# Introduction

Scientific Programming in Python

# Organizational matters

# About us

Philipp

- 6th semester Bachelor
- 4 years of Python experience
- pthoelke@uos.de

Chris

- some year in the Master
- 5 years of Python experience
- cstenkamp@uos.de

- If you have any questions, don't hesitate to write us an email or in the forum!
- If you have suggestions  for content, please also write!
- If you encounter errors in the the slides or the homework, please do so via a github-issue!  The repository for homework is https://github.com/scientificprogrammingUOS

# Date and Time

During Corona

- Lecture-Videos uploaded on Tuesday
  - Split into multiple parts available in Courseware
  - Including small exercises to test your attention
  - Videos should be 90 minutes in length
- We will try live-Meetings Thursday 14:00 - 16:00
  - These Meetings are for your questions
  - We will also answer any questions you ask via Mail/Forum/…
  - **Ask questions!** (see “*Infrastructure*” for where)

**This lecture is for you!**

Ask questions when you don’t understand something, everything else is a waste of your time!

# Date and Time

Next Thursday

- 14:00 - 15:00: Live Stud.IP Meeting (non-mandatory)
- 15:00 - 18:00: Available for private conversations in Skype for individual (installation-) problems
  - Philipp: https://join.skype.com/invite/q1r9ULtOTxGO
  - Chris: https://join.skype.com/invite/mT3yXuxQESAf

# Date and Time

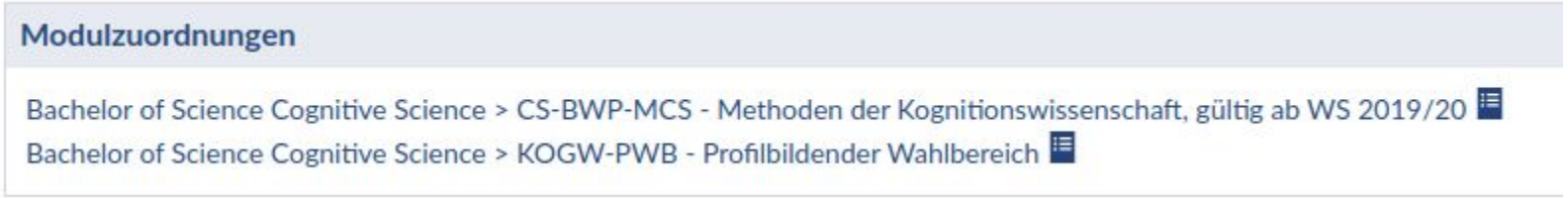
After Corona

- One **session** every *Tuesday 12:00 - 14:00*
- One **session** every *Thursday 14:00 - 16:00*
- No mandatory attendance
- Lecture will still be filmed

Approach:

- Lectures will be a mix of concepts, coding tutorial and interactive exercises

# Organizational matters




- New Examination Regulations:
  - 4 Credits for the “Methods of Cognitive Science” Module
  - You need 12 Credits to fulfill this module, 8 of which need to have a grade
- Old Examination Regulations:
  - 4 Credits for “Profilbildender Wahlbereich” (your 30 free credits)

Questions regarding the new examination regulations to mentoring@cogsci.uni-osnabrueck.de

- **Complete enough homework to get a “pass”, *Additionally* write the exam to get a grade**
  - Exam: On the computer (hopefully in the same room), coding tasks
  - Open book exam, use any source you want, time will be your constraint
  - *Not* automatically graded

# Homework

- Weekly coding homework, done individually
- Homework corrected automatically, and you get the tests, too!
- 1-5 Tasks per sheet, maximally 25 points per sheet
  - No partial points per task!
- 12-13 Sheets → 12*25 = 300 points maximally
  - **Reach 200 points (⅔) to get the Schein**
  - Some homework will give less points, so there will be bonus exercises to make sure there are 300 points to reach

More info on how to work on the homework later!

# Intro

# Why scientific programming?

# Science

- Build and organize knowledge
- Test explanation about our world
- Communicate our results to others
- Systematically
- Objectively
- Transparently
- Reproducibly

Otherwise it’s not science.

Cf. PyData Ann Arbor: Katy Huff | Doing Our Best: Practices in Open, Reproducible, Scientific Computing

# Programming helps us

- Build and organize knowledge → by building databases of scientific results
- Test explanation about our world → by automating experiments
- Communicate our results to others →by sharing code on top of papers
- Systematically → by easily making analyses exhaustive
- Objectively → computers are not subject to human biases (computer programs still are)
- Transparently → by using open source tools and sharing our analyses
- Reproducibly → by codifying our analyses we make them reproducible

You need to write **clean code**!

Cf. PyData Ann Arbor: Katy Huff | Doing Our Best: Practices in Open, Reproducible, Scientific Computing

# Why Python?

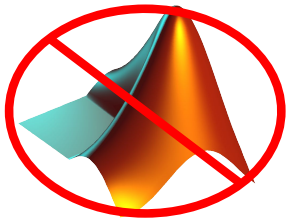
# Python

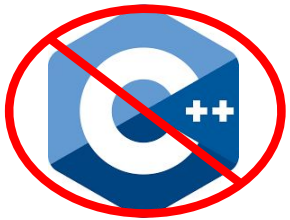
- Create by Guido van Rossum in the 90s
- Now open source project developed by the Python Software foundation
- High-level language (no hardware-knowledge necessary)
- Interpreted and dynamically typed language
- Consistent and minimal syntax
- → easy to learn and write
- Great ecosystem and great community!

[1]

# Python is better

- Better than Matlab → As a free and open source project you can save money and actually share your results
- Better than Java → Get more done with less code and without overly complex object orientation.
- Better than C++ (at least for science) → With a great ecosystem and a great community you can get stuff done, instead of trying to figure out documentation yourself
- Better than R →As a general purpose programming language you can do anything with Python not just statistics

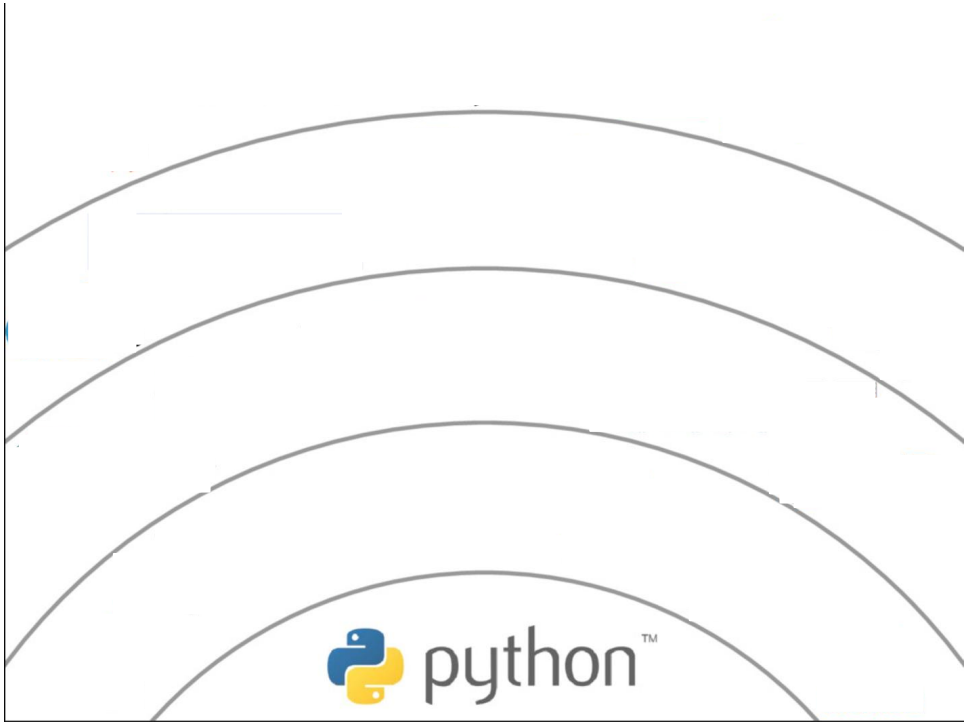



[1,2,3,4,5]

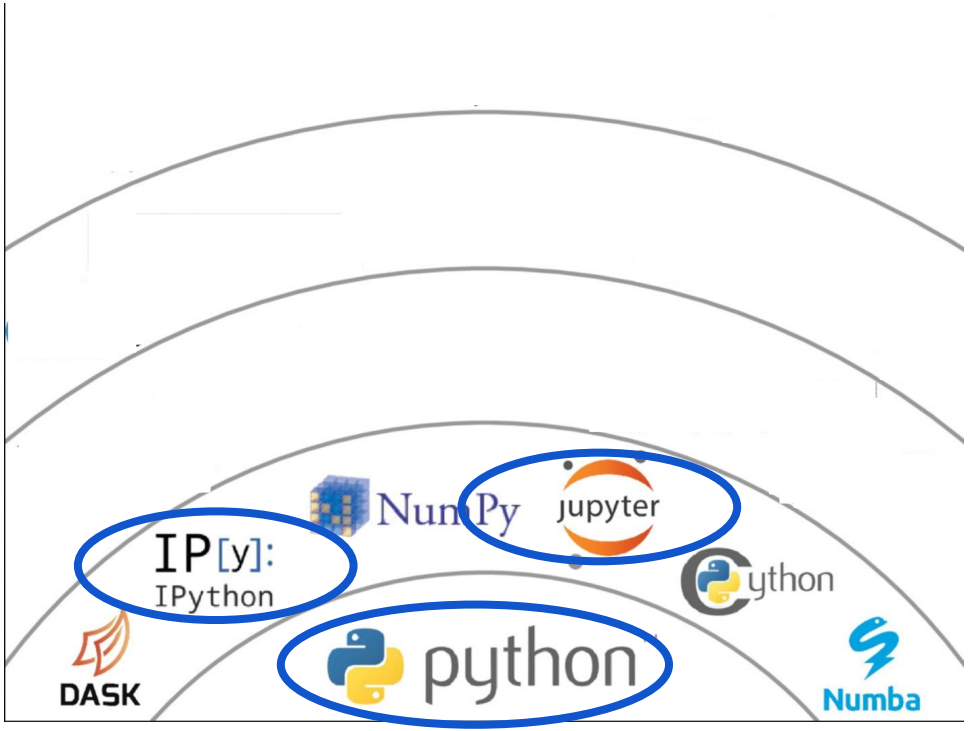
# Our path through scientific python

# Our path through scientific python




https://www.datacamp.com/community/blog/python-scientific-computing-case

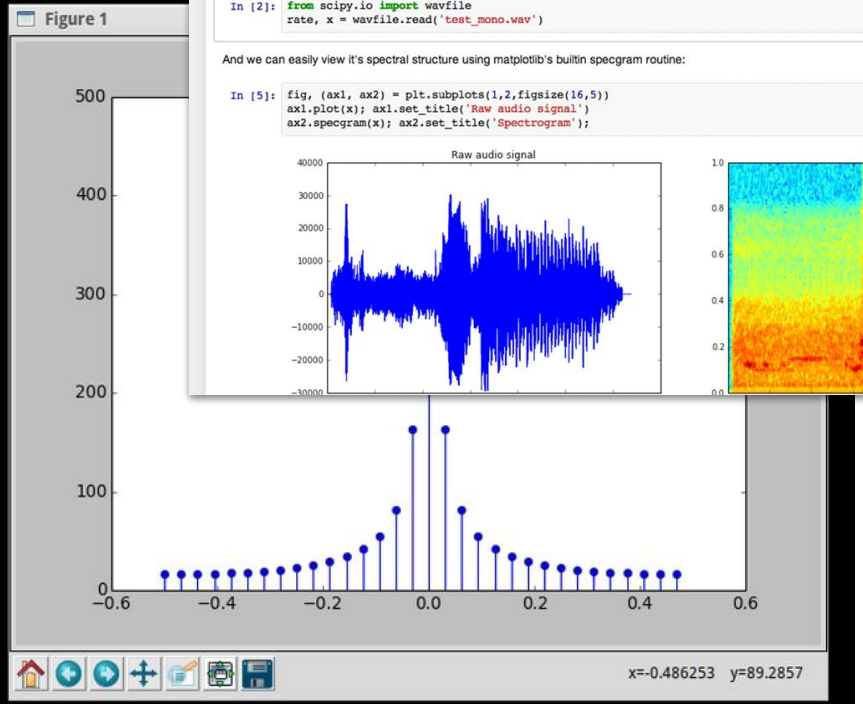
# Our path through scientific python

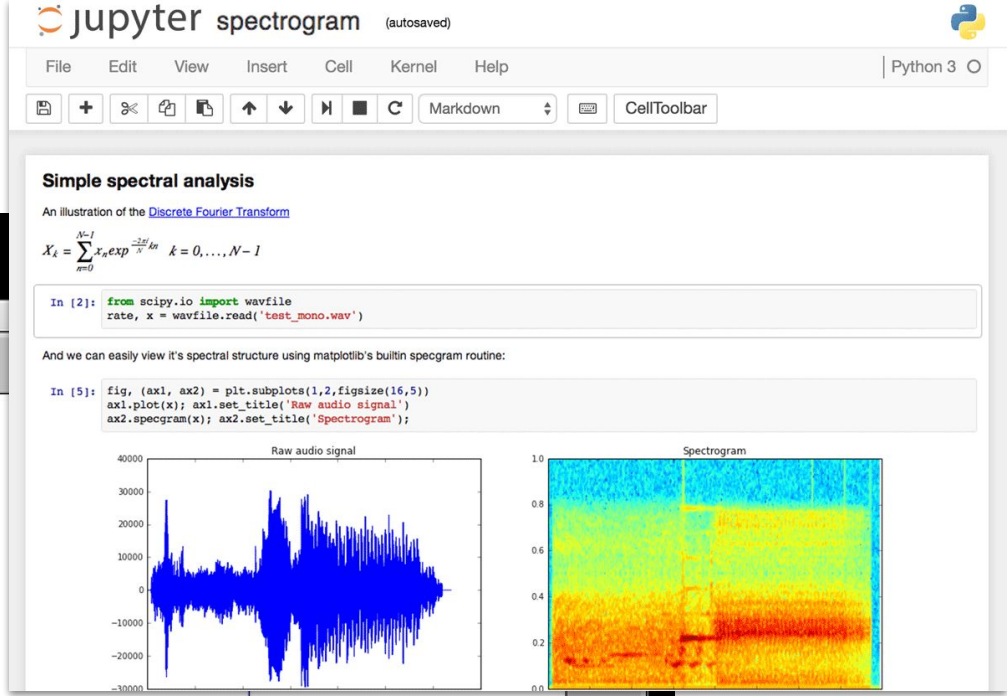



https://www.datacamp.com/community/blog/python-scientific-computing-case

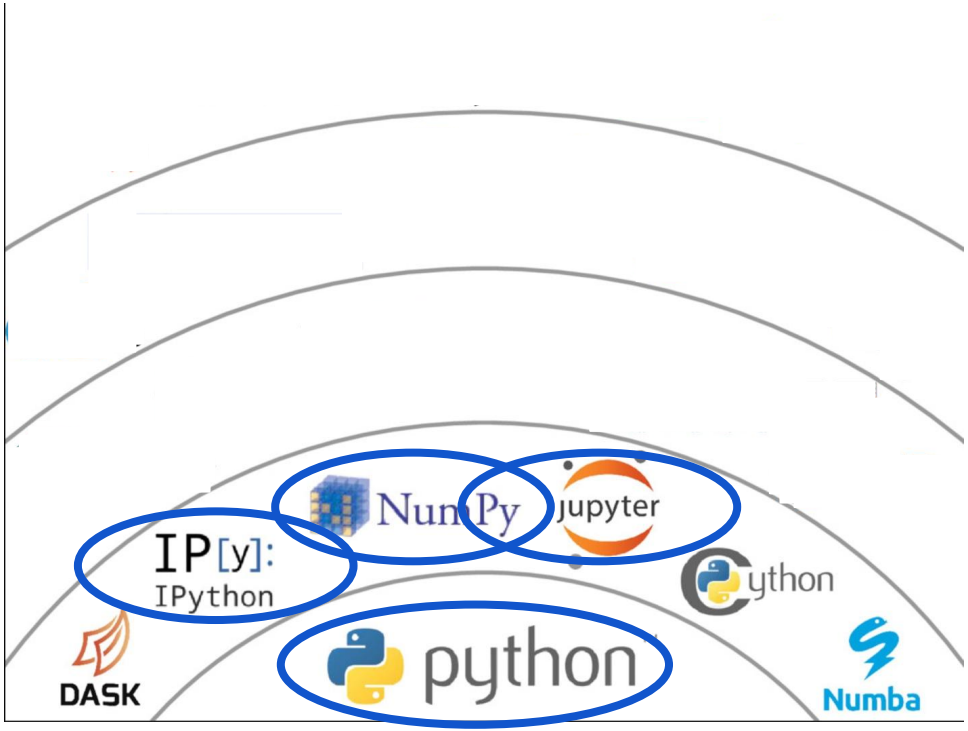
# Python, Jupyter, IPython

```
Python 3.2.3 (default, Sep 25 2013, 18:25:56)
Type "copyright", "credits" or "license" for more information.

IPython 1.1.0 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object', use 'object??' for extra details.
Using matplotlib backend: TkAgg

In [1]: from numpy.fft import *

In [2]: a = arange(32)

In [3]: A = fft(a)

In [4]: f = fftfreq(32)

In [5]: stem(f,abs(A))
Out[5]: <Container object of 3 artists>

In [6]:
```



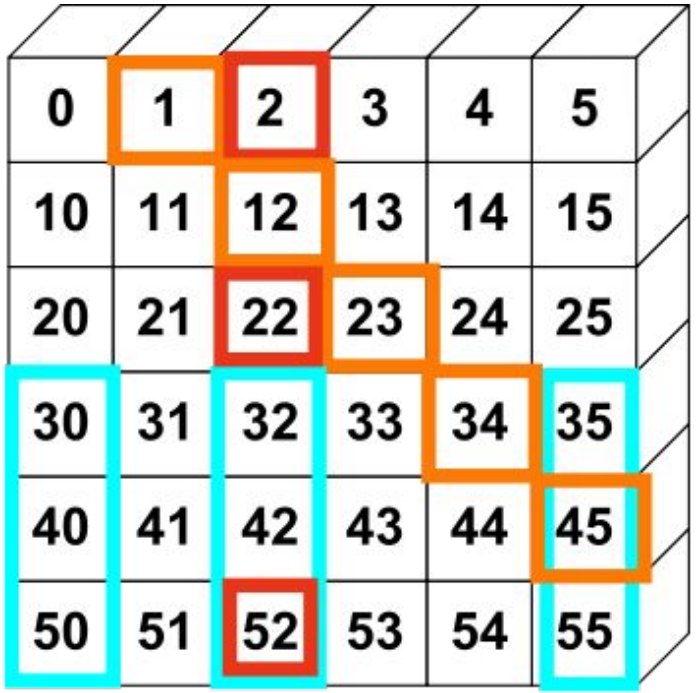
# Our path through scientific python



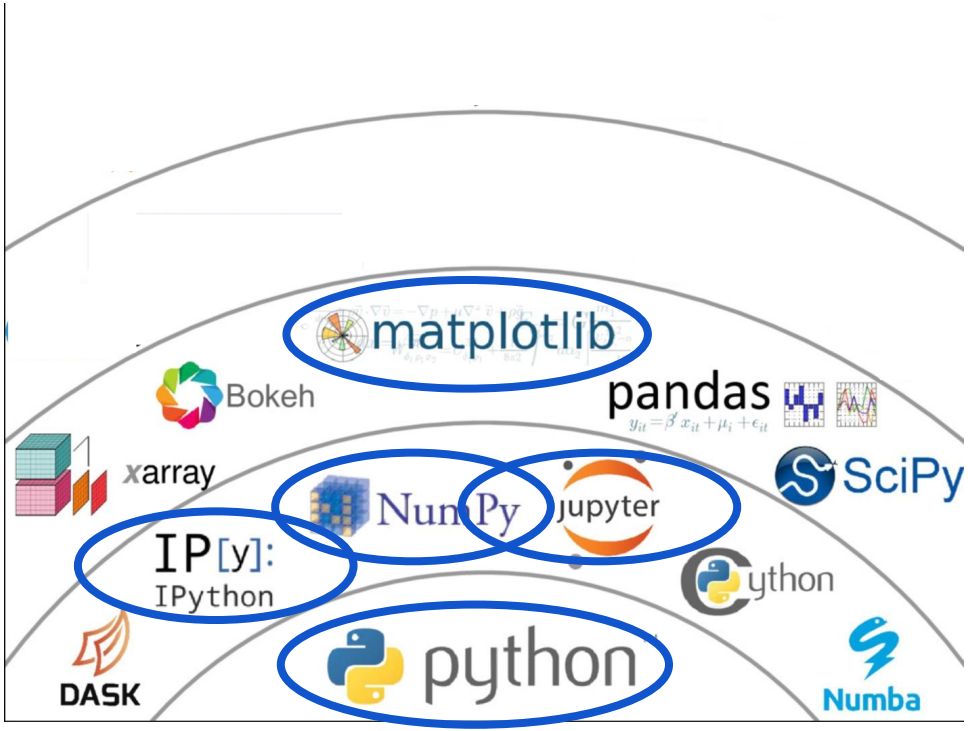

https://www.datacamp.com/community/blog/python-scientific-computing-case

# NumPy

```
>>> a[(0,1,2,3,4),(1,2,3,4,5)]
array([ 1, 12, 23, 34, 45])

>>> a[3:,[0, 2, 5]]
array([[30, 32, 35],
       [40, 42, 45]])
       [50, 52, 55]])

>>> mask = array([1,0,1,0,0,1],
                 dtype=bool)
>>> a[mask,2]
array([2,22,52])
```



# Our path through scientific python

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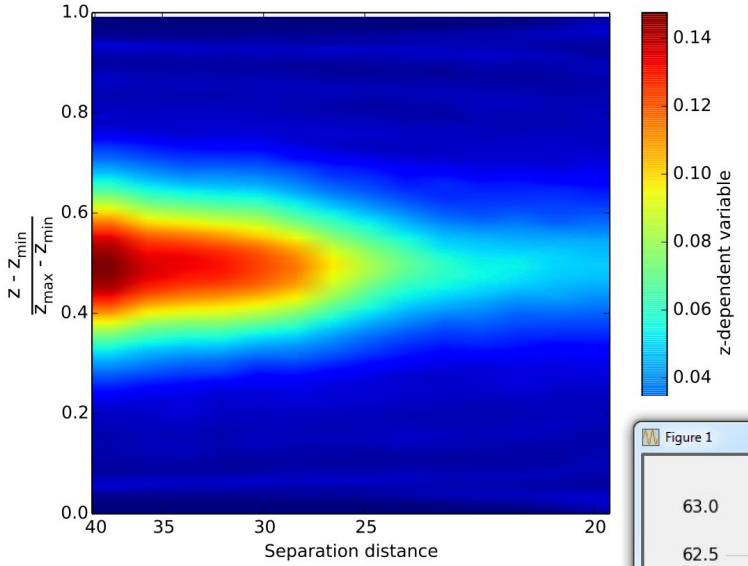
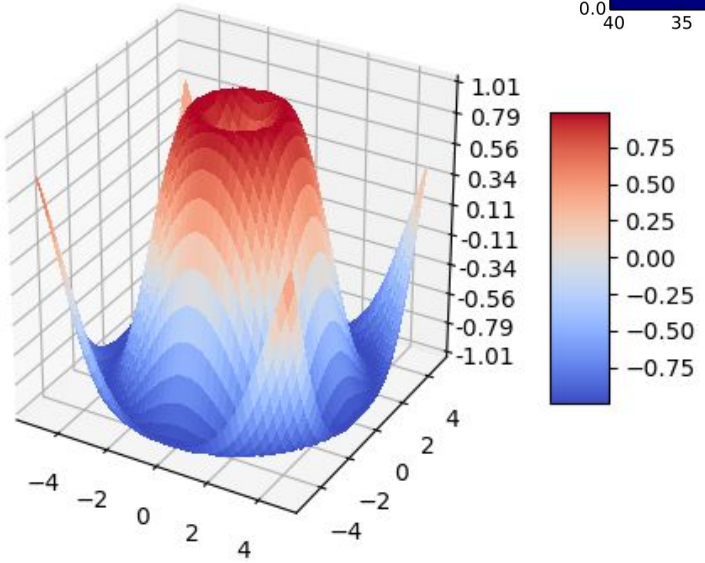
# Matplotlib


1.0
0.8
0.6
0.4
0.2
0.0
$\frac{z - z_{min}}{z_{max} - z_{min}}$
40
35
30
25
20
Separation distance
0.14
0.12
0.10
0.08
0.06
0.04
z-dependent variable


1.01
0.79
0.56
0.34
0.11
-0.11
-0.34
-0.56
-0.79
-1.01
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−4
−2
0
2
4
−4
−2
0
2
4

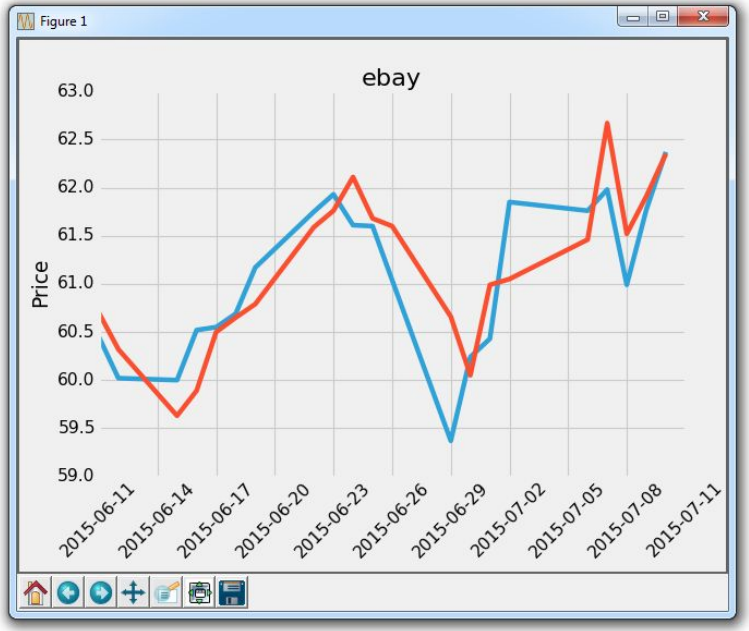
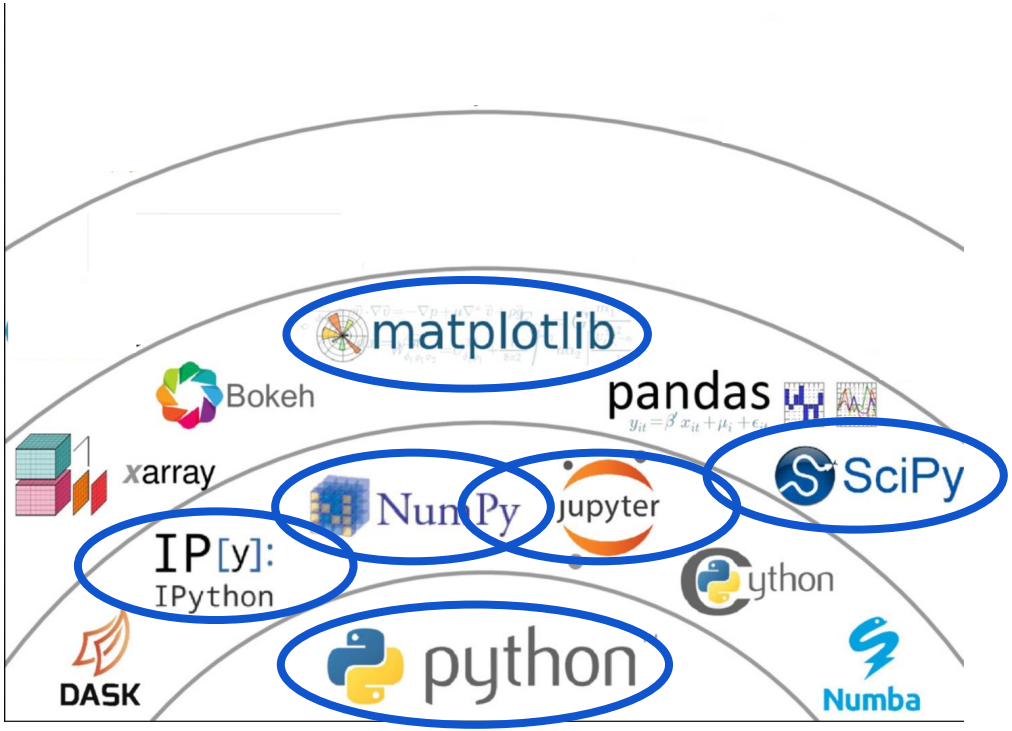


Figure 1
ebay
63.0
62.5
62.0
61.5
61.0
60.5
60.0
59.5
59.0
Price
2015-06-11
2015-06-14
2015-06-17
2015-06-20
2015-06-23
2015-06-26
2015-06-29
2015-07-02
2015-07-05
2015-07-08
2015-07-11

# Our path through scientific python

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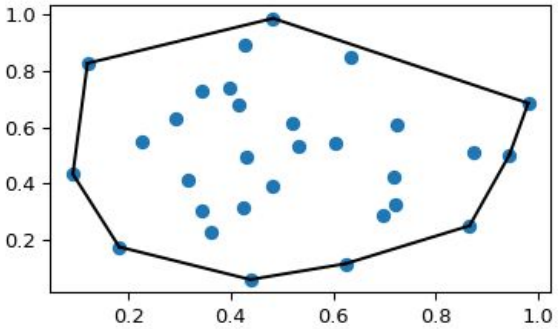
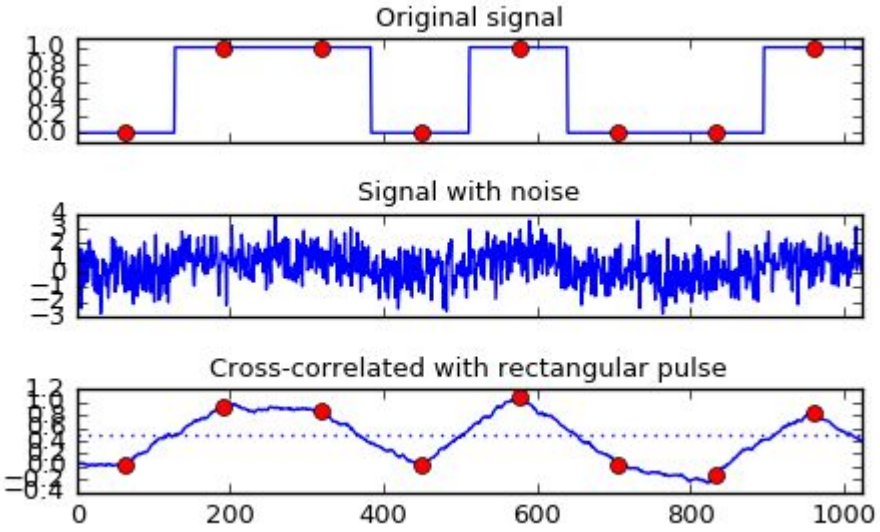
# SciPy

$$\int_0^\infty \int_1^\infty \frac{e^{-xt}}{t^n}\, dt\, dx$$

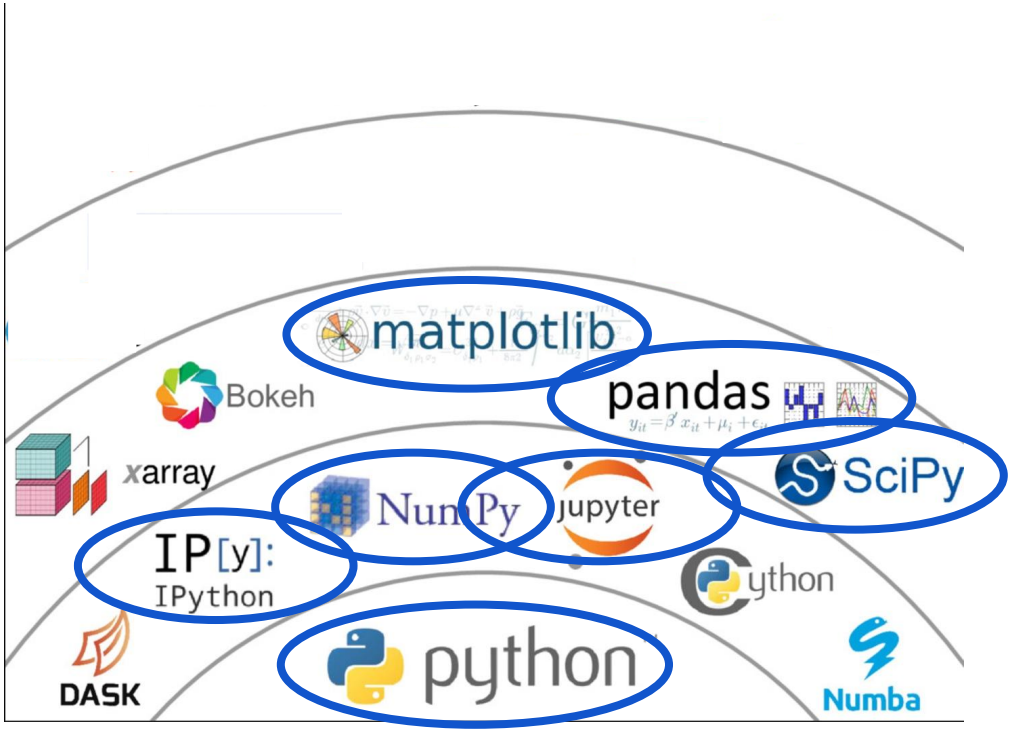
$$\begin{aligned} x + 3y + 5z &= 10 \\ 2x + 5y + z &= 8 \\ 2x + 3y + 8z &= 3 \end{aligned}$$




```
>>> a = np.array([ 0.7972,  0.0767,  0.4383,  0.7866,  0.8091,
...                 0.1954,  0.6307,  0.6599,  0.1065,  0.0508])
>>> from scipy import stats
>>> stats.zscore(a)
array([ 1.1273, -1.247 , -0.0552,  1.0923,  1.1664, -0.8559,  0.5786,
        0.6748, -1.1488, -1.3324])
```

# Our path through scientific python

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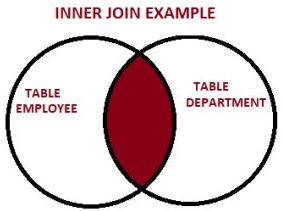
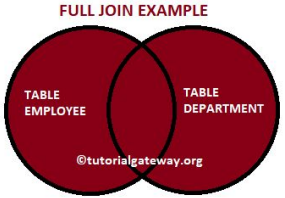
# Pandas

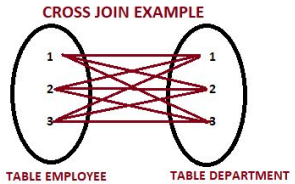
```
# Create a dataframe with dates as your index
States = ['NY', 'NY', 'NY', 'NY', 'FL', 'FL', 'GA', 'GA', 'FL', 'FL']
data = [1.0, 2, 3, 4, 5, 6, 7, 8, 9, 10]
idx = pd.date_range('1/1/2012', periods=10, freq='MS')
df1 = pd.DataFrame(data, index=idx, columns=['Revenue'])
df1['State'] = States

# Create a second dataframe
data2 = [10.0, 10.0, 9, 9, 8, 8, 7, 7, 6, 6]
idx2 = pd.date_range('1/1/2013', periods=10, freq='MS')
df2 = pd.DataFrame(data2, index=idx2, columns=['Revenue'])
df2['State'] = States
```

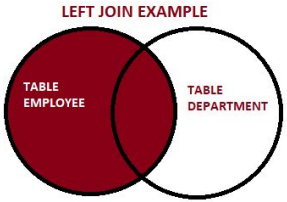
```
# Combine dataframes
df = pd.concat([df1,df2])
df
```

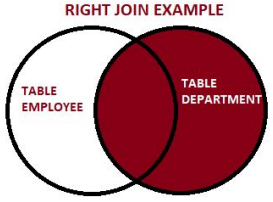
| | Revenue | State |
|---|---|---|
| 2012-01-01 | 1.0 | NY |
| 2012-02-01 | 2.0 | NY |
| 2012-03-01 | 3.0 | NY |
| 2012-04-01 | 4.0 | NY |
| 2012-05-01 | 5.0 | FL |
| 2012-06-01 | 6.0 | FL |
| 2012-07-01 | 7.0 | GA |
| 2012-08-01 | 8.0 | GA |

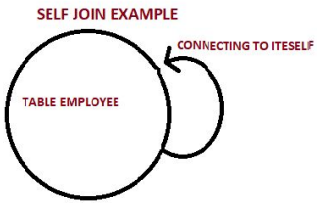


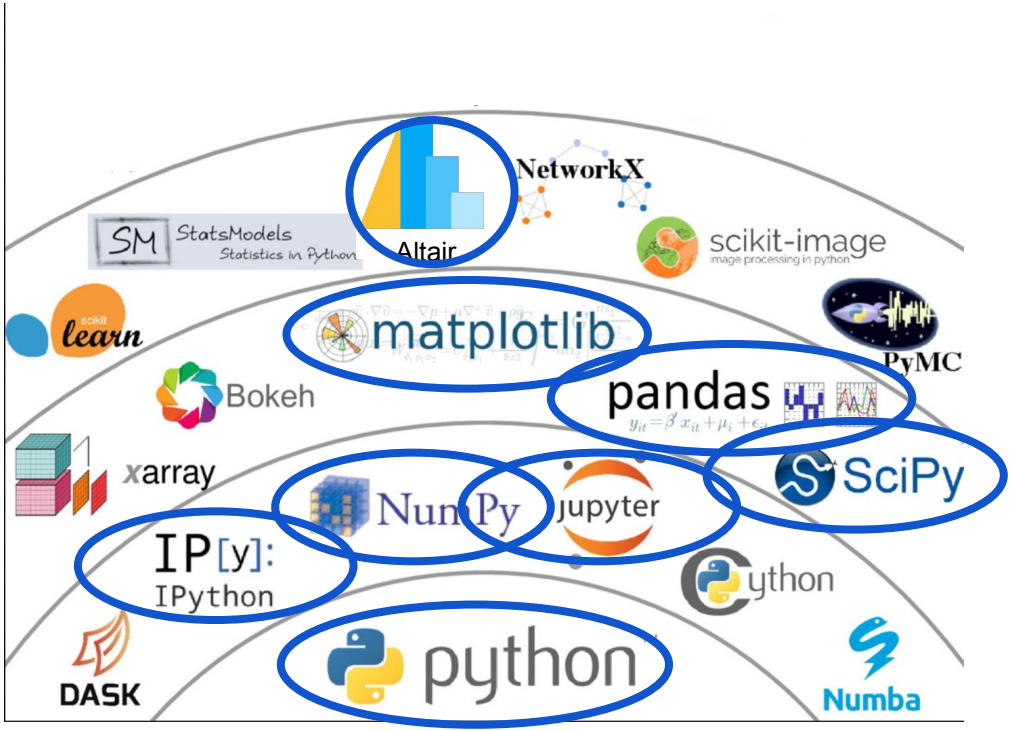



# Our path through scientific python

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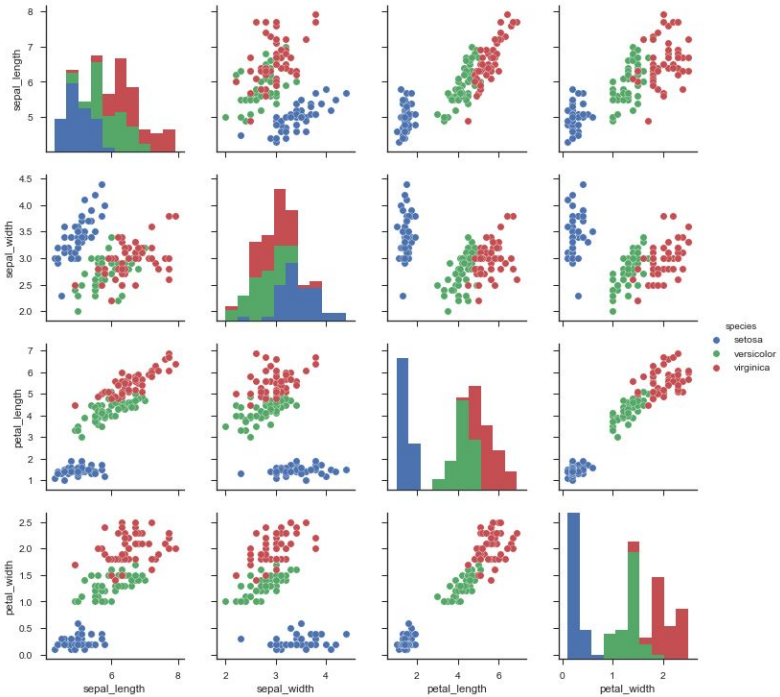
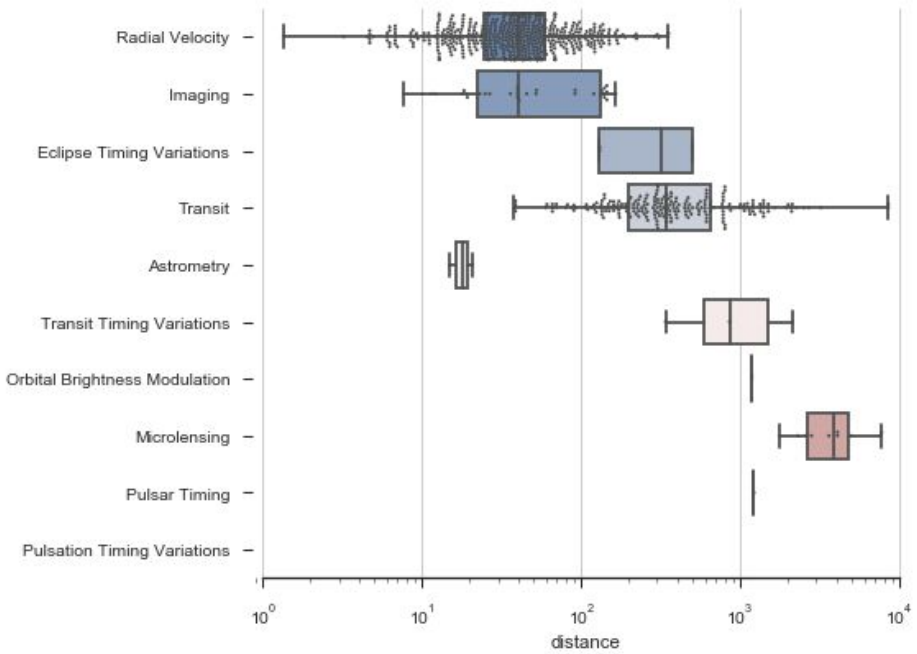
# Statistical visualization



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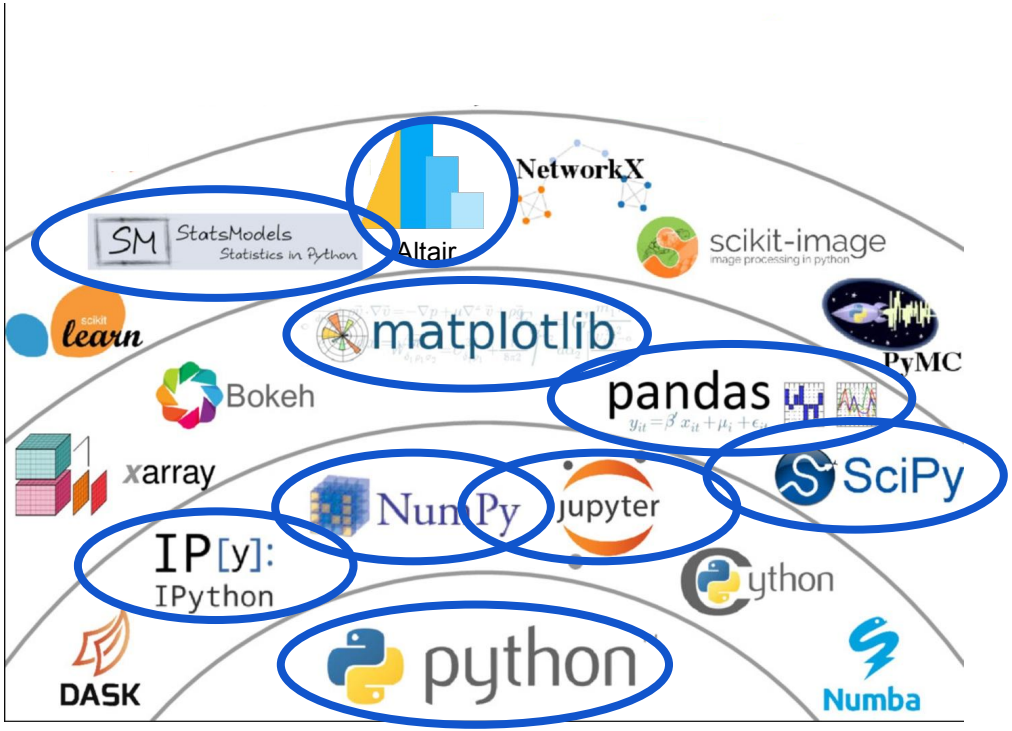


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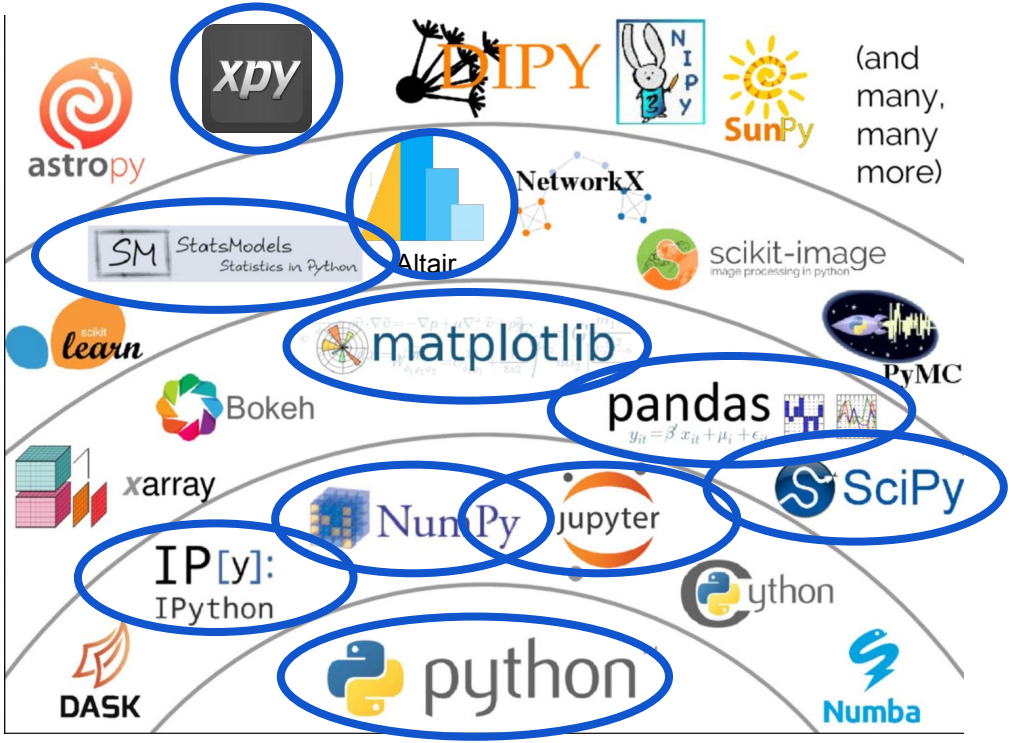
# Statsmodels

```
In [5]: results = smf.ols('Lottery ~ Literacy + np.log(Pop1831)', data=dat).fit()
```

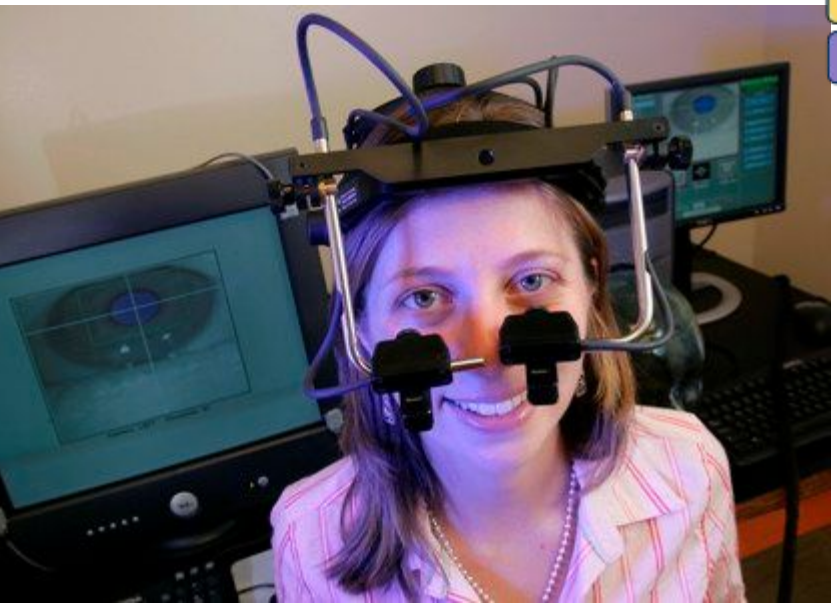
```
                            OLS Regression Results
==============================================================================
Dep. Variable:                Lottery   R-squared:                       0.348
Model:                            OLS   Adj. R-squared:                  0.333
Method:                 Least Squares   F-statistic:                     22.20
Date:                Tue, 28 Feb 2017   Prob (F-statistic):           1.90e-08
Time:                        21:38:05   Log-Likelihood:                -379.82
No. Observations:                  86   AIC:                             765.6
Df Residuals:                      83   BIC:                             773.0
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept    246.4341     35.233      6.995      0.000     176.358     316.510
Literacy      -0.4889      0.128     -3.832      0.000      -0.743      -0.235
np.log(Pop1831)   -31.3114      5.977     -5.239      0.000     -43.199     -19.424
==============================================================================
Omnibus:                        3.713   Durbin-Watson:                   2.019
Prob(Omnibus):                  0.156   Jarque-Bera (JB):                3.394
Skew:                          -0.487   Prob(JB):                        0.183
Kurtosis:                       3.003   Cond. No.                         702.
==============================================================================
```

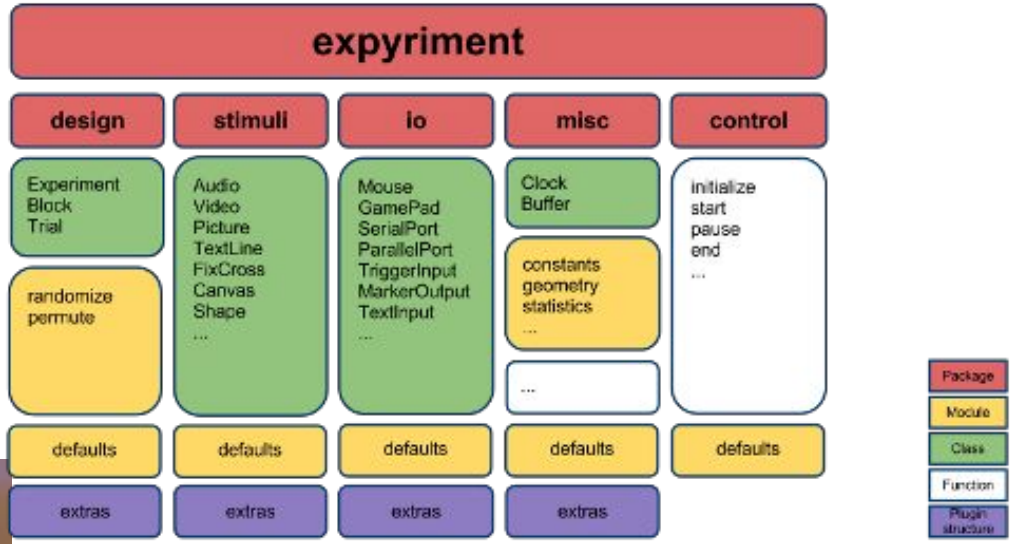
# Our path through scientific python




https://www.datacamp.com/community/blog/python-scientific-computing-case

# Expyriment






http://docs.expyriment.org/Overview.html

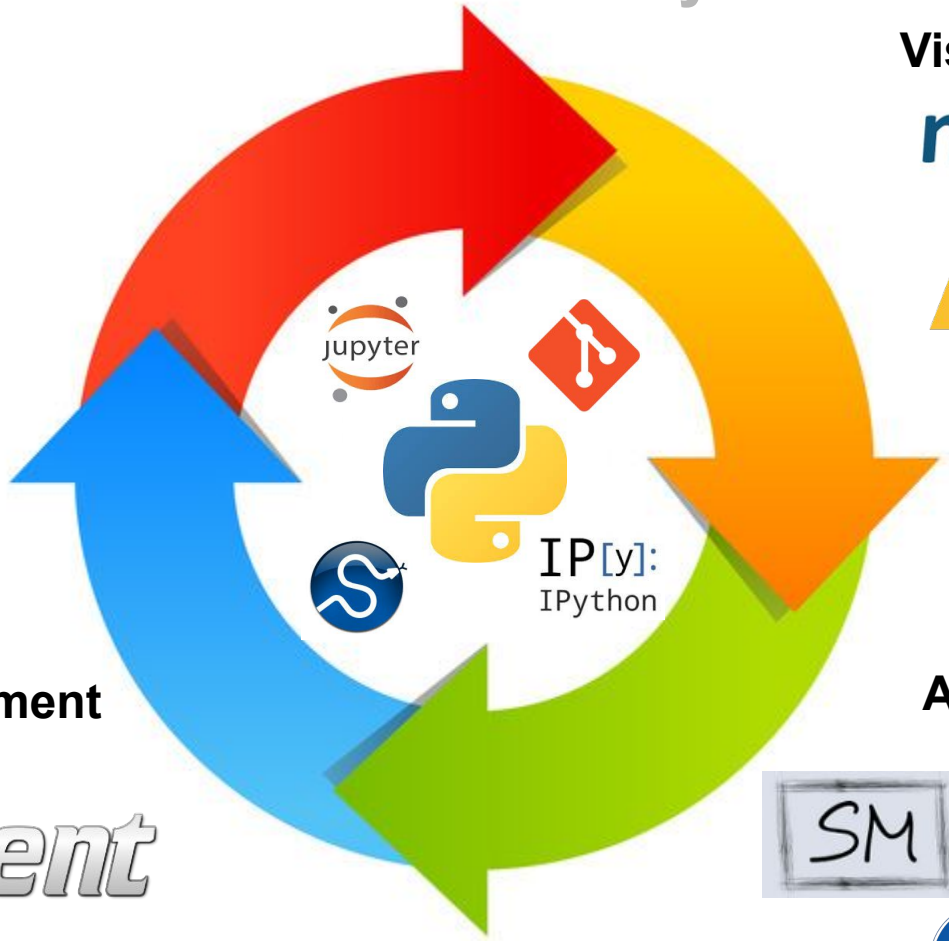
# Your workflow with Python

## Extracting your data

NumPy

pandas

$y_i t = \beta' x_{it} + \mu_i + \epsilon_{it}$




## Visualizing your data

matplotlib

Altair

plotnine

## Making your experiment

expyriment

## Analyzing your data

SM StatsModels
Statistics in Python

SciPy

# Let’s compute!

Go to https://github.com/scientificprogrammingUOS/lectures and click “launch binder”

# Outline

1. Intro & Organization
2. Basic Python
3. Advanced Python
4. Numerical Computing with NumPy
5. Debugging in Python
6. Visualizations with Matplotlib
7. Framing and Cleaning Data with Pandas
8. Exploring and Analyzing Data with Pandas
9. Statistical and Interactive Visualizations
10. SciPy and Statistical Computing
11. Statistical Modeling with statsmodels
12. Creating Experiments with Expyriment
13. Performance Optimization and Multithreading

***Basic Programming in Python:***

- *Hello World*
- *Variables & Assignments*
- *Control Structures*
- *Data Structures*
- *Strings & Formatting*
- *Input & Output*
- *Debugging & Good Practices*
- *Built-In Packages*
- *Object-Oriented Programming*

→ *External Packages*
→ *Working on Projects*

# Course Infrastructure & Communication

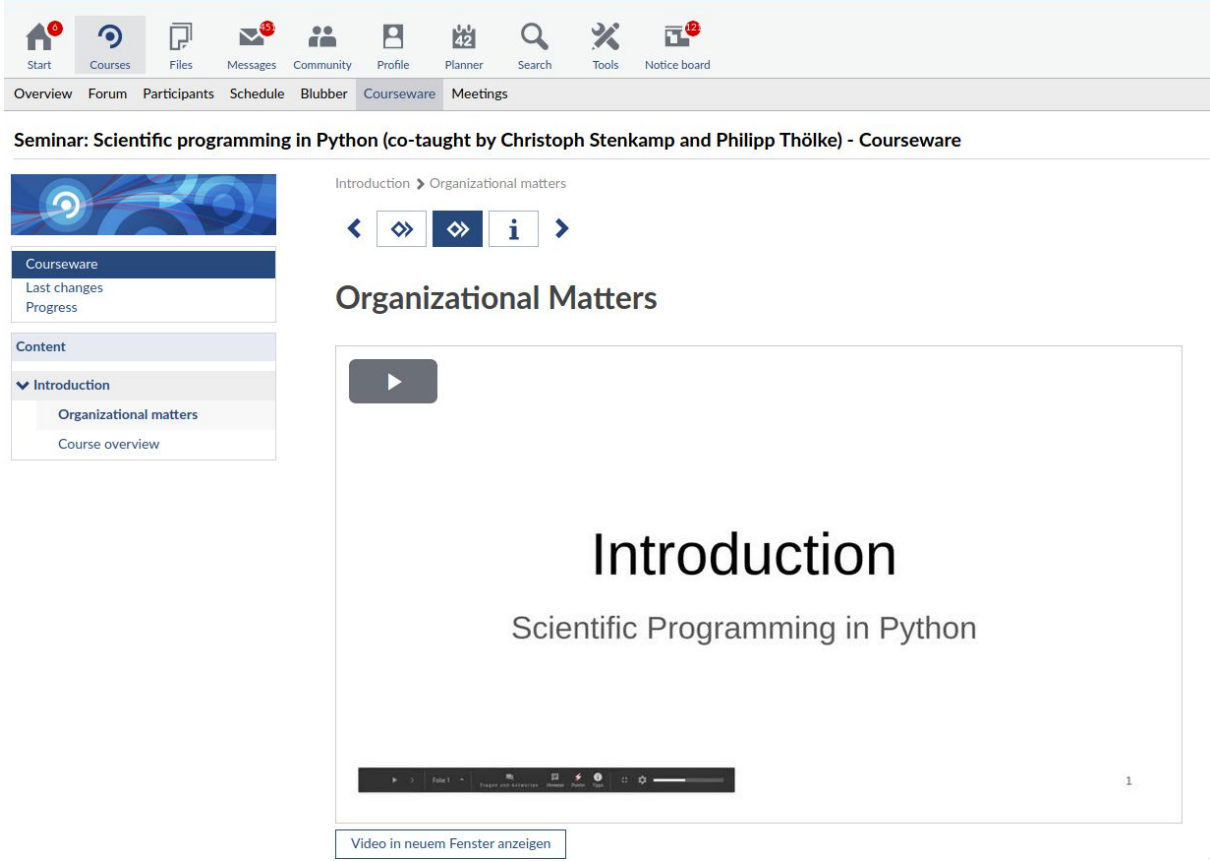
# Communication

- Where to find Information?
  - Stud.IP
  - Lectures-repository
  - Dashboard

- Where to ask questions?
  - Private questions: Email
  - Casual questions: Blubber
  - Questions that can be answered by the community: Stackoverflow Team
  - More detailed questions: Stud.IP Forum

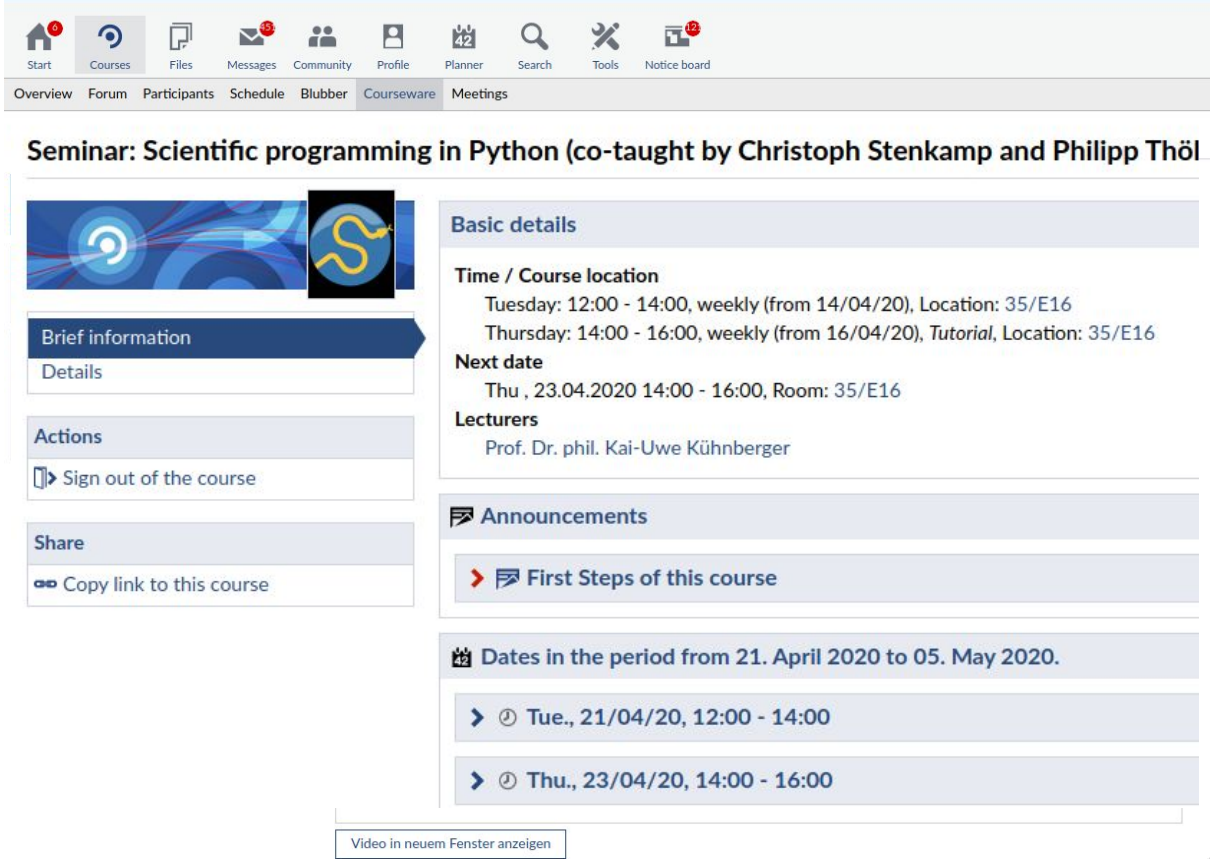
# Stud.IP

- Your first place to go for lecture-recordings



# Stud.IP

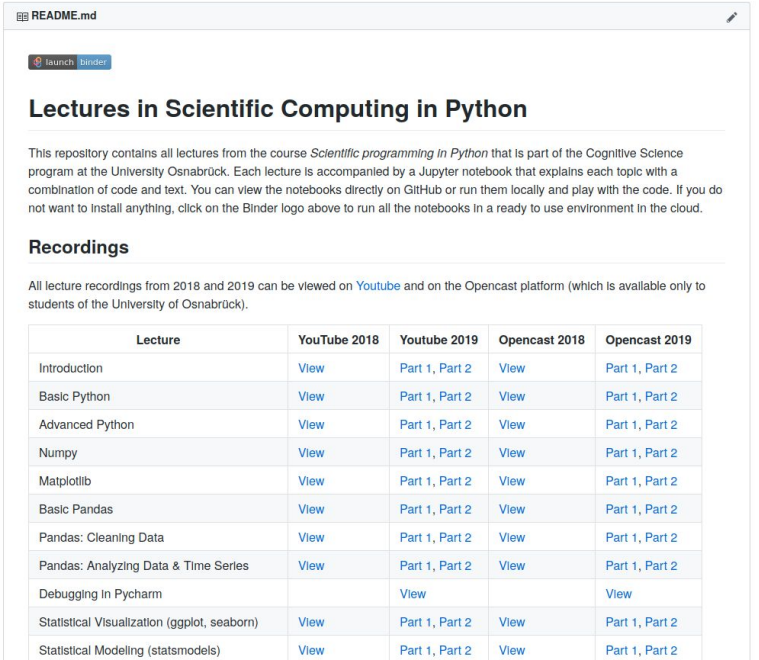
- Your first place to go for lecture-recordings



# Lectures-repository

- Your first place to go for lecture-notebooks

- Binder explained in a previous video
- See following video for how to install the necessary libraries
- If you want to see content not this year, look at last year's recordings



README.md

launch binder

## Lectures in Scientific Computing in Python

This repository contains all lectures from the course *Scientific programming in Python* that is part of the Cognitive Science program at the University Osnabrück. Each lecture is accompanied by a Jupyter notebook that explains each topic with a combination of code and text. You can view the notebooks directly on GitHub or run them locally and play with the code. If you do not want to install anything, click on the Binder logo above to run all the notebooks in a ready to use environment in the cloud.

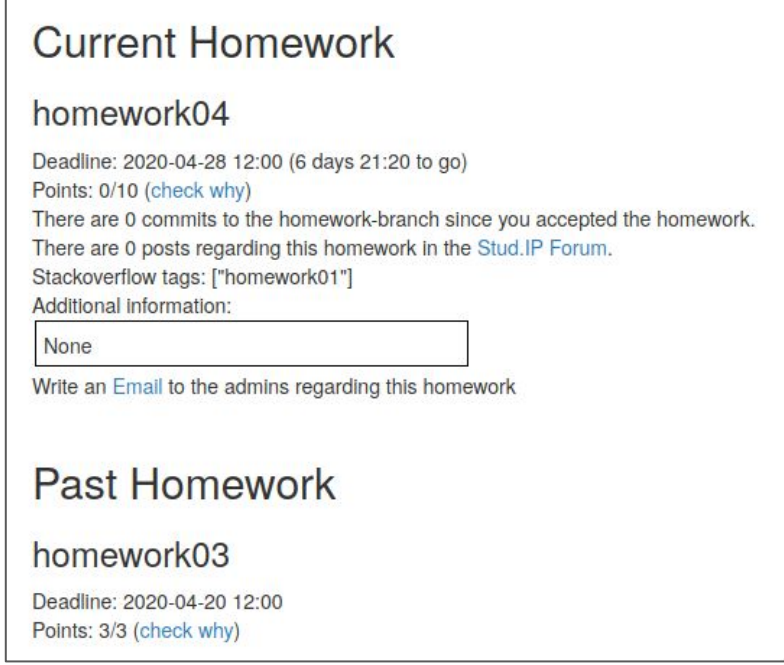
### Recordings

All lecture recordings from 2018 and 2019 can be viewed on Youtube and on the Opencast platform (which is available only to students of the University of Osnabrück).

| Lecture | YouTube 2018 | Youtube 2019 | Opencast 2018 | Opencast 2019 |
|---|---|---|---|---|
| Introduction | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Basic Python | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Advanced Python | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Numpy | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Matplotlib | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Basic Pandas | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Pandas: Cleaning Data | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Pandas: Analyzing Data & Time Series | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Debugging in Pycharm | | View | | View |
| Statistical Visualization (ggplot, seaborn) | View | Part 1, Part 2 | View | Part 1, Part 2 |
| Statistical Modeling (statsmodels) | View | Part 1, Part 2 | View | Part 1, Part 2 |

# Dashboard

- Your first place to go for the homework
- Work-in-Progress, far from perfect
- Login via GitHub - only possible after accepting the first homework
  - See following video for how to do that
- Your go-to place to see how many points You got so far
- Gets live information from GitHub and Stud.IP
  - Homework information
  - Announcements
  - Git-Commits
  - Forum-Posts

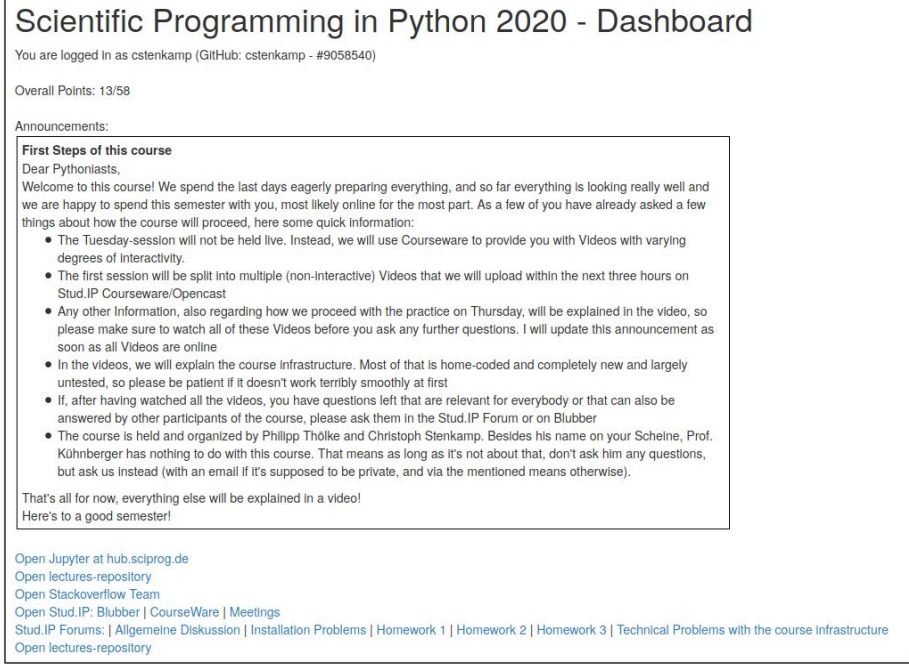



http://dashboard.sciprog.de/

# Dashboard

- Your first place to go for the homework
- Work-in-Progress, far from perfect

- Links to all other necessary places
- Link to the JupyterHub-instance



Scientific Programming in Python 2020 - Dashboard

You are logged in as cstenkamp (GitHub: cstenkamp - #9058540)

Overall Points: 13/58

Announcements:

**First Steps of this course**

Dear Pythoniasts,

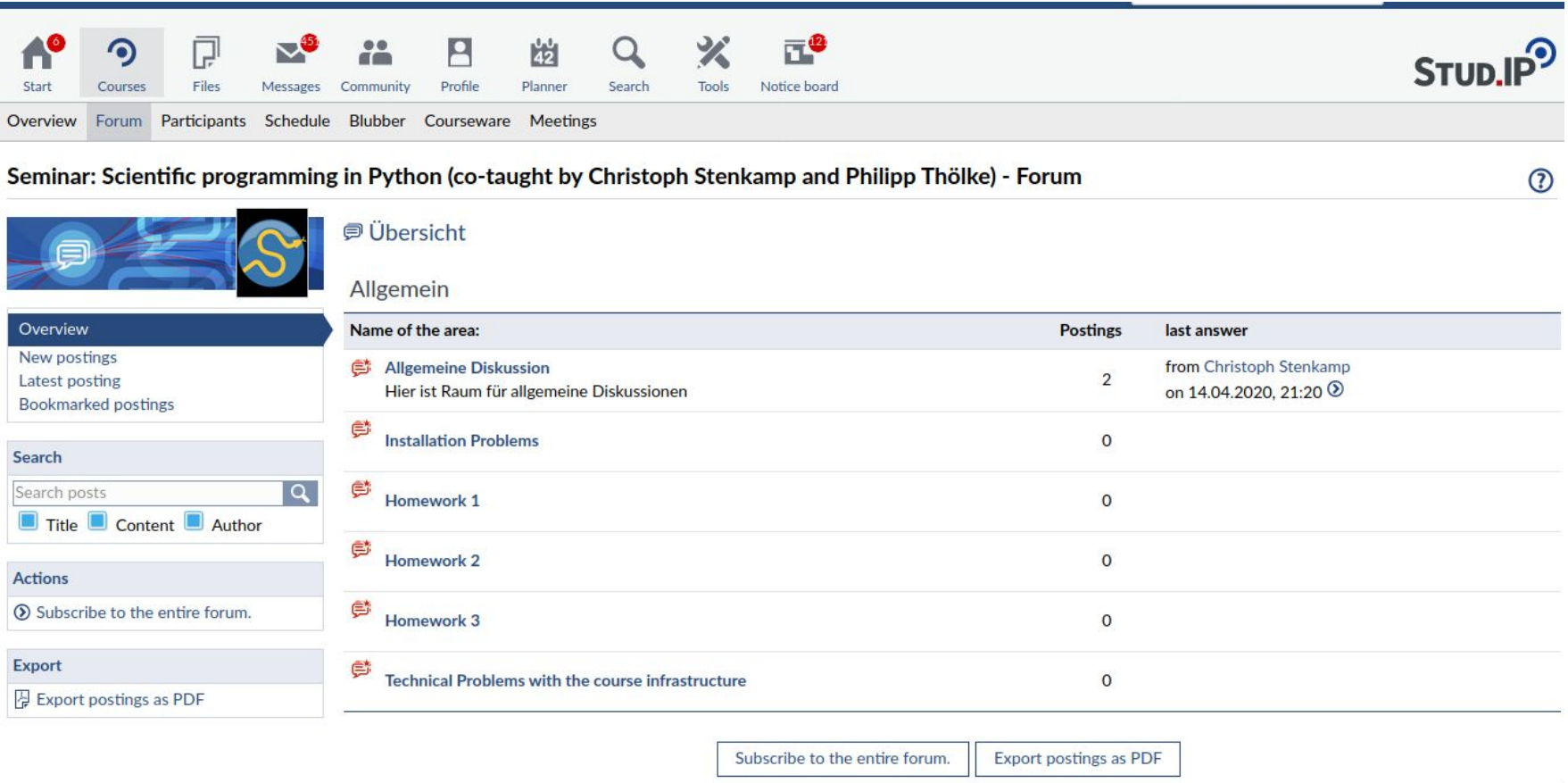
Welcome to this course! We spend the last days eagerly preparing everything, and so far everything is looking really well and we are happy to spend this semester with you, most likely online for the most part. As a few of you have already asked a few things about how the course will proceed, here some quick information:

- The Tuesday-session will not be held live. Instead, we will use Courseware to provide you with Videos with varying degrees of interactivity.
- The first session will be split into multiple (non-interactive) Videos that we will upload within the next three hours on Stud.IP Courseware/Opencast
- Any other Information, also regarding how we proceed with the practice on Thursday, will be explained in the video, so please make sure to watch all of these Videos before you ask any further questions. I will update this announcement as soon as all Videos are online
- In the videos, we will explain the course infrastructure. Most of that is home-coded and completely new and largely untested, so please be patient if it doesn't work terribly smoothly at first
- If, after having watched all the videos, you have questions left that are relevant for everybody or that can also be answered by other participants of the course, please ask them in the Stud.IP Forum or on Blubber
- The course is held and organized by Philipp Thölke and Christoph Stenkamp. Besides his name on your Scheine, Prof. Kühnberger has nothing to do with this course. That means as long as it's not about that, don't ask him any questions, but ask us instead (with an email if it's supposed to be private, and via the mentioned means otherwise).

That's all for now, everything else will be explained in a video!
Here's to a good semester!

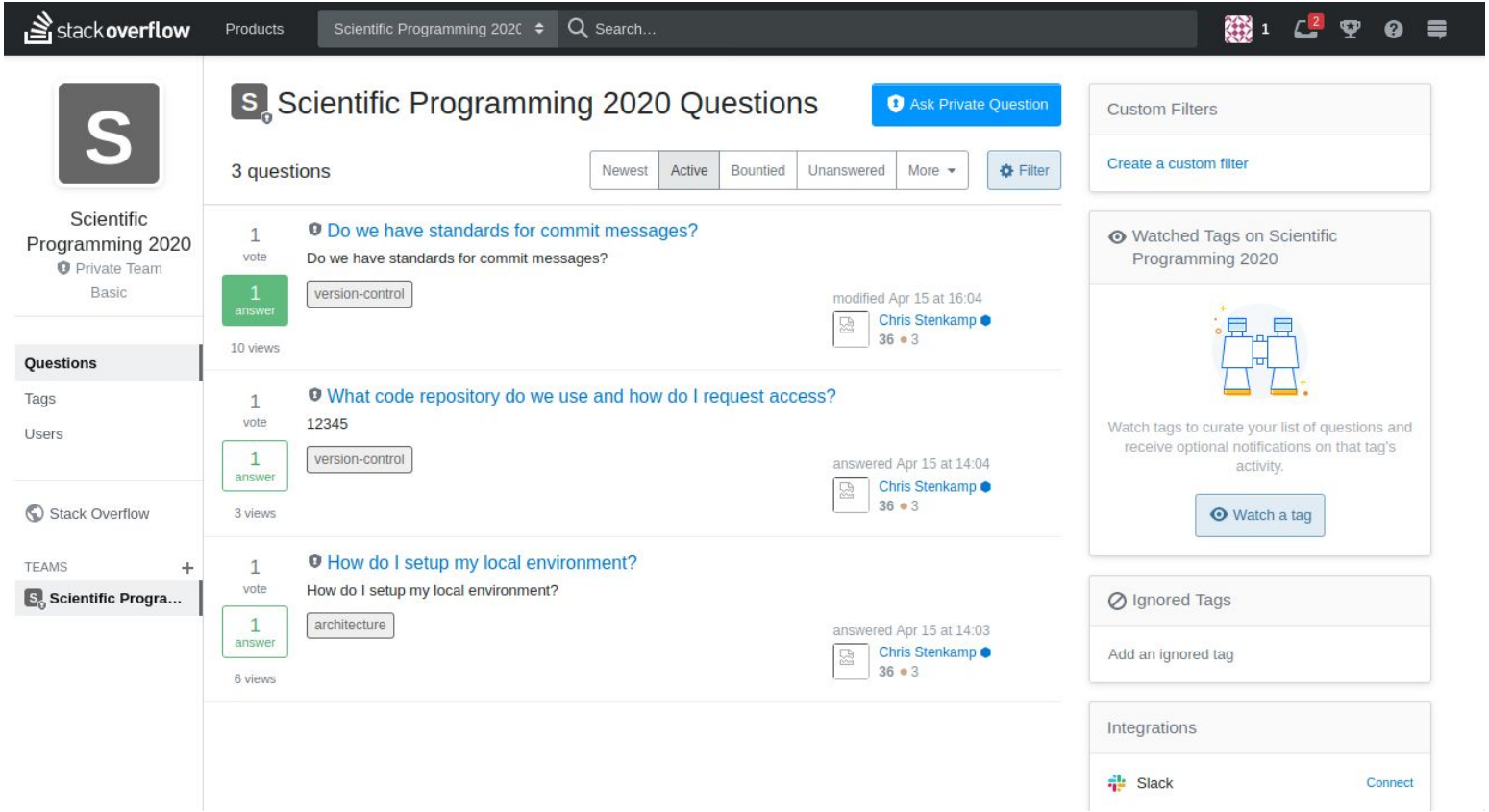
Open Jupyter at hub.sciprog.de
Open lectures-repository
Open Stackoverflow Team
Open Stud.IP: Blubber | CourseWare | Meetings
Stud.IP Forums: | Allgemeine Diskussion | Installation Problems | Homework 1 | Homework 2 | Homework 3 | Technical Problems with the course infrastructure
Open lectures-repository

# Stud.IP Forum



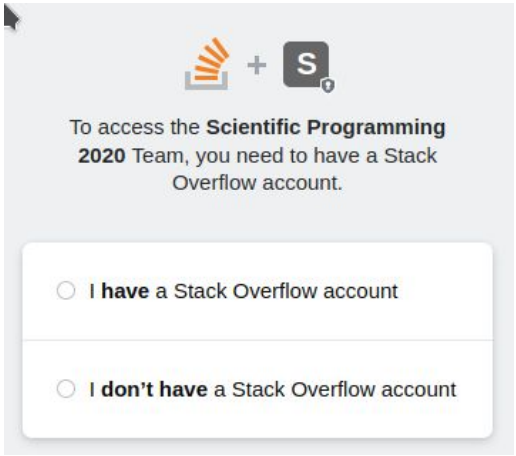
https://stackoverflow.com/c/scientific-programming-2020

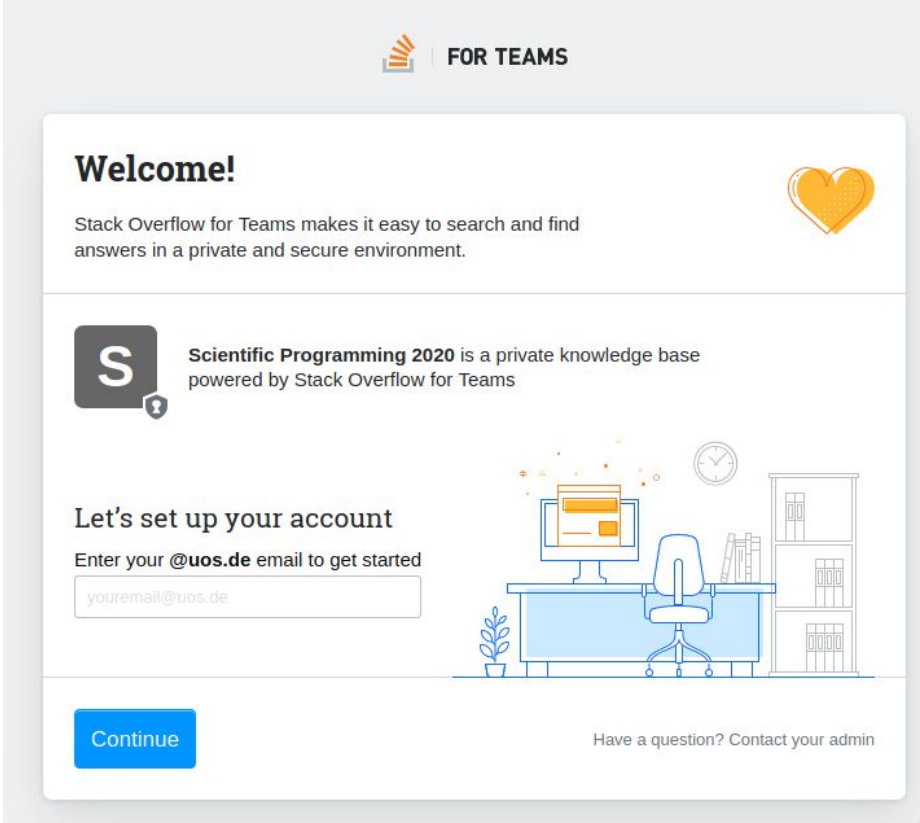
# Stackoverflow Team



https://stackoverflow.com/c/scientific-programming-2020

# Stackoverflow Team



# Setup for the course

# Which IDE?

Save yourself the pain and don’t code in notepad, without any kind of syntax highlighting or code completion

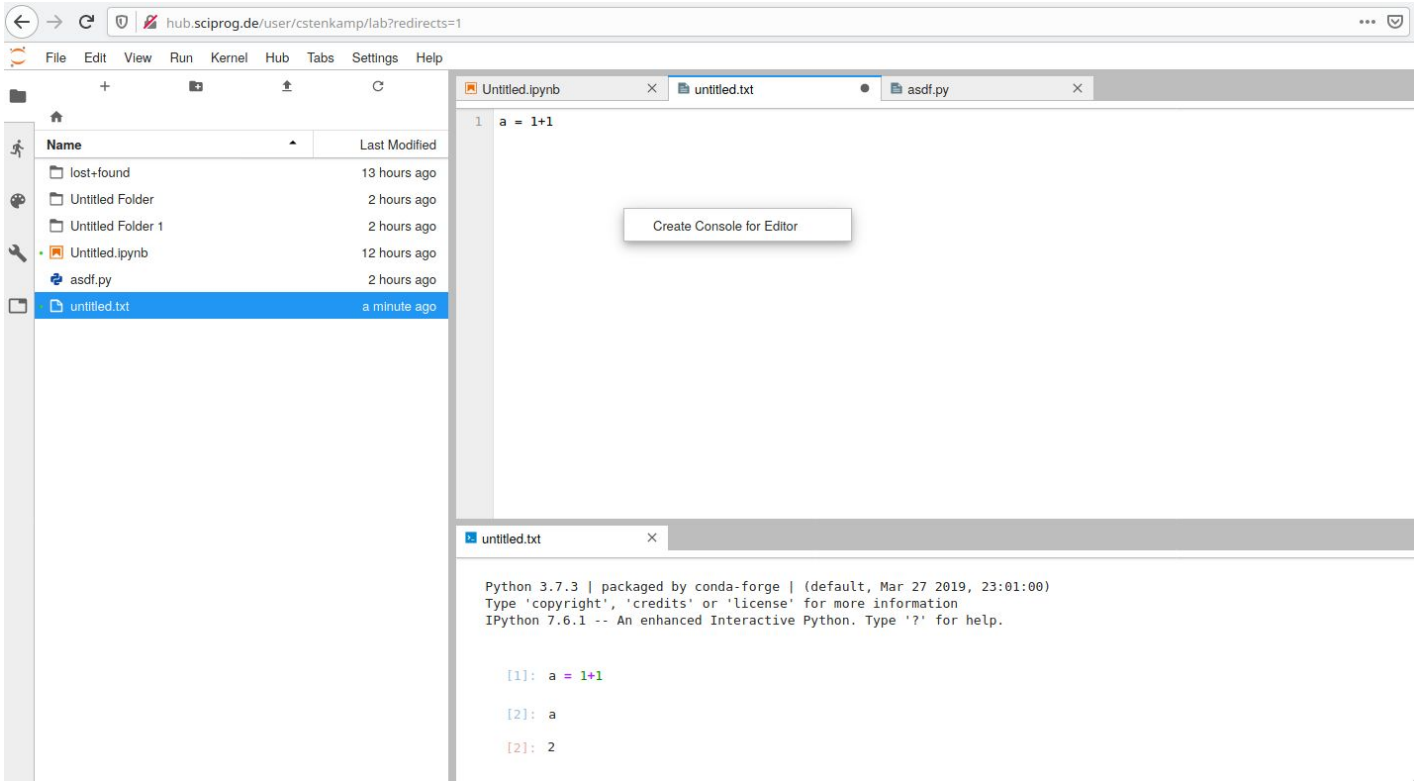
- There are as many IDEs as there are opinions about them
- Pycharm, vscode, atom, notepad++, vi, emacs…
- For this course we will only use **JupyterLab**
- Contains all you need and is great for interactive development as usually encountered in scientific contexts

# Which IDEs are there?

- Atom https://atom.io/ (or for linux *apt-get install atom*)
  - Useful Packages: **Hydrogen** by *nteract* & **hydrogen-launcher** by *lgeiger,* providing an interactive Kernel
  - Free and open source
  - Recommended for smaller projects (containing only few files)
- Pycharm https://www.jetbrains.com/pycharm/
  - Commercial, closed source, however Community edition free and Professional  free as student
  - Features many components - debugger, code analysis features, git integration, ...
  - Useful for big projects, not recommended for homework of this course
- vi
  - Integrated into Unix-systems, runs *inside* the terminal
  - Hard to master, but supposedly much faster once you did
- Jupyter Lab
  - Can not only work with pure code-files, but also *Notebook-Files* that contain code, formatted text and results of running your code
    - These notebooks are nicely rendered on Github and can be exported to HTML or PDF, or simply to a .py-script
  - Can also edit standard-python-files and use them with an interactive Kernel

# Working without installing anything

# http://hub.sciprog.de



# http://hub.sciprog.de

- The hub is a nice way to work on the tasks without having to install python on your system, all you need is a web browser
- Only use it if you need it, and close the sessions after you're, because the more users are online the more we pay
- It may also be a bit buggy at first, so please bear with us!

# Working with installing everything

# Virtual environments

- Virtual environments are sandboxes for your python and its packages - allowing you to have different Python versions with different packages side by side
- Working with the default Python leads to a mess or can even corrupt your operating system!
- Conda is the easiest option to get Python virtual envs on all platforms
- Cheat sheets:
  - http://know.continuum.io/rs/387-XNW-688/images/conda-cheatsheet.pdf
  - https://conda.io/projects/conda/en/latest/_downloads/1f5ecf5a87b1c1a8aaf5a7ab8a7a0ff7/conda-cheatsheet.pdf

# Install Anaconda or Miniconda

- **Anaconda** is a *Python distribution* made for scientific computing, packed with its own package manager (*conda*).
  - Anaconda contains >720 pre-installed packages at ~3GB
  - Download: https://www.anaconda.com/distribution/

- **Miniconda** is the same as Anaconda, just without all the pre-installed packages (besides the package manager)
  - Thus its only 66MB, and every package you need can be installed via *conda*
  - Download: https://docs.conda.io/en/latest/miniconda.html

We strongly recommend you to install Miniconda, as Anaconda simply installs Miniconda plus >160 packages into your base-environment (most of which you don't need, and certainly not in your base-environment)

# Installation instructions: Miniconda & Linux

- Download your version from https://docs.conda.io/en/latest/miniconda.html
- *bash Miniconda3-latest-Linux-x86_64.sh* (saying yes when it asks you to add it to the terminal)
  - Make sure to `conda update --all` afterwards.
  - Once you have installed it and opened a new shell, conda will automatically enable the base-environment
    - It will indicate that with a `(base)` in front of each line.
    - Further, which python should now answer .../anaconda3/bin/python or .../miniconda3/bin/python
    - If you don't want conda to automatically activate the conda-base-environment, you can turn it off using `conda config --set auto_activate_base false`
- If you don't have git already (try by running `which git`), install it using `sudo apt-get install git`

To have jupyterlab globally on your system:

- `conda install jupyter`
- `conda install jupyterlab`
- `conda install nodejs=10.13`
- `jupyter lab build`

To create the environment for the class:

- `git clone https://github.com/scientificprogrammingUOS/lectures.git`
- `conda env create -f lectures/environment.yml`
- `conda activate scientific_programming`
- `jupyter lab build`

# Installation instructions: Miniconda & Windows

- Download your version from https://docs.conda.io/en/latest/miniconda.html
- Run the graphical installer.
  - **Make sure to add conda to your PATH**[1], such that you can use it from your standard terminal.
- Afterwards, open the command-prompt as Administrator (hit Win-Key, type "cmd", right-click "Command Prompt", select "as Admin")
  - Test if your installation was correct by running `where python`
    → it should return a path containing .../anaconda3/… or ../miniconda3/...
  - Update your Conda installation by running `conda update --all`
  - Note that if you want to use the conda-base-environment without side effects, you have to run `conda activate` every time you open a shell
- Install git from https://git-scm.com/downloads
  - Make sure that git **can** be used from your command-line[2]
  - Make sure that you use one of the two options **committing unix-style**[3]
  - Leave everything else the way it is
- Afterwards you should have the commands *python*, *conda* and *git* as registered commands[4]

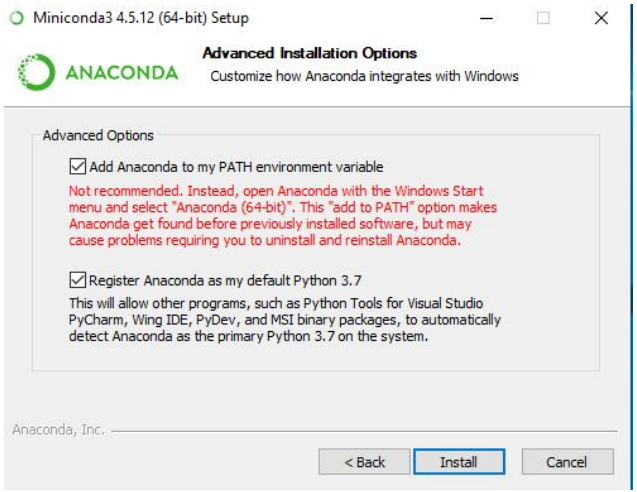
To have jupyterlab globally on your system:

- `conda install jupyter`
- `conda install jupyterlab`
- `conda install nodejs=10.13`
- `jupyter lab build`[5]

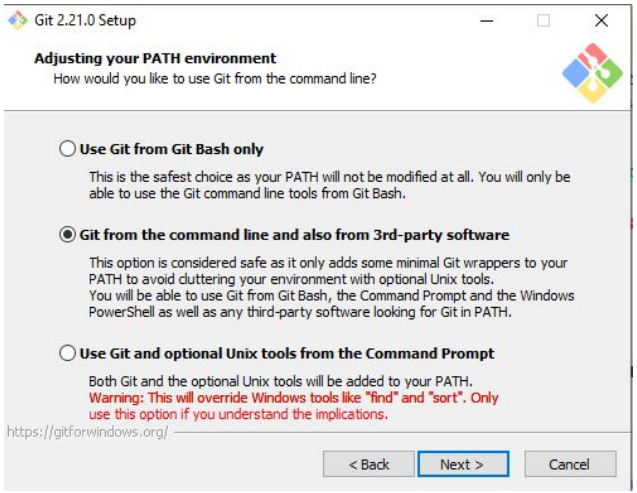
To create the environment for the class:

- `git clone https://github.com/scientificprogrammingUOS/lectures.git`
- `conda env create -f lectures/environment.yml`
- `conda activate scientific_programming`
- `jupyter lab build`[5]

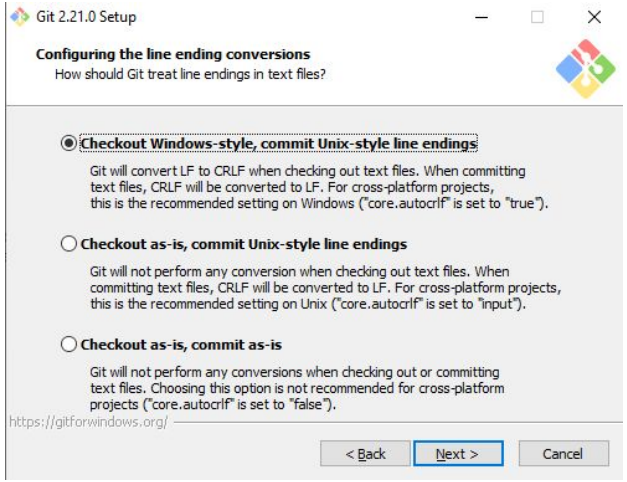
1)


Miniconda3 4.5.12 (64-bit) Setup
ANACONDA
Advanced Installation Options
Customize how Anaconda integrates with Windows
Advanced Options
Add Anaconda to my PATH environment variable
Not recommended. Instead, open Anaconda with the Windows Start menu and select "Anaconda (64-bit)". This "add to PATH" option makes Anaconda get found before previously installed software, but may cause problems requiring you to uninstall and reinstall Anaconda.
Register Anaconda as my default Python 3.7
This will allow other programs, such as Python Tools for Visual Studio PyCharm, Wing IDE, PyDev, and MSI binary packages, to automatically detect Anaconda as the primary Python 3.7 on the system.
Anaconda, Inc.
< Back
Install
Cancel

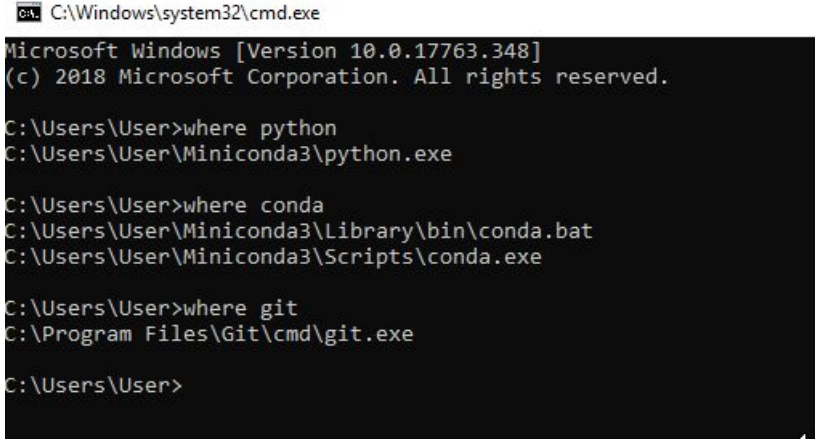
2)


Git 2.21.0 Setup
Adjusting your PATH environment
How would you like to use Git from the command line?
Use Git from Git Bash only
This is the safest choice as your PATH will not be modified at all. You will only be able to use the Git command line tools from Git Bash.
Git from the command line and also from 3rd-party software
This option is considered safe as it only adds some minimal Git wrappers to your PATH to avoid cluttering your environment with optional Unix tools.
You will be able to use Git from Git Bash, the Command Prompt and the Windows PowerShell as well as any third-party software looking for Git in PATH.
Use Git and optional Unix tools from the Command Prompt
Both Git and the optional Unix tools will be added to your PATH.
Warning: This will override Windows tools like "find" and "sort". Only use this option if you understand the implications.
https://gitforwindows.org/
< Back
Next >
Cancel

3)


Git 2.21.0 Setup
Configuring the line ending conversions
How should Git treat line endings in text files?
Checkout Windows-style, commit Unix-style line endings
Git will convert LF to CRLF when checking out text files. When committing text files, CRLF will be converted to LF. For cross-platform projects, this is the recommended setting on Windows ("core.autocrlf" is set to "true").
Checkout as-is, commit Unix-style line endings
Git will not perform any conversion when checking out text files. When committing text files, CRLF will be converted to LF. For cross-platform projects, this is the recommended setting on Unix ("core.autocrlf" is set to "input").
Checkout as-is, commit as-is
Git will not perform any conversions when checking out or committing text files. Choosing this option is not recommended for cross-platform projects ("core.autocrlf" is set to "false").
https://gitforwindows.org/
< Back
Next >
Cancel

4)


C:\Windows\system32\cmd.exe
Microsoft Windows [Version 10.0.17763.348]
(c) 2018 Microsoft Corporation. All rights reserved.
C:\Users\User>where python
C:\Users\User\Miniconda3\python.exe
C:\Users\User>where conda
C:\Users\User\Miniconda3\Library\bin\conda.bat
C:\Users\User\Miniconda3\Scripts\conda.exe
C:\Users\User>where git
C:\Program Files\Git\cmd\git.exe
C:\Users\User>

# Windows: If the previous didn’t work

- If you are sure you followed the previous steps as described, and you still get an error when trying to set up the environment, you can instead not install the complete environment via conda, but instead via pip:

```
conda create -n scientific_programming python=3.7
conda activate scientific_programming
pip install jupyter nodejs jupyterlab ipywidgets numpy matplotlib  pandas statsmodels
seaborn plotnine pivottablejs pandas-profiling altair vega_datasets numba pytest cython
tqdm markdown expyriment pygame jupyterlab-solutions jupyterlab_code_formatter nb_black
ipympl scikit-misc pySerial tqdm cleanipynbconda install nodejs -y
conda install mpl_sample_data
```

- Afterwards, you can enable this environment just as if you installed it using the environment.yml file.
- As conda is however better for installing packages (due to better storage use and dependency resolution), this should only be an emergency solution.

# After Installation

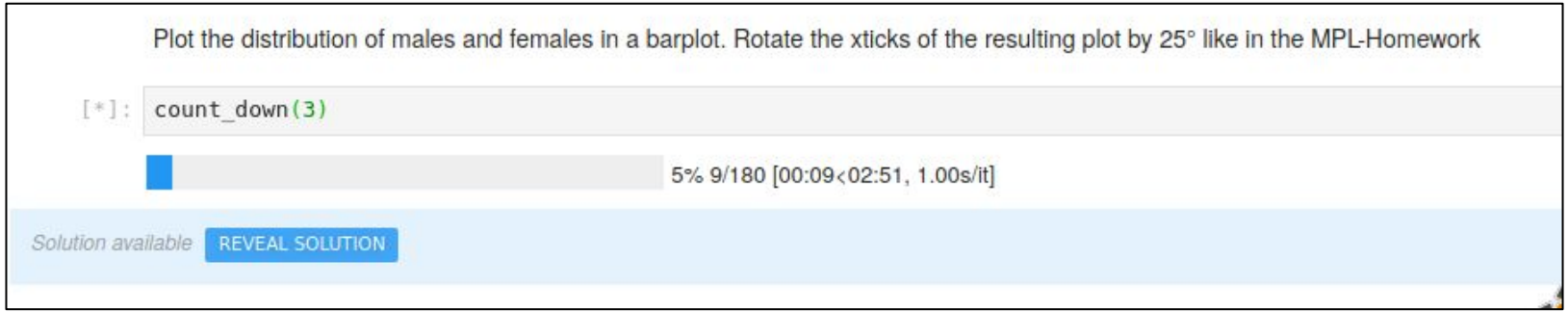
- Once you activate your environment using `conda activate scientific_programming`, your shell should indicate that you're inside this environment
- Note that you have to **activate your this environment every time you work on the exercises!**
- To test if all packages are installed successfully, run `conda list` and check if all demanded packages are indeed listed.
- To start working inside jupyter lab, navigate to the correct directory using **`cd`**, and then start jupyterlab by executing `jupyter lab .` (yes, including the dot)[5]

5) If the commands involving jupyter don't work on Windows, try using a hyphen instead of a space:

```
→ jupyter-labextension install @lckr/jupyterlab_variableinspector  (exemplary, do this for all the labextensions)
→ jupyter-lab .
```

# Get the lectures-repository to run

To nicely render some stuff in our repository (see image), you need additional libraries




To install, open a terminal/cmd, **`cd`** to the lectures-repo, activate the environment and run the following:

On Windows:

- `jupyter lab build`[5]
- *if needed:* `jupyter labextension uninstall jupyterlab-jupytext && jupyter labextension install jupyterlab-jupytext`
- `postbuild_windows.bat`

On Linux/Mac:

- `jupyter lab build`
- *if needed:* `jupyter labextension uninstall jupyterlab-jupytext && jupyter labextension install jupyterlab-jupytext`
- `chmod +x postbuild_linux`
- `./postbuild_linux`

# Installation instructions: Miniconda & Linux

You can also try to just go for one single command on Linux, replacing all the previous steps:

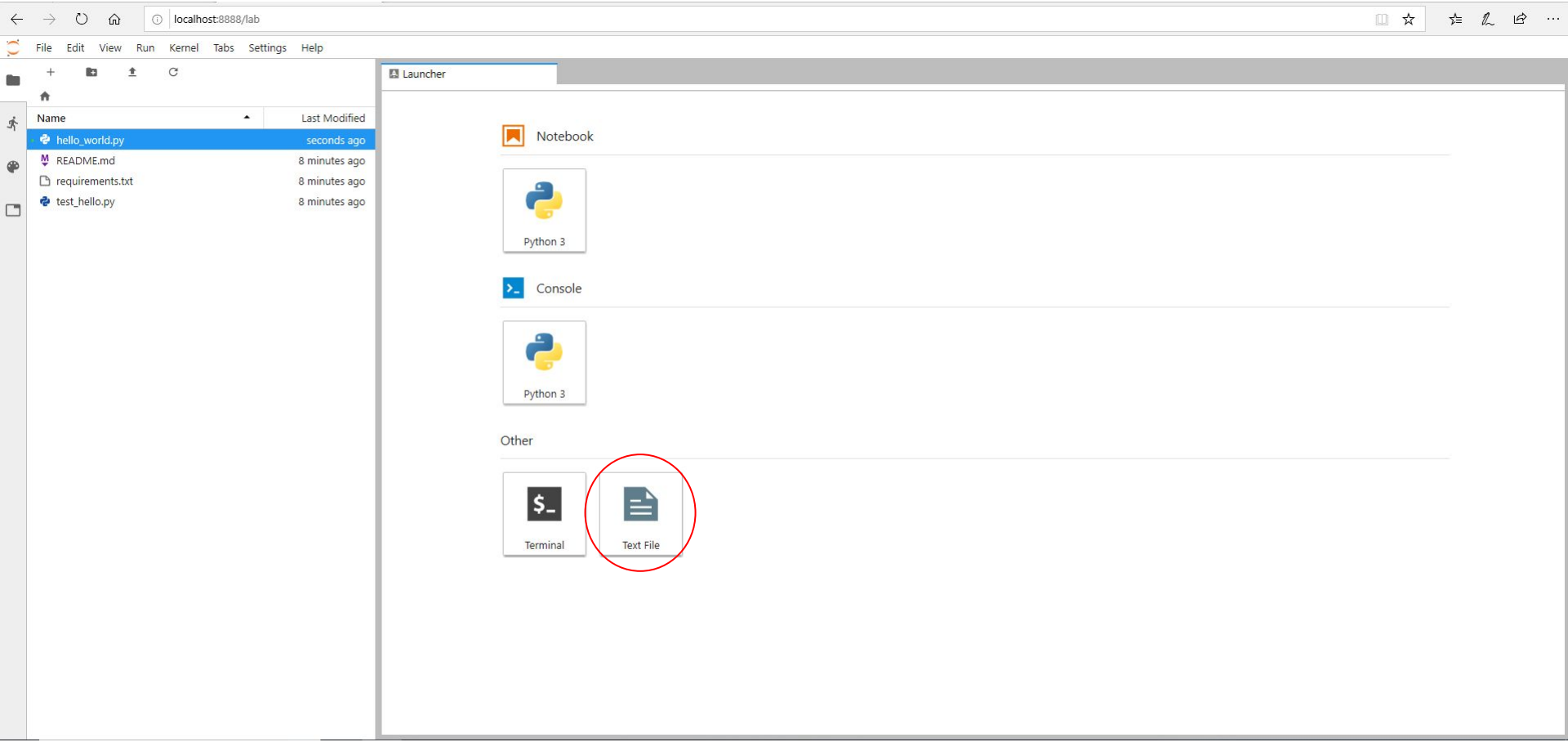
```
cd ~ && wget
https://repo.anaconda.com/miniconda/Miniconda3-latest-Linux-x86_64.sh && chmod +x
Miniconda3-latest-Linux-x86_64.sh && ./Miniconda3-latest-Linux-x86_64.sh -b -p
$PWD/conda && eval "$($PWD/conda/bin/conda shell.bash hook)" && echo $0 | awk
-F"/" '{print $NF}' | read myshell && conda init myshell && cd ~ && git clone
https://github.com/scientificprogrammingUOS/lectures.git && conda env create -f
lectures/environment.yml && conda activate scientific_programming && jupyter lab
build && chmod +x lectures/postbuild_linux && lectures/postbuild_linux
```

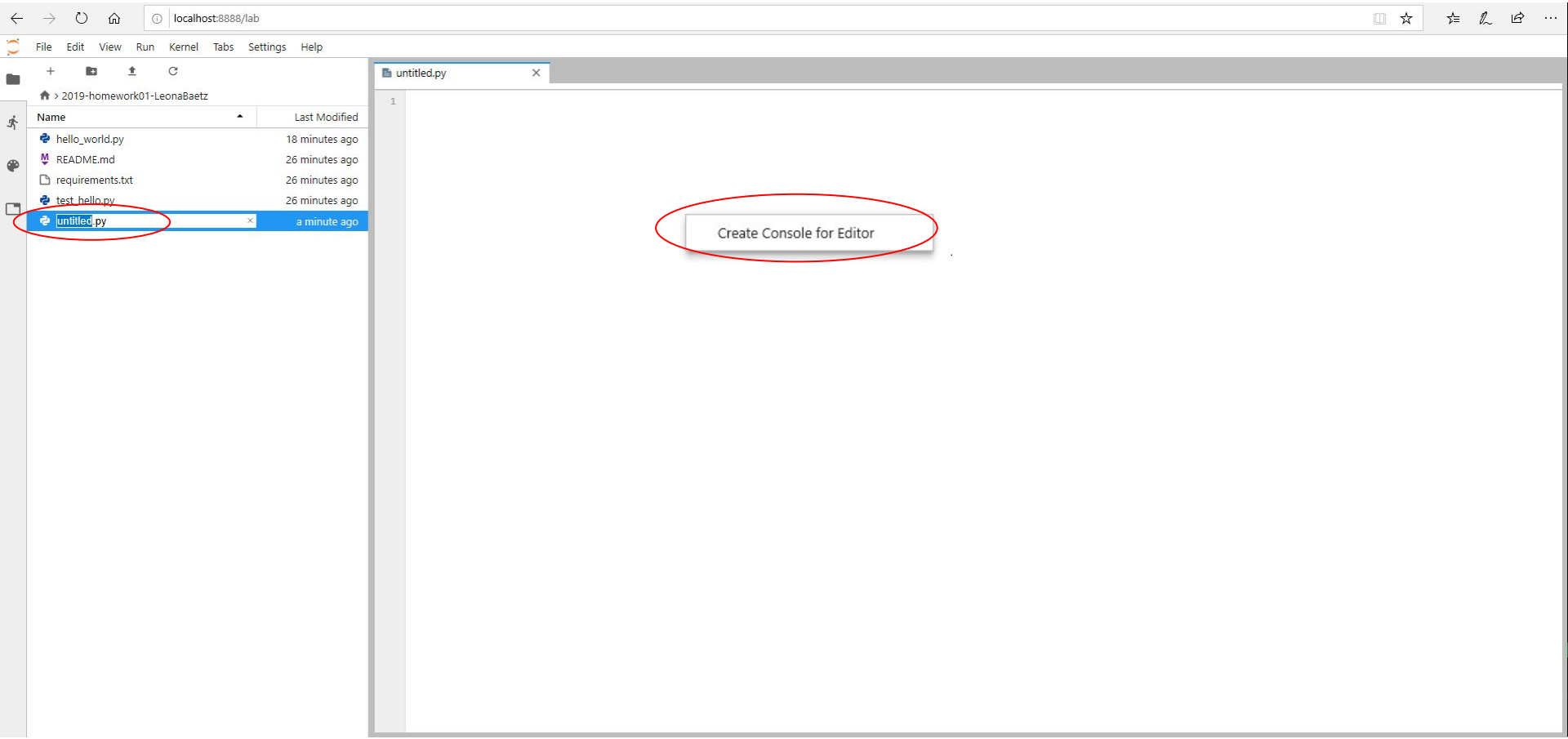
# Howto: Jupyterlab

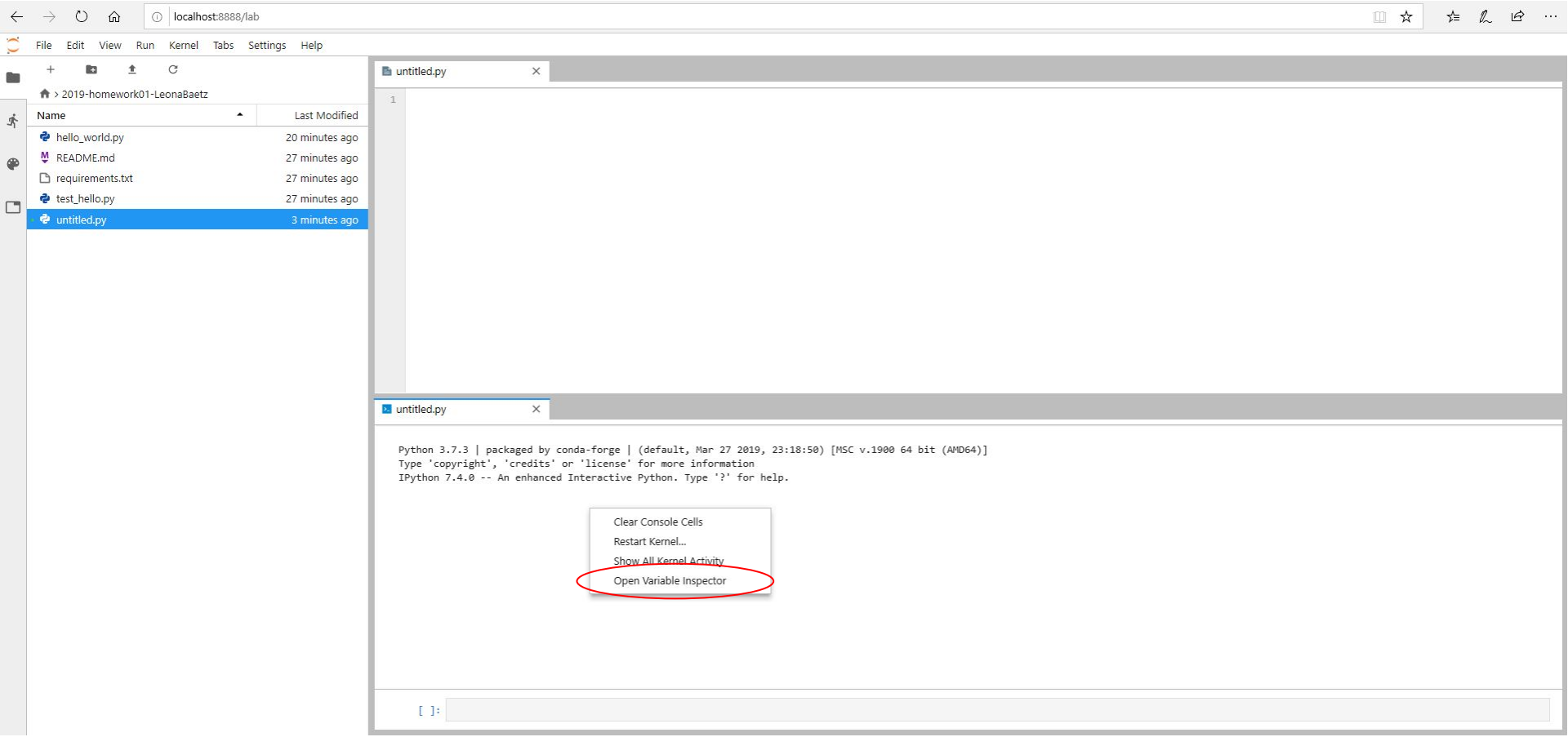
# Getting used to Jupyter lab

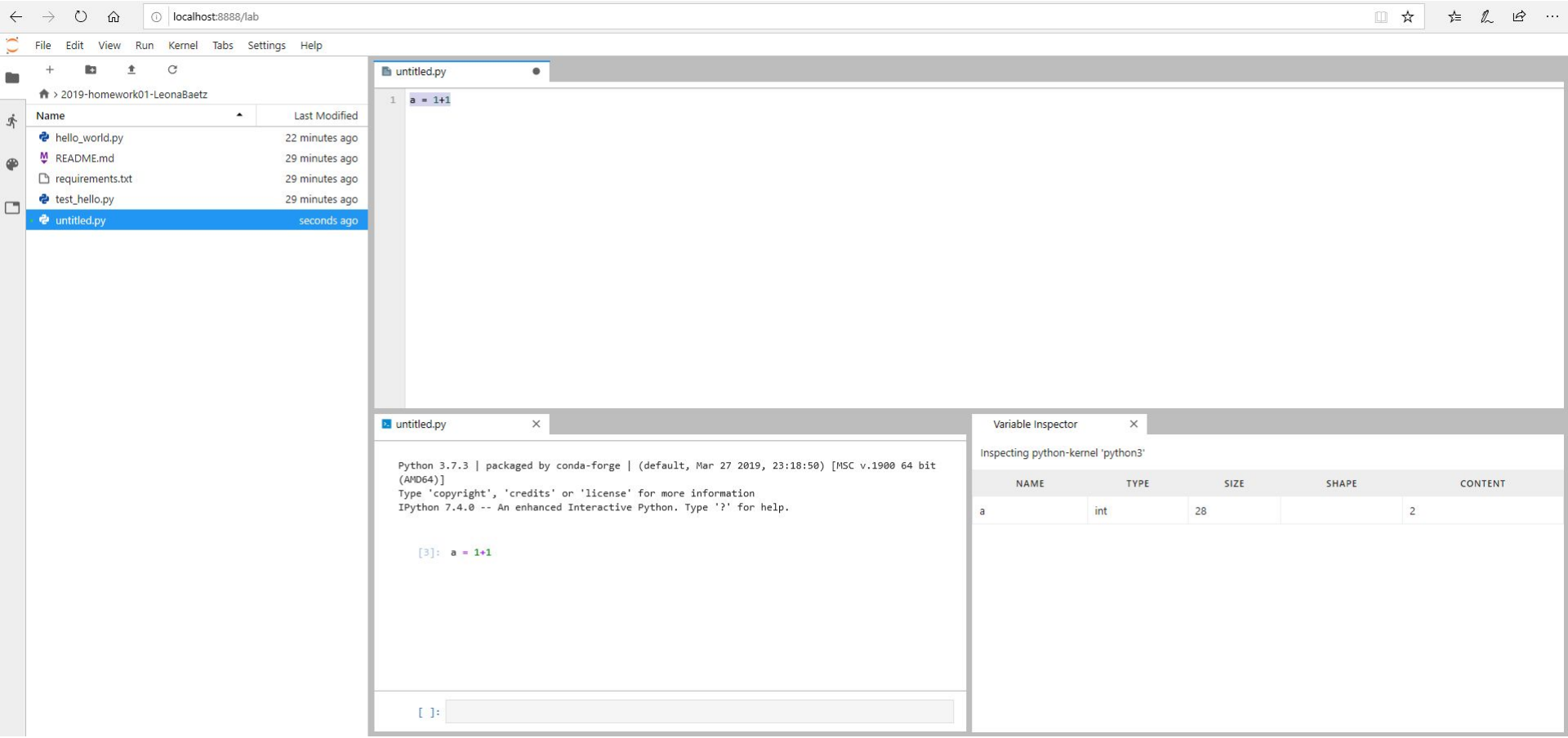
- Jupyter Lab Cheat-sheet: https://www.cheatography.com/weidadeyue/cheat-sheets/jupyter-notebook/pdf_bw/
- Markdown-Commands Cheat-Sheet: https://github.com/adam-p/markdown-here/wiki/Markdown-Cheatsheet

# Howto: Interactive Kernel


localhost:8888/lab
File Edit View Run Kernel Tabs Settings Help
Name
Last Modified
hello_world.py
seconds ago
README.md
8 minutes ago
requirements.txt
8 minutes ago
test_hello.py
8 minutes ago
Launcher
Notebook
Python 3
Console
Python 3
Other
Terminal
Text File


localhost:8888/lab
File Edit View Run Kernel Tabs Settings Help
2019-homework01-LeonaBaetz
Name
Last Modified
hello_world.py 18 minutes ago
README.md 26 minutes ago
requirements.txt 26 minutes ago
test_hello.py 26 minutes ago
untitled.py a minute ago
untitled.py
1
Create Console for Editor


localhost:8888/lab
File Edit View Run Kernel Tabs Settings Help
2019-homework01-LeonaBaetz
Name
Last Modified
hello_world.py 20 minutes ago
README.md 27 minutes ago
requirements.txt 27 minutes ago
test_hello.py 27 minutes ago
untitled.py 3 minutes ago
untitled.py
1
untitled.py
Python 3.7.3 | packaged by conda-forge | (default, Mar 27 2019, 23:18:50) [MSC v.1900 64 bit (AMD64)]
Type 'copyright', 'credits' or 'license' for more information
IPython 7.4.0 -- An enhanced Interactive Python. Type '?' for help.
Clear Console Cells
Restart Kernel...
Show All Kernel Activity
Open Variable Inspector
[ ]:


localhost:8888/lab
File Edit View Run Kernel Tabs Settings Help
2019-homework01-LeonaBaetz
Name
Last Modified
hello_world.py 22 minutes ago
README.md 29 minutes ago
requirements.txt 29 minutes ago
test_hello.py 29 minutes ago
untitled.py seconds ago
untitled.py
1 a = 1+1
untitled.py
Python 3.7.3 | packaged by conda-forge | (default, Mar 27 2019, 23:18:50) [MSC v.1900 64 bit (AMD64)]
Type 'copyright', 'credits' or 'license' for more information
IPython 7.4.0 -- An enhanced Interactive Python. Type '?' for help.
[3]: a = 1+1
[ ]:
Variable Inspector
Inspecting python-kernel 'python3'
NAME TYPE SIZE SHAPE CONTENT
a int 28 2

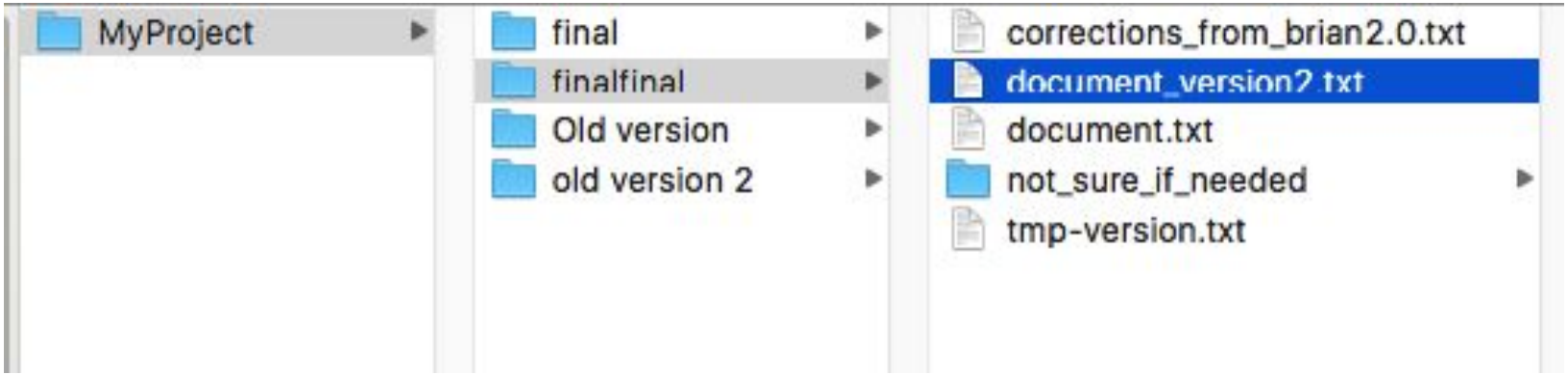
# Intro: git

[These slides are basing on the ones created by Lukas Kalbertodt, all credits to him]

# Getting started with git

- Git is a free and open source VCS (version control system) [7]
- It allows you to track changes to files over time, compare new versions to old versions, have multiple versions in parallel, and work simultaneously on projects
- VCS are commonly used for programming projects, but can also be useful for any other project

# Why version control?




# Version control

Tracks & logs changes in your files with…

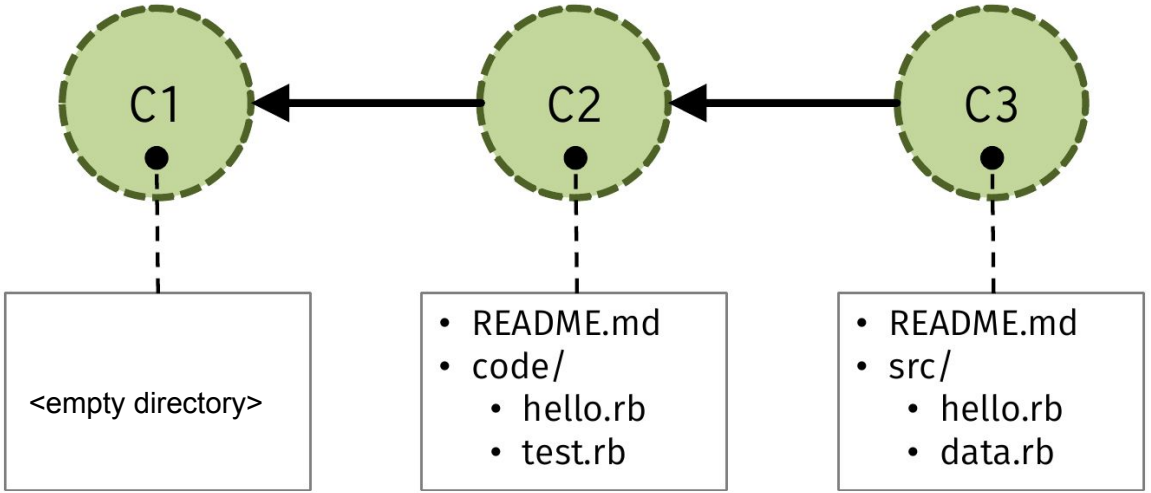
- Author
- Timestamp
- Description

Allows…

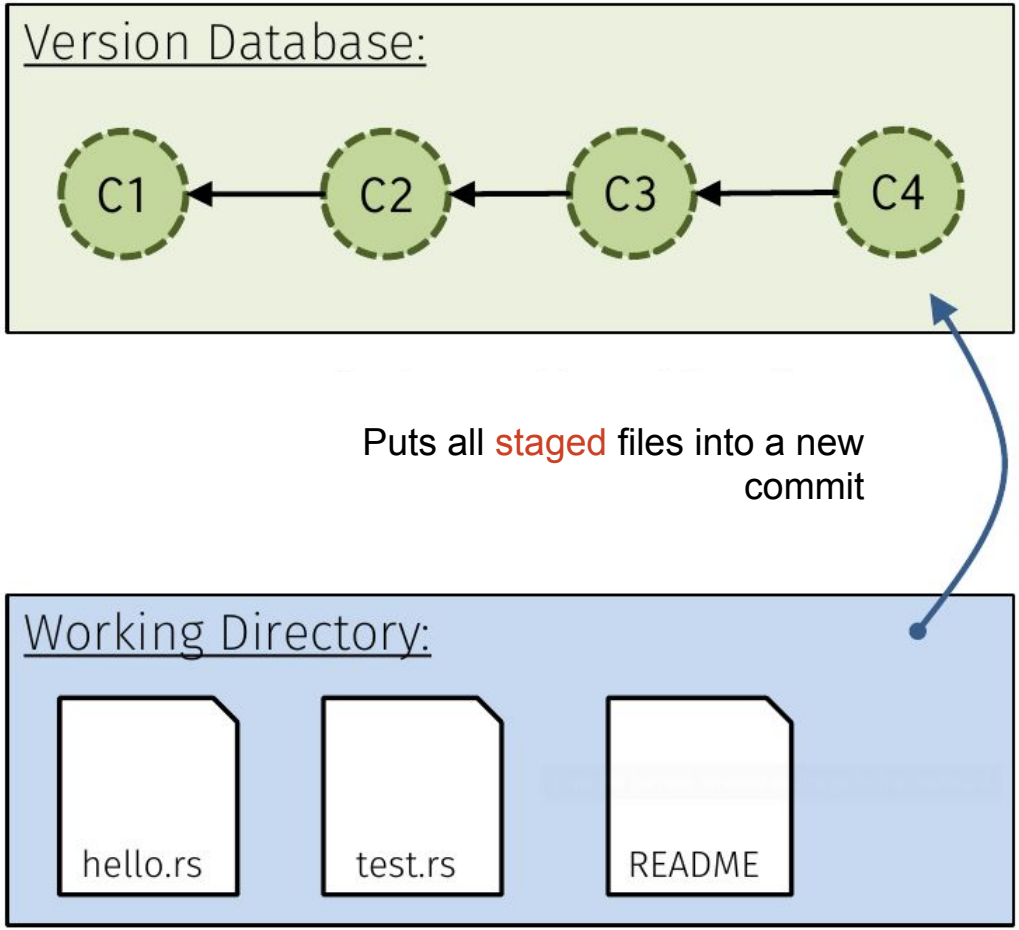
- Restoring old versions
- Having multiple parallel versions
- Analyzing your code
- Collaborating on code

# A commit

- Snapshot of the whole project at certain time
- A commit saves…
  - Its predecessor
  - Changes in the files (delta from predecessor)
  - Author, time, commit message
- Identified by Hash (eg. C1, C2, ..)



# The repository




- Contains all commits
- Saved in a hidden folder called .git

# File status

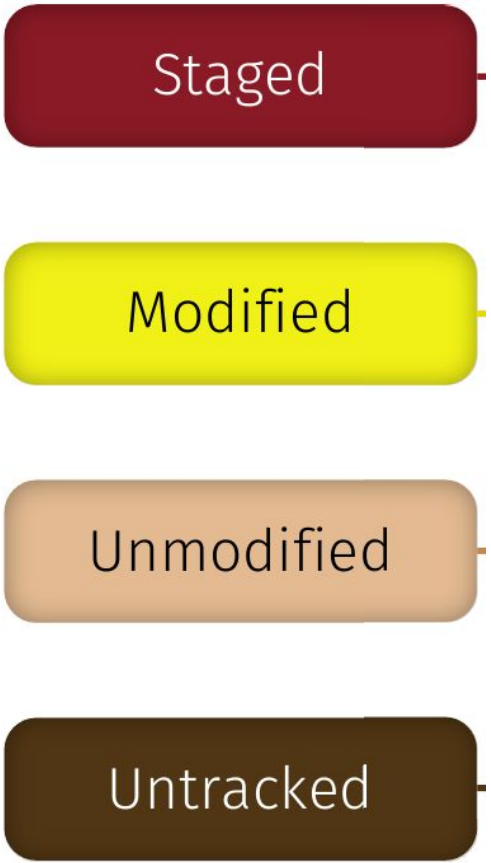

File will be committed with the next commit


File is registered for git and was changed since the last commit

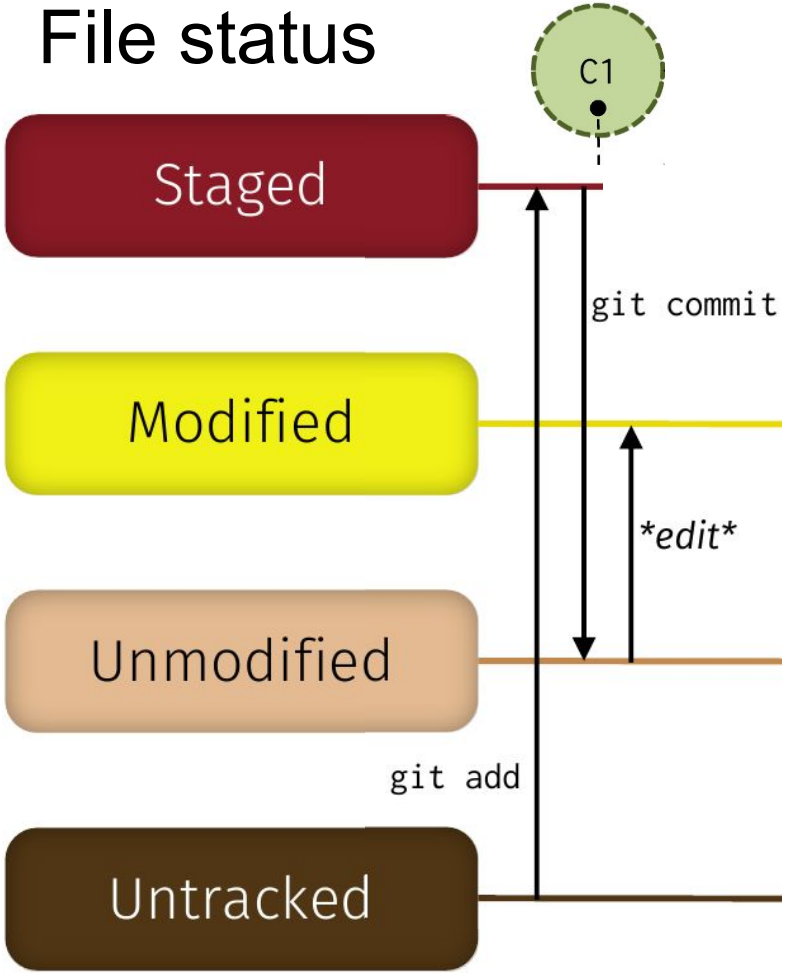

File is registered in git, but equal to the last commit


Git knows the file exists, but won’t do anything with it

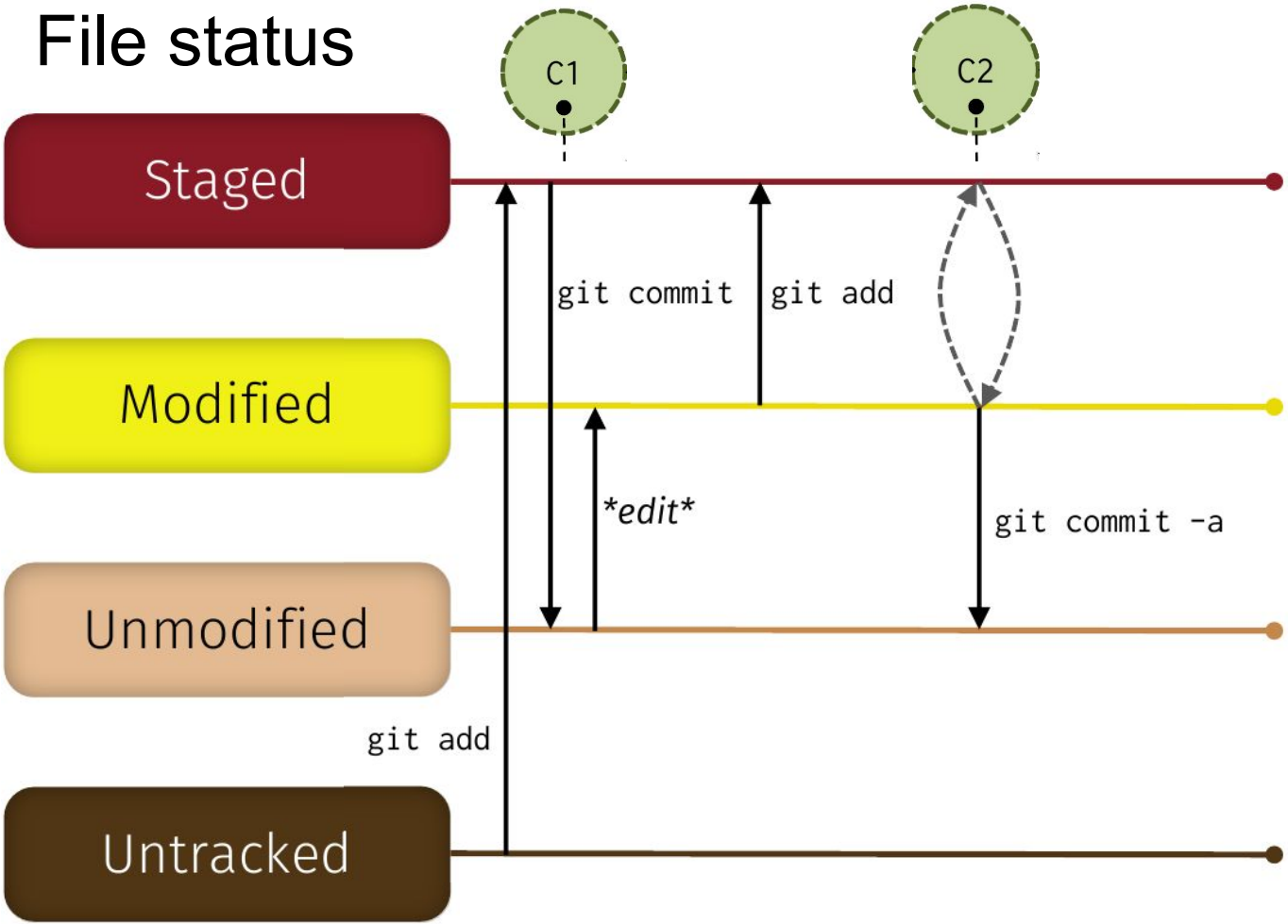
# File status



# File status


C1
Staged
git commit
Modified
*edit*
Unmodified
git add
Untracked

# File status


C1
C2
Staged
Modified
Unmodified
Untracked
git commit
git add
*edit*
git commit -a
git add

# git status

Staged

Modified

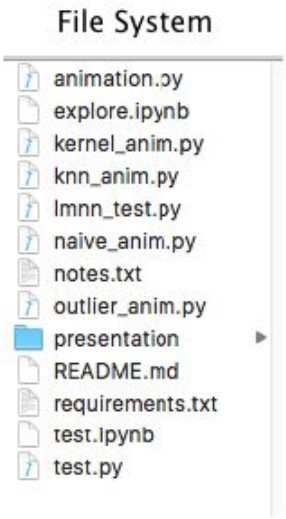
Unmodified

Untracked

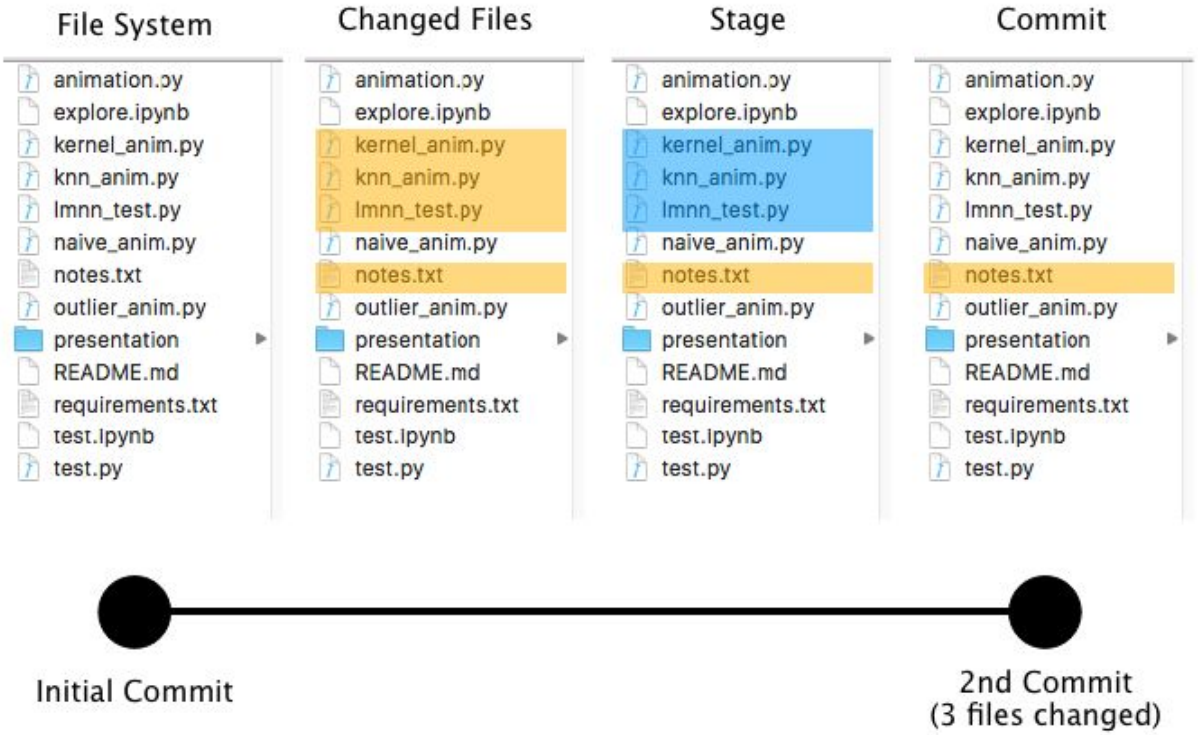
```
$ git status
On branch dev
Your branch is up-to-date with 'origin/dev'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        new file: bye.rs
        new file: hello.rs

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified: Cargo.toml

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

        test.rs
```

Run *git status* before any other command to know what's going on!

# Git workflow

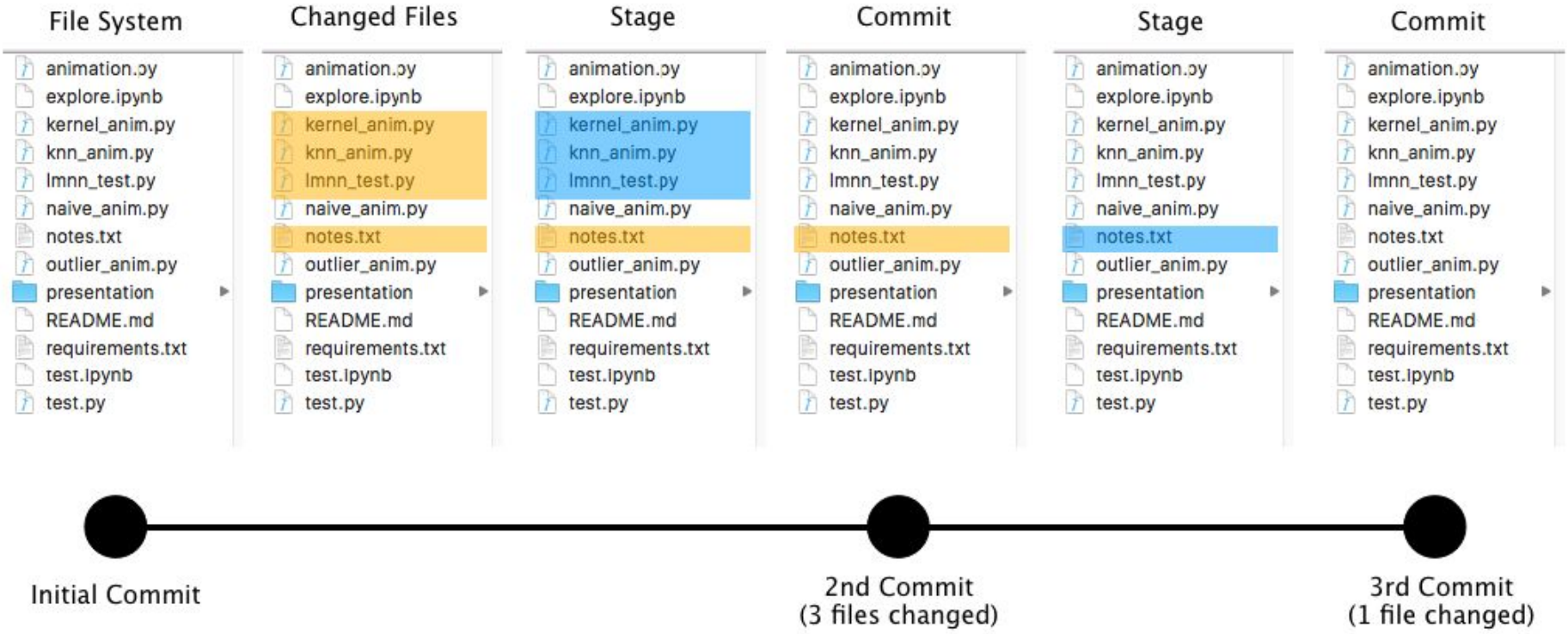


# Git workflow



https://try.github.io/

# Git workflow



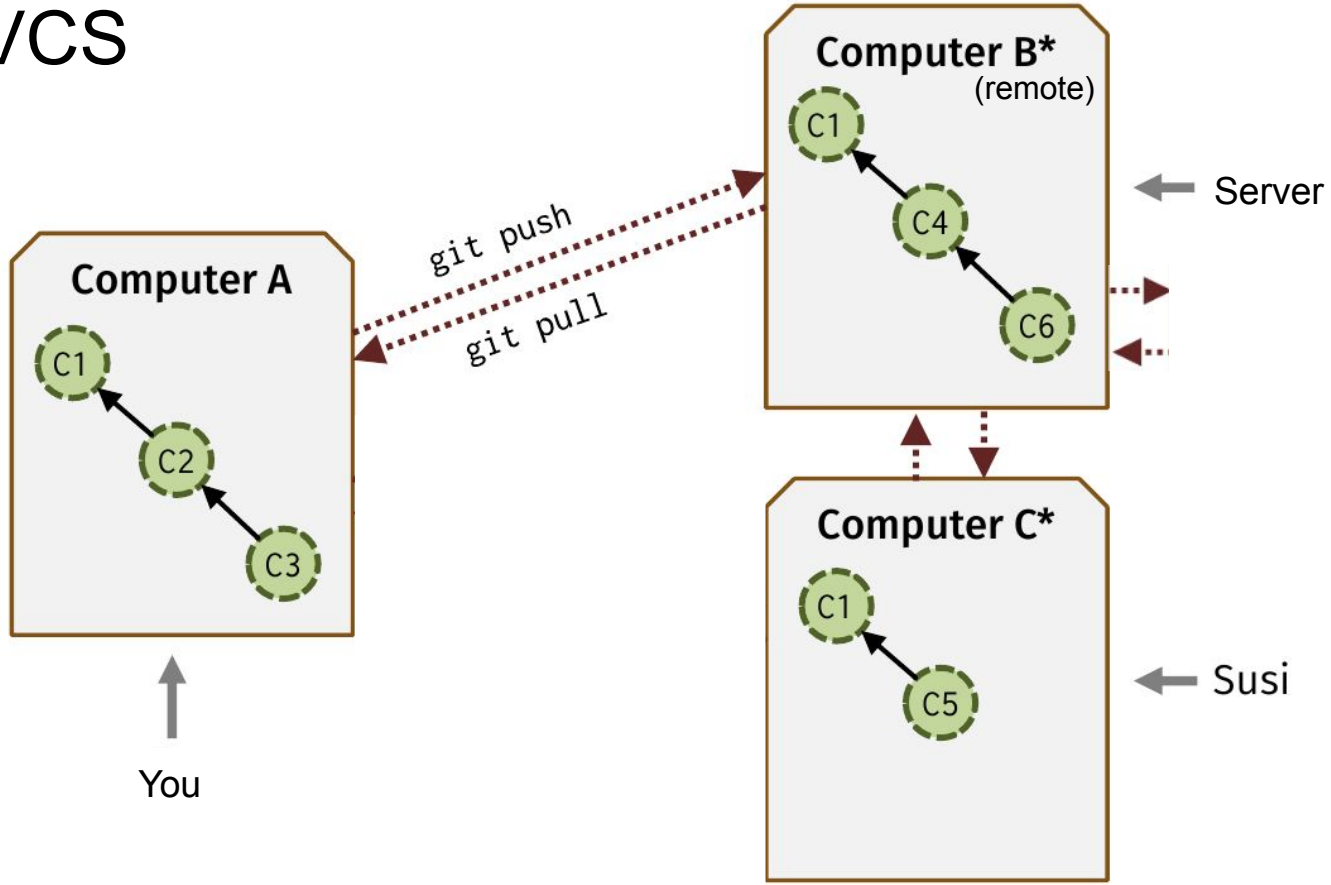
# Getting started with GitHub

- Github is a website, providing a server to store your projects and also a web-interface to easily access them and to collaborate with others
- GitHub adds many additional features, like Pull-Requests with Code review, Issues, Wikis, …

- Github is only an *external storage (+UI)* for git projects
- Git works perfectly fine locally, without GitHub
- Github allows for easy access from multiple computers
- You need to manually synchronize your local directory with GitHub!

[7,8]

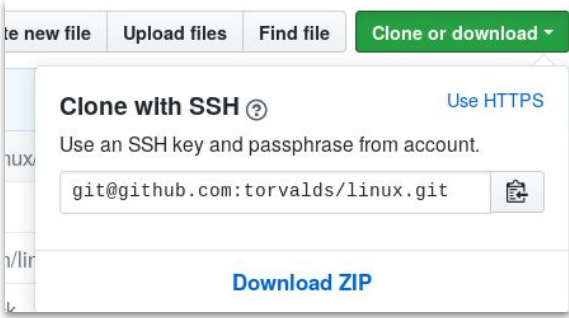
# Distributed VCS



# Demo: git

# Demo: shells

# What to do




1. Create a new repository

   - *git init* PROJECT1
   - Creates a new folder PROJECT1
   - *cd* PROJECT1

2. Add some files

   - *echo "hallo" > file.txt*
   - *ls/dir* — Folder contains *file.txt*
   - *git status* — Untracked files: “file.txt”
   - *git add file.txt*
   - *git status* — Changes to be committed: “file.txt”
   - *git commit -m “added a file”*
   - *git status* — nothing to commit, working tree clean

OR

1. Clone a repository

   - *git clone GIT_URL*
   - Creates a local copy of the repository and adds URL as *remote* **origin**

3. Push local changes

   - (Create repo: https://github.com/new
   - *git remote add origin* GIT_URL)
   - *git push origin master*

# Git commands cheat-sheet

- `git init` to create a new project
- `git clone <url>` to copy an existing project from eg. GitHub or BitBucket
- `git status` to view which files changed in status
- `git diff` to view each file's difference to the last commit (or also between commits)
- `git checkout <file>` to reset a file to the last commit
- `git checkout -b <branch> <hash>` to completely restore an older commit (to a branch)
- `git checkout <branch>` to switch branches (eg. back to master)
- `git log` to view your latest commits incl. messages
- `git pull` to update your local repository to the state of the one on GitHub/BitBucket
- `git push` to update the repository on GitHub/BitBucket to your local version
- `git add <file>` such that git will stage the file to be considered in the next commit
- `git rm <file>` to delete a file from filesystem and also stop tracking it
- `git commit -m "<message>"` to create a commit of the currently staged files

# Final remarks on git

- Git is made for source-code and is no dropbox! → Add only text-based (diff'able) files
- Gitignores may help to not add unnecessary files. Add a ".gitignore" file to your repository and write filename-masks you want git to completely ignore into it. A useful start is https://github.com/github/gitignore/blob/master/Python.gitignore
- Modern editors all come with git integration, however we advise to not use it until you're really familiar with git! Learning the console always helps!
- If you are not familiar with git https://try.github.io/
- For deeper looks https://git-scm.com/book/en/v2

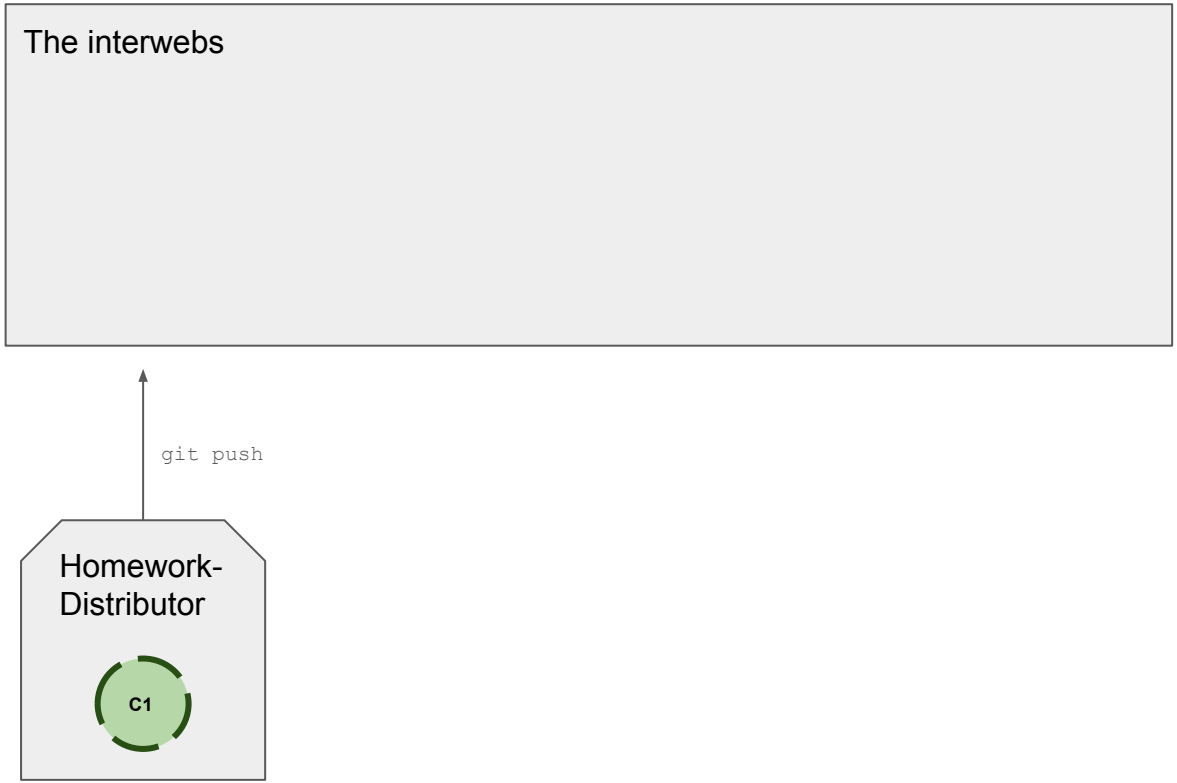
# Homework

# Homework

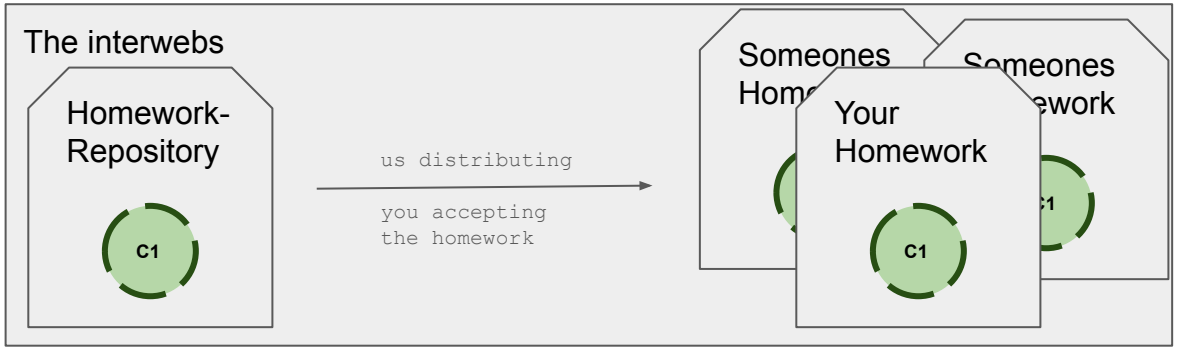
- Homework is distributed via *Github classroom*
- You need a GitHub-account to work on the homework!

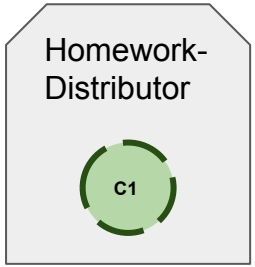
- We will submit sample-solutions for the homework, and to see them, you need to at least accept the homework!

# Working with Github Classroom

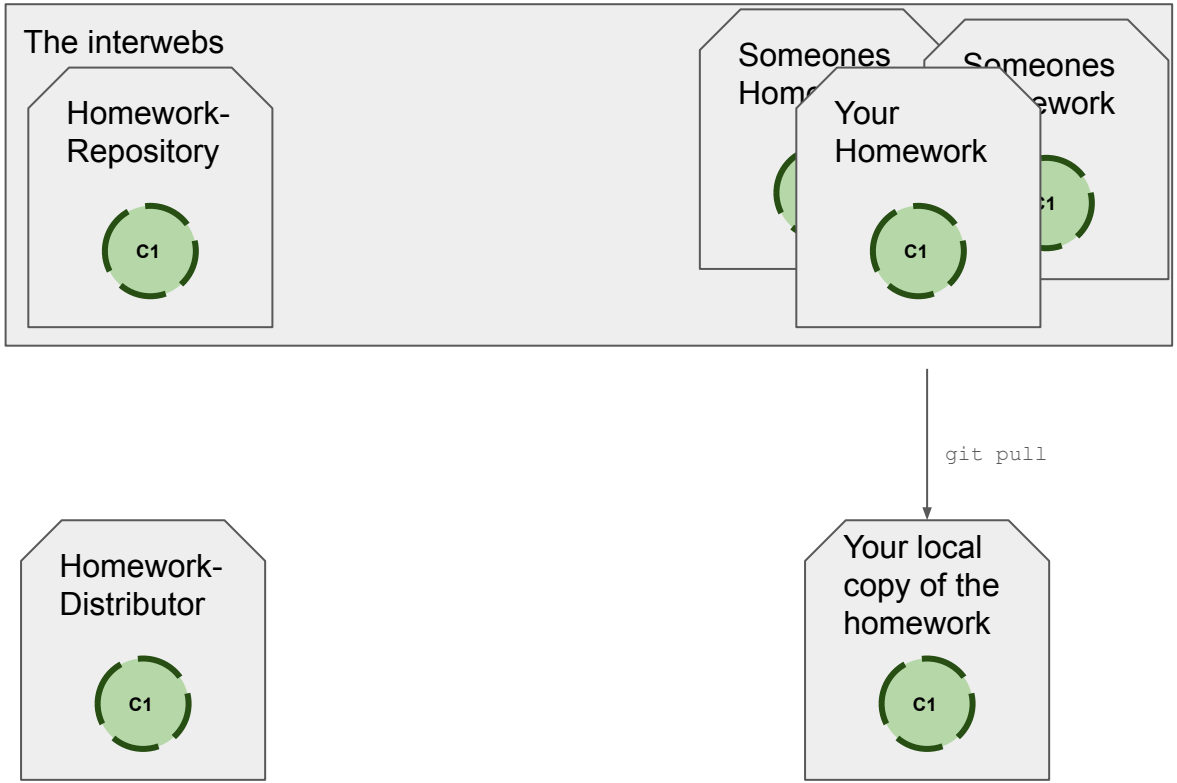


# Working with Github Classroom

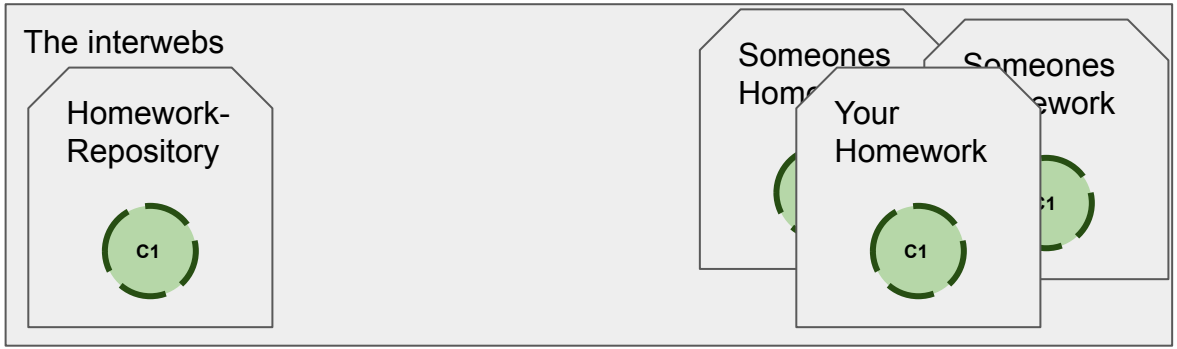


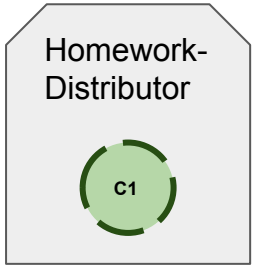



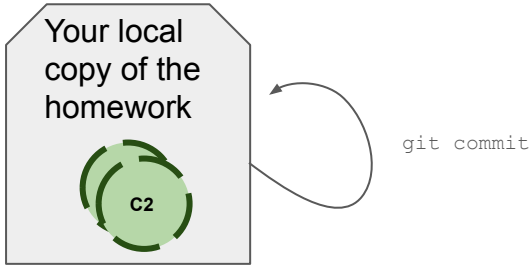
# Working with Github Classroom



# Working with Github Classroom



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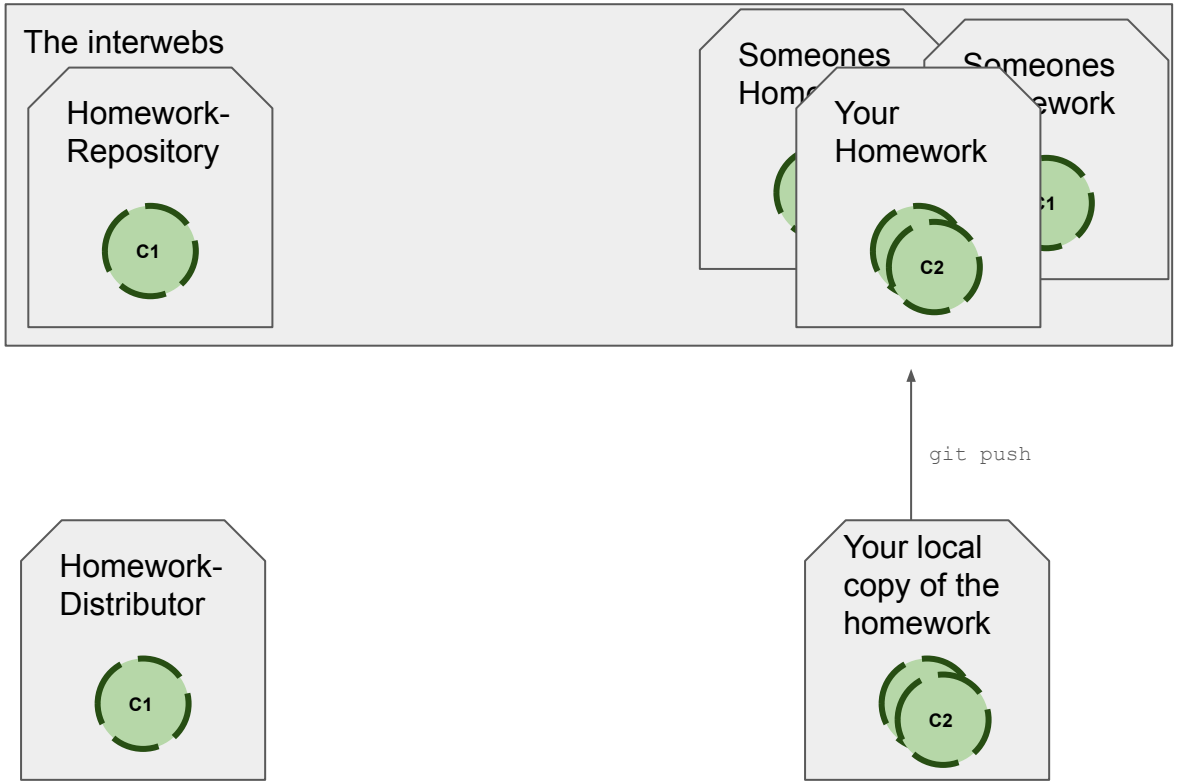

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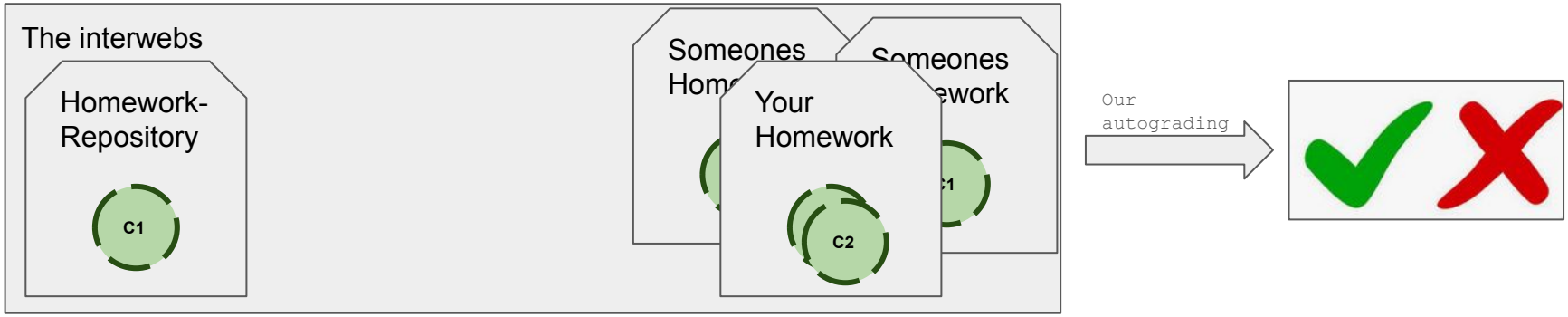
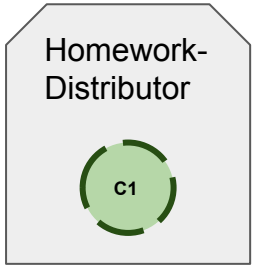
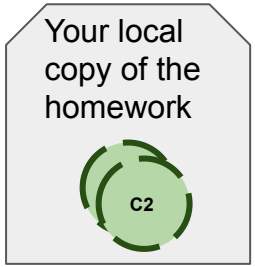
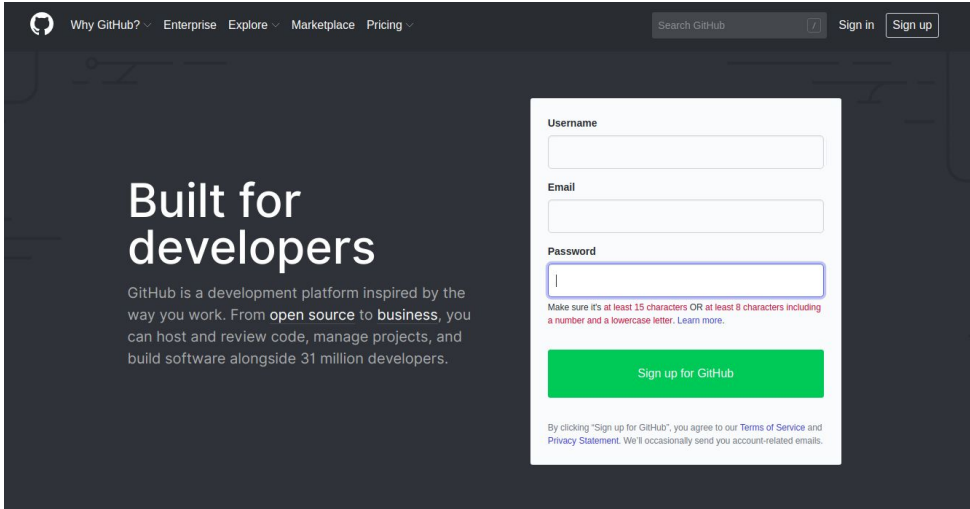


# Get your homework

- Create your GitHub-Account
  - Go to https://github.com/
  - Your GitHub account is like your portfolio for programming, so use something you can show to others instead of xXOmqItzPotatoXx
  - Use your @uos-mail to get unlimited free repositories! https://education.github.com/pack/offers



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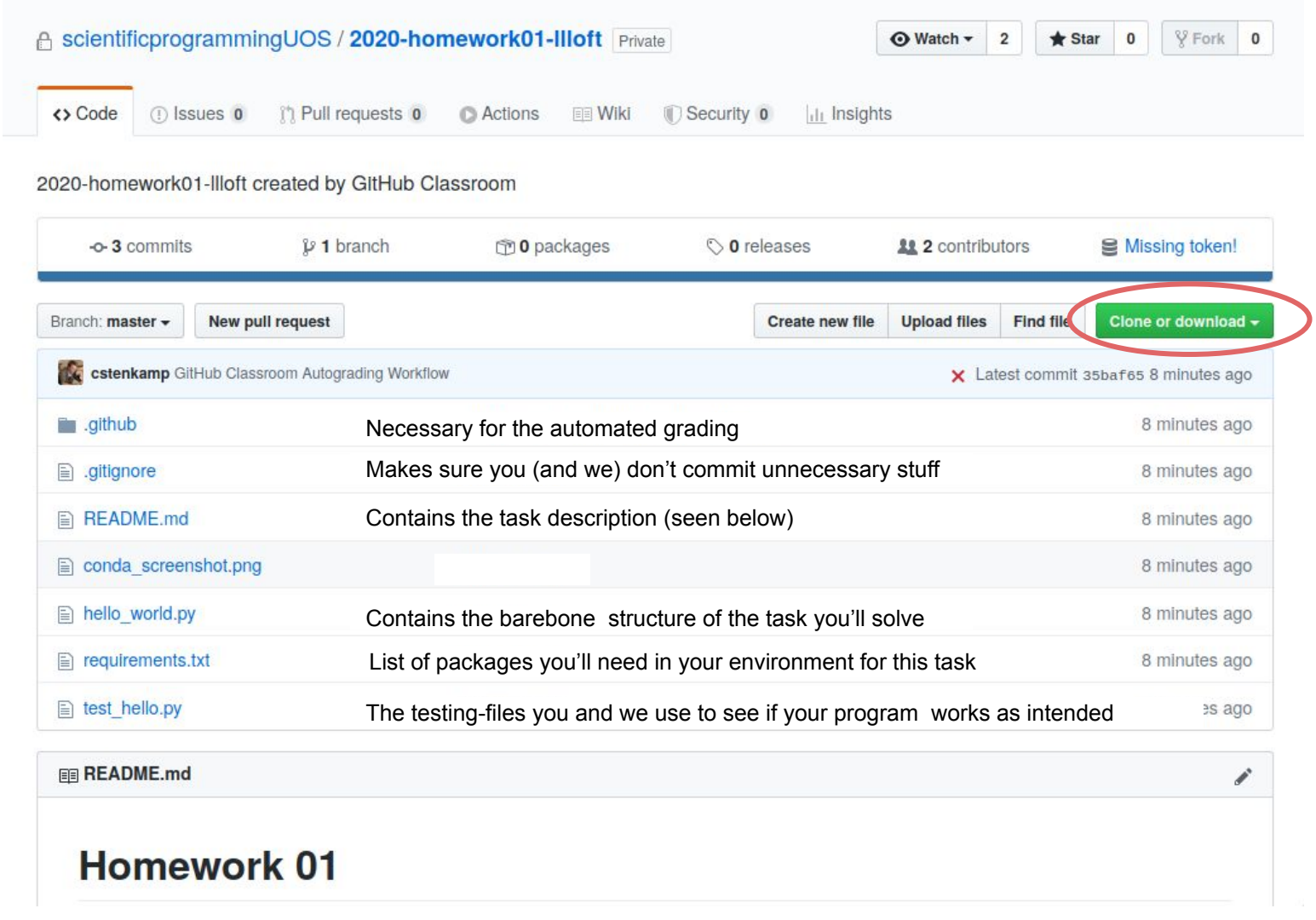
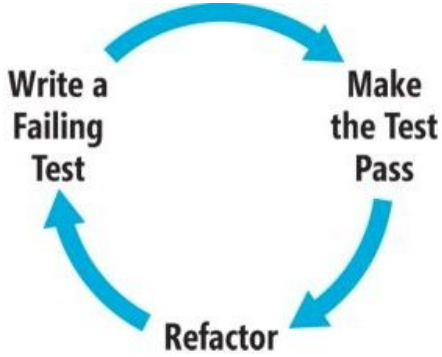
  - Use your @uos-mail to get unlimited free repositories! https://education.github.com/pack/offers
- Accept the first homework for 2020 at this link:
  - https://classroom.github.com/a/tEzM8Vux


scientificprogrammingUOS / 2020-homework01-llloft Private
Watch 2
Star 0
Fork 0
Code
Issues 0
Pull requests 0
Actions
Wiki
Security 0
Insights
2020-homework01-llloft created by GitHub Classroom
3 commits
1 branch
0 packages
0 releases
2 contributors
Missing token!
Branch: master
New pull request
Create new file
Upload files
Find file
Clone or download
cstenkamp GitHub Classroom Autograding Workflow
Latest commit 35baf65 8 minutes ago
.github
Necessary for the automated grading
8 minutes ago
.gitignore
Makes sure you (and we) don't commit unnecessary stuff
8 minutes ago
README.md
Contains the task description (seen below)
8 minutes ago
conda_screenshot.png
8 minutes ago
hello_world.py
Contains the barebone structure of the task you'll solve
8 minutes ago
requirements.txt
List of packages you'll need in your environment for this task
8 minutes ago
test_hello.py
The testing-files you and we use to see if your program works as intended
README.md
Homework 01

# Pytest and Test-Driven Development

- `pytest` is a testing library included with python
- It will grab all `test_`-functions in all `test_`-files, execute them, and check for errors
- To do so, it uses assertions: `assert prime.find_prime(1)==2`

```
chris@debian:~/Documents/UNI/sem_10/Scientific_Programming_Python/homework/bonus01$ pytest
========================================= test session starts ==========================================
platform linux -- Python 3.6.5rc1, pytest-3.5.0, py-1.5.3, pluggy-0.6.0
rootdir: /home/chris/Documents/UNI/sem_10/Scientific_Programming_Python/homework/bonus01, inifile:
collected 2 items

test_prime.py .F                                                                              [100%]

================================================ FAILURES ================================================
_____________________________________ test_find_prime_method _____________________________________

    def test_find_prime_method():
        assert hasattr(prime, 'find_prime'), "Your Script must have a 'find_prime'-method!"

        assert prime.find_prime(1) == 2
>       assert prime.find_prime(8) == 19
E       assert 11 == 19
E        +  where 11 = <function find_prime at 0x7f8407982bf8>(8)
E        +    where <function find_prime at 0x7f8407982bf8> = prime.find_prime

test_prime.py:19: AssertionError
================================== 1 failed, 1 passed in 0.02 seconds ==================================
chris@debian:~/Documents/UNI/sem_10/Scientific_Programming_Python/homework/bonus01$
```



# Pytest and Test-Driven Development

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```
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========================================= test session starts ==========================================
platform linux -- Python 3.6.5rc1, pytest-3.5.0, py-1.5.3, pluggy-0.6.0
rootdir: /home/chris/Documents/UNI/sem_10/Scientific_Programming_Python/homework/bonus01, inifile:
collected 2 items

test_prime.py ..                                                                              [100%]

====================================== 2 passed in 0.03 seconds ========================================
chris@debian:~/Documents/UNI/sem_10/Scientific_Programming_Python/homework/bonus01$
```
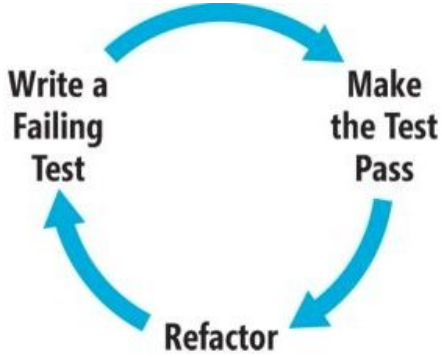

```
pytest test_file_1                  to run only one test-file
pytest test_file_2::test_func_1a    to run only one test-function
pytest -vv                          to get longer error messages
pytest --tb=no                      to only check pass/fail

pytest test_file_1 --vv -tb=0 you can combine these arguments!
```




Once this is the result of pytest, your homework will pass!

# How to download and work on Homework

- Homework-link:
  - https://classroom.github.com/a/tEzM8Vux
  - → click on “clone or download”, copy the url

```
git clone REPOSITORY_URL
cd YOUR_REPOSITORY_PATH
conda activate scientific_programming
jupyter lab .
...
pytest
...
git status
git add CHANGED_FILE
git commit -m “solved the exercise”
git push
conda deactivate
```

http://dashboard.sciprog.de

# Scientific Programming in Python 2020 - Dashboard

You are logged in as sneuhoff (GitHub: llloft - #46219090)

Overall Points: 10/10

Announcements:

**First Steps of this course**

Dear Pythoniasts,

Welcome to this course! We spend the last days eagerly preparing everything, and so far everything is looking really well and we are happy to spend this semester with you, most likely online for the most part. As a few of you have already asked a few things about how the course will proceed, here some quick information:

- The Tuesday-session will not be held live. Instead, we will use Courseware to provide you with Videos with varying degrees of interactivity.
- The first session will be split into multiple (non-interactive) Videos that we will upload within the next three hours on Stud.IP Courseware/Opencast
- Any other Information, also regarding how we proceed with the practice on Thursday, will be explained in the video, so please make sure to watch all of these Videos before you ask any further questions. I will update this announcement as soon as all Videos are online
- In the videos, we will explain the course infrastructure. Most of that is home-coded and completely new and largely untested, so please be patient if it doesn't work terribly smoothly at first
- If, after having watched all the videos, you have questions left that are relevant for everybody or that can also be answered by other participants of the course, please ask them in the Stud.IP Forum or on Blubber
- The course is held and organized by Philipp Thölke and Christoph Stenkamp. Besides his name on your Scheine, Prof. Kühnberger has nothing to do with this course. That means as long as it's not about that, don't ask him any questions, but ask us instead (with an email if it's supposed to be private, and via the mentioned means otherwise).

That's all for now, everything else will be explained in a video!
Here's to a good semester!

Open Jupyter at hub.sciprog.de
Open lectures-repository
Open Stackoverflow Team
Open Stud.IP: Blubber | CourseWare | Meetings
Stud.IP Forums: | Allgemeine Diskussion | Installation Problems | Homework 1 | Homework 2 | Homework 3 | Technical Problems with the course infrastructure
Open lectures-repository

## Current Homework

### homework01

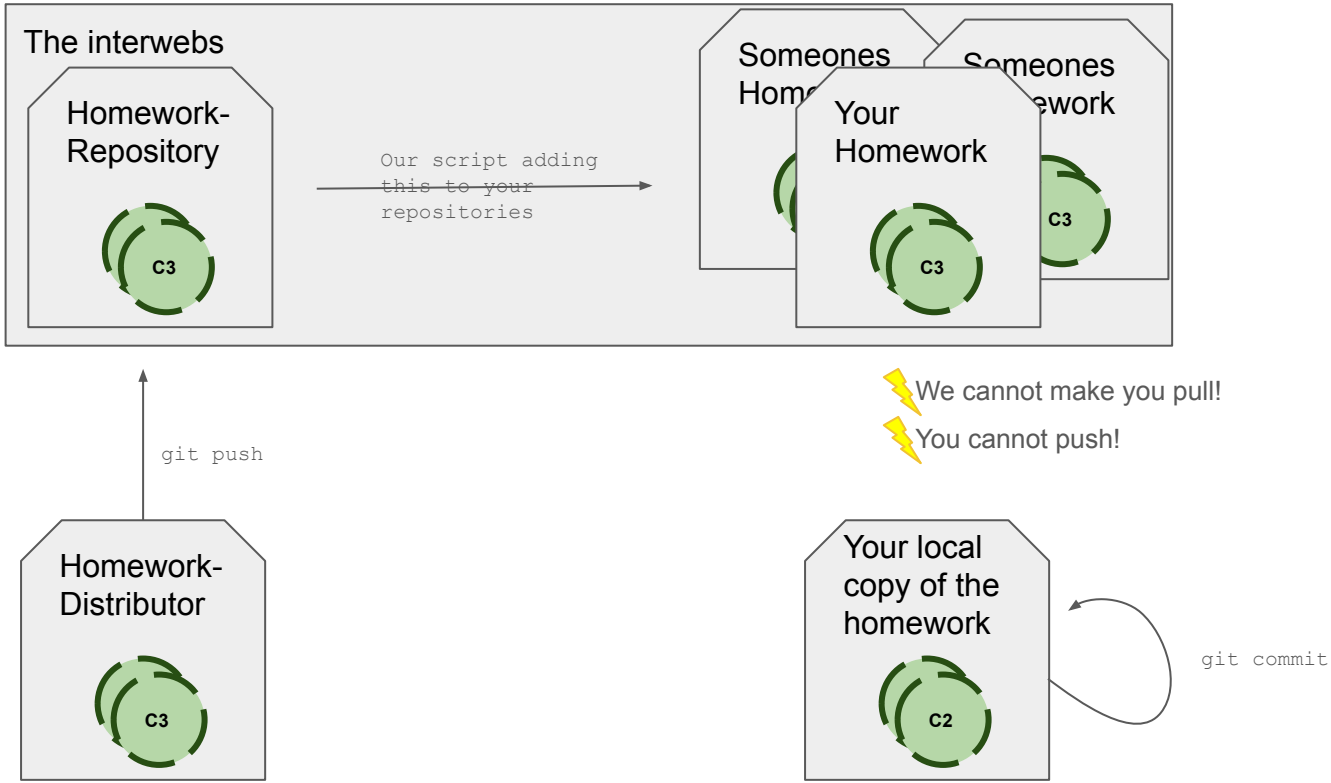
Deadline: 2020-04-28 12:00 (5 days 22:11 to go)
Points: 10/10 (check why)
There are 0 commits to the homework-branch since you accepted the homework.
There are 0 posts regarding this homework in the Stud.IP Forum.
Stackoverflow tags: ["homework01"]
Additional information:

None

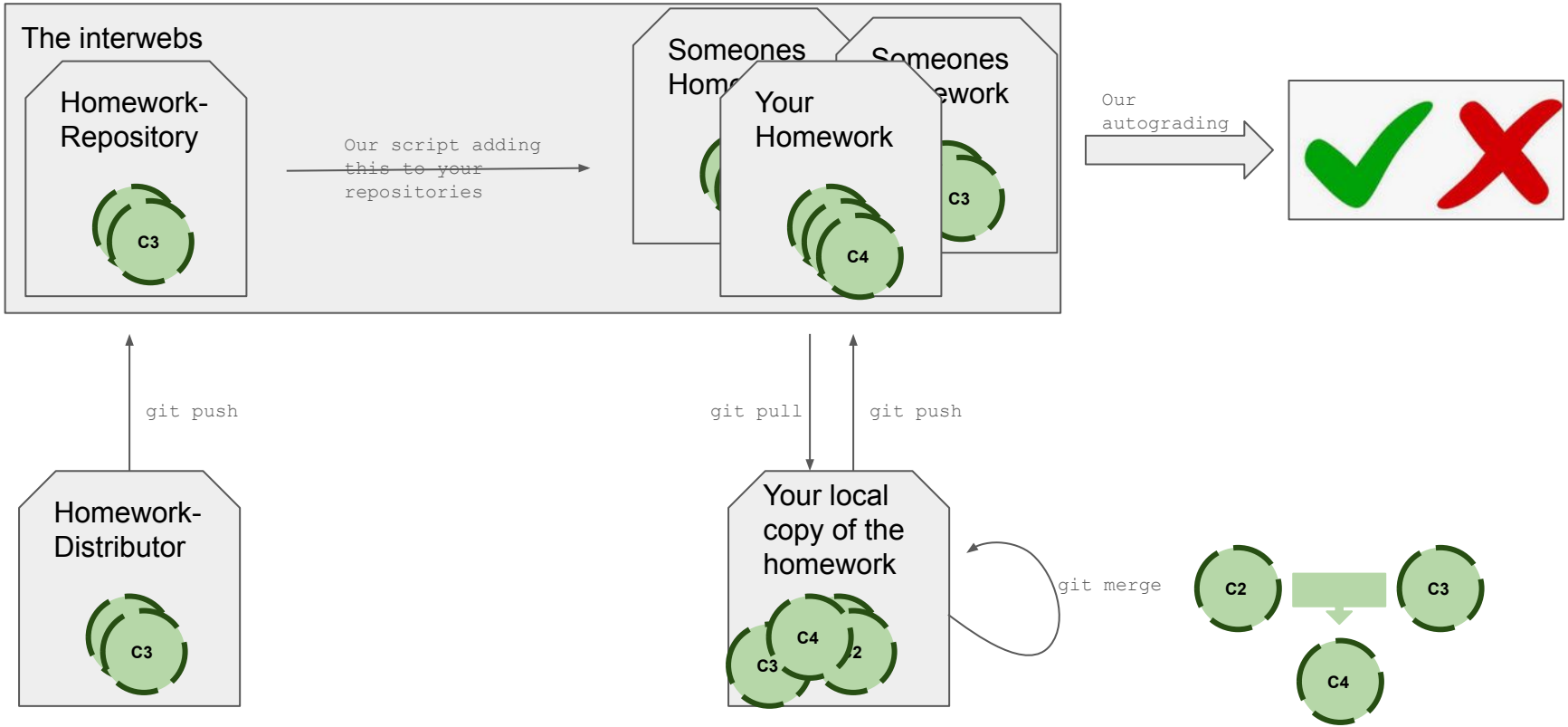
Write an Email to the admins regarding this homework

<demo: homework>

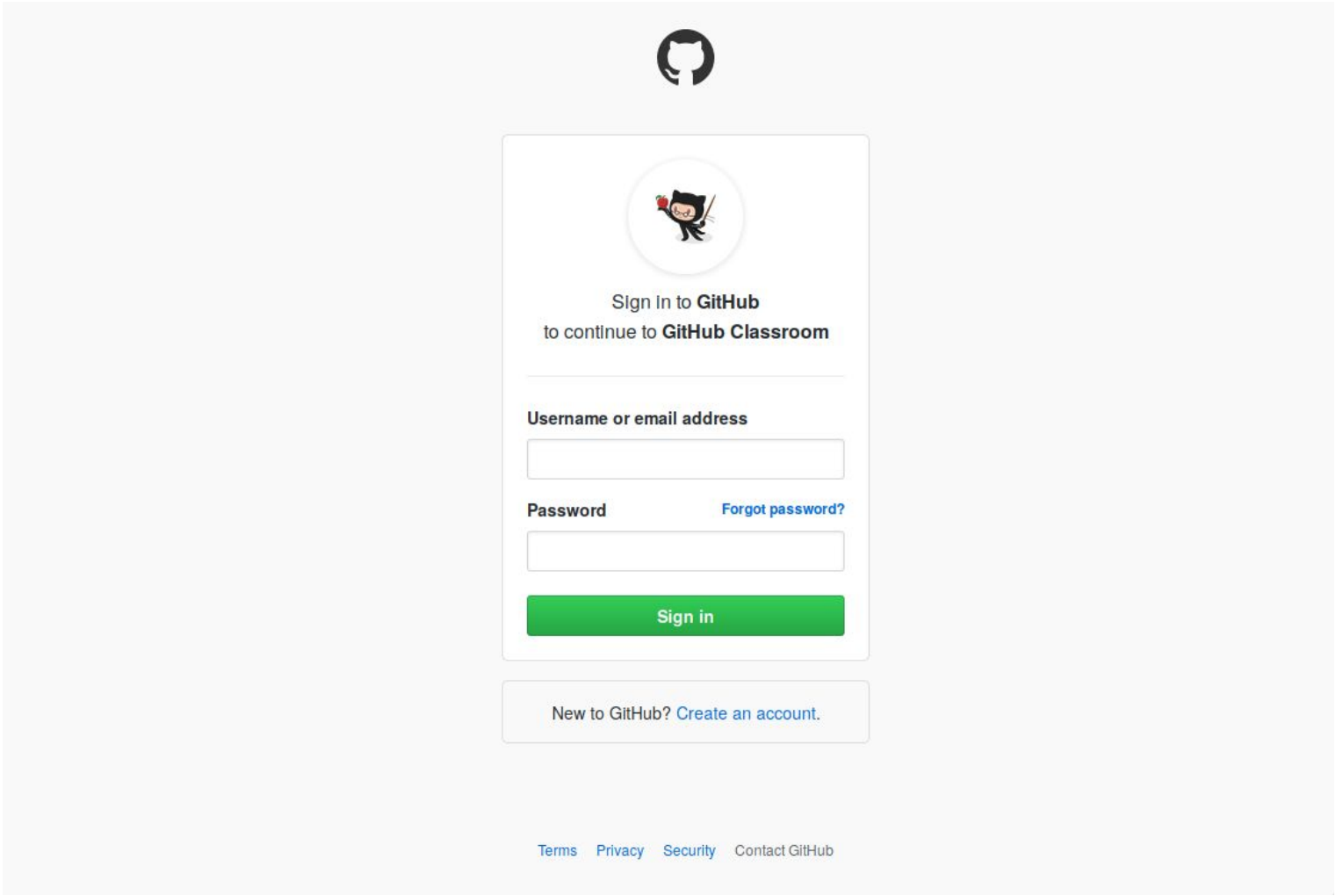
# When there are errors in the homework

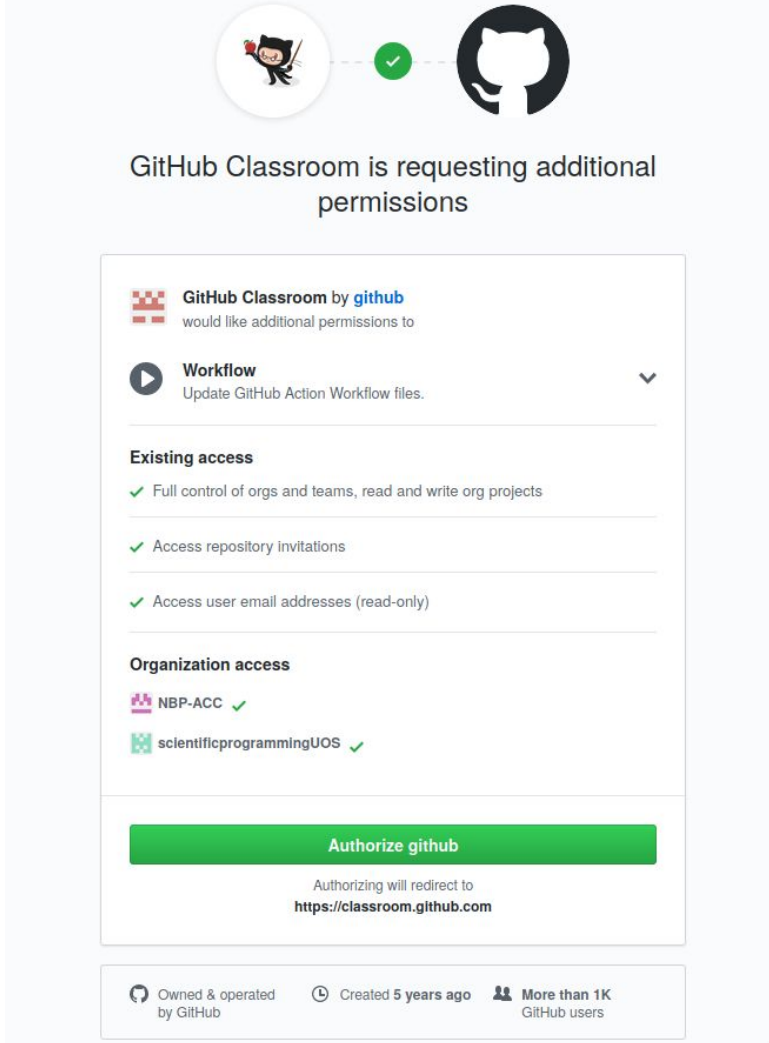


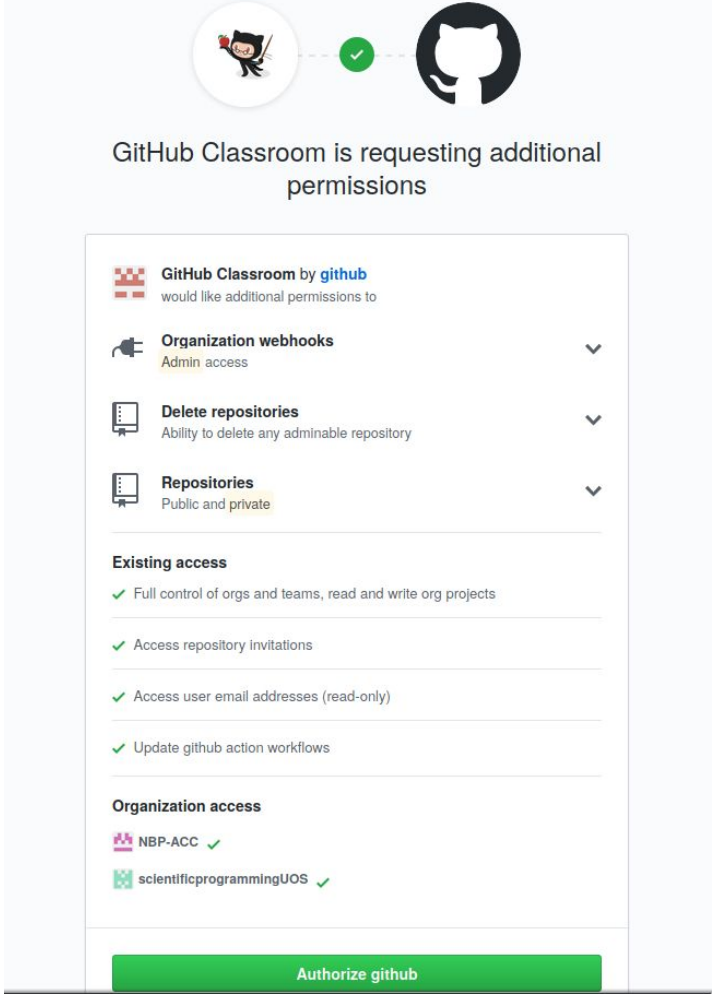
# When there are errors in the homework



# <Screenshots of Presentation>


Sign in to GitHub
to continue to GitHub Classroom
Username or email address
Password
Forgot password?
Sign in
New to GitHub? Create an account.
Terms
Privacy
Security
Contact GitHub


GitHub Classroom is requesting additional permissions
GitHub Classroom by github
would like additional permissions to
Workflow
Update GitHub Action Workflow files.
Existing access
Full control of orgs and teams, read and write org projects
Access repository invitations
Access user email addresses (read-only)
Organization access
NBP-ACC
scientificprogrammingUOS
Authorize github
Authorizing will redirect to
https://classroom.github.com
Owned & operated by GitHub
Created 5 years ago
More than 1K GitHub users

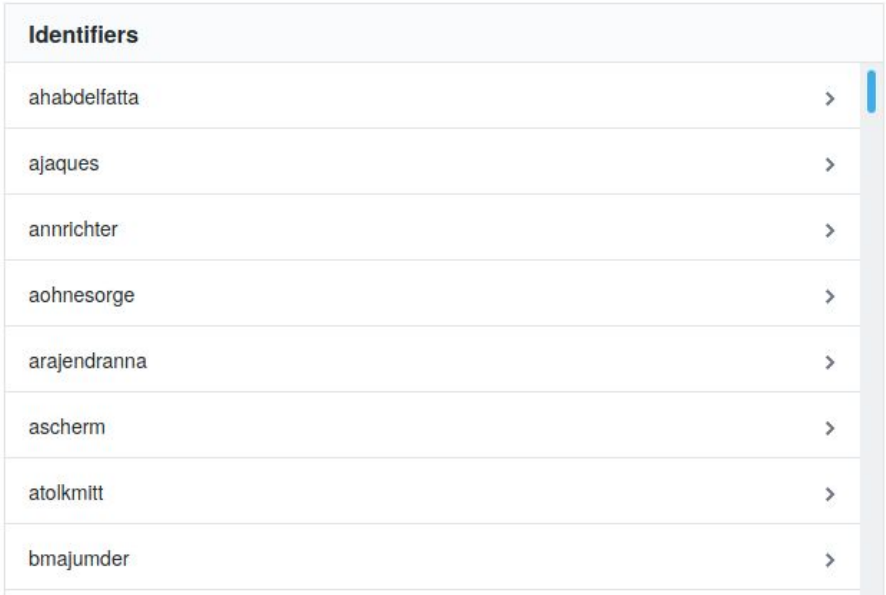

GitHub Classroom is requesting additional permissions
GitHub Classroom by github
would like additional permissions to
Organization webhooks
Admin access
Delete repositories
Ability to delete any adminable repository
Repositories
Public and private
Existing access
Full control of orgs and teams, read and write org projects
Access repository invitations
Access user email addresses (read-only)
Update github action workflows
Organization access
NBP-ACC
scientificprogrammingUOS
Authorize github

## Join the classroom:

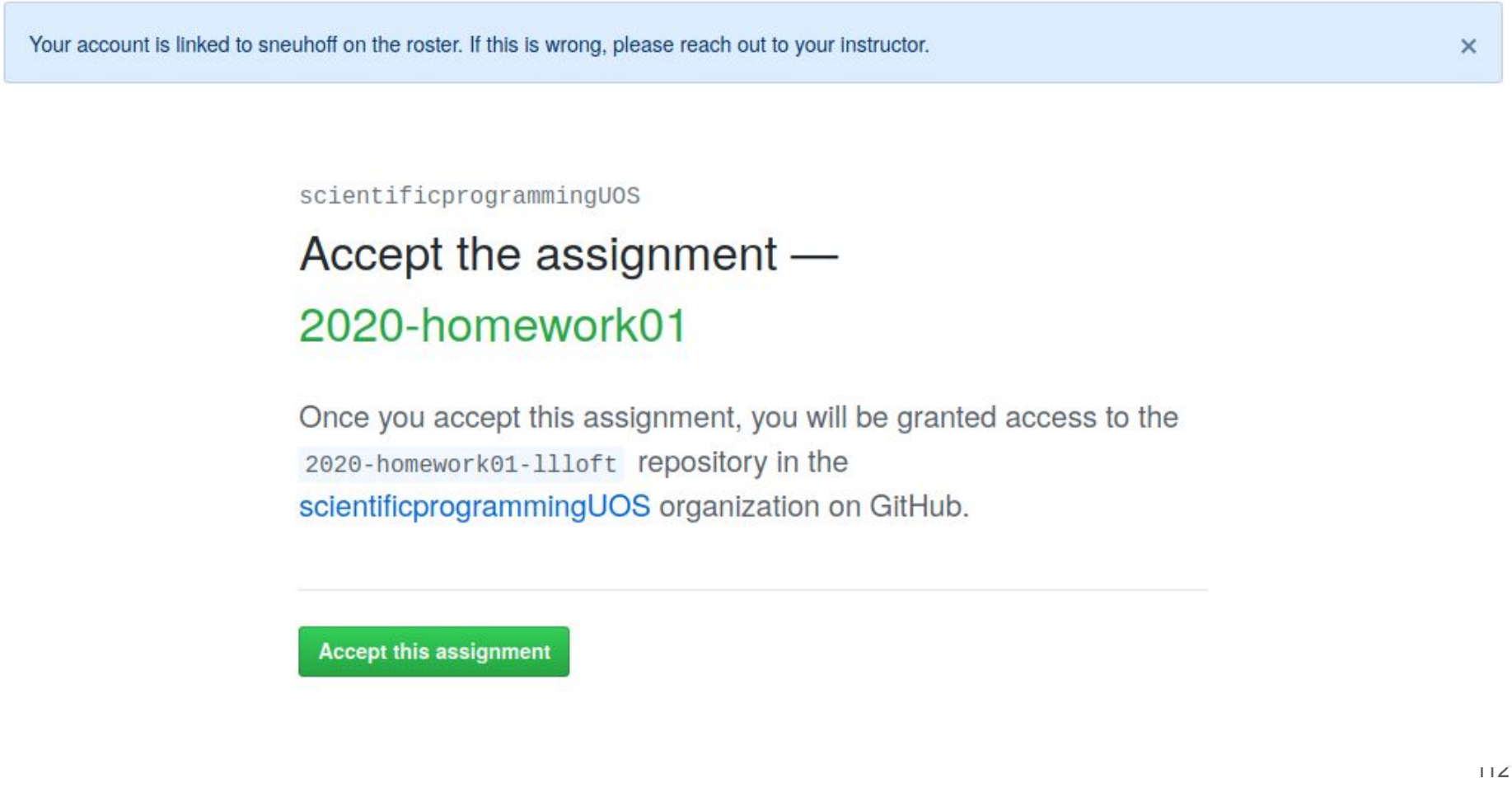
## scientificprogrammingUOS

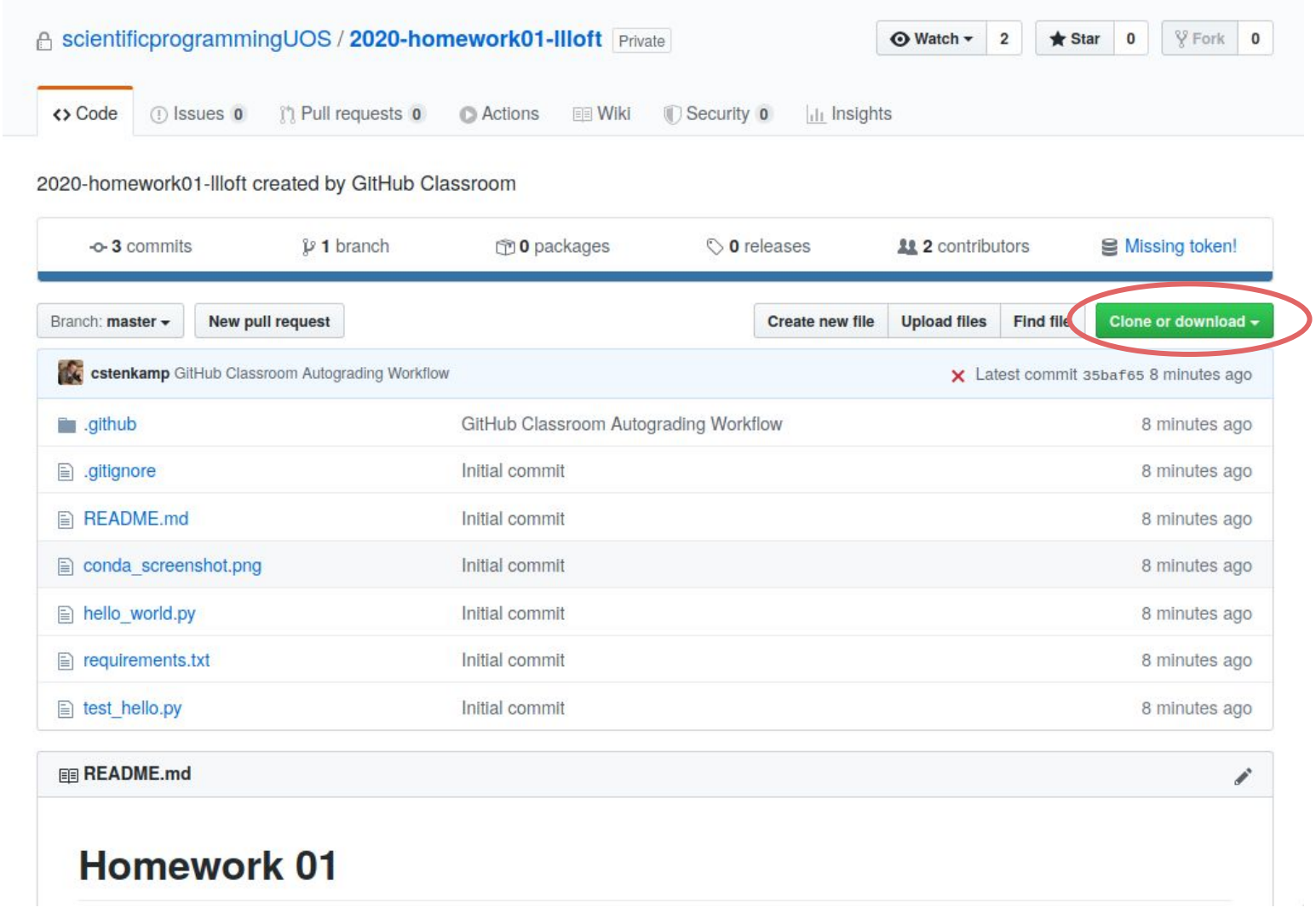
To join the GitHub Classroom for this course, please select yourself from the list below to associate your GitHub account with your school's identifier (i.e., your name, ID, or email).

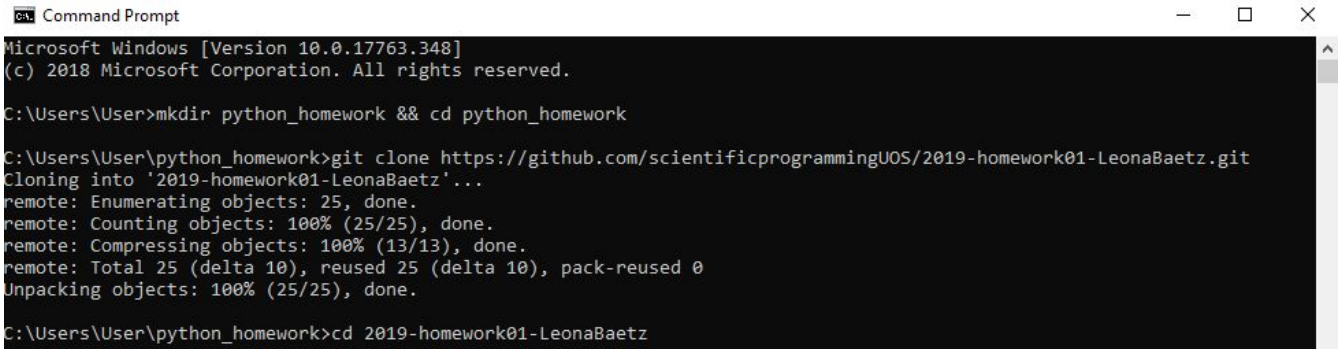
Can't find your name? Skip to the next step →



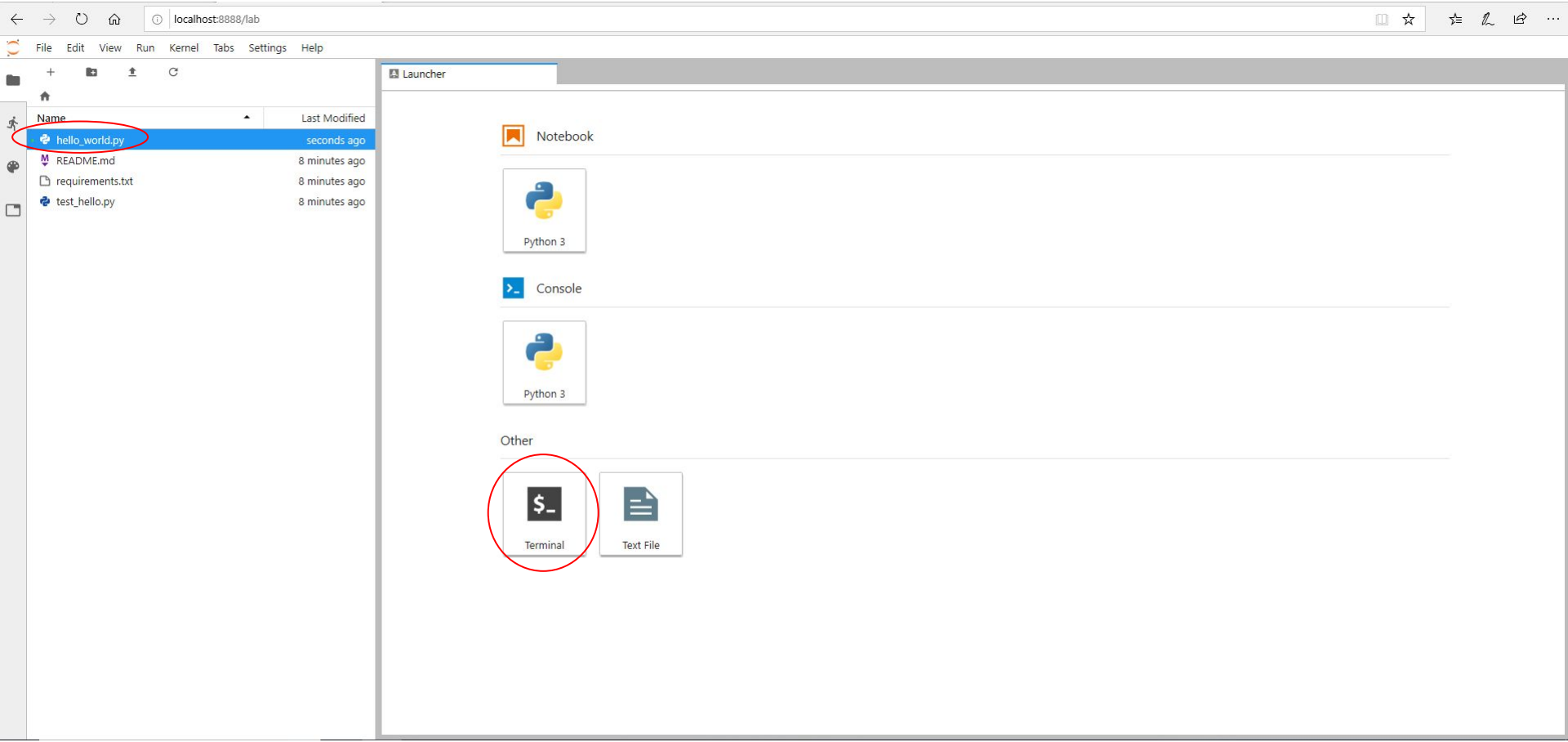

If your RZ-login is not listed here, please write us an email!


Your account is linked to sneuhoff on the roster. If this is wrong, please reach out to your instructor.
scientificprogrammingUOS
Accept the assignment —
2020-homework01
Once you accept this assignment, you will be granted access to the 2020-homework01-llloft repository in the scientificprogrammingUOS organization on GitHub.
Accept this assignment

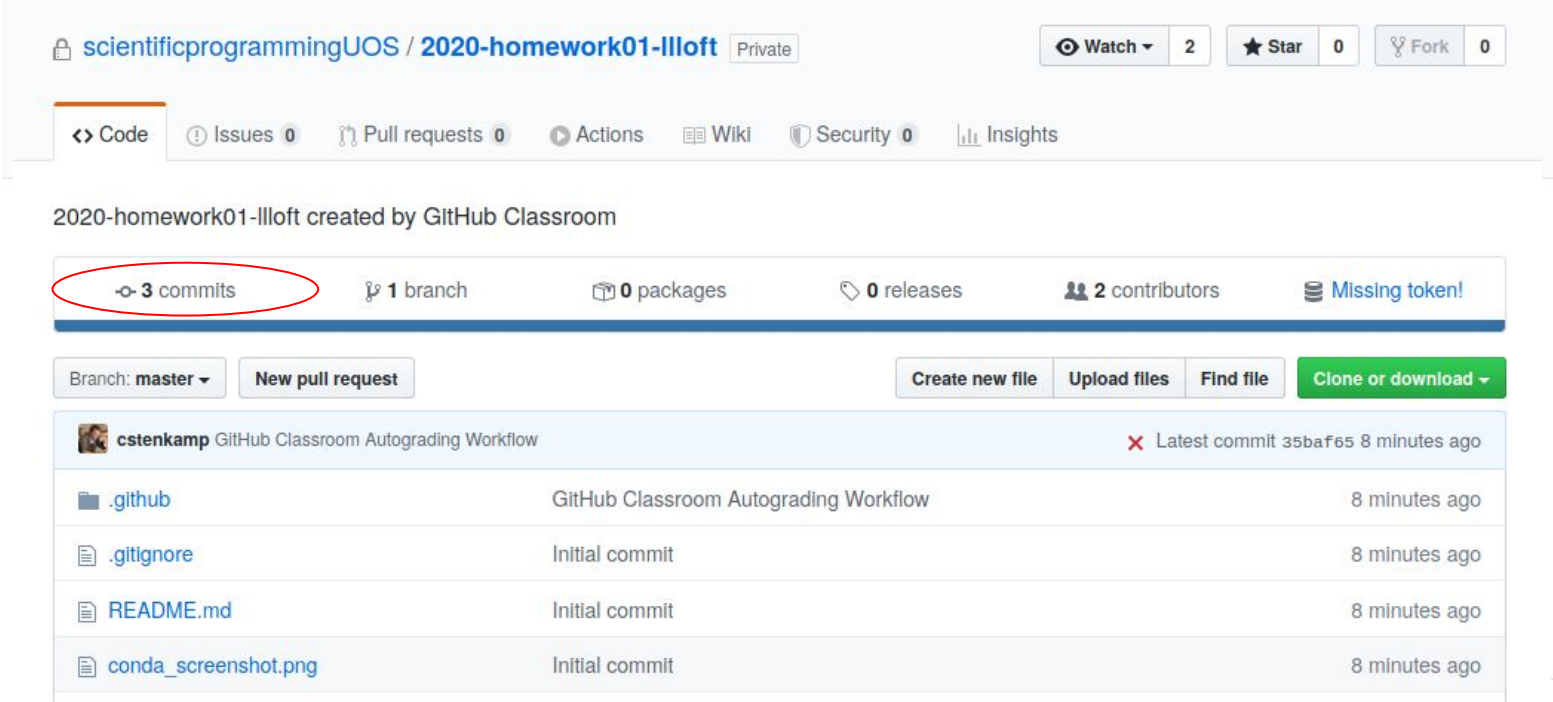

scientificprogrammingUOS / 2020-homework01-llloft
Private
Watch 2
Star 0
Fork 0
Code
Issues 0
Pull requests 0
Actions
Wiki
Security 0
Insights
2020-homework01-llloft created by GitHub Classroom
3 commits
1 branch
0 packages
0 releases
2 contributors
Missing token!
Branch: master
New pull request
Create new file
Upload files
Find file
Clone or download
cstenkamp GitHub Classroom Autograding Workflow
Latest commit 35baf65 8 minutes ago
.github GitHub Classroom Autograding Workflow 8 minutes ago
.gitignore Initial commit 8 minutes ago
README.md Initial commit 8 minutes ago
conda_screenshot.png Initial commit 8 minutes ago
hello_world.py Initial commit 8 minutes ago
requirements.txt Initial commit 8 minutes ago
test_hello.py Initial commit 8 minutes ago
README.md
Homework 01


Command Prompt
Microsoft Windows [Version 10.0.17763.348]
(c) 2018 Microsoft Corporation. All rights reserved.
C:\Users\User>mkdir python_homework && cd python_homework
C:\Users\User\python_homework>git clone https://github.com/scientificprogrammingUOS/2019-homework01-LeonaBaetz.git
Cloning into '2019-homework01-LeonaBaetz'...
remote: Enumerating objects: 25, done.
remote: Counting objects: 100% (25/25), done.
remote: Compressing objects: 100% (13/13), done.
remote: Total 25 (delta 10), reused 25 (delta 10), pack-reused 0
Unpacking objects: 100% (25/25), done.
C:\Users\User\python_homework>cd 2019-homework01-LeonaBaetz

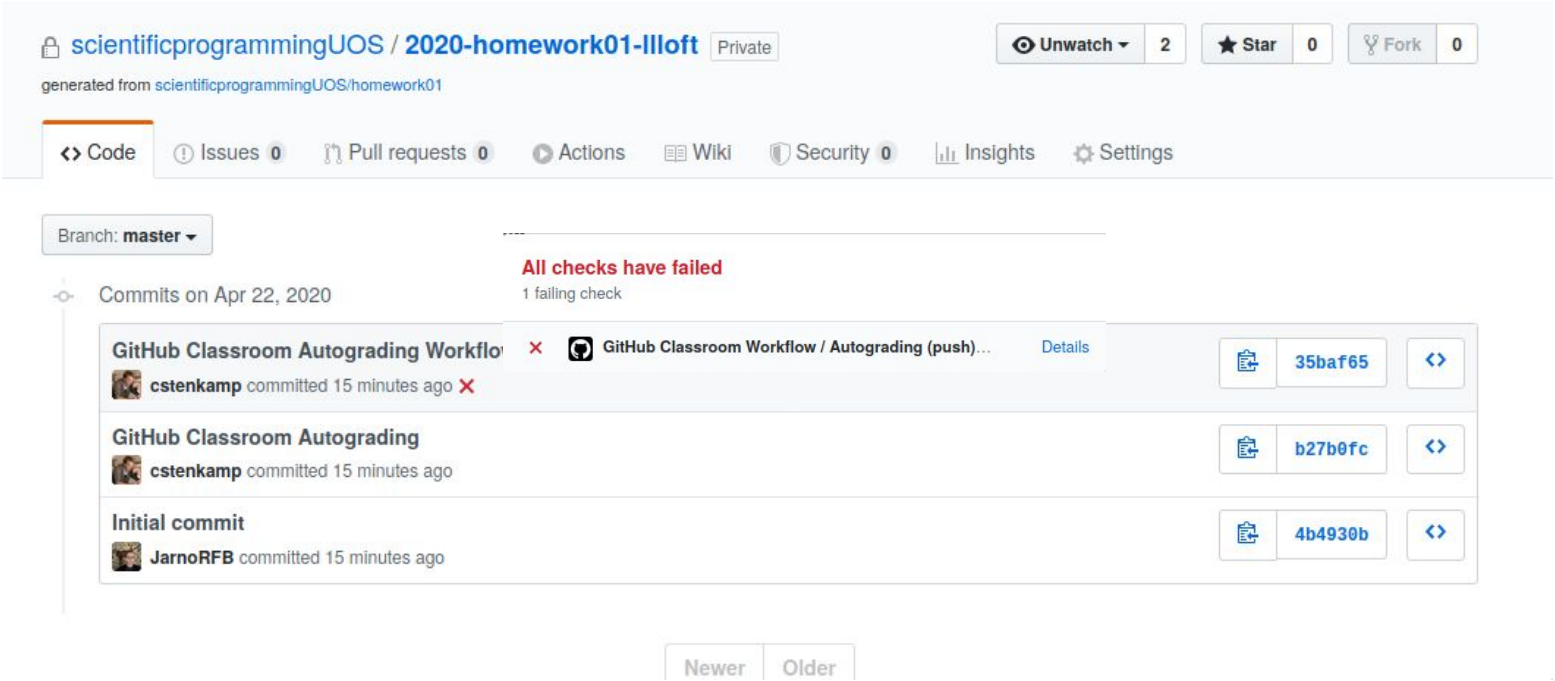
```
C:\Users\User\python_homework\2019-homework01-LeonaBaetz>dir
 Volume in drive C has no label.
 Volume Serial Number is 045F-2CF3

 Directory of C:\Users\User\python_homework\2019-homework01-LeonaBaetz

04/03/2019  11:42 AM    <DIR>          .
04/03/2019  11:42 AM    <DIR>          ..
04/03/2019  11:42 AM             1,339 .gitignore
04/03/2019  11:42 AM               138 .travis.yml
04/03/2019  11:42 AM               346 hello_world.py
04/03/2019  11:42 AM             6,937 README.md
04/03/2019  11:42 AM                15 requirements.txt
04/03/2019  11:42 AM               382 test_hello.py
               6 File(s)          9,157 bytes
               2 Dir(s)  92,013,391,872 bytes free

C:\Users\User\python_homework\2019-homework01-LeonaBaetz>conda activate scientific_programming

(scientific_programming) C:\Users\User\python_homework\2019-homework01-LeonaBaetz>pytest
============================================= test session starts =============================================
platform win32 -- Python 3.7.3, pytest-4.4.0, py-1.8.0, pluggy-0.9.0
rootdir: C:\Users\User\python_homework\2019-homework01-LeonaBaetz
collected 1 item

test_hello.py F                                                                                      [100%]

================================================== FAILURES ===================================================
_____________________________________________ test_say_hello _____________________________________________

    def test_say_hello():
        assert hasattr(hello_world, 'say_hello'), "Your Script must have an 'say_hello'-function!"

        mystdout = StringIO()
        saved_stdout = sys.stdout
        sys.stdout = mystdout
>       hello_world.say_hello()

test_hello.py:11:
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

    def say_hello():
        """Use the print function to say 'hello world'."""
        # once you created your function, you can delete the line below this one.
>       raise NotImplementedError
E       NotImplementedError

hello_world.py:4: NotImplementedError
========================================== 1 failed in 0.11 seconds ===========================================

(scientific_programming) C:\Users\User\python_homework\2019-homework01-LeonaBaetz>
```

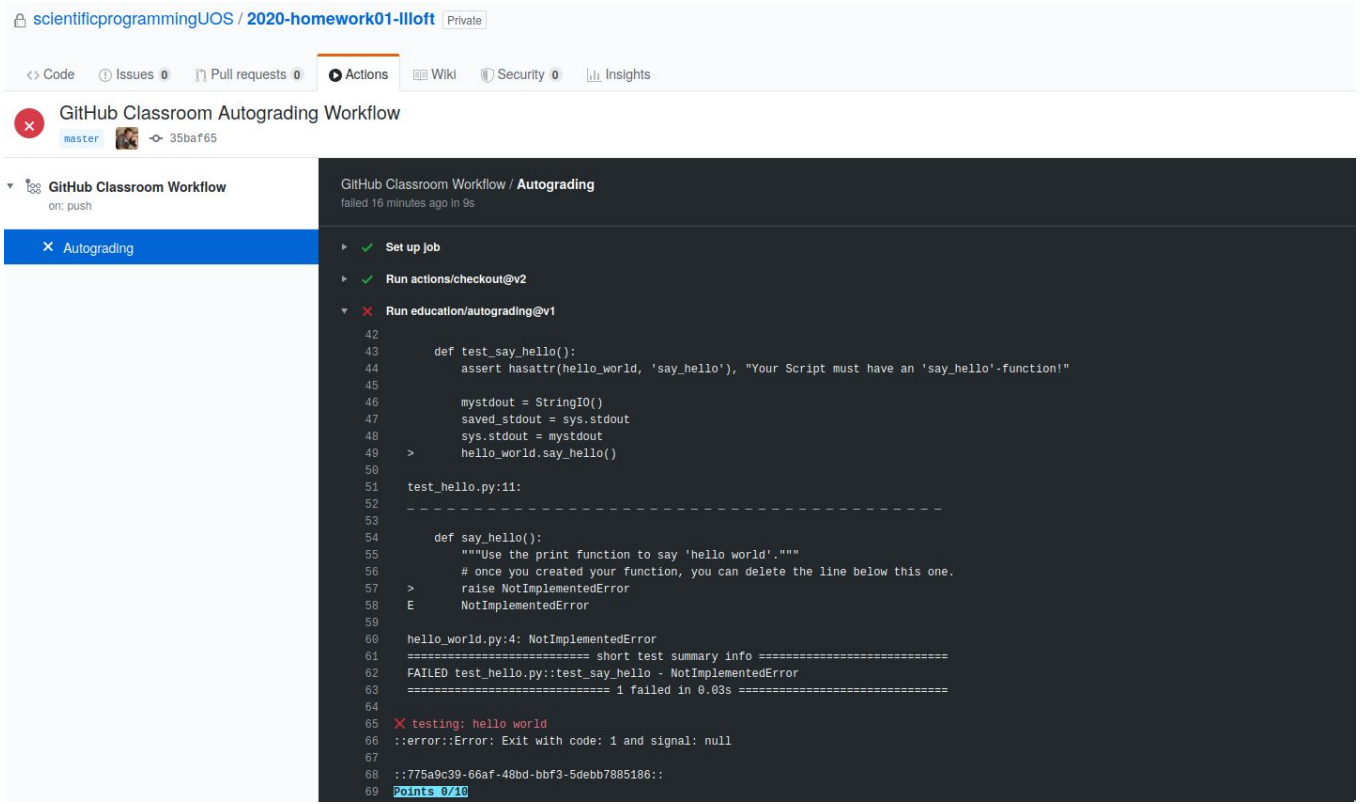

localhost:8888/lab
File Edit View Run Kernel Tabs Settings Help
Name
Last Modified
hello_world.py
seconds ago
README.md
8 minutes ago
requirements.txt
8 minutes ago
test_hello.py
8 minutes ago
Launcher
Notebook
Python 3
Console
Python 3
Other
Terminal
Text File

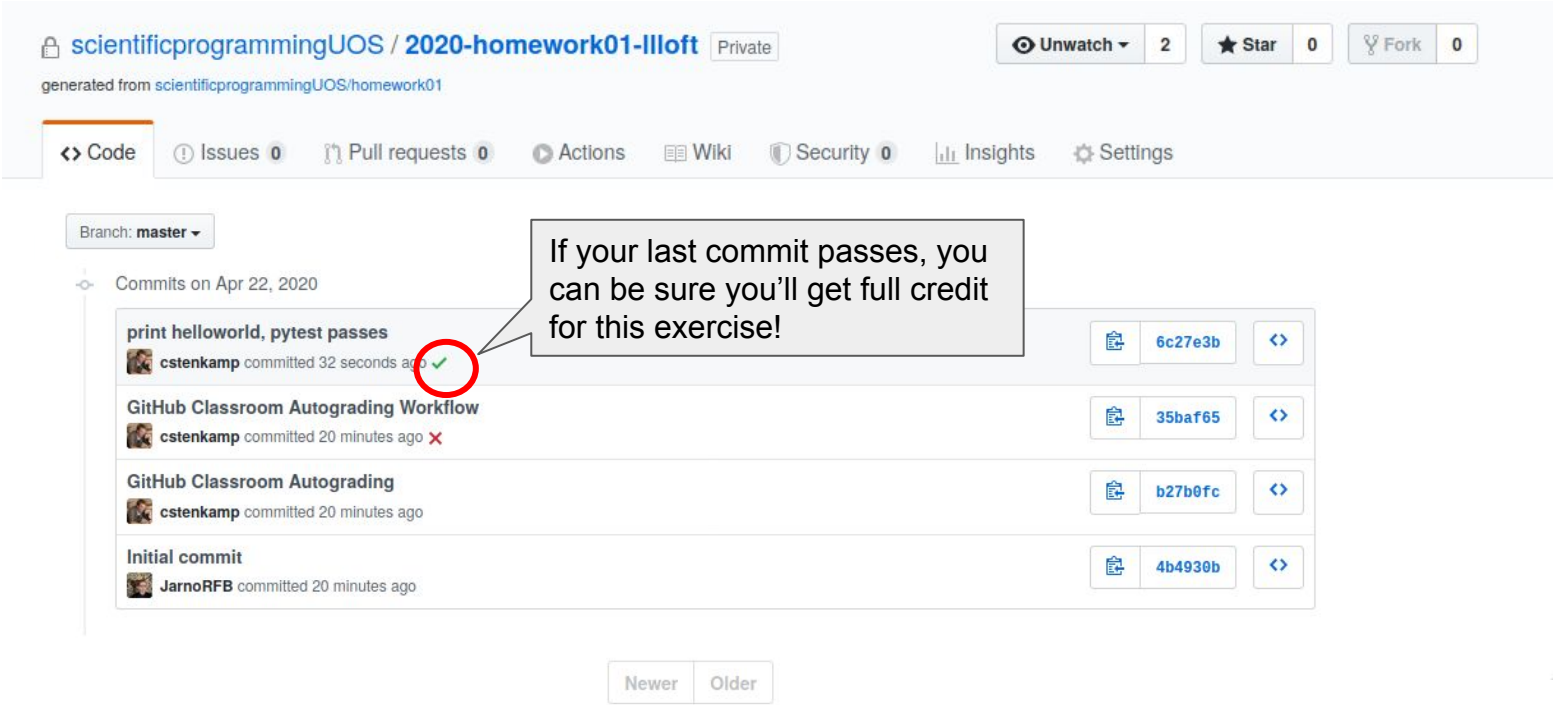
- `git config --get remote.origin.url` tells you the domain of your remote repository



- `git config --get remote.origin.url` tells you the domain of your remote repository




scientificprogrammingUOS / 2020-homework01-lloft
Private
Code
Issues 0
Pull requests 0
Actions
Wiki
Security 0
Insights
GitHub Classroom Autograding Workflow
master
35baf65
GitHub Classroom Workflow
on: push
Autograding
GitHub Classroom Workflow / Autograding
failed 16 minutes ago in 9s
Set up job
Run actions/checkout@v2
Run education/autograding@v1
42
43 def test_say_hello():
44 assert hasattr(hello_world, 'say_hello'), "Your Script must have an 'say_hello'-function!"
45
46 mystdout = StringIO()
47 saved_stdout = sys.stdout
48 sys.stdout = mystdout
49 > hello_world.say_hello()
50
51 test_hello.py:11:
52 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
53
54 def say_hello():
55 """Use the print function to say 'hello world'."""
56 # once you created your function, you can delete the line below this one.
57 > raise NotImplementedError
58 E NotImplementedError
59
60 hello_world.py:4: NotImplementedError
61 ========================== short test summary info ==========================
62 FAILED test_hello.py::test_say_hello - NotImplementedError
63 ============================== 1 failed in 0.03s ===============================
64
65 testing: hello world
66 ::error::Error: Exit with code: 1 and signal: null
67
68 ::775a9c39-66af-48bd-bbf3-5debb7885186::
69 Points 0/10




If your last commit passes, you can be sure you'll get full credit for this exercise!

# Thanks for your attention!

- Any questions and remarks please via the mentioned means!
- Content-suggestions are always welcome!

Thanks to Rüdiger Busche, Patrick Faion and Brian Lewis for previous iterations of the *Scientific Programming in Python* lecture

# Sources


1. https://commons.wikimedia.org/wiki/File:Python.svg
2. https://pixabay.com/vectors/swiss-army-knife-pocket-knife-blade-154314/
3. https://en.wikipedia.org/wiki/R_(programming_language)
4. https://commons.wikimedia.org/wiki/File:Matlab_Logo.png
5. https://commons.wikimedia.org/wiki/File:Images_200px-ISO_C%2B%2B_Logo_svg.png
6. https://pt.wikipedia.org/wiki/Julia_(linguagem_de_programa%C3%A7%C3%A3o)
7. https://commons.wikimedia.org/wiki/File:Git_icon.svg
8. https://farm2.staticflickr.com/1482/24588096069_59a0513790_z.jpg