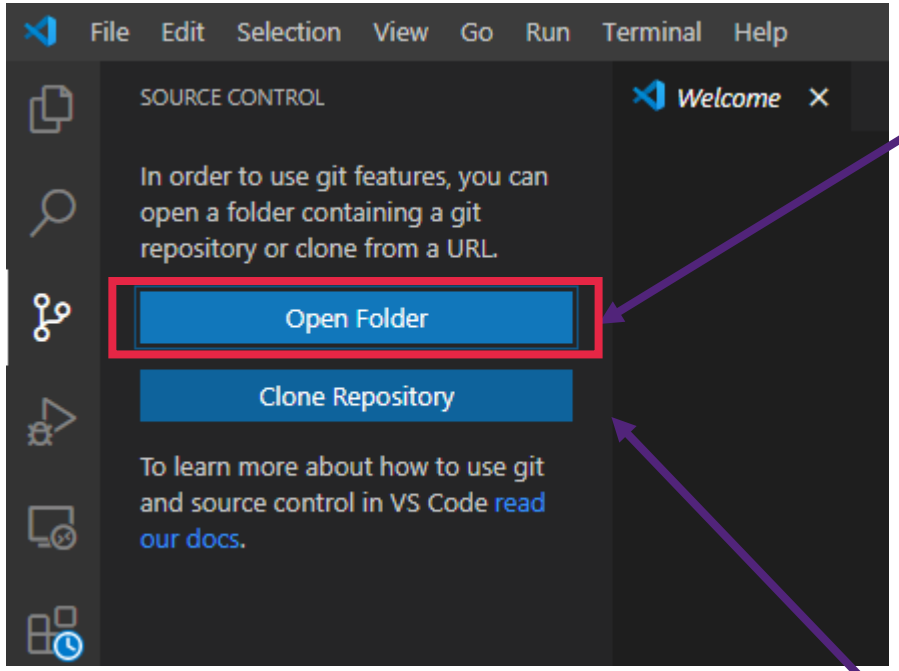
# Writing the README.md



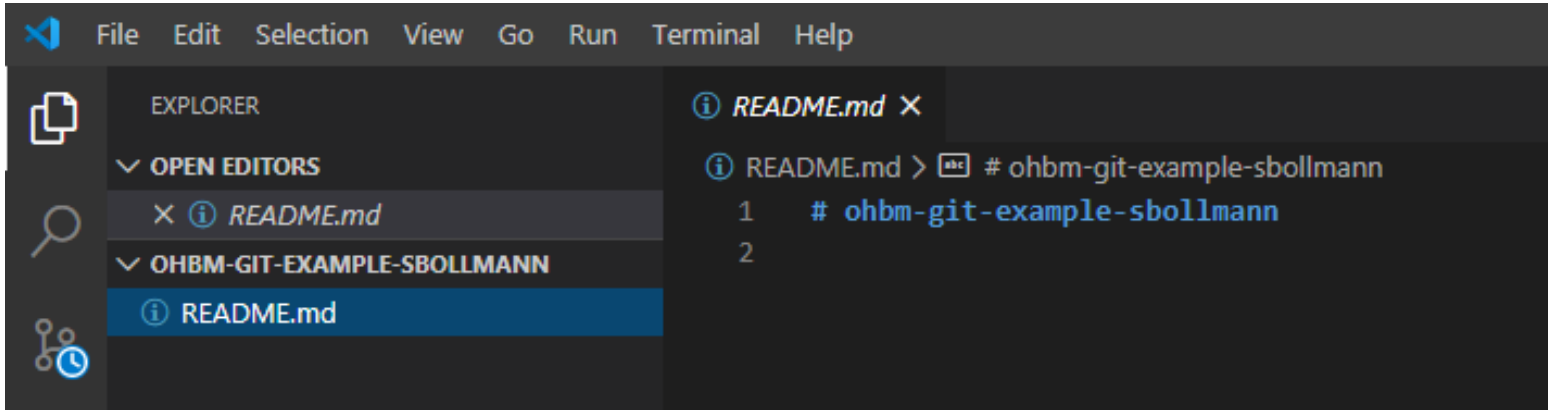
# Writing the README.md



# Working in visual studio code

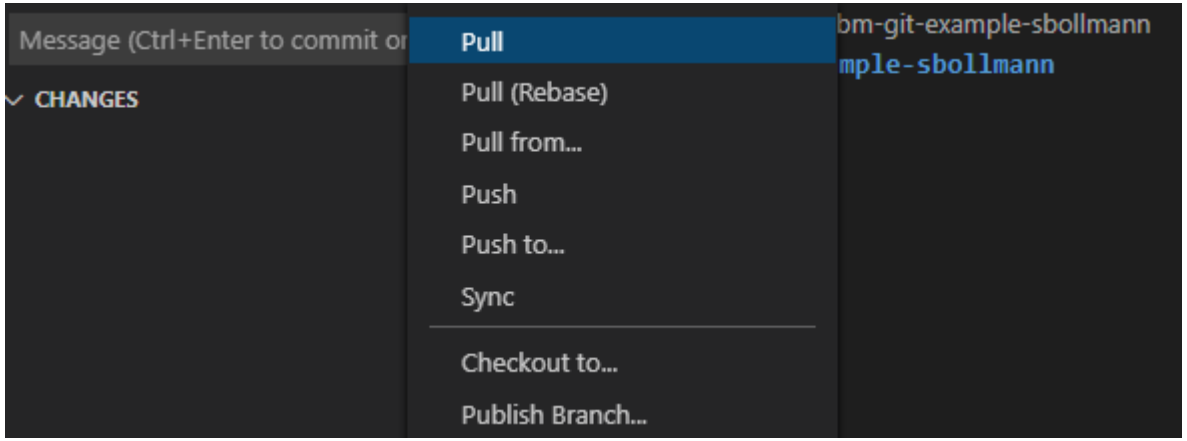



Repository exists locally




Repository exists online

# Pull to update local repository




README.md

README.md > # ohbm-git-example-sbollmann

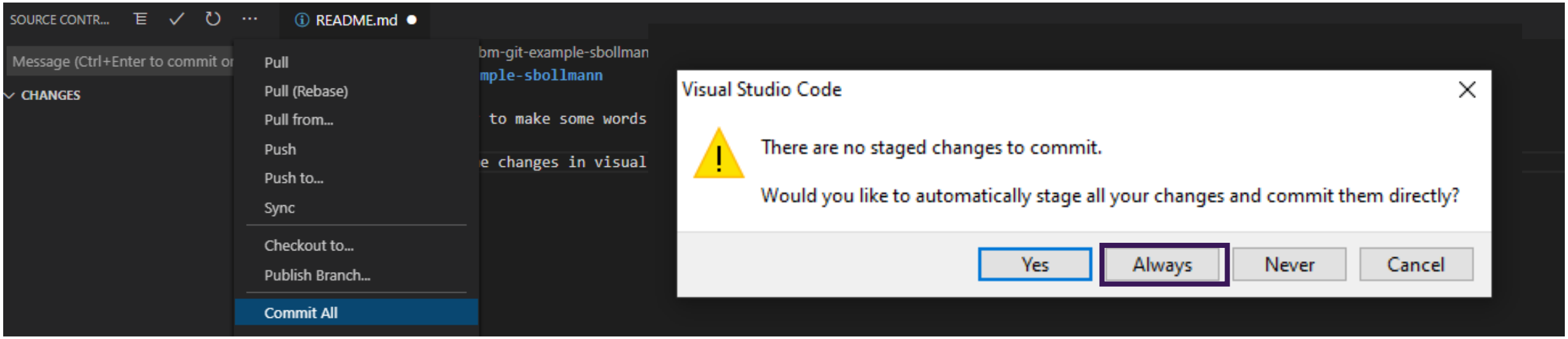
```
1  # ohbm-git-example-sbollmann
2
3  It's very easy to make some words **bold** and other words *italic* with Markdown. You can even [link to Google!](http://google.com)
4
```

# Making local changes

README.md ●

README.md > # ohbm-git-example-sbollmann

```
1  # ohbm-git-example-sbollmann
2
3  It's very easy to make some words **bold** and other words *italic* with Markdown. You can even [link to Google!](http://google.com)
4
5  Let's make some changes in visual studio code.
```



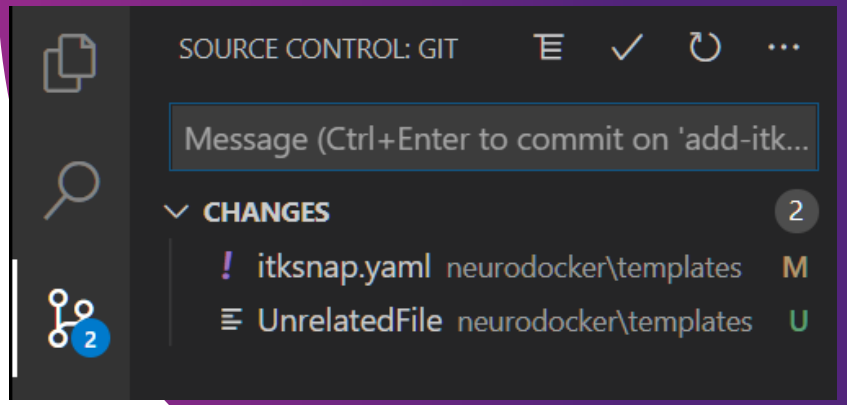
# Staging Area

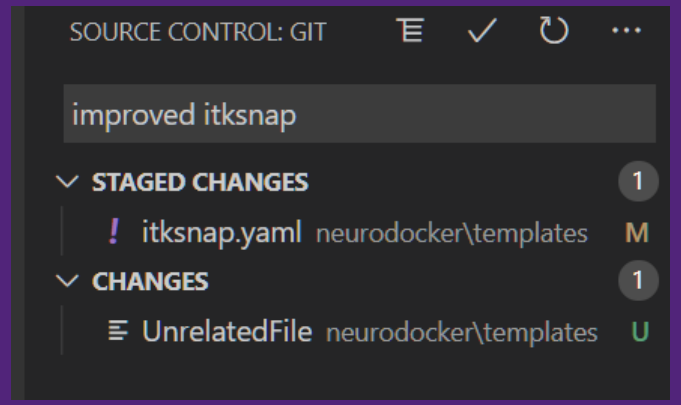


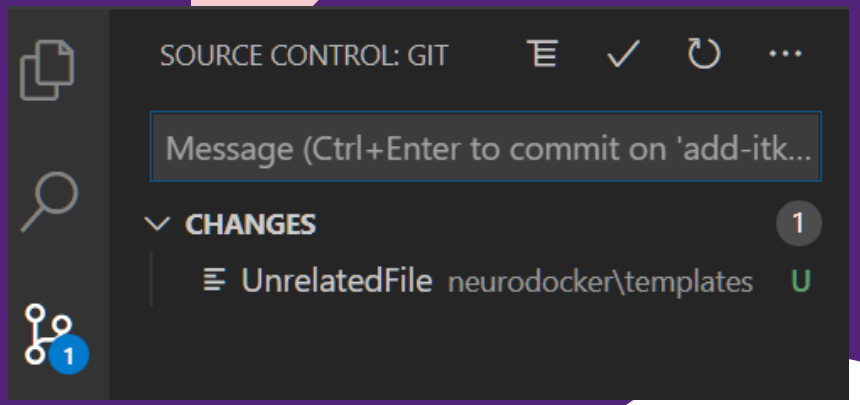
Changes in Folder

Staging Area (files to be used for the next commit)

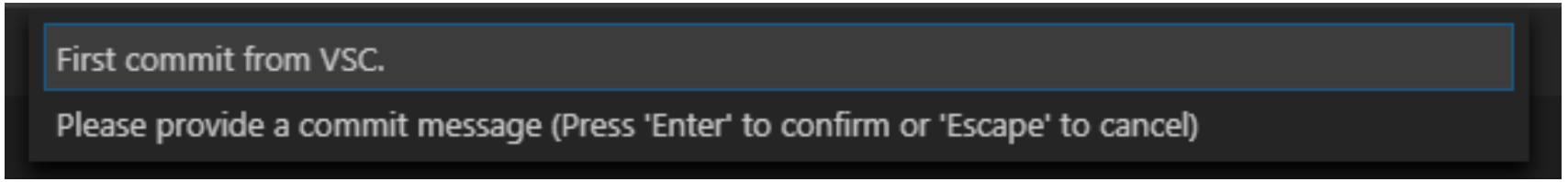
Repository

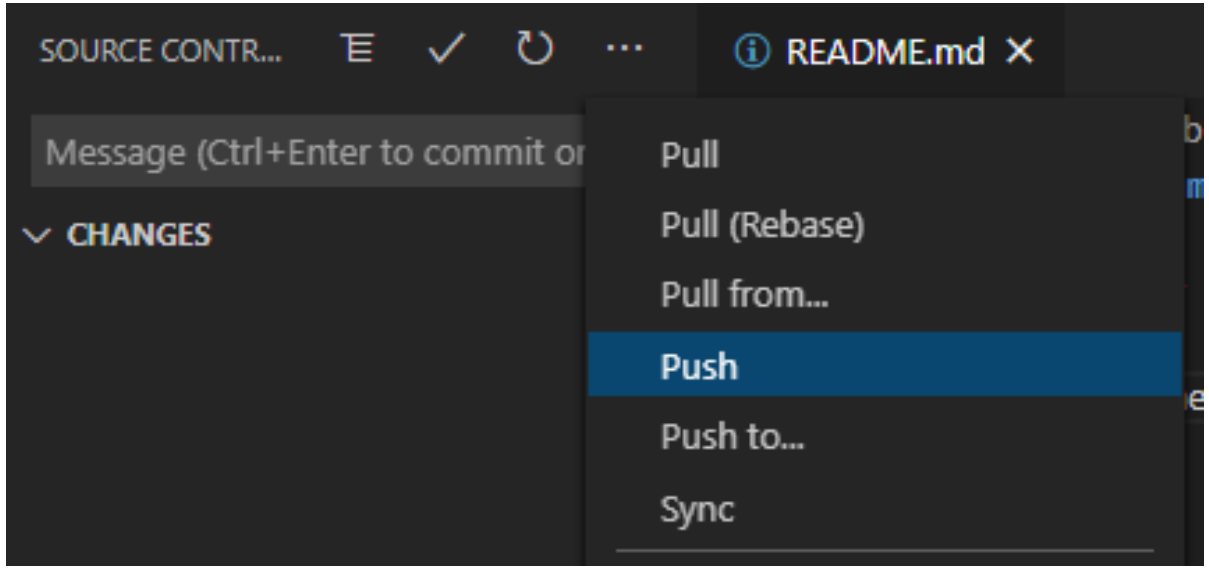


# Commit and Push



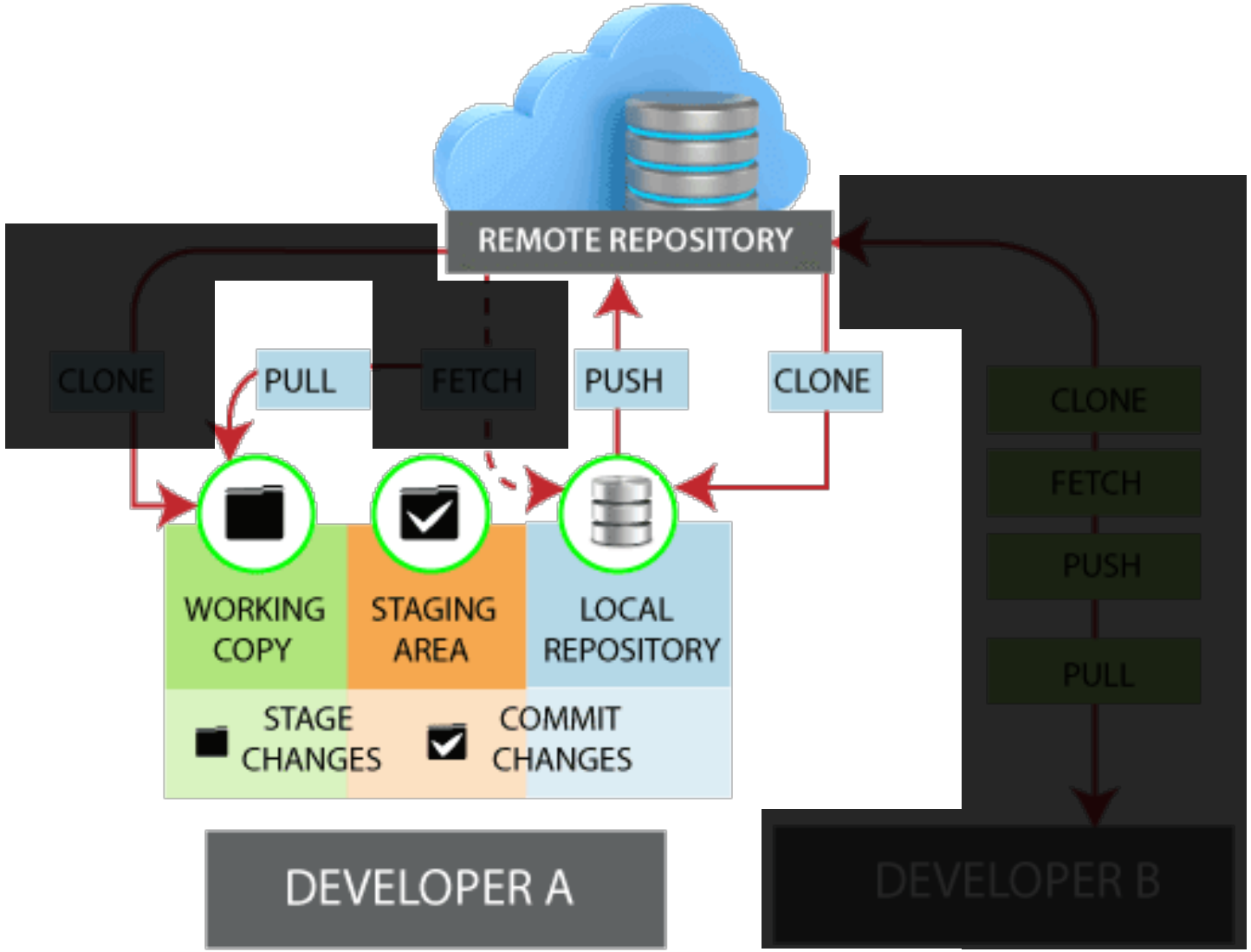

```
> git push origin master:master
To github.com:SaskiaBollmann/ohbm-git-example-sbollmann.git
   9823e83..8fa93bf  master -> master
```

# Summary

Staging Area and Working Copy

Git commands

- git status
- git commit –am “Hello”
- git push
- git pull

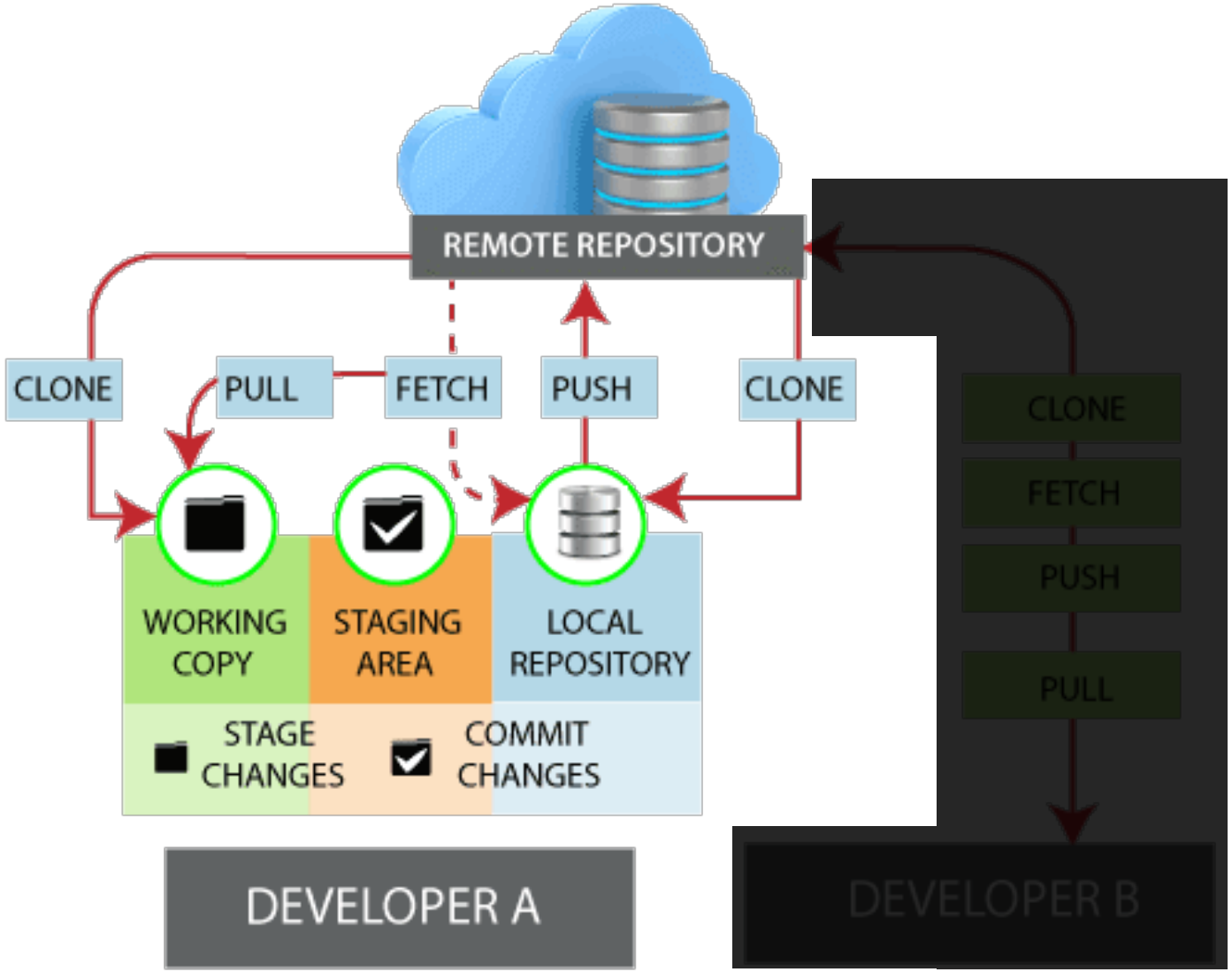



https://www.javatpoint.com/git-remote

# Summary

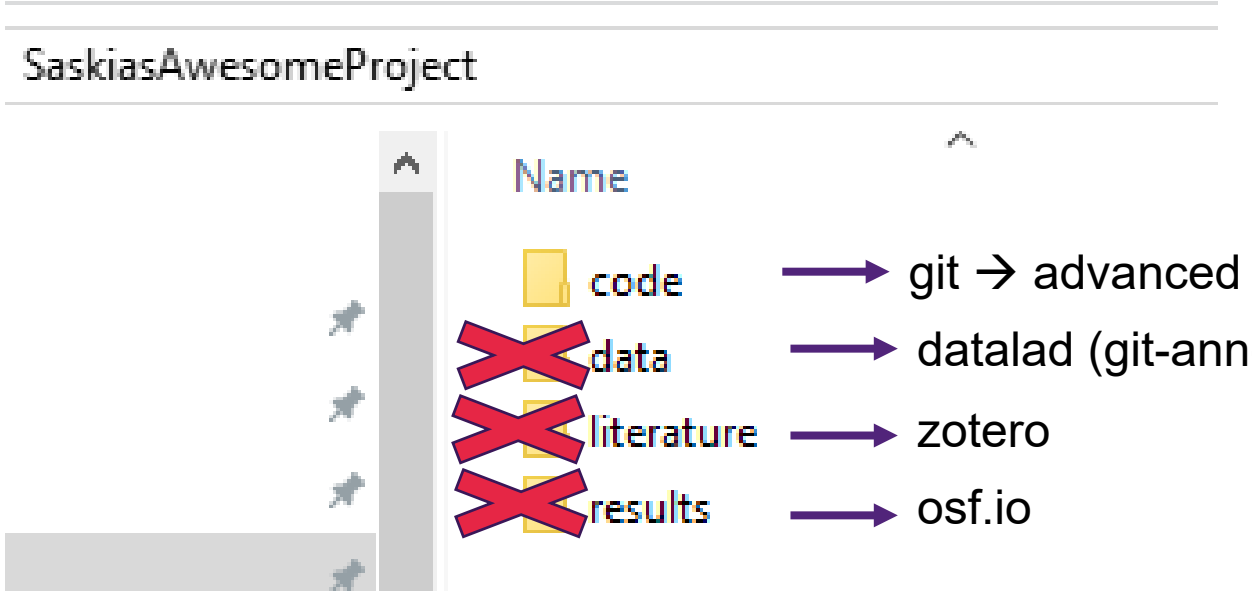
Git commands

- git fetch = update a local repository to the state of a remote
- git pull = git fetch + merge → incorporate changes from a remote repository into the current branch




https://www.javatpoint.com/git-remote

# Never commit large files to git!




→ git → advanced topic: Continuous Integration = running tests

→ datalad (git-annex)

→ zotero

→ osf.io

1) Using code from github.com

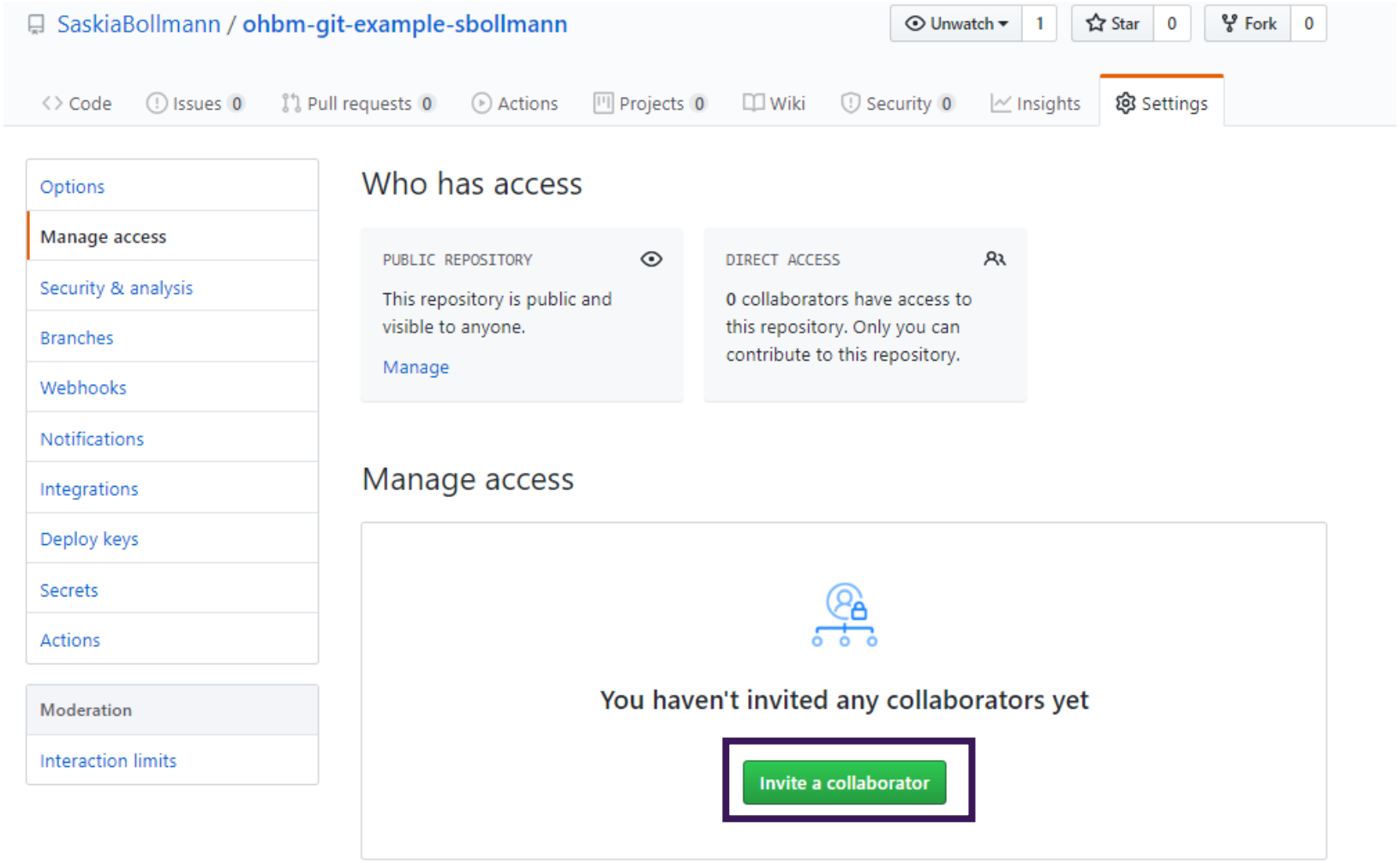
2) Version Control for your project

Use Cases

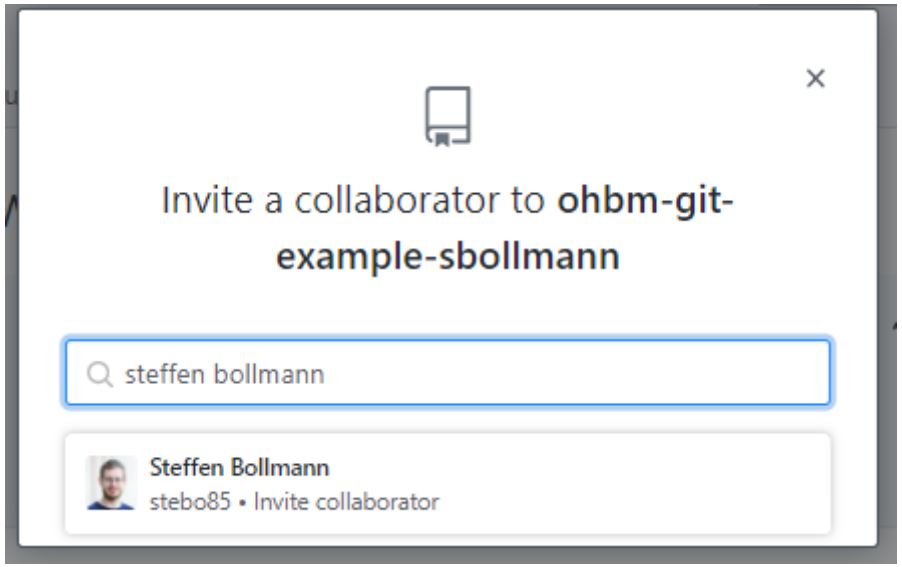
3) Adding someone to your project

4) Contributing to a project

# Adding a collaborator



# Adding a collaborator



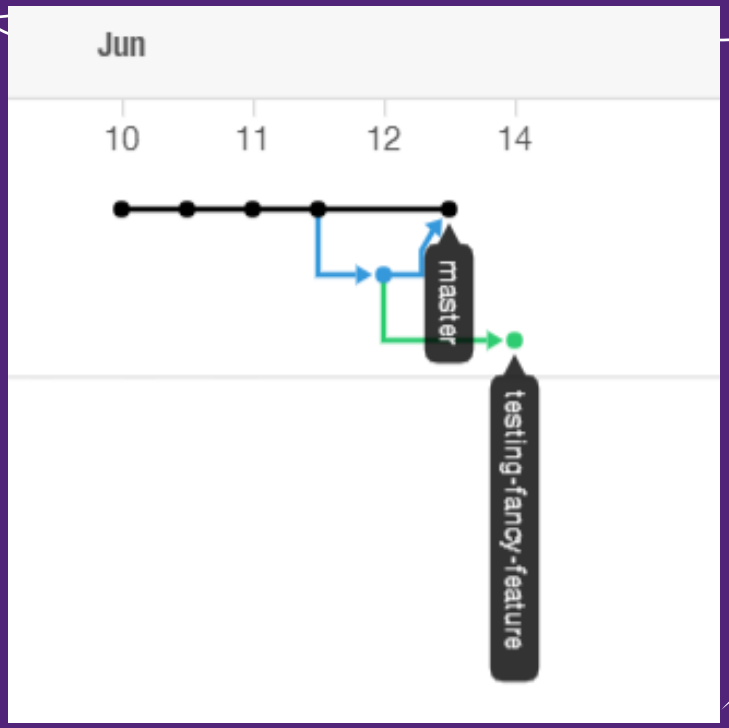
# What is a branch?

Master = main branch
-> stable code

all other branches =
testing or bug fixes

Remote 1:
Origin

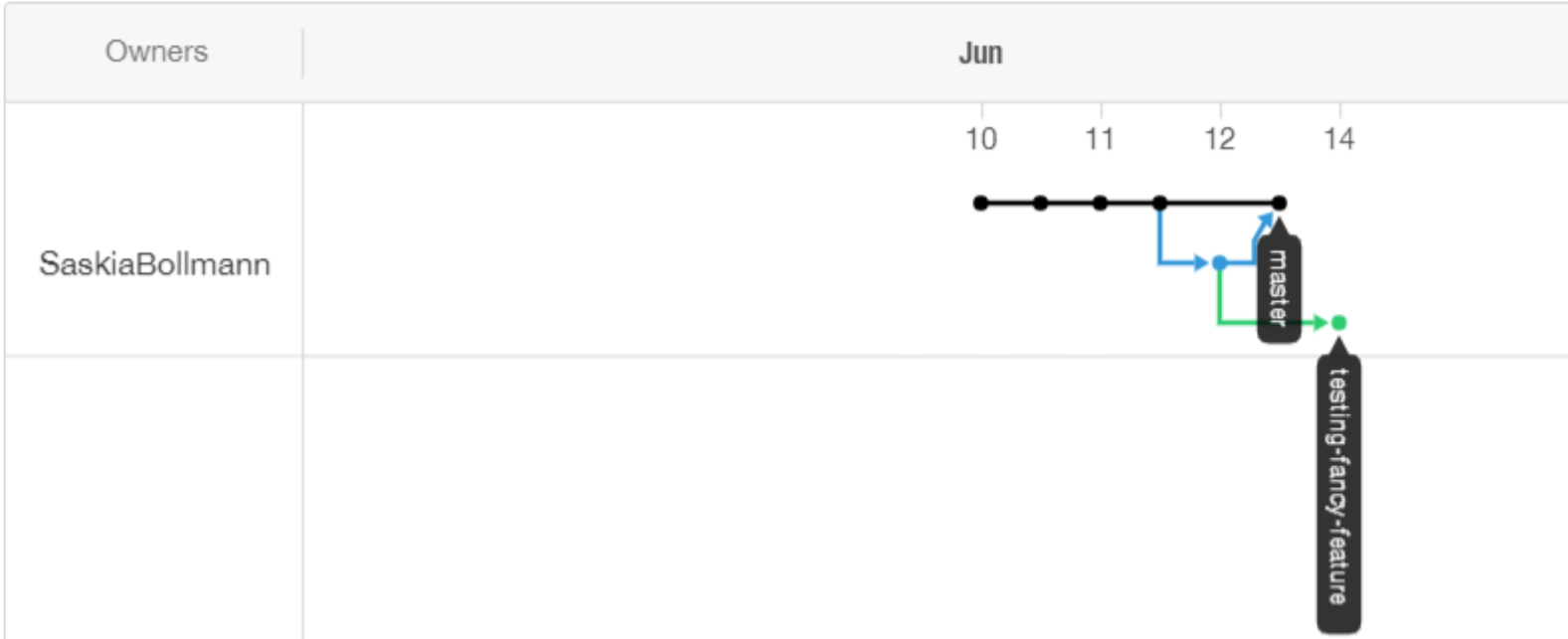
https://github.com/SaskiaBollmann/
ohbm-git-example-sbollmann



Pulse
Contributors
Community
Traffic
Commits
Code frequency
Dependency graph
Network
Forks

# Network graph

Timeline of the most recent commits to this repository and its network ordered by most recently pushe

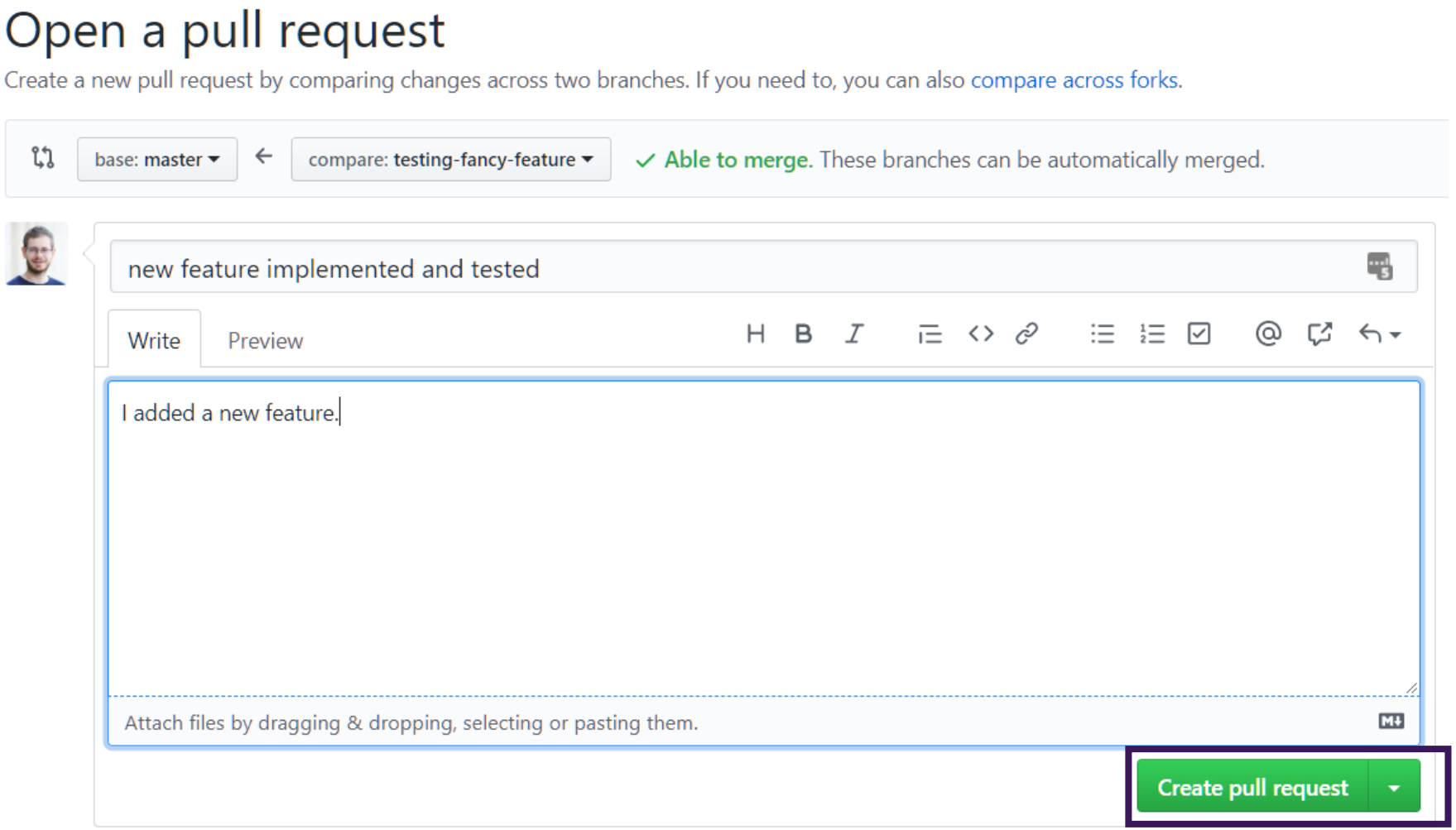


# Switching to new branch

```
(base) uqsbollm@cai-wks3:~/ohbm-git-example-sbollmann$ git pull
From github.com:SaskiaBollmann/ohbm-git-example-sbollmann
 * [new branch]      testing-fancy-feature -> origin/testing-fancy-feature
Already up-to-date.
```

```
(base) uqsbollm@cai-wks3:~/ohbm-git-example-sbollmann$ git checkout testing-fanc
y-feature
Branch testing-fancy-feature set up to track remote branch testing-fancy-feature
 from origin.
Switched to a new branch 'testing-fancy-feature'
```

# Ready to merge?



1) Using code from github.com

2) Version Control for your project

Use Cases

3) Adding someone to your project

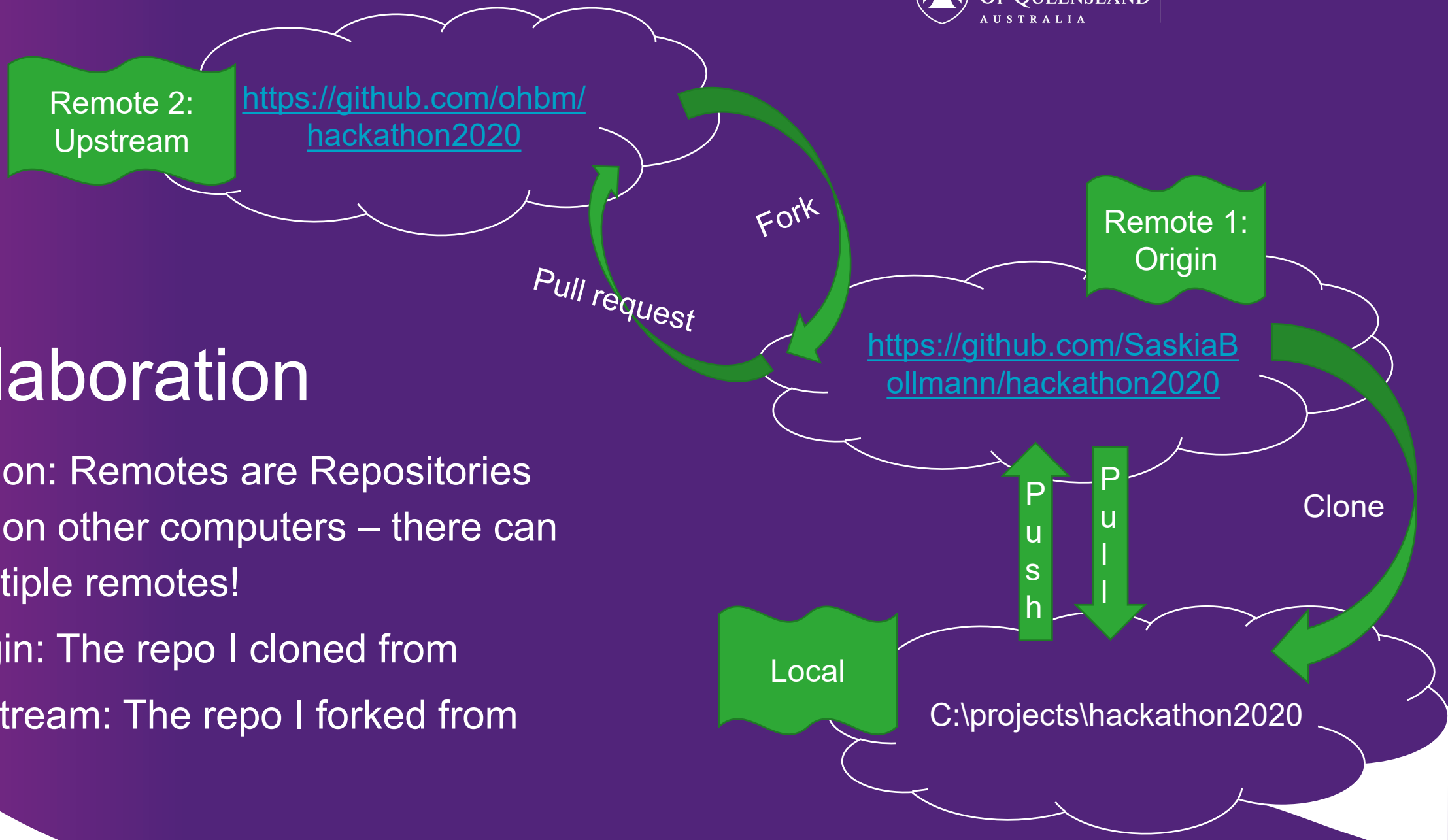
4) Contributing to a project

# Collaboration

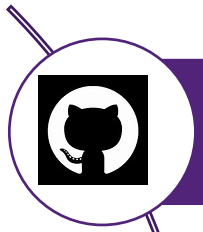
Definition: Remotes are Repositories stored on other computers – there can be multiple remotes!

-> Origin: The repo I cloned from

-> Upstream: The repo I forked from



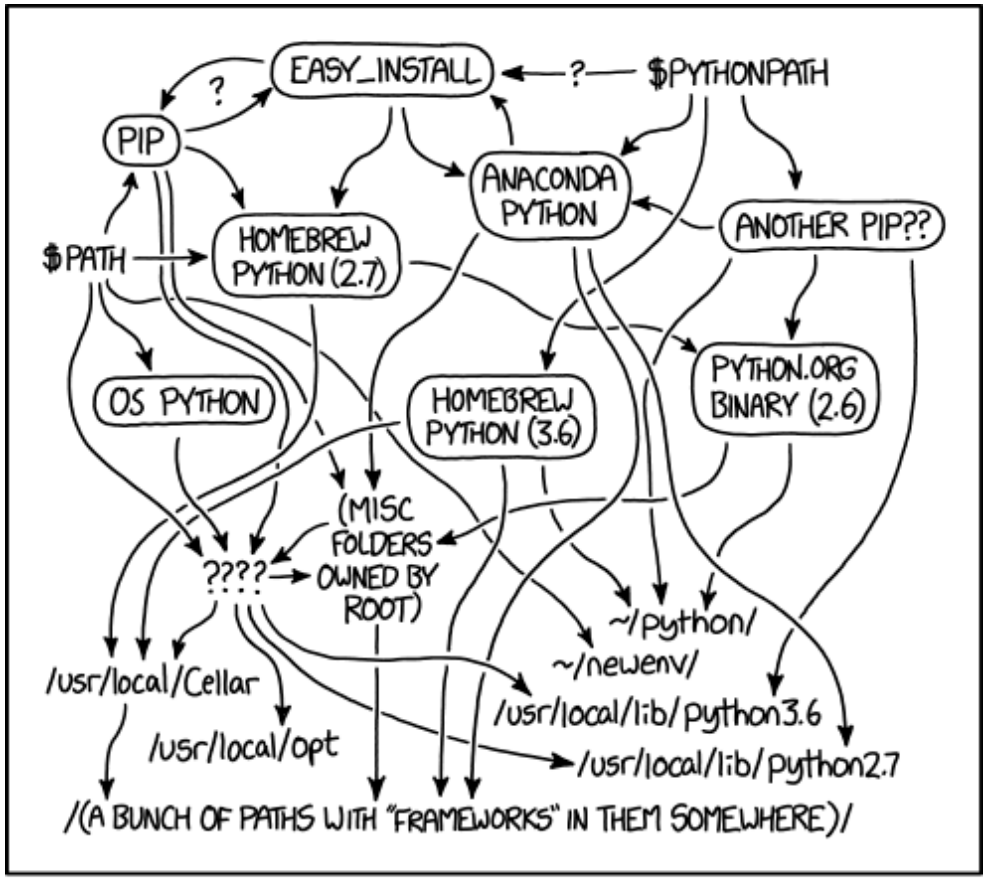
# … building AI models is easy? Right?



Code under version control -> **basics in git**


Most models developed in Python -> **some conda magic**

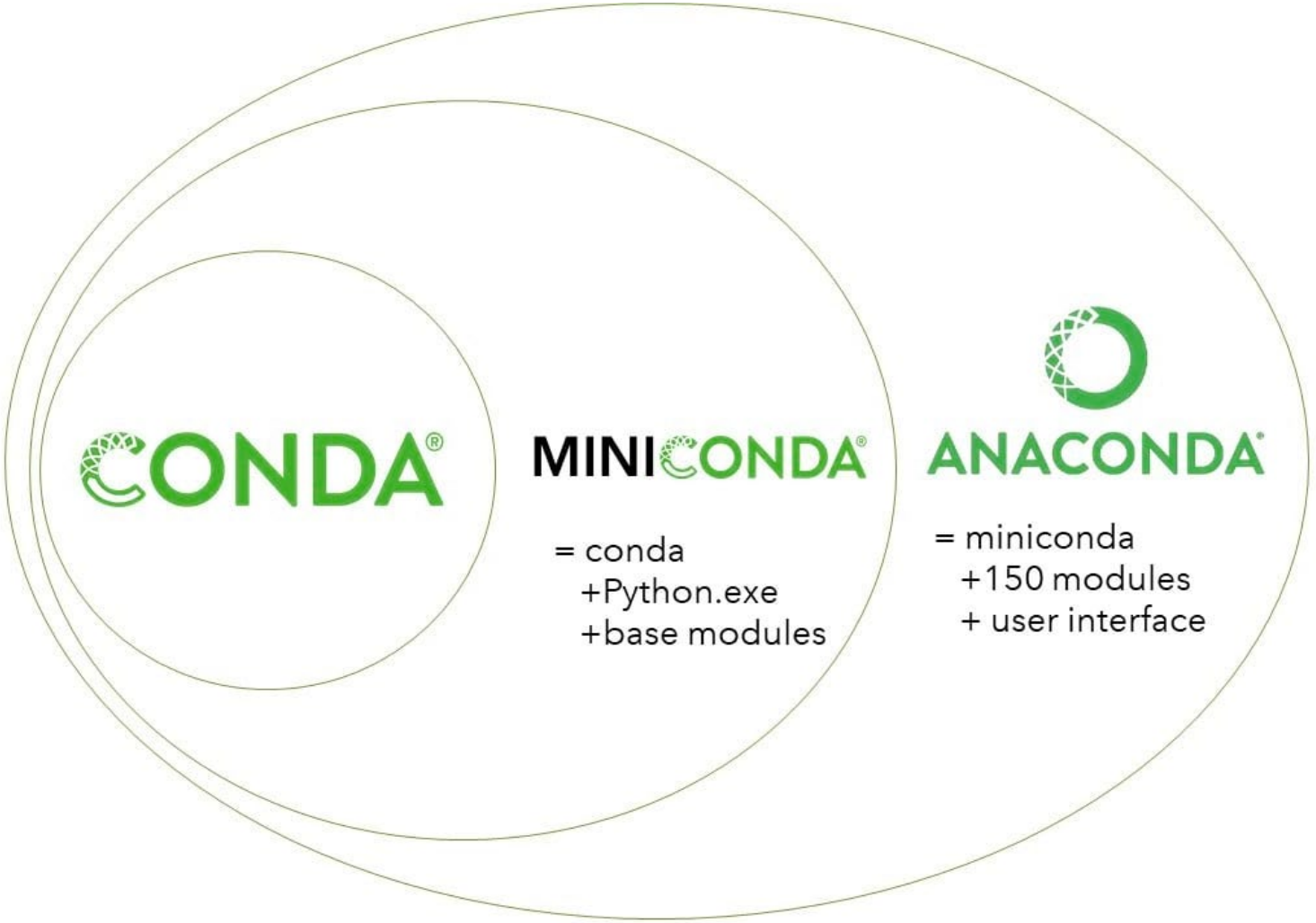
# Python is easy, right?




MY PYTHON ENVIRONMENT HAS BECOME SO DEGRADED THAT MY LAPTOP HAS BEEN DECLARED A SUPERFUND SITE.

https://xkcd.com/1987/

# Conda to the rescue




https://docs.conda.io/en/latest/miniconda.html

# GPU driver has to be installed and working:

```
(base) uqsbollm@cai-wks3:~$ nvidia-smi
Thu Dec  3 08:36:30 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 455.45.01    Driver Version: 455.45.01    CUDA Version: 11.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Quadro K4200        On   | 00000000:03:00.0 Off |                  N/A |
| 30%   40C    P8    14W / 110W |    118MiB /  4035MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
|   1  Tesla K40c          On   | 00000000:04:00.0 Off |                    0 |
| 23%   36C    P8    21W / 235W |      2MiB / 11441MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

# Install miniconda in Linux:

```
(base) uqsbollm@cai-wks3:~$ wget https://repo.anaconda.com/miniconda/Miniconda3-latest-Linux-x86_64.sh
--2020-12-03 08:38:07--  https://repo.anaconda.com/miniconda/Miniconda3-latest-Linux-x86_64.sh
Resolving repo.anaconda.com (repo.anaconda.com)... 104.16.130.3, 104.16.131.3, 2606:4700::6810:8203, ...
Connecting to repo.anaconda.com (repo.anaconda.com)|104.16.130.3|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 94235922 (90M) [application/x-sh]
Saving to: 'Miniconda3-latest-Linux-x86_64.sh'

Miniconda3-latest-Linux-x86_64  10%[====>                                                ]   9.19M  4.38MB/s
```

```
(base) uqsbollm@cai-wks3:~$ bash Miniconda3-latest-Linux-x86_64.sh

Welcome to Miniconda3 py38_4.9.2
```

# Installing Tensorflow using conda gets dependencies right (including GPU stuff ☺)

```
(base) uqsbollm@cai-wks3:~$ conda install tensorflow-gpu
Collecting package metadata (current_repodata.json): done
Solving environment: failed with initial frozen solve. Retrying with flexible solve.
Solving environment: failed with repodata from current_repodata.json, will retry with next repodata source.
Collecting package metadata (repodata.json): done
Solving environment: done

## Package Plan ##

  environment location: /data/home/uqsbollm/miniconda3

  added / updated specs:
    - tensorflow-gpu


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    ca-certificates-2020.10.14 |                0         121 KB
    certifi-2020.11.8          |   py37h06a4308_0         148 KB
    conda-4.9.2                |   py37h06a4308_0         2.9 MB
    cudatoolkit-10.1.243       |       h6bb024c_0       347.4 MB
    cudnn-7.6.5                |       cuda10.1_0       179.9 MB
    cupti-10.1.168             |                0         1.4 MB
    tensorflow-2.1.0           |gpu_py37h7a4bb67_0           4 KB
    tensorflow-base-2.1.0      |gpu_py37h6c5654b_0       155.3 MB
    tensorflow-gpu-2.1.0       |       h0d30ee6_0           3 KB
    ------------------------------------------------------------
                                           Total:       687.2 MB
```

# Hint: work in conda environments to avoid conflicts of packages!

```
(base) uqsbollm@cai-wks3:~$ conda create -n tensorflow_latest
Collecting package metadata (current_repodata.json): done
Solving environment: done


==> WARNING: A newer version of conda exists. <==
  current version: 4.8.3
  latest version: 4.9.2

Please update conda by running

    $ conda update -n base -c defaults conda



## Package Plan ##

  environment location: /data/home/uqsbollm/miniconda3/envs/tensorflow_latest



Proceed ([y]/n)?
```

# Hint: work in conda environments to avoid conflicts of packages!

```
#
# To activate this environment, use
#
#     $ conda activate tensorflow_latest
#
# To deactivate an active environment, use
#
#     $ conda deactivate
```

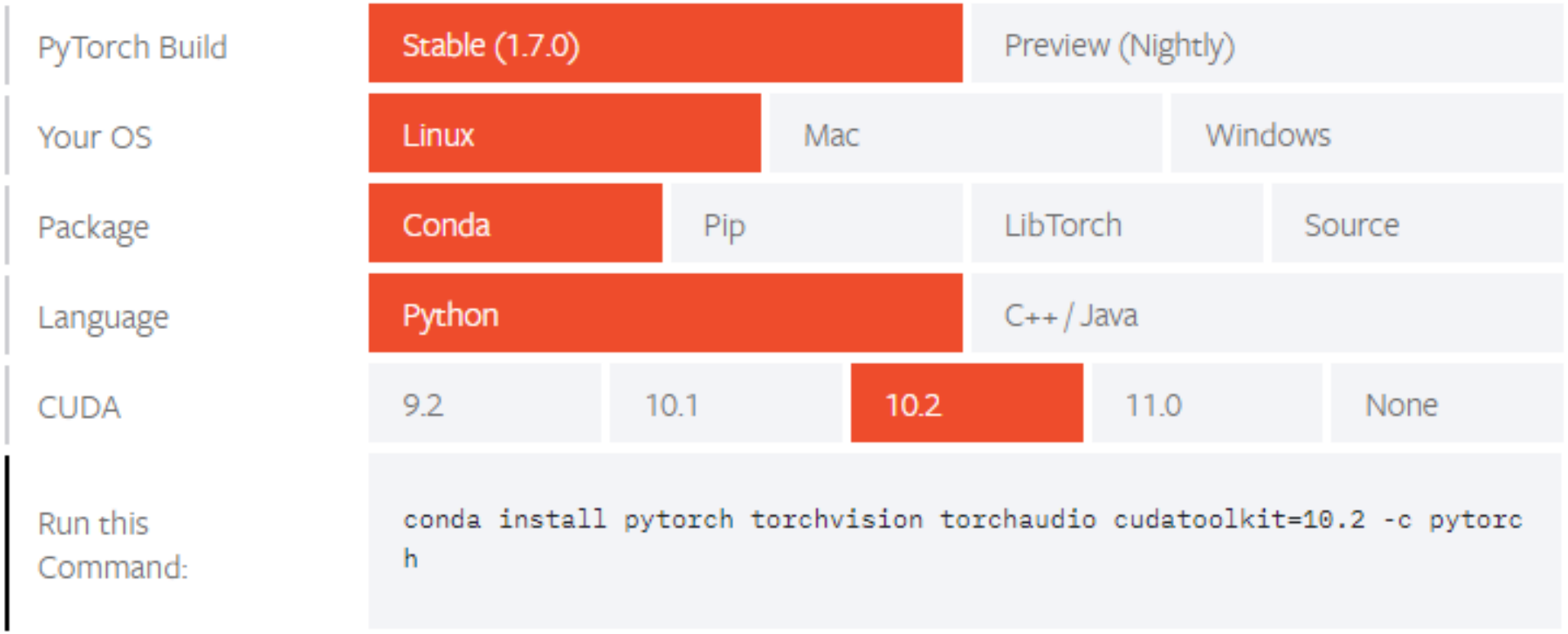
```
(base) uqsbollm@cai-wks3:~$ conda activate tensorflow_latest
(tensorflow_latest) uqsbollm@cai-wks3:~$
```

# HINT: Tensorflow versions require specific Python versions (+Cuda library versions):

https://anaconda.org/conda-forge/tensorflow/files?page=2


```
(base) C:\Users\uqsbollm>conda create -n fatsegnet python=3.6
Collecting package metadata (current_repodata.json): done
Solving environment: done

## Package Plan ##

  environment location: C:\Users\uqsbollm\Miniconda3\envs\fatsegnet

  added / updated specs:
    - python=3.6
```

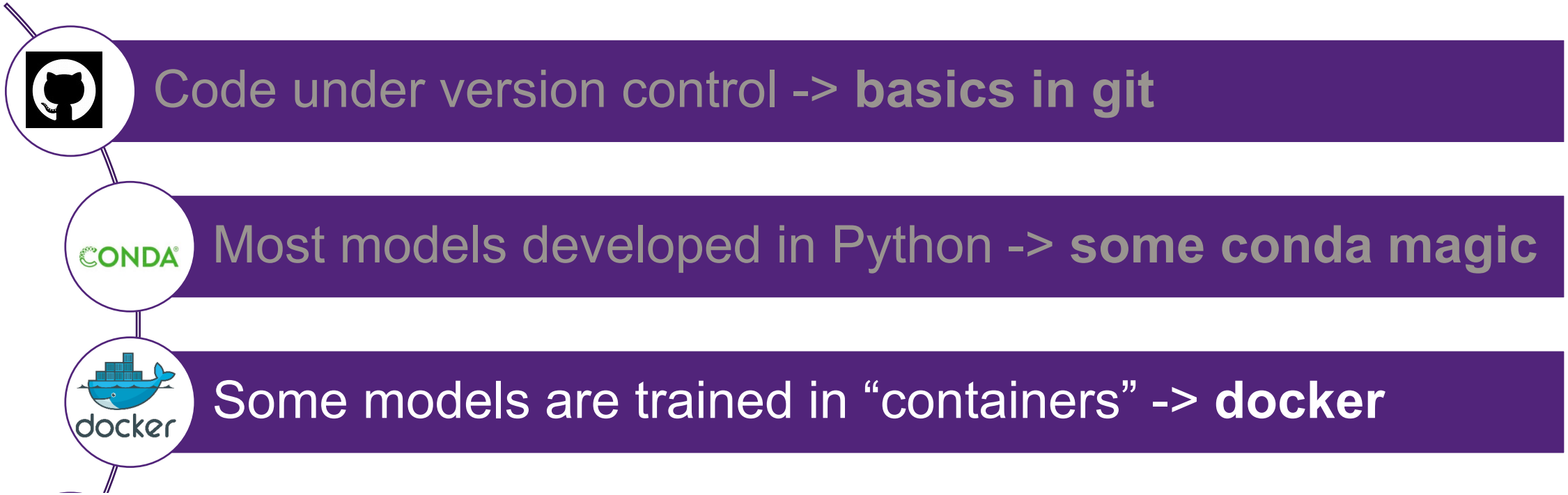
# PyTorch also installable using Conda:



# PyTorch also installable using Conda:

```
The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    ca-certificates-2020.10.14 |                0         121 KB
    certifi-2020.11.8          |   py37h06a4308_0         148 KB
    conda-4.9.2                |   py37h06a4308_0         2.9 MB
    cudatoolkit-10.2.89        |       hfd86e86_1       365.1 MB
    freetype-2.10.4            |       h5ab3b9f_0         596 KB
    lcms2-2.11                 |       h396b838_0         307 KB
    libtiff-4.1.0              |       h2733197_1         449 KB
    libuv-1.40.0               |       h7b6447c_0         736 KB
    lz4-c-1.9.2                |       heb0550a_3         175 KB
    ninja-1.10.2               |   py37hff7bd54_0         1.4 MB
    olefile-0.46               |           py37_0          50 KB
    pillow-8.0.1               |   py37he98fc37_0         619 KB
    pytorch-1.7.0              |py3.7_cuda10.2.89_cudnn7.6.5_0       575.2 MB  pytorch
    torchaudio-0.7.0           |             py37         9.8 MB  pytorch
    torchvision-0.8.1          |       py37_cu102        17.8 MB  pytorch
    typing_extensions-3.7.4.3  |             py_0          28 KB
    zstd-1.4.5                 |       h9ceee32_0         619 KB
    ------------------------------------------------------------
                                          Total:       975.9 MB
```

# … building AI models is easy? Right?



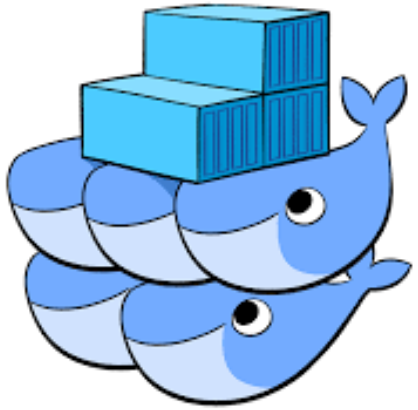
# POLL – what ARE containers?

a) Little virtual machines but without virtualisation of hardware

b) Plastic boxes to store food in and keep it separated in the fridge

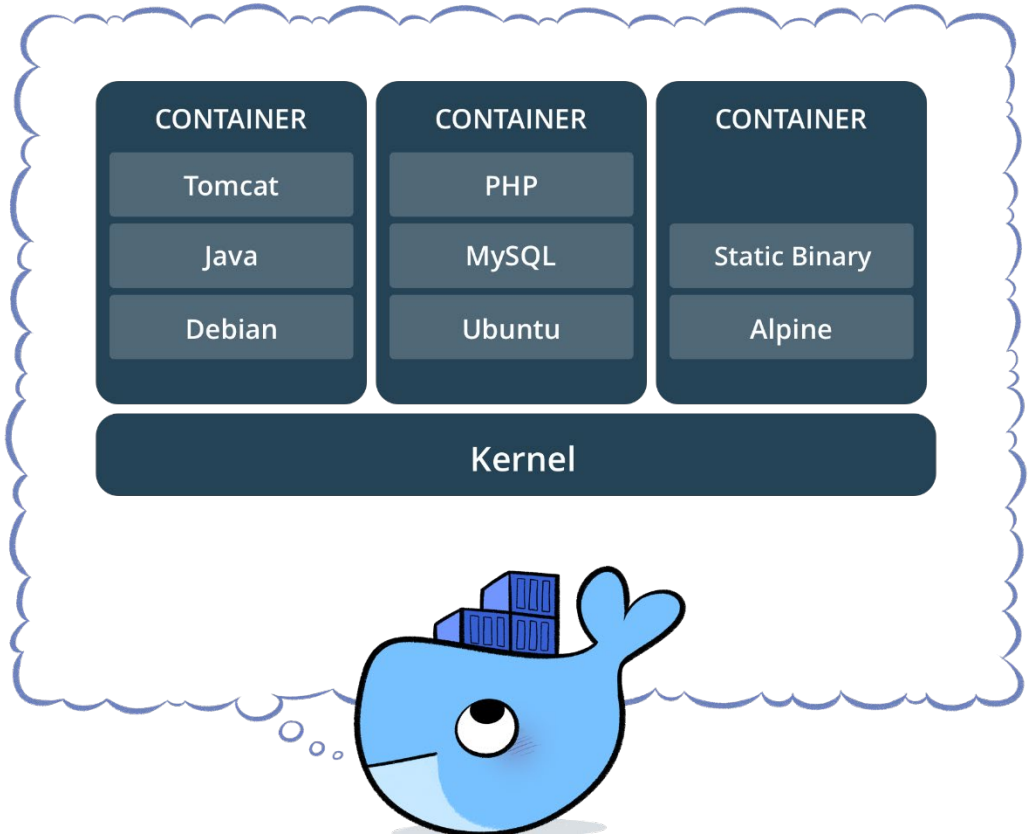
c) A collection of tools to keep programs from interfering with each other using Linux kernel features, like cgroups and namespaces

d) all of the above



# What are containers?

- isolate software from its surroundings
- container image includes: code, runtime, system tools, system libraries, settings
- resource management provided by the Linux kernel (namespaces and cgroups)
- recipe = describes what should be in an image
- image = stores everything we need to run
- container = what we launch based on an image




https://www.docker.com/what-container#/package_software

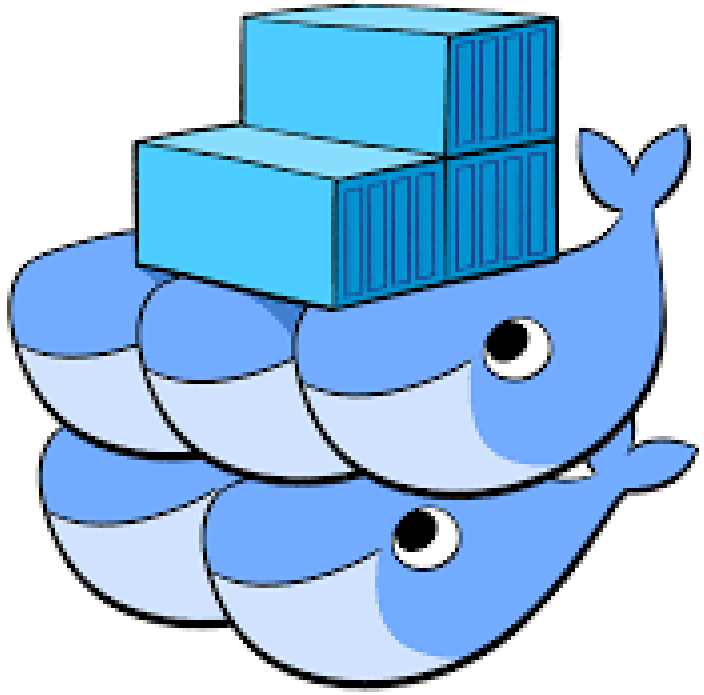
# Docker

started the container hype by providing easy to use packages for Linu

widely adopted and supported by cloud providers, including orchestra

not easy to run graphical applications ☹

requires elevated privileges ☹



# Singularity

Built to run on HPCs

- simple to install
- untrusted users running untrusted containers
- same user inside image than outside

built for data science

- GPU devices can be accessed in container
- graphical applications can run inside containers

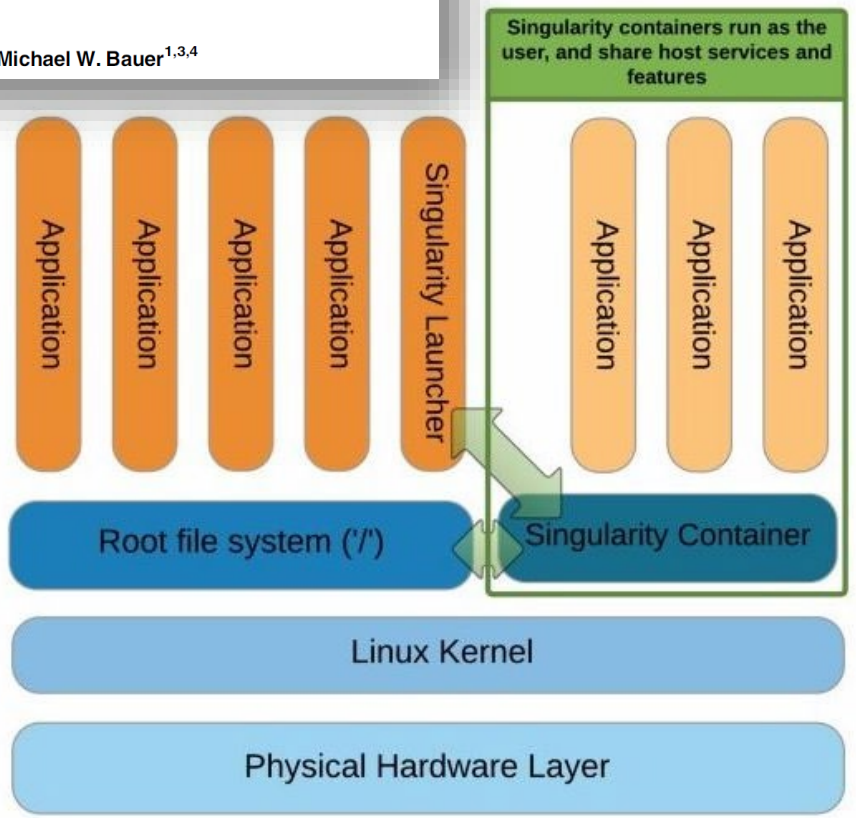
container format based on a single file

- simple file transfer and archive

RESEARCH ARTICLE

Singularity: Scientific containers for mobility of compute

Gregory M. Kurtzer[1], Vanessa Sochat[2]*, Michael W. Bauer[1,3,4]



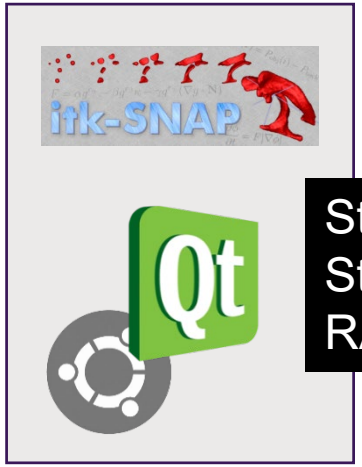

https://www.hpcwire.com/2017/05/04/singularity-hpc-container-technology-moves-lab/

# Virtual Machines VS Containers

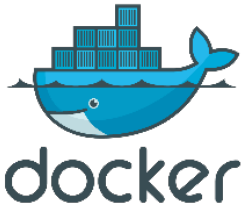
Storage: 10 GB
Startup: 15s
RAM: 4GB



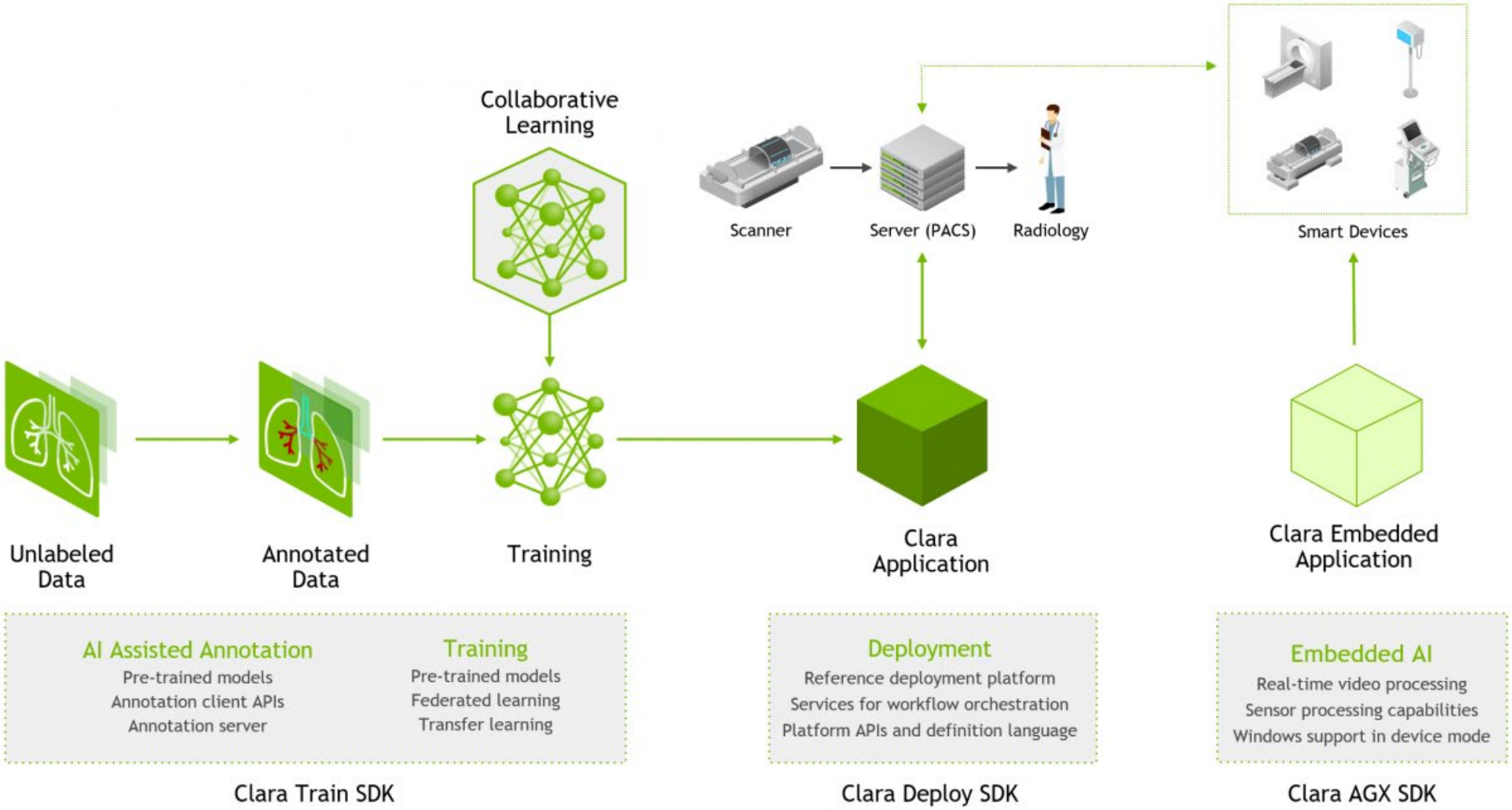
| | |
|---|---|
| Application | • e.g. itksnap |
| Libraries | • e.g. QT4 |
| Guest OS | • e.g. Ubuntu 16.04 |
| Hypervisor | • e.g. Virtualbox |
| Host OS | • e.g. Centos 6 |
| Hardware | • e.g. Dell Precision |




Storage: 0.1 GB
Startup: 0.2 s
RAM: 0.1 GB




# NVIDIA Clara




https://developer.nvidia.com/clara

# Setting up docker (+Nvidia Docker for GPU access)

```
curl https://get.docker.com | sh \
  && sudo systemctl start docker \
  && sudo systemctl enable docker
```

```
distribution=$(. /etc/os-release;echo $ID$VERSION_ID) \
   && curl -s -L https://nvidia.github.io/nvidia-docker/gpgkey | sudo apt-key add - \
   && curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.list | sudo tee
/etc/apt/sources.list.d/nvidia-docker.list
```

```
sudo apt-get update
sudo apt-get install -y nvidia-docker2
sudo systemctl restart docker
```

**https://docs.nvidia.com/datacenter/cloud-native/container-toolkit/install-guide.html#docker**

# Let's test ☺

```
$ sudo docker run --rm --gpus all nvidia/cuda:11.0-base nvidia-smi
```

```
Unable to find image 'nvidia/cuda:11.0-base' locally
11.0-base: Pulling from nvidia/cuda
54ee1f796a1e: Pull complete
f7bfea53ad12: Pull complete
46d371e02073: Pull complete
b66c17bbf772: Pull complete
3642f1a6dfb3: Pull complete
e5ce55b8b4b9: Pull complete
155bc0332b0a: Pull complete
Digest: sha256:774ca3d612de15213102c2dbbba55df44dc5cf9870ca2be6c6e9c627fa63d67a
Status: Downloaded newer image for nvidia/cuda:11.0-base
Wed Dec  2 22:58:53 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 455.45.01    Driver Version: 455.45.01    CUDA Version: 11.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Quadro K4200        On   | 00000000:03:00.0 Off |                  N/A |
| 30%   40C    P8    14W / 110W |    119MiB /  4035MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
|   1  Tesla K40c          On   | 00000000:04:00.0 Off |                    0 |
| 23%   36C    P8    21W / 235W |      2MiB / 11441MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

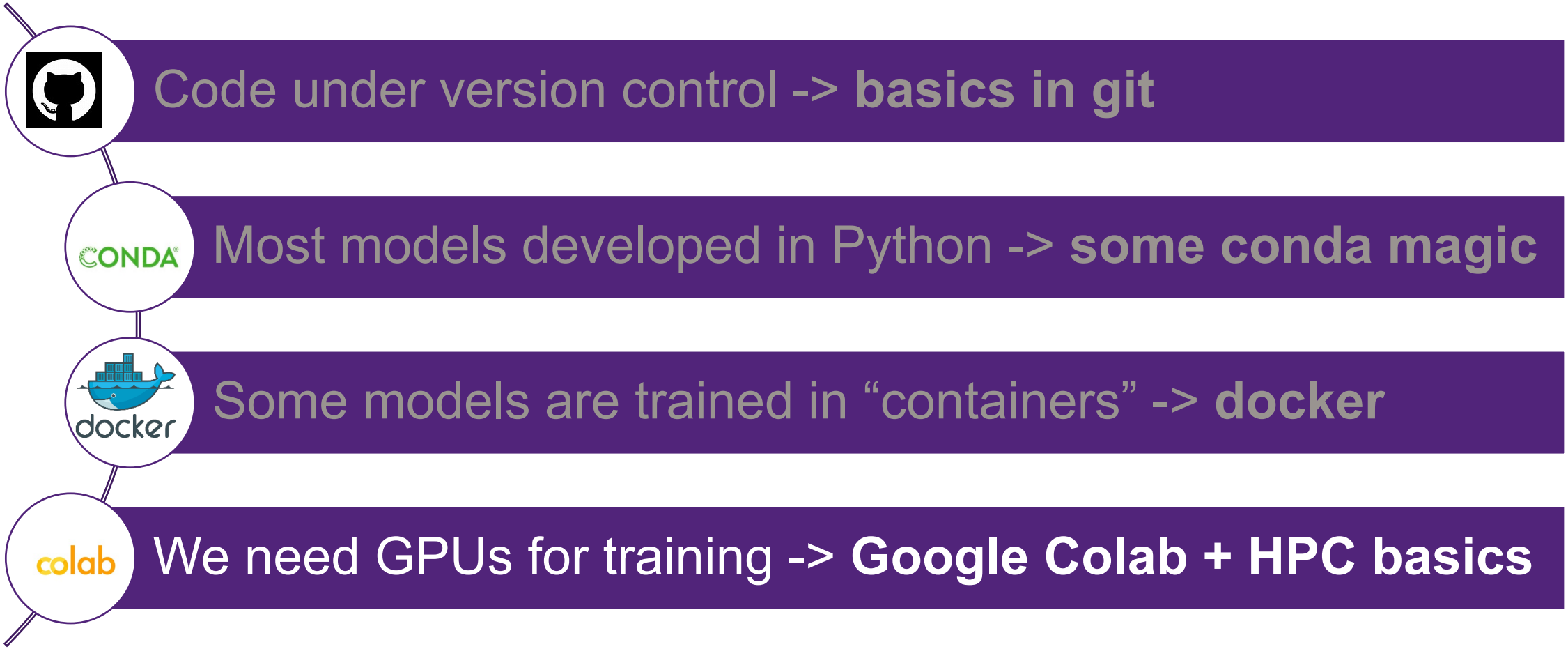
# Clara Containers for Medical Imaging Deep Learning

Pull Command

```
docker pull nvcr.io/nvidia/clara-train-sdk:v3.1
```

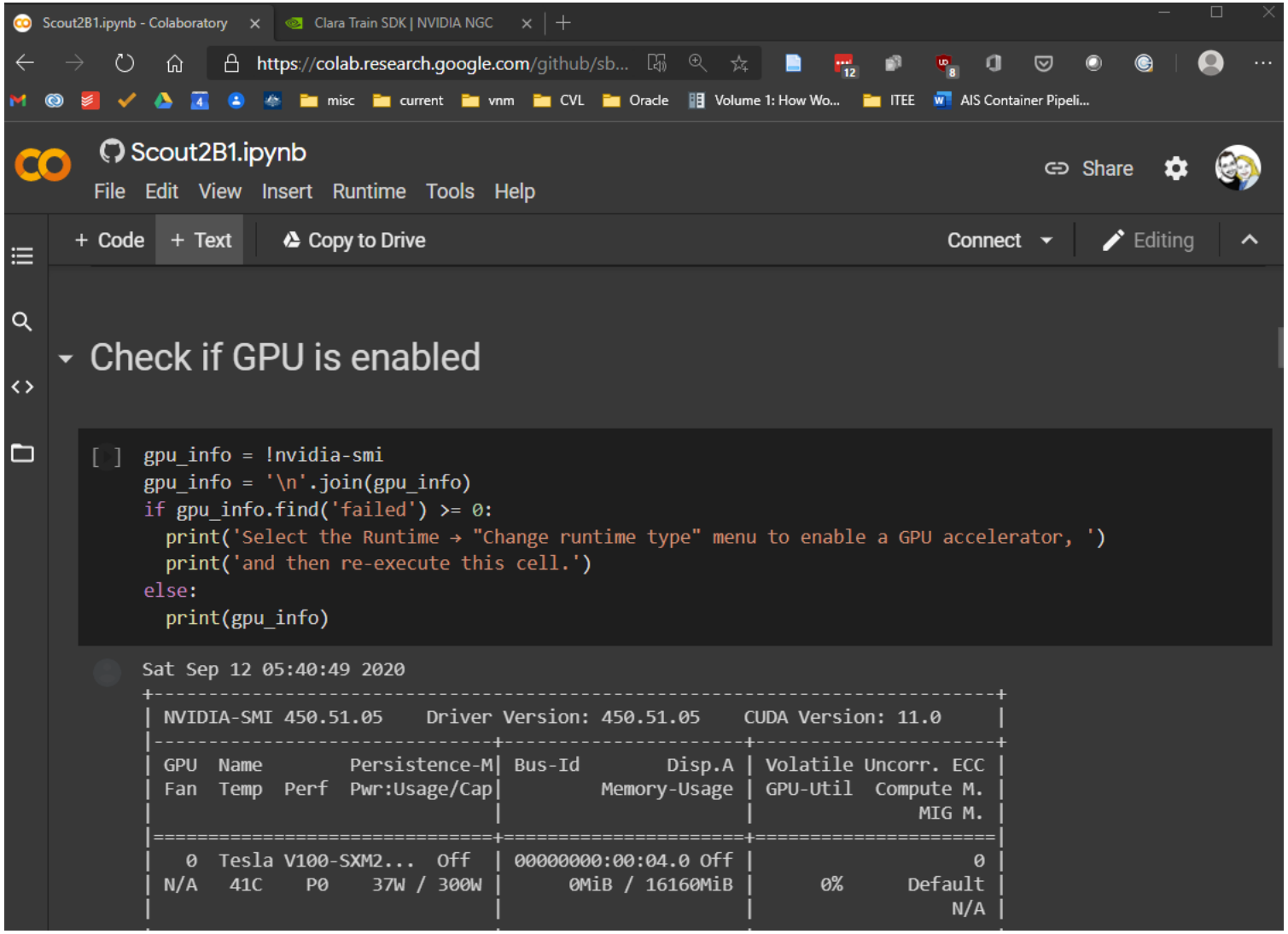
**https://ngc.nvidia.com/catalog/containers/nvidia:clara-train-sdk**

# … building AI models is easy? Right?

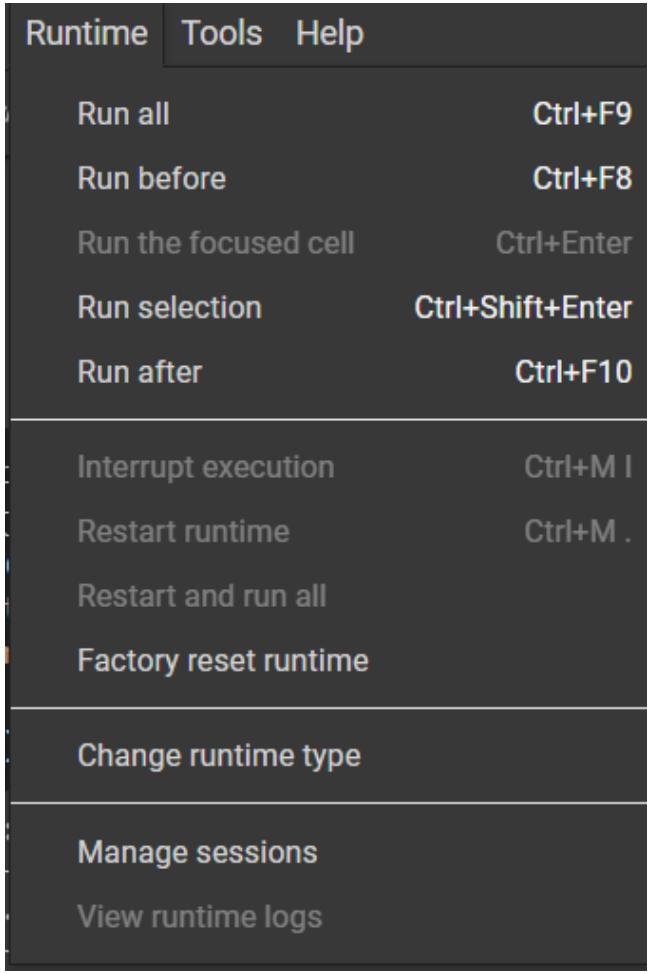


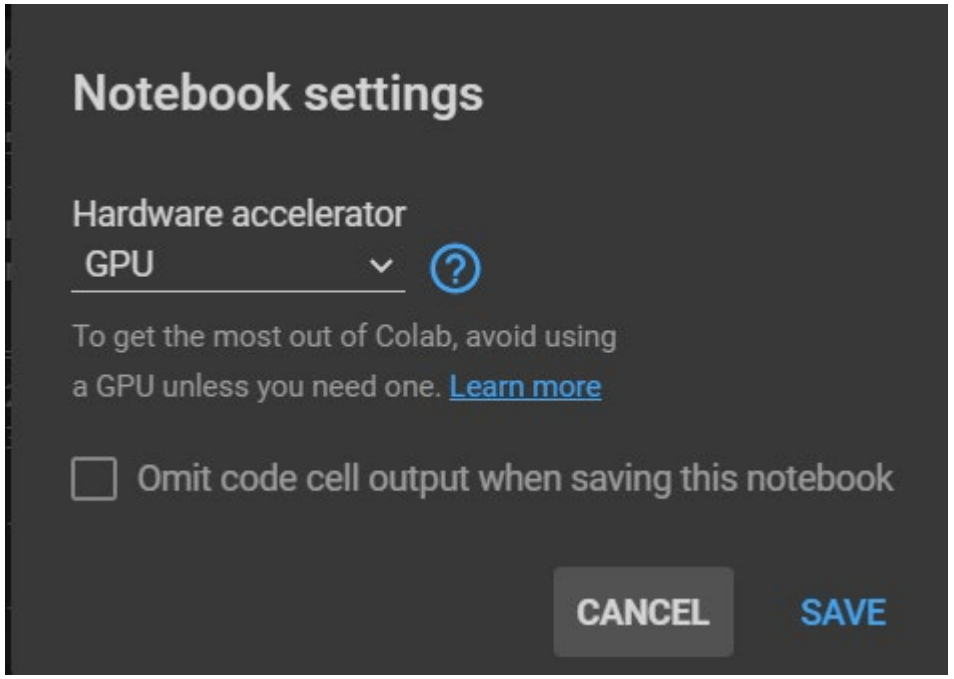
# Google Colab https://colab.research.google.com

- Free service provided by google for running python code + DL + free GPUs and TPUs!
- Runs in Browser
- Connect to your Google drive
- Can also connect to your local GPU!



# Using a GPU/TPU in colab



# Testing GPU

```
gpu_info = !nvidia-smi
gpu_info = '\n'.join(gpu_info)
if gpu_info.find('failed') >= 0:
  print('Select the Runtime → "Change runtime type" menu to enable a GPU accelerator, ')
  print('and then re-execute this cell.')
else:
  print(gpu_info)
```

```
Sat Sep 12 05:40:49 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 450.51.05    Driver Version: 450.51.05    CUDA Version: 11.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla V100-SXM2...  Off  | 00000000:00:04.0 Off |                    0 |
| N/A   41C    P0    37W / 300W |      0MiB / 16160MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

# Connecting Colab to Google drive

```
import os

try:
  from google.colab import drive
  google_drive_dir = '/content/drive/My Drive/scout2B1'
  # select where to store the data - a free google account is sufficient to store all data in
  data_directory = google_drive_dir
  # data_directory = local_scratch_dir
  drive.mount('/content/drive')
except:
  local_scratch_dir = '/content'
  data_directory = local_scratch_dir

if not os.path.isdir(data_directory):
    os.mkdir(data_directory)
os.chdir(data_directory)
```

# Using Tensorflow inside colab is (un)surprisingly easy

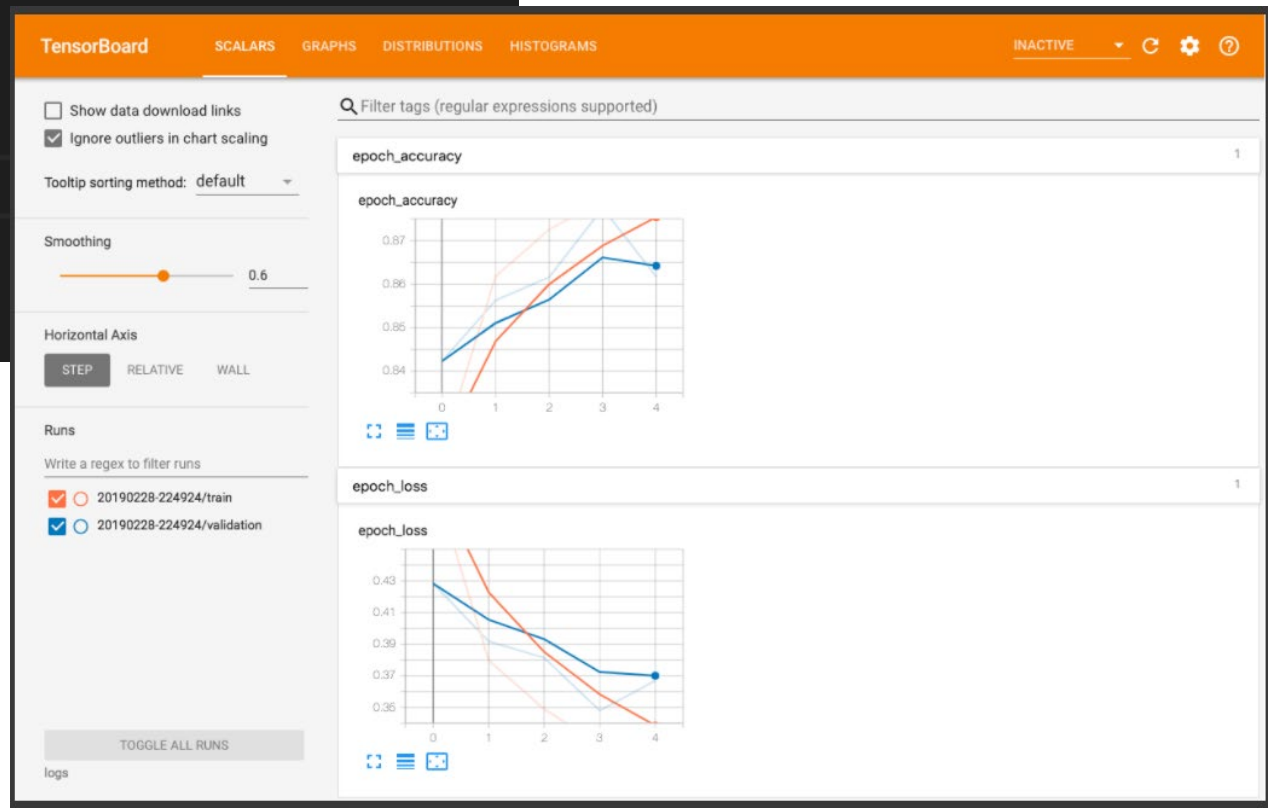
```
%tensorflow_version 2.x
```

```
[5] import tensorflow
    print(tensorflow.__version__)
```

```
2.3.0
```

# Tensorboard inside Colab

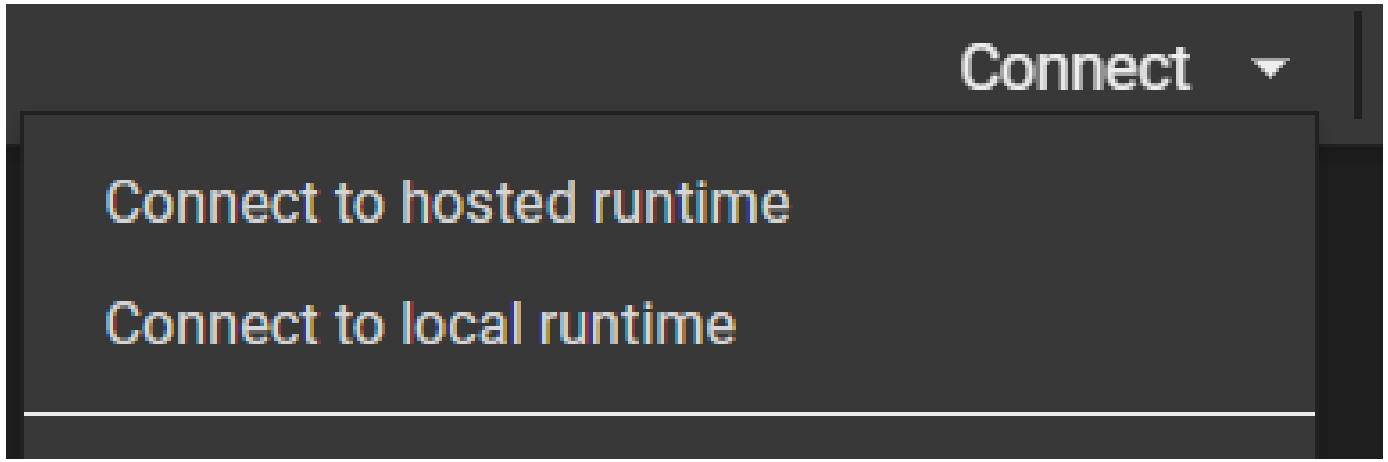
```
try:
  # more Colab magic that only works on google's servers.
  %load_ext tensorboard
  print(checkpoint_directory)
  os.chdir(checkpoint_directory)
  %tensorboard --logdir .
except Exception:
  pass
```



# Connecting Colab to local/Cloud GPU

```
ssh -L 8888:127.0.0.1:8888 user@your-GPU-server
```

```
jupyter notebook  --ip=0.0.0.0   --
NotebookApp.allow_origin='https://colab.research.google.com'   --
port=8888   --NotebookApp.port_retries=0
```




http://localhost:8888/?token=....

# Using GPUs on our Wiener cluster

**wiener.hpc.dc.uq.edu.au**

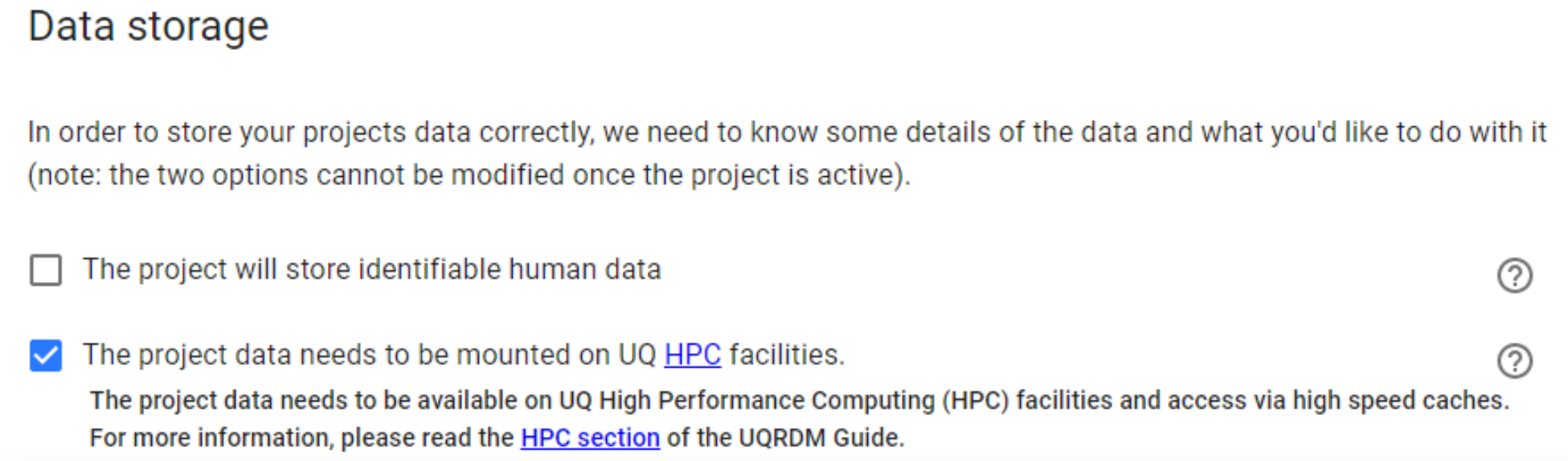
- great for large scale deep learning projects at UQ http://www2.rcc.uq.edu.au/hpc/guides/

# Metropolitan Data Caching Infrastructure (MEDICI)


https://rcc.uq.edu.au/data-storage

# RDM

create storage per project here: https://rdm.uq.edu.au/ (check HPC option!, don't select identifiable human data)




**Warning**: Do not have more than 100 000 files on one collection – otherwise things will go really really wrong! Compress folders with many files as much as you can by using the program 7Zip!

# RDM

data is also available via a cloud interface (and syncs via nextcloud) https://cloud.rdm.uq.edu.au

files are also available

- on windows: \\uq.edu.au\UQ-Research
- If the collection is mirrored to CAI (send email to helpdesk@cai.uq.edu.au) it will be faster and at: \\uq.edu.au\UQ-Inst-Gateway1
- on workstations: /winmounts/username/data.cai.uq.edu.au
- on clusters: /QRISdata

Note: changes can take a while to propagate between different locations!

# Thank you

s.bollmann@uq.edu.au

www.mri.sbollmann.net

@sbollmann_MRI

github.com/sbollmannmri