Institute of Automotive Technology
Faculty for Mechanical Engineering
Technical University of Munich

Autonomous Driving Software Engineering

Prof. Dr.-Ing. Markus Lienkamp

Dipl. Ing. Nico Uhlemann

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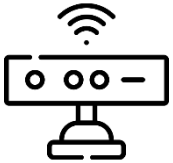

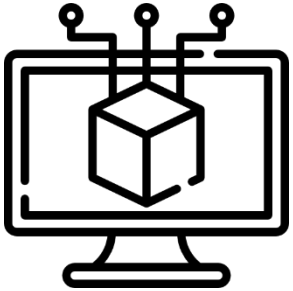

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Agenda

1. Introduction
2. Homework
3. Programming Environment
4. System Setup
5. Working on your weekly homework

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Practice – General Information

Idea

- The lecture's focus is on software. Software means coding and coding requires experience and practice.
- The lectures give the overview about the applied algorithm and software methods, the practice sessions show the application.

Procedure of the practice sessions

- Practical coding examples will be presented
- The idea is that you get a practical insight to specific algorithms and software modules
- The practice sessions are interactive, so you are invited to ask questions and discuss the presented software
- Additionally, there will be a weekly homework you can do on your own at home (1 week time)

Practice and Homework – Coding Skills

WARNING

We are doing coding tutorials and coding tests in this lecture which are based on Python3 programming.

Knowing how the Python3 syntax works is a prerequisite of this lecture.

If you do not have Python3 experience, please do this free tutorial, where you can learn the syntax:

Online Tutorial: https://www.learnpython.org/

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5. Task submission

General Information

- The homework builds upon the practice sessions, so attendance to the practice sessions is helpful
- Each homework is only available for one week:
  - (this) Tuesday, 0:00 – (next) Tuesday, 23:59
- There is no time limit for each task of the homework within the week
- You can stop a task and restart any time within this week
- You can change your answers as long as the homework is still open
- You can submit your answers and evaluate it on your own to check if everything is correct
- If you do the homework regularly and achieve a score of **50% correct answers** (mean value calculated from each homework) by the end of the semester

  → You will get a bonus on your final grade of **+0.3**

  → Note: The bonus will only be given if you passed the exam regularly, i.e. your exam result has to be 4.0 or better

Framework Information

- The homework consists of small coding tests you need to solve
- You can access the homework on the lecture's website: https://adse.ftm.ed.tum.de/
- We are using CodeFREAK to provide the task and for you to submit your results
- To work on the task we recommend to use PyCharm + Anaconda
- We use **Python3.8** for all coding tasks
- The in- and output of each tasks are described within the homework. Please read the description properly

Honor Code Rules

Rule 1
Prior to each submission, it must be indicated whether you got assistance for developing the code and who assisted you in the development.

Rule 2
No current program code or solutions to individual problems should be shared with other students.

Rule 3
Solutions must not be uploaded to or shared via the internet.

Rule 4
All students must be able to explain the homework submitted at all times.

Evaluation

- After you submitted the homework, you must run the evaluation on your own
- For each task, there are multiple points to receive:
  - → Each task has a different number of points
  - → Each task will be checked by **Pytest**, an automated **Code Checker**
  - → For some homework, you will get points for your **Code Style**, checked via **Flake8**
  - → The next points are granted when completing the unittests successfully, done via **Pytest**
  - → Your code will be automatically evaluated through these tests, so no manual evaluation will be given. You can check if your code passes the tests a priori.
- After the submission you will see the evaluation of each task separately.

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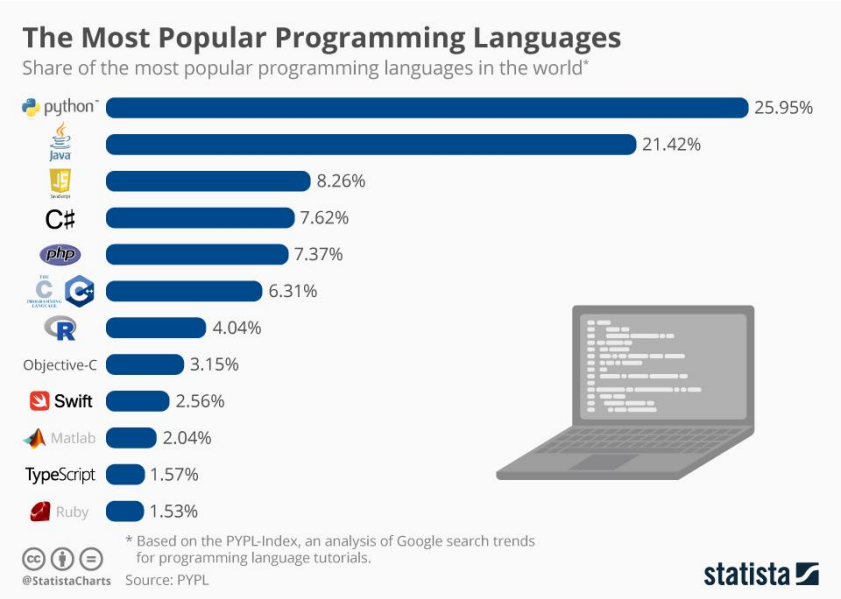
Programming environment

- Homework and practices consist of programming tasks using Python 3.8.
- Being able to code in Python is a prerequisite of this lecture.
- If you don‘t have Python experience, have a look in the following tutorial: https://www.learnpython.org/
- The programming environment consists of: Anaconda, PyCharm, Jupyter Notebook and CodeFREAK.

Why Python?

- Python is an interpreted, high-level, general-purpose programming language.
- Most popular scientific programming language and is open-source
- Used for Deep Learning, Data Science, Rapid Development, etc.



Python Packages

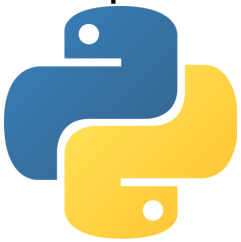
- Python scripts usually start with import commands. You don‘t program everything yourself. It is an open source community!

```python
import numpy as np

list_in = [1, 2, 3, 10.0, 23.3]

# Mean of a list ##
np.mean(list_in)
```

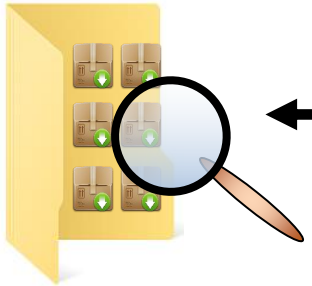
```python
# import packages
import numpy as np
from joblib import load, dump
from sklearn.model_selection import train_test_split, ParameterSampler
from tensorflow.keras.models import load_model
```

Code with imports

Interpreter

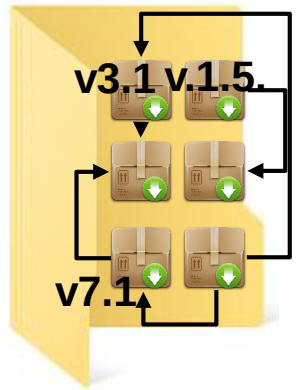


Package directories



Package Management

- Python packages experience constant change (multiple versions).
- Python packages may have interdependencies.
- Package managers (e.g. Anaconda) handle installation, versioning updates, mutual dependencies and even come with an actual interpreter.



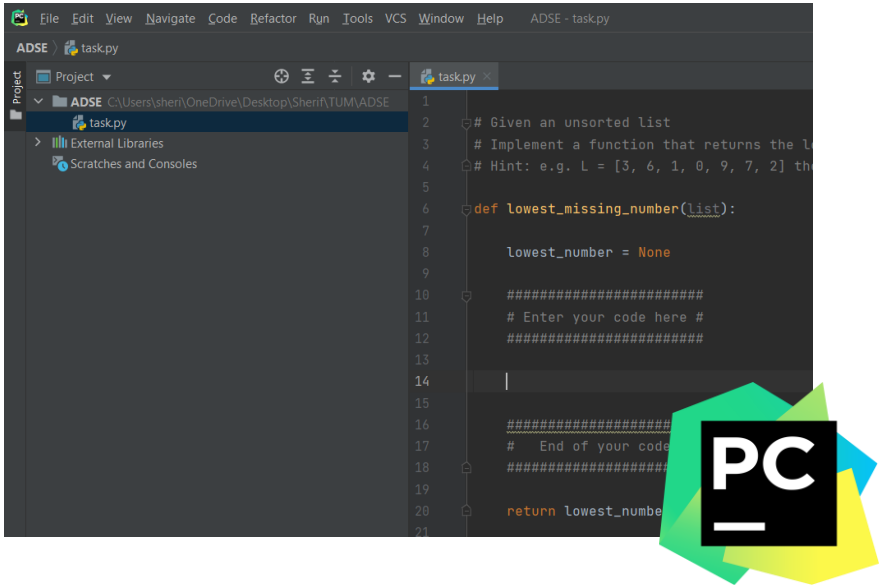
Package Directories

ANACONDA®

Integrated Development Environment (IDE)

- For actual coding in Python you need an editor or an integrated development environment (IDE).
- IDEs include additional functionalities compared to a editor, such as debugging, compiling and many more.

→ PyCharm is, where you code your functions and homework.

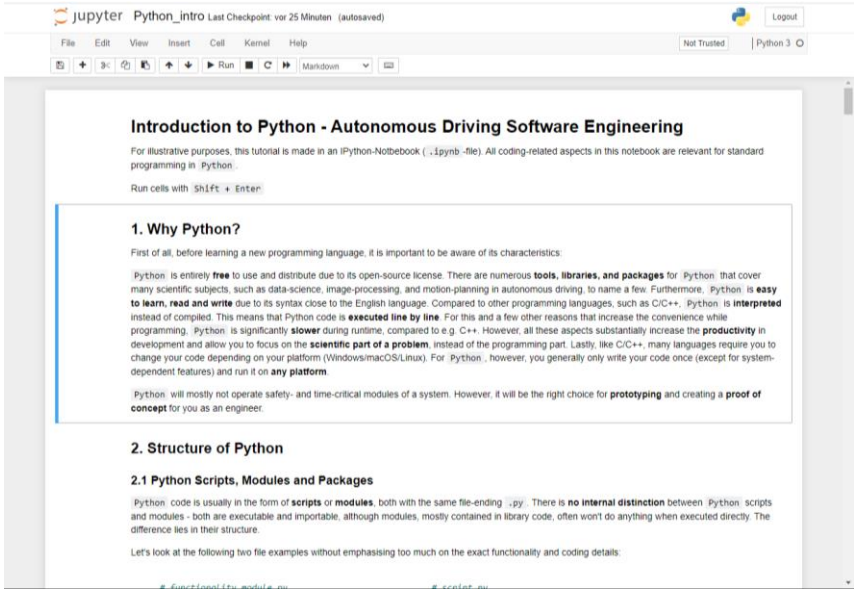


PyCharm IDE

Jupyter Notebook for Practice Sessions

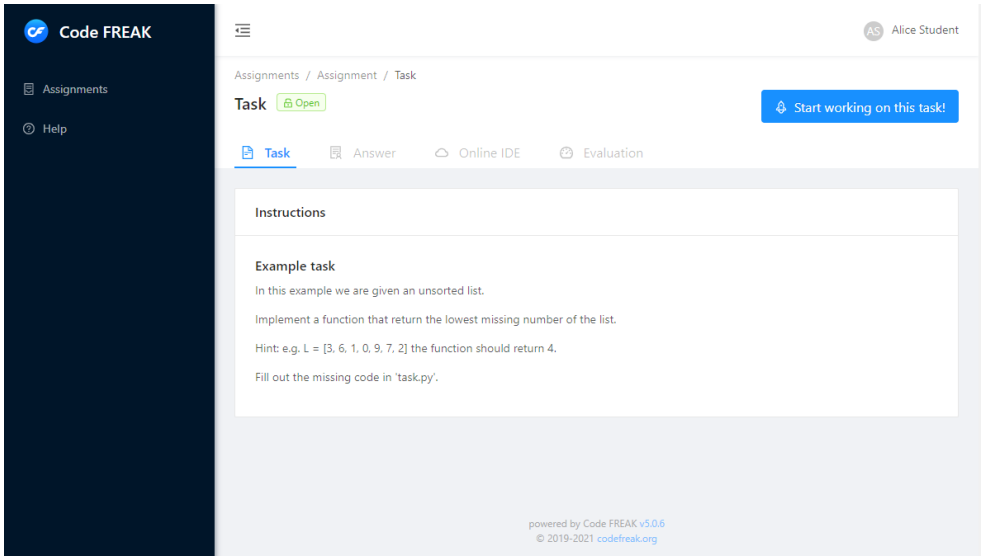
- During the lecture we will show coding examples in Jupyter Notebook

*The **Jupyter Notebook** is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text. **Uses** include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and much more*



Homework

- Idea: Focus on Practice and Coding
- Automated Testing and Evaluation via Code FREAK
- You will get homework, which you can download and submit on a separate domain: https://adse.ftm.ed.tum.de/



Code FREAK task submission page

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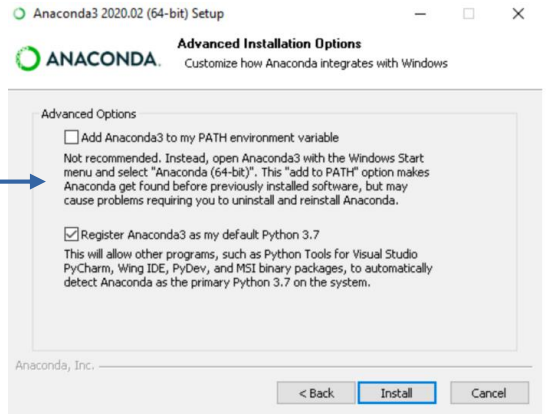
Your task at home

Setting up your system – Anaconda Navigator

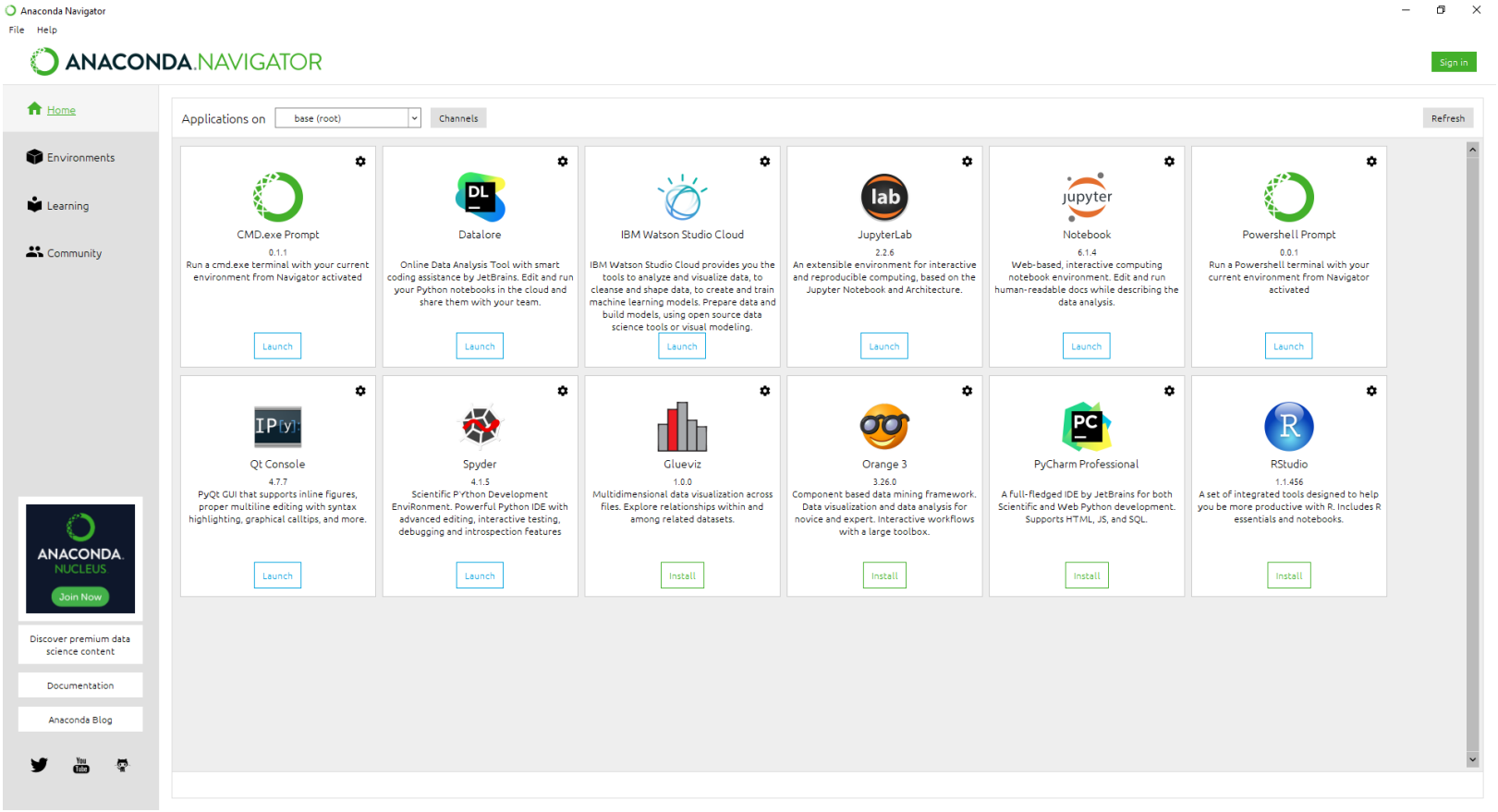
- Anaconda Navigator combines Python (Explicit installation of Python interpreter not needed) with a GUI to setup project environments, to install packages and to launch your IDE.
- Download the most recent version available on the Anaconda homepage: https://www.anaconda.com/products/individual
  - Go to **Download** and select the Python 3.8 version.
  - After the download, start the installation, for further information: https://docs.anaconda.com/anaconda/install/

Warning: When installing on Windows, do **not** add Anaconda to the PATH environment.



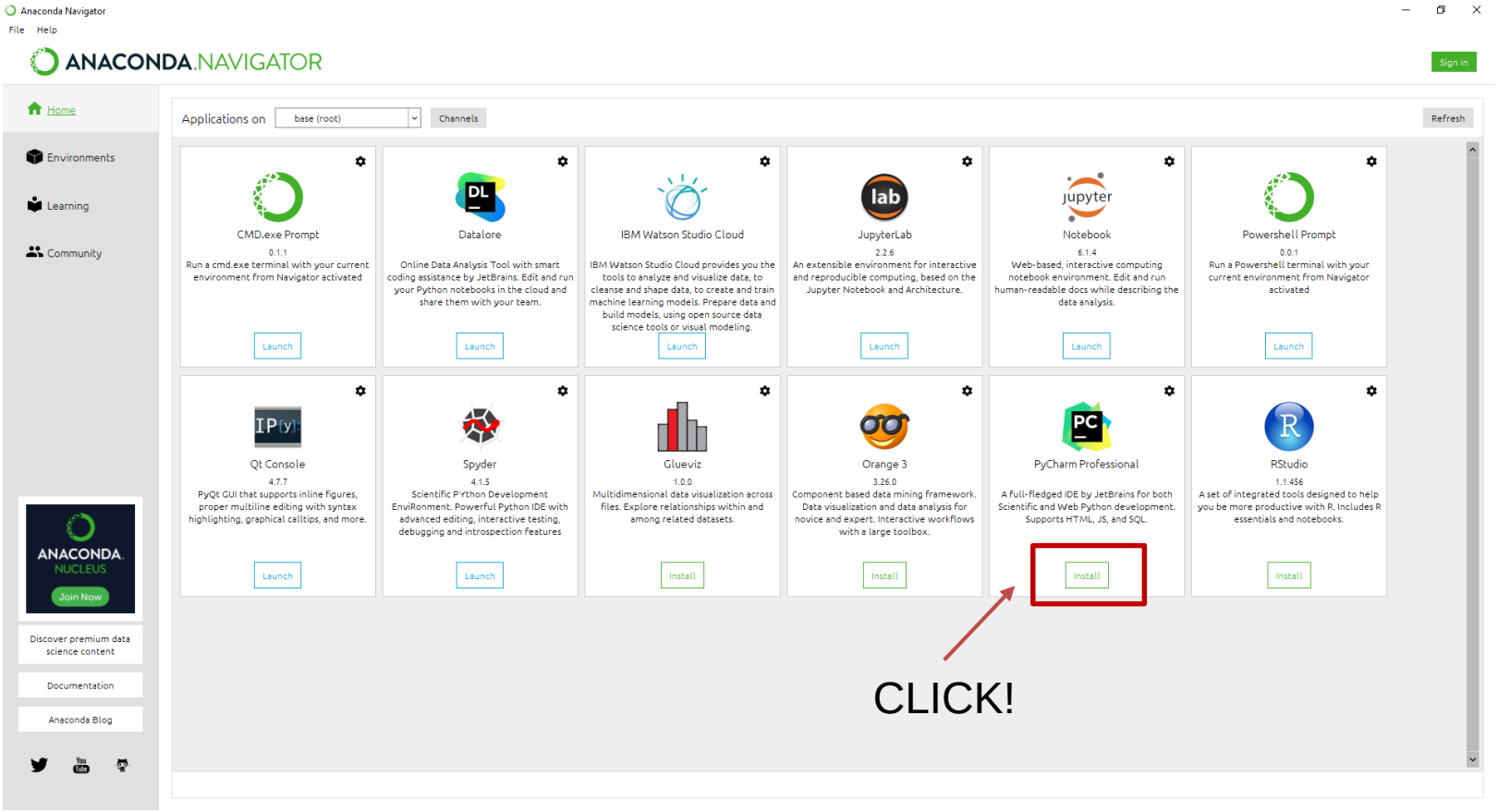
Setting up your system – Anaconda Navigator

- Launch the Anaconda Navigator.



Setting up your system – PyCharm

- Install PyCharm Professional.



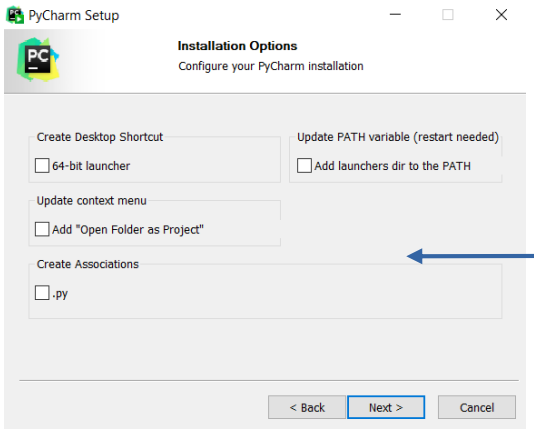
Setting up your system – PyCharm

- Install PyCharm from the Anaconda Navigator.
- Default download is **pro**-version of PyCharm.
  - Free for students but requires registration with your <TUMID>@mytum.de email-address under: https://www.jetbrains.com/shop/eform/students
  - Your mail address is then registered as JB-Account.
- **Alternative**: Chose the community edition which is free from registration at: https://www.jetbrains.com/pycharm/download/

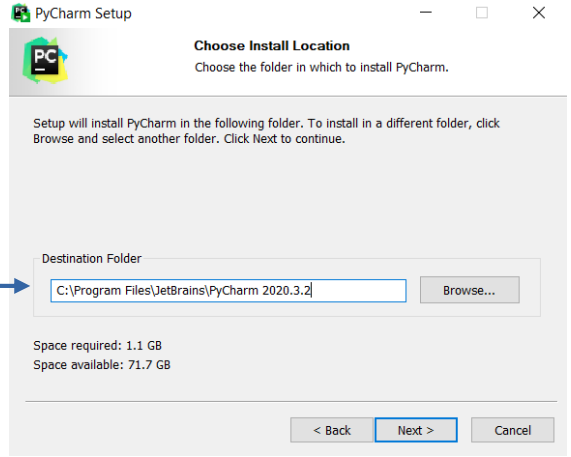
Refresh the Anaconda Navigator. Updates your available applications.

Setting up your system – PyCharm

Pro / Community edition steps:

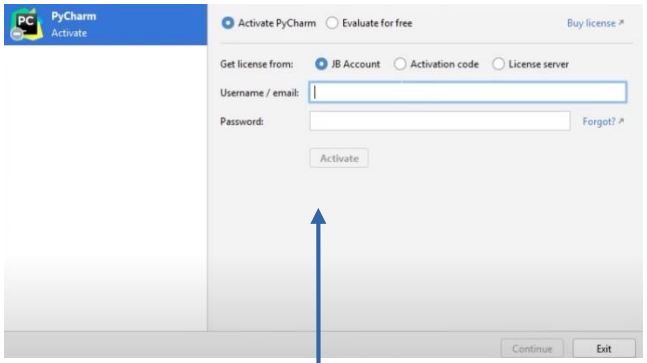


Nothing to select, as we will always launch PyCharm from the Anaconda Navigator.



Don’t change path. Otherwise Anaconda might have trouble finding PyCharm.

Additional step for PyCharm pro:



Activate PyCharm with your TUM mail adress after registration.

Setting up your system – Folder structure

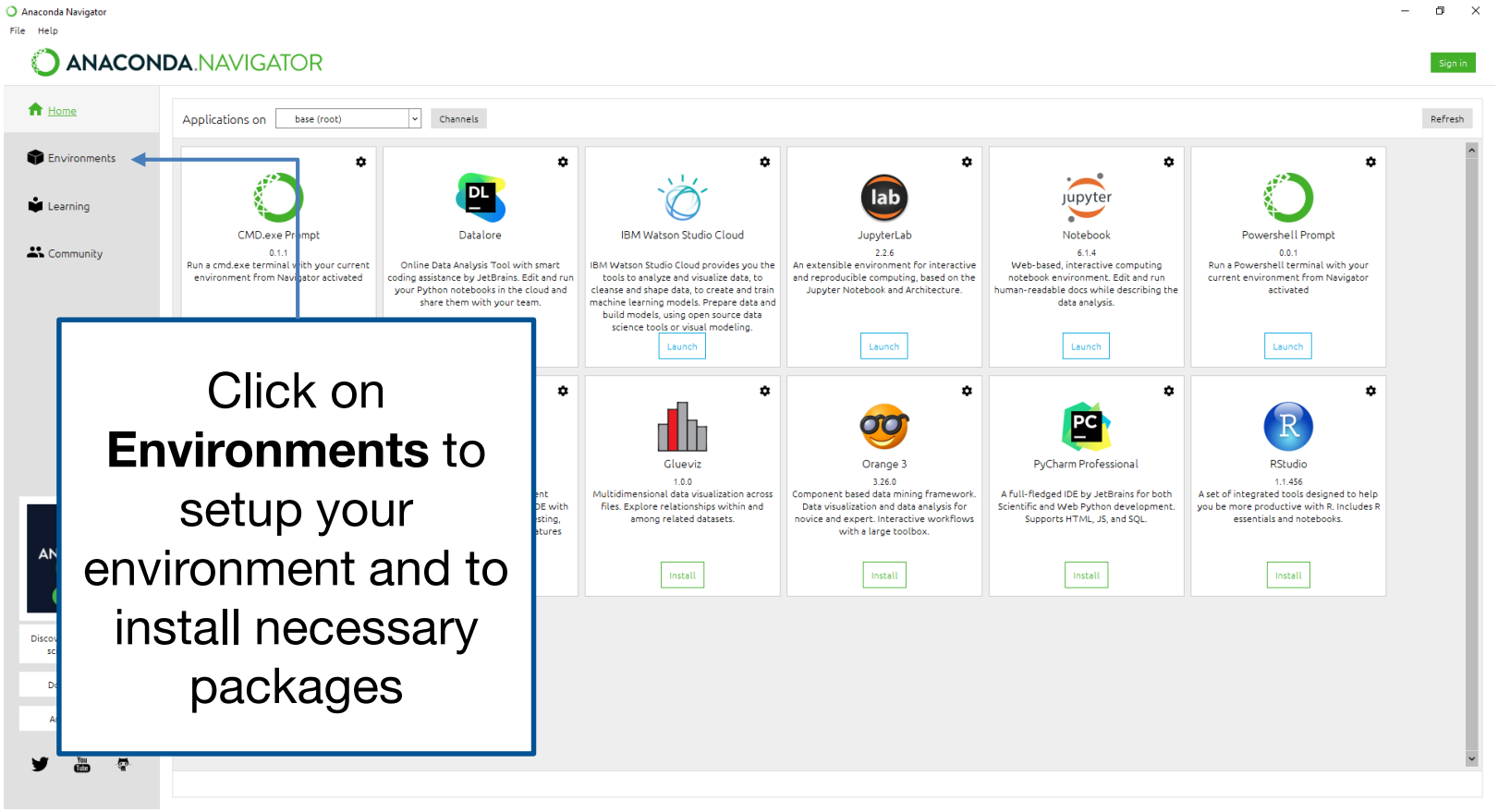
To keep the overview about your weekly homework, we recommend a folder structure, which looks like this:

```
C:\Users\<username>\source\ADSE_2023
    python_intro
        python_intro.ipynb
        <Here your can place the Repetitorium>
    homework_01
        <Here you can create your weekly PyCharm Projects>
        task1
            task1.py

            …
        task2
            …
    homework_02
        task1
            …
```

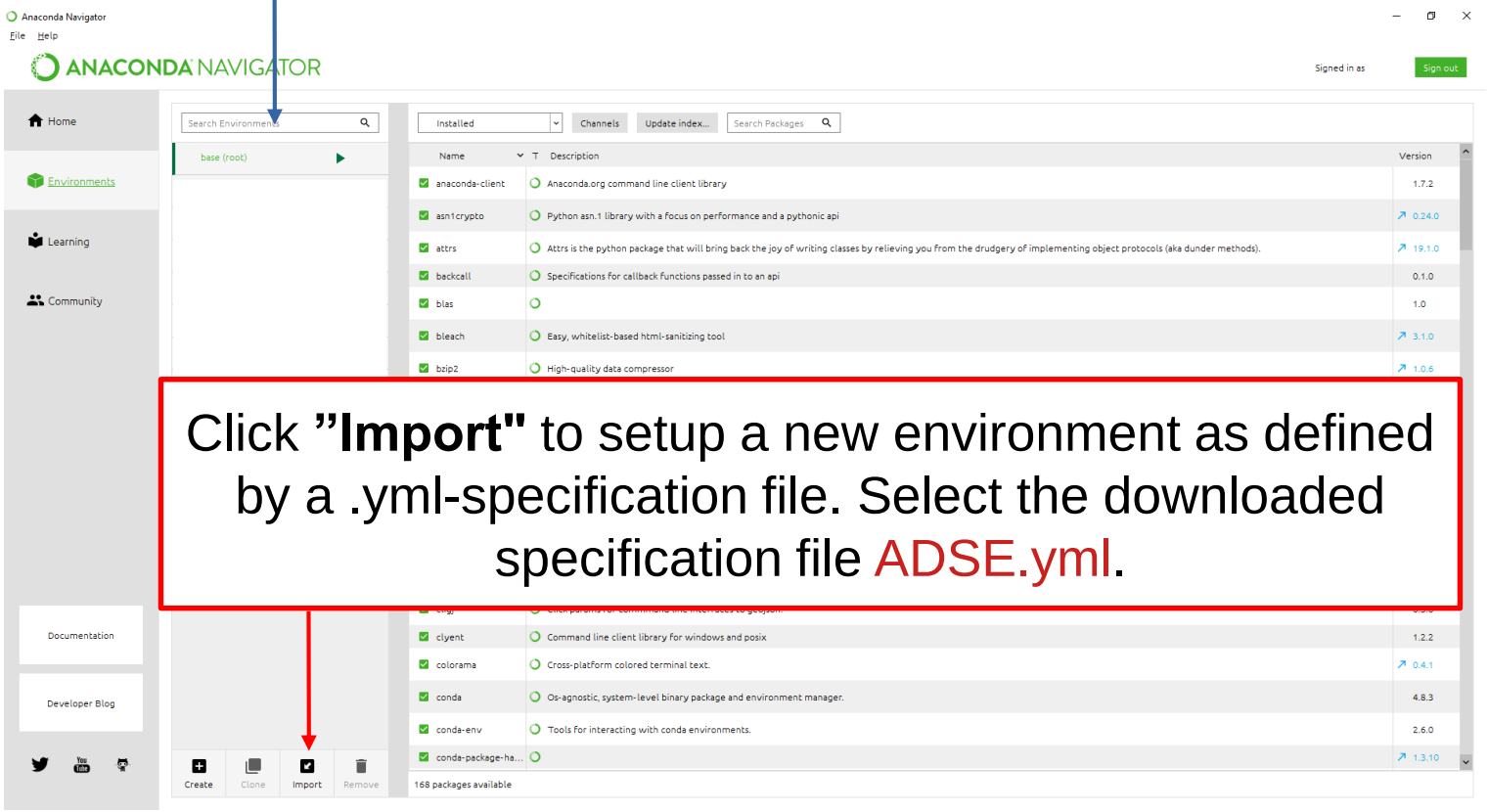
Setting up your system – Environment

- Return to the Anaconda navigator and navigate to the environments section.



Setting up your system – Environment

The "base" environment is available after the installation of Anaconda containing commonly used python packages.



Click **"Import"** to setup a new environment as defined by a .yml-specification file. Select the downloaded specification file ADSE.yml.

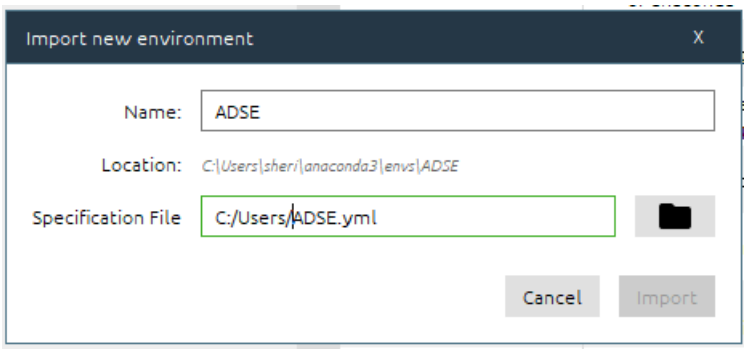
Setting up your system – Environment

- The necessary specification file can be downloaded from our Moodle course and looks as follows:

ADSE.yml

```yaml
name: ADSE
channels:
  - conda-forge
  - defaults
dependencies:
  - python=3.8
  - numpy=1.18.1
  - matplotlib=3.2.1
  - opencv=4.2.0
  - moviepy=1.0.1
  - scikit-learn=0.22.2
  - scikit-image=0.16.2
  - ipywidgets=7.5.1
  - folium=0.10.1
  - pandas=1.0.3
  - shapely=1.7.0
  - geopy=1.21.0
  - haversine=2.2.0
  - tensorflow=1.13.1
```

Required dependencies are listed with their package versions

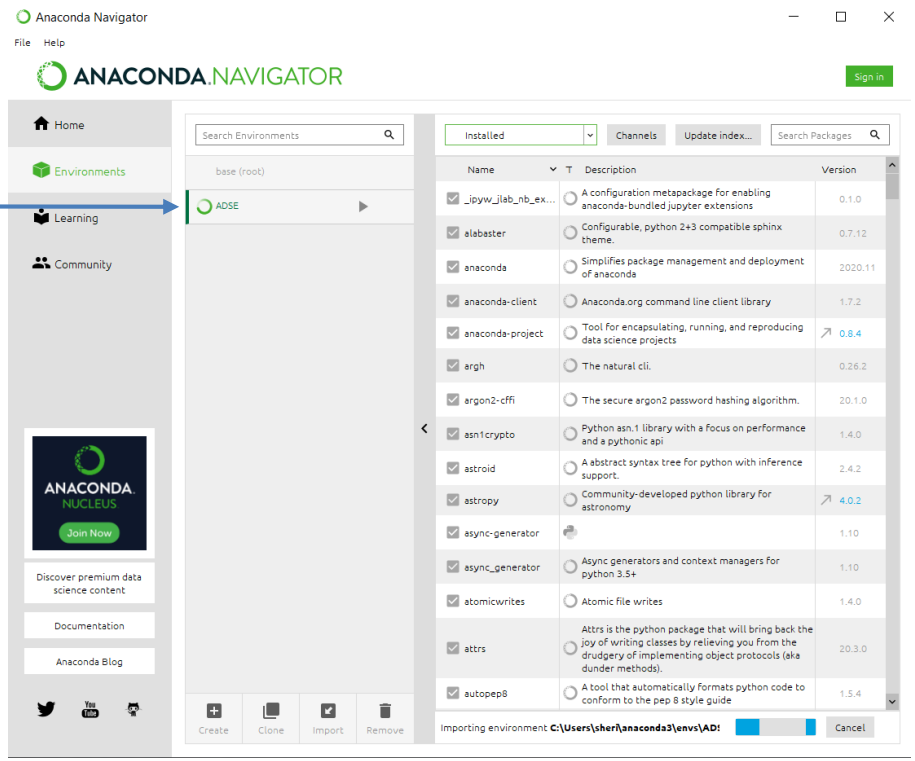


Select the downloaded specification file named ADSE.yml

Setting up your system – Environment

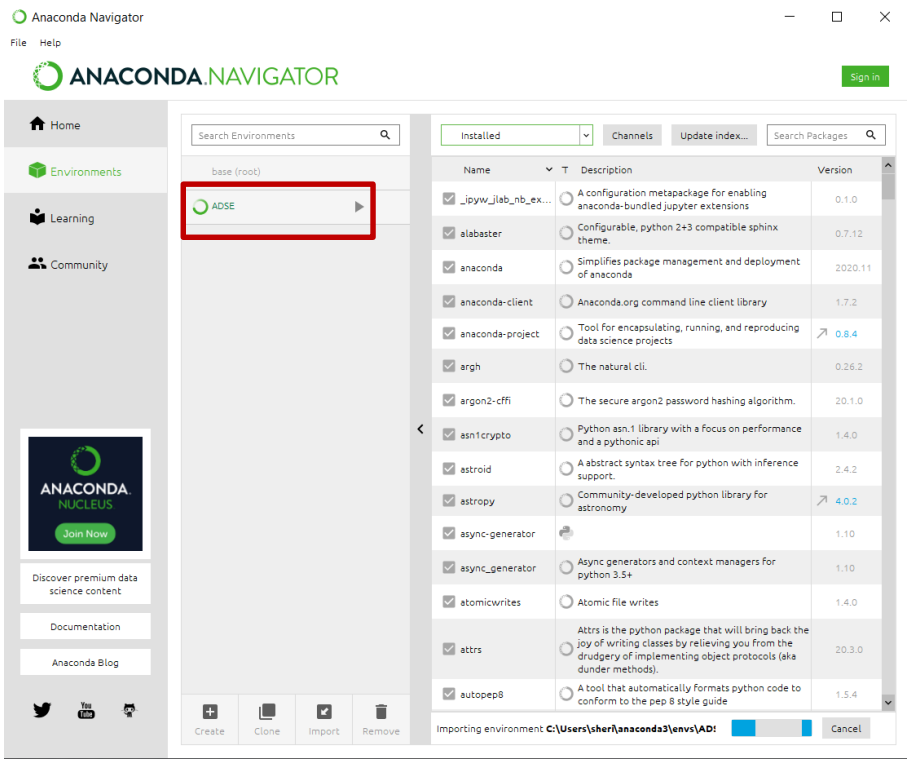
- The installation process takes some time because several packages need to be downloaded and installed.

There is a new button available after the setup of a new environment.



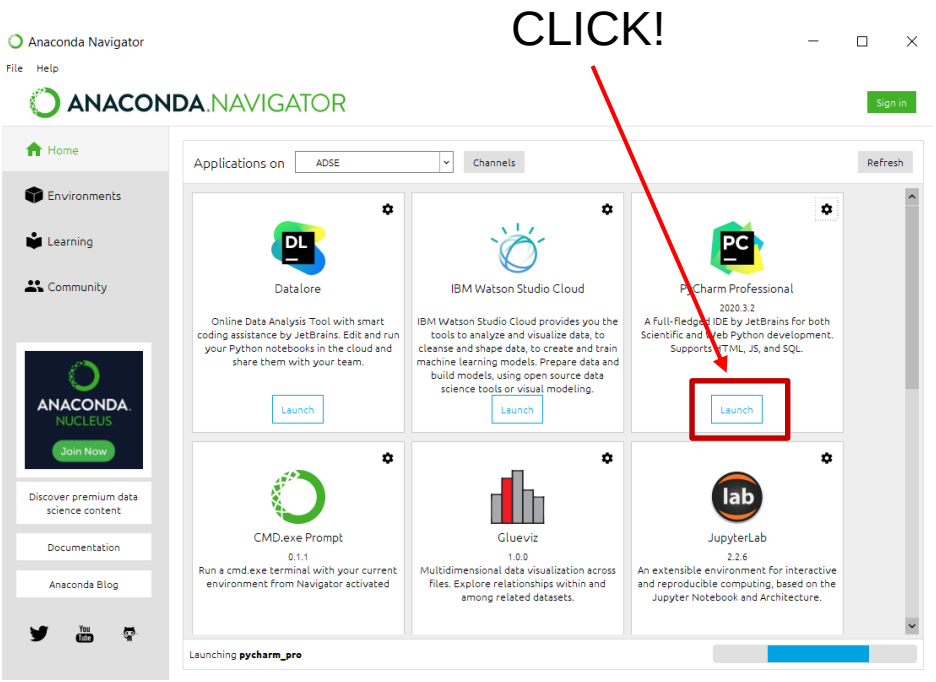
Setting up your system – Environment

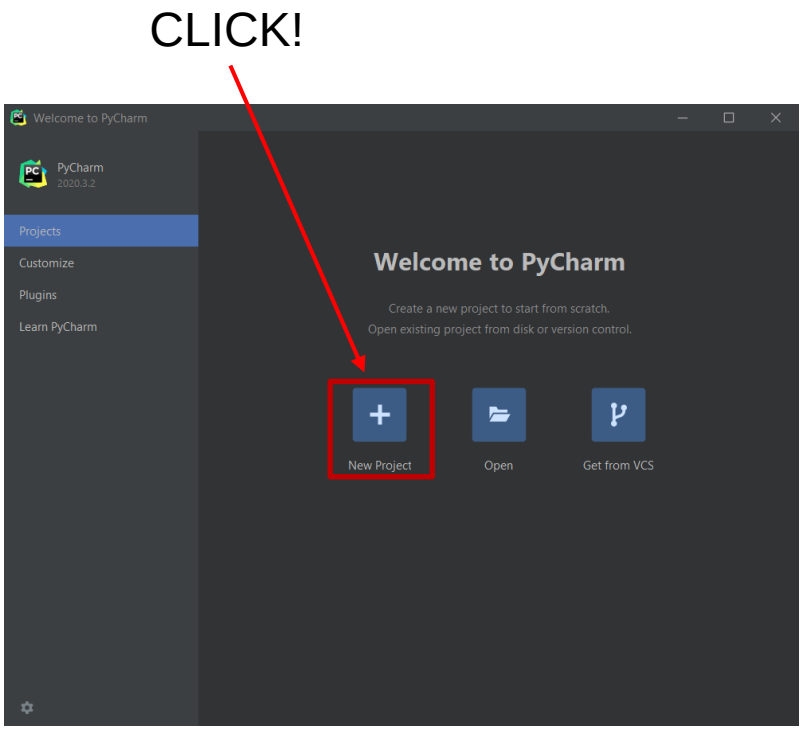
- Click on the button “ADSE” (name of the environment) to activate this course’s environment.



Setting up your system – Environment

- Launch PyCharm and begin with a new project.

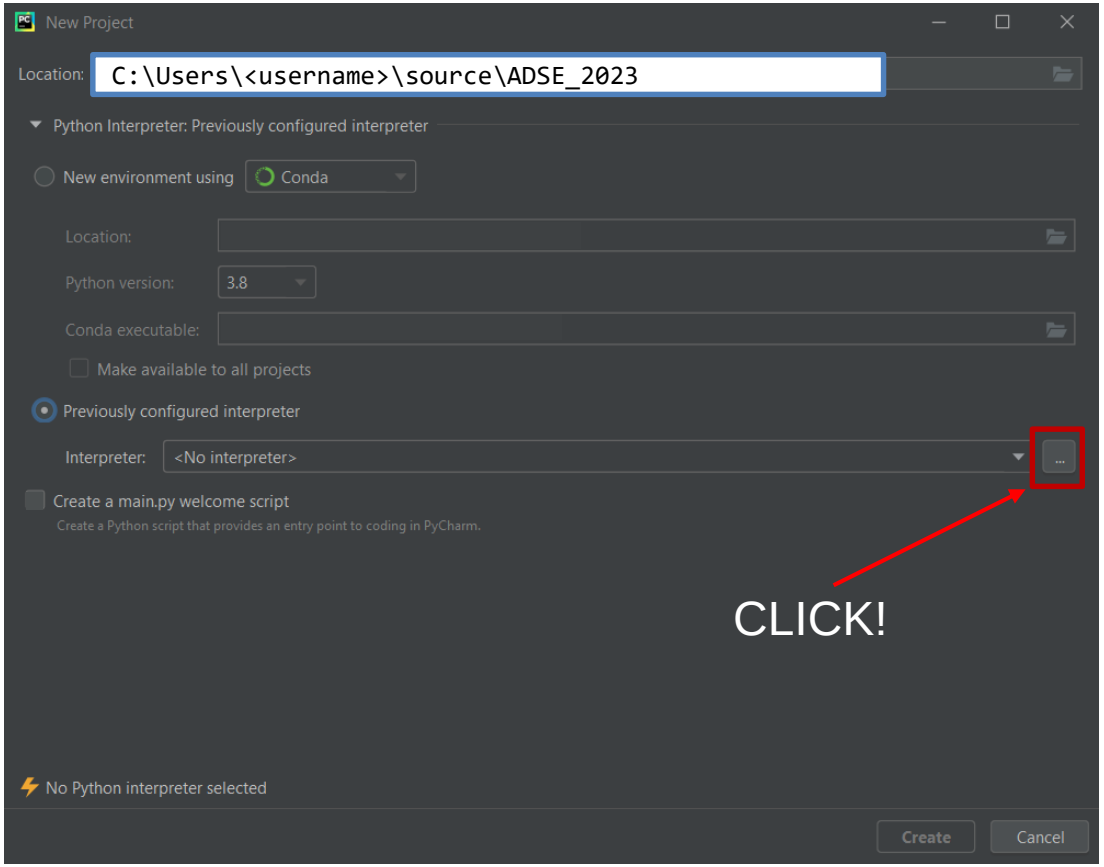




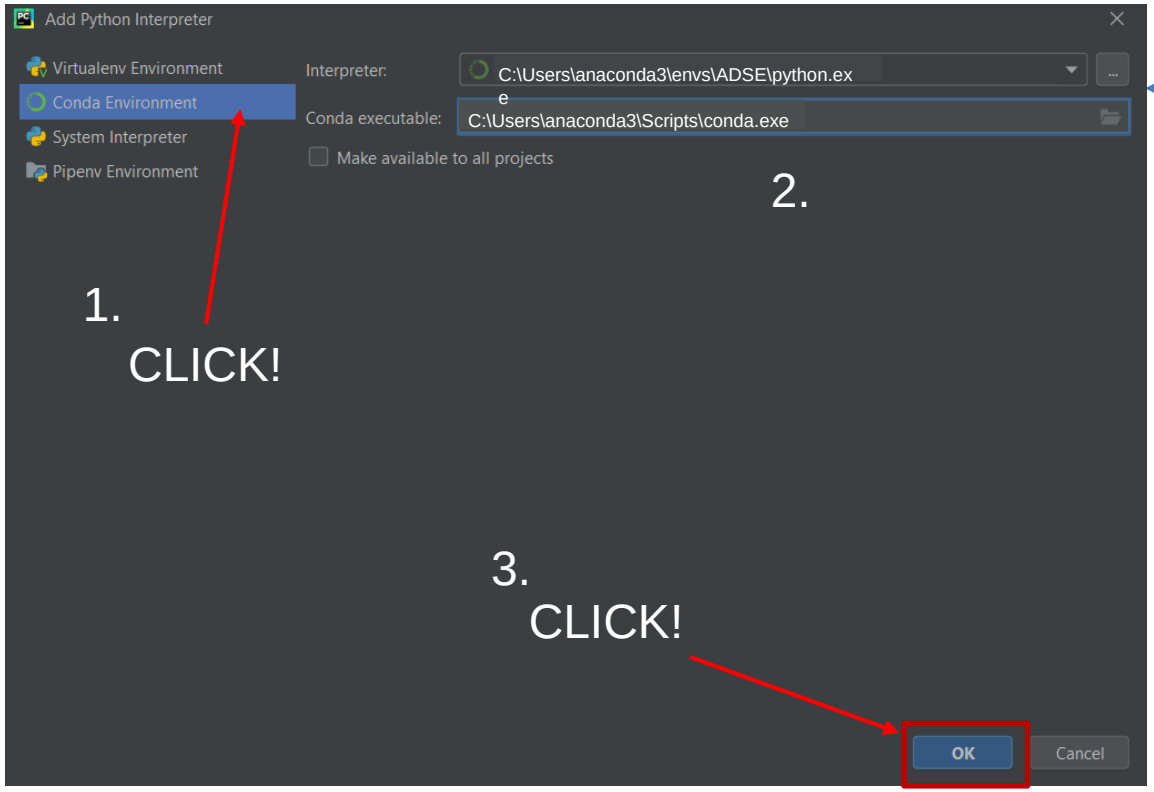
Setting up your system – Environment

The new project should be at the location of the weekly homework, **see Slide 1-25**.

Important: Instead of generating a new environment, we want to use the previously configured environment from Anaconda!

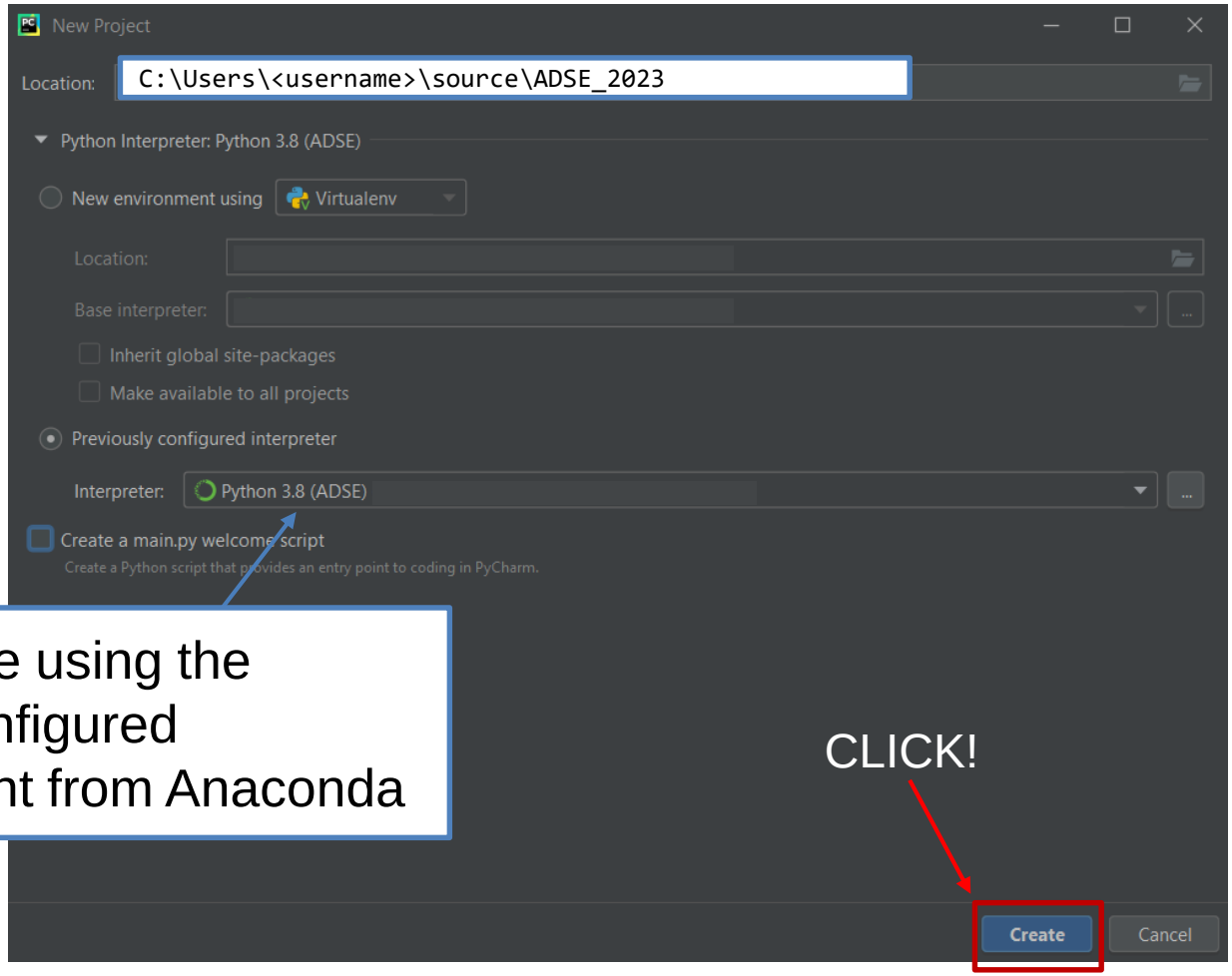


Setting up your system – Environment



Pycharm should automatically choose the correct Conda executable and the interpreter. If not navigate to the according folders as shown. Choose the Choose the python.exe-file in the ADSE Folder.

Setting up your system – Environment

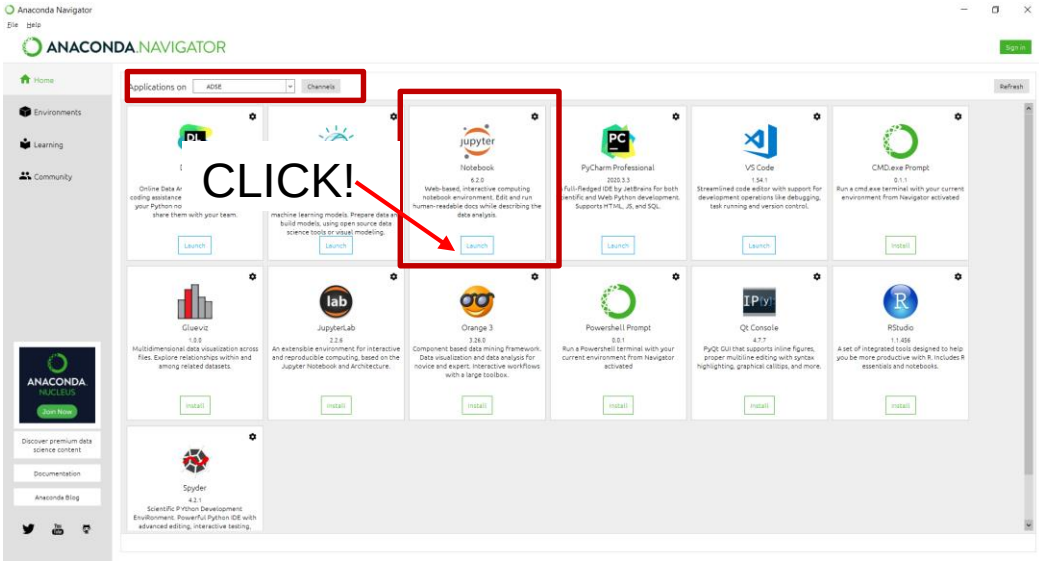


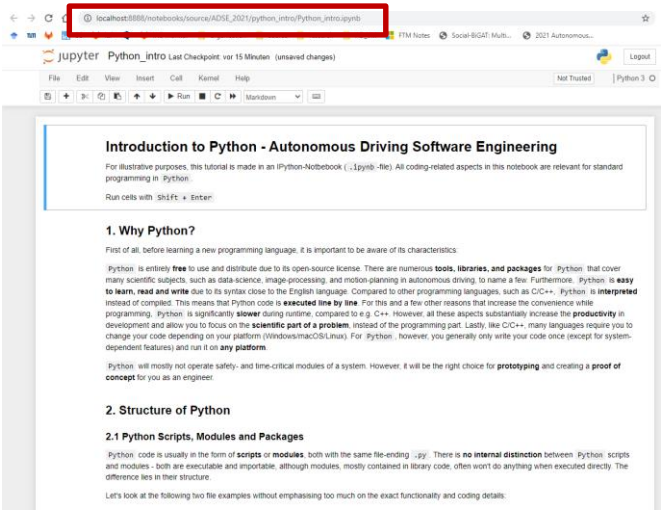
Now we are using the already configured environment from Anaconda

CLICK!

Setting up your system – Jupyter Notebook

- During the practice, we will show Code Examples in Jupyter Notebook. If you want to repeat the practice session on your own at home, you need to start Jupyter Notebook.
- To do so just (*install* &) *launch* Jupyter Notebook within your *ADSE-Environment.*
- Then navigate to the desired directory and run the .ipynb-files





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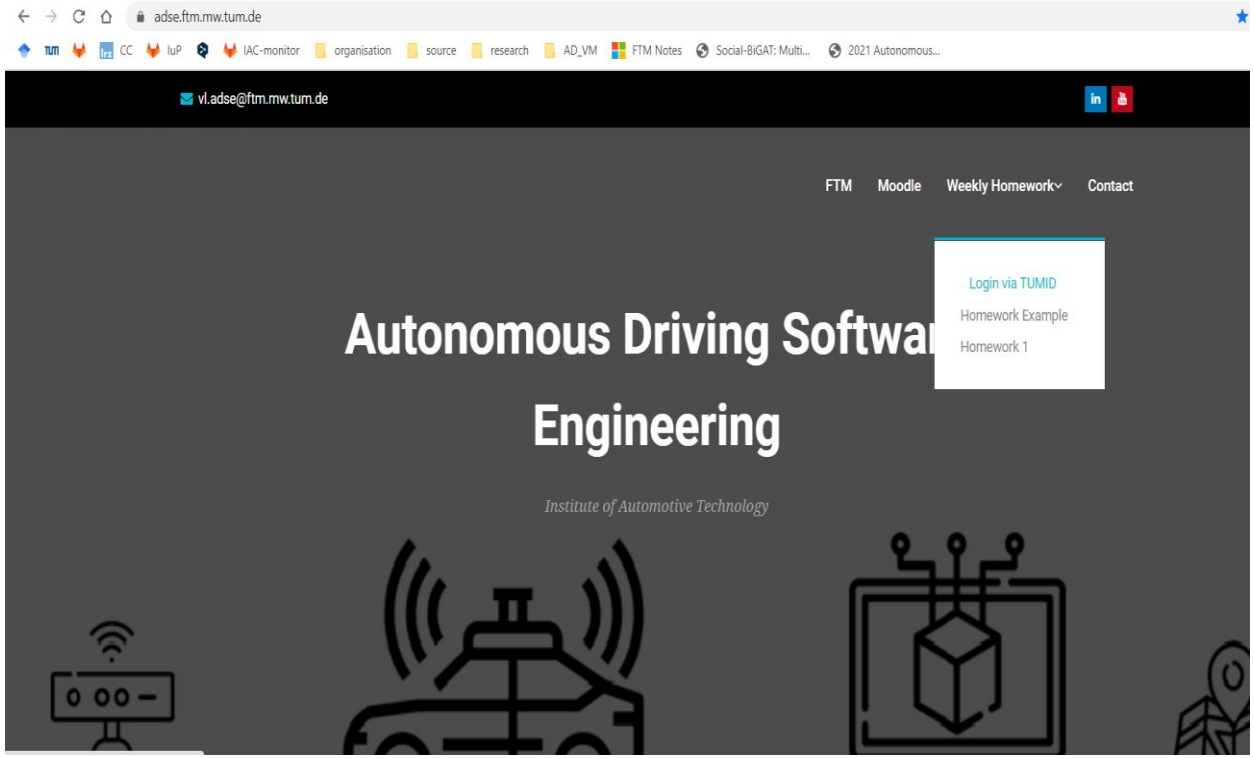
Working on your weekly homework – Code FREAK

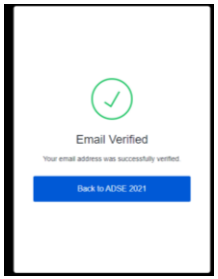
- The first step is to access your programming tasks submission website under: https://adse.ftm.ed.tum.de/



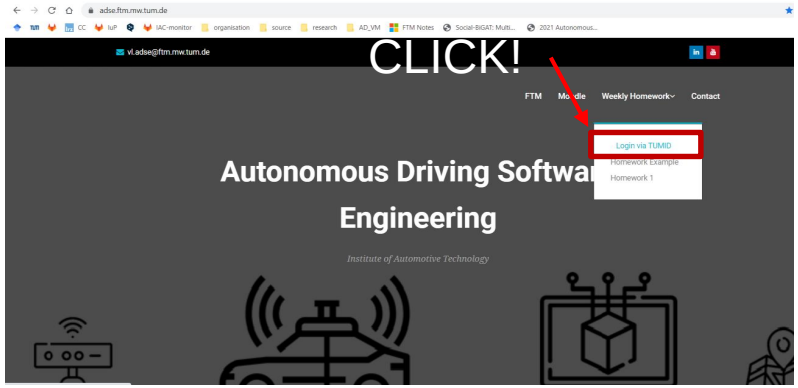
Working on your weekly homework – Code FREAK

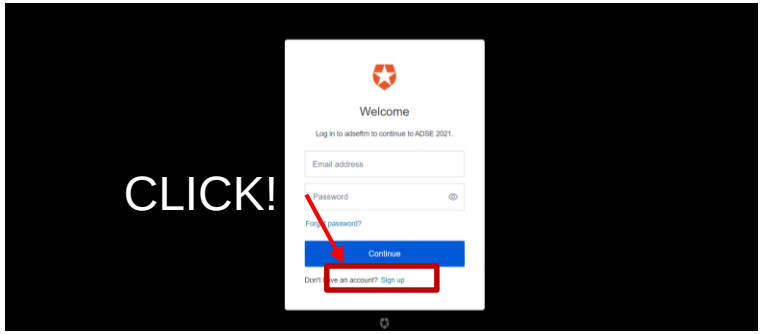
At the beginning of the semester:

- An initial Sign Up with your <TUMID>@mytum.de email-address is necessary.
- So click on *Weekly Homework* → *Login via TUMID* → *Redirecting to Student's Login* → *Sign up* (Don't forget to Verify you email)



PLEASE USE ONLY YOUR TUMID@mytum.de eMail-address, otherwise your results will not be evaluated





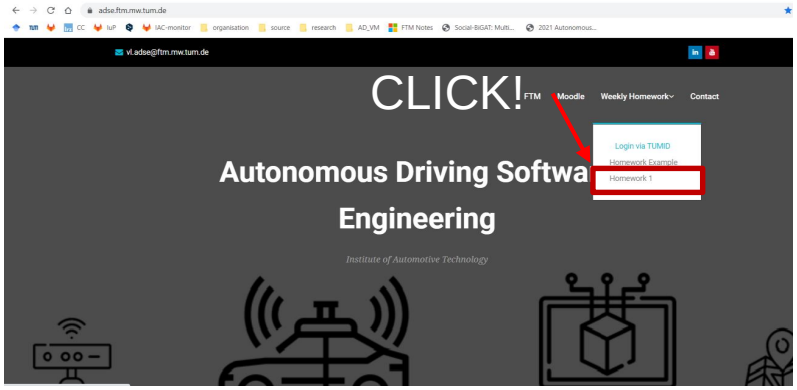
Working on your weekly homework – Code FREAK

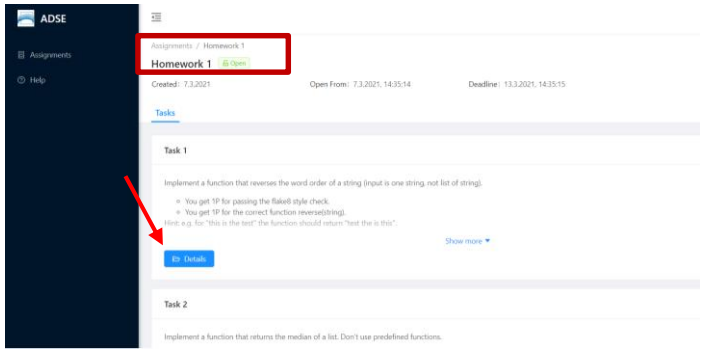
To start your weekly homework:

1. Login with <TUMID>@mytum.de to get to https://adse.ftm.ed.tum.de/submissions/. If you click on *Assignments*, the homework won't be visible yet.

2. To subscribe to the current homework, you have to go back to https://adse.ftm.ed.tum.de/ and click on *Weekly Homework → Homework <XYZ>.* Now you should get redirect to Assignments / Homework <XYZ>.

3. To add the homework to your assignments, just do *Task 1 → Details → Start working on this task1.* Now, the homework is stored in your assignment pool





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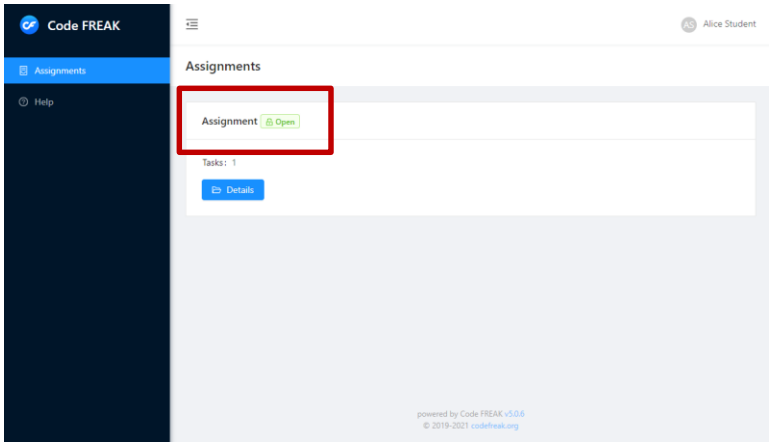
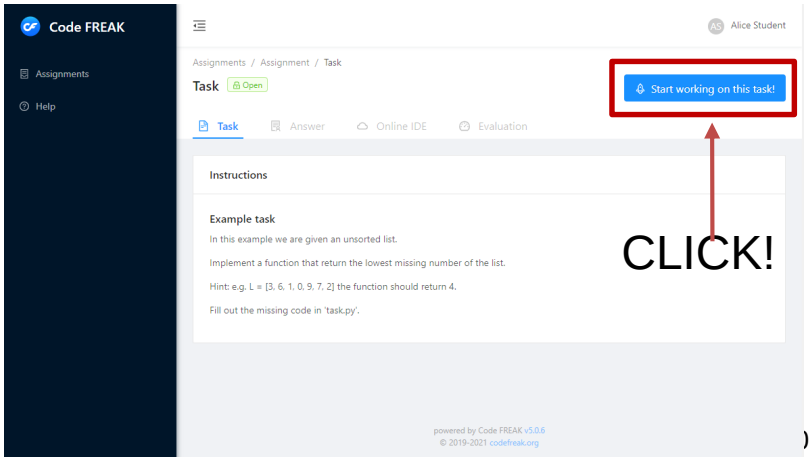
3. To add the homework to your assignments, just do *Task 1 → Details → Start working on this task1.* Now, the homework is stored in your assignment pool



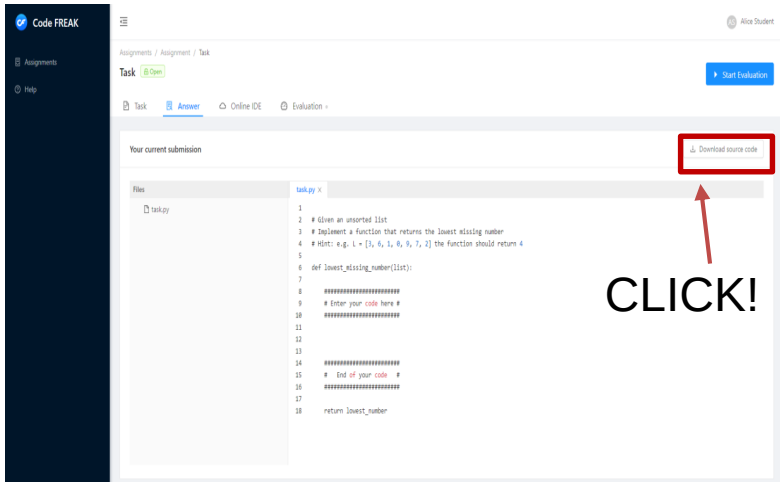


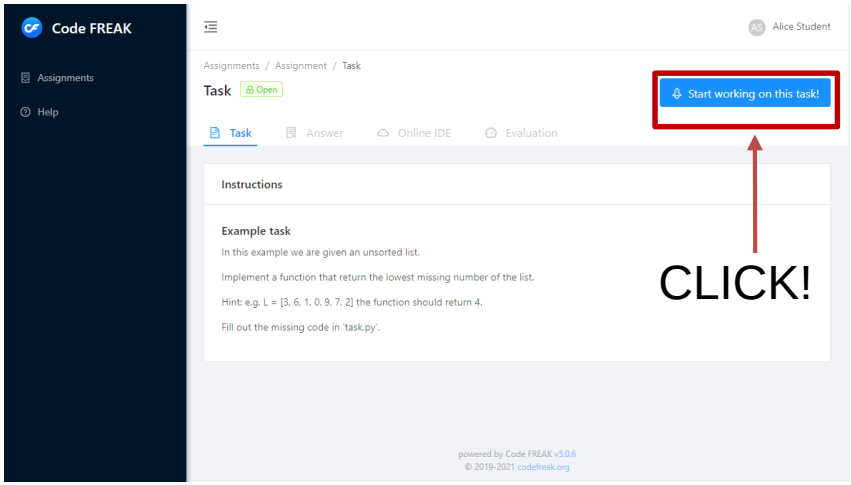
Working on your weekly homework – Code FREAK

To work on your weekly homework:

1. To start coding, choose click on *Task <XYZ>* → *Details* → *Start working on this task!*

2. Download the source code of the task to work on it locally on your computer in PyCharm. Make sure you have a neat folder structure for the exercises. (see Slide 1 – 25). Open your PyCharm Project

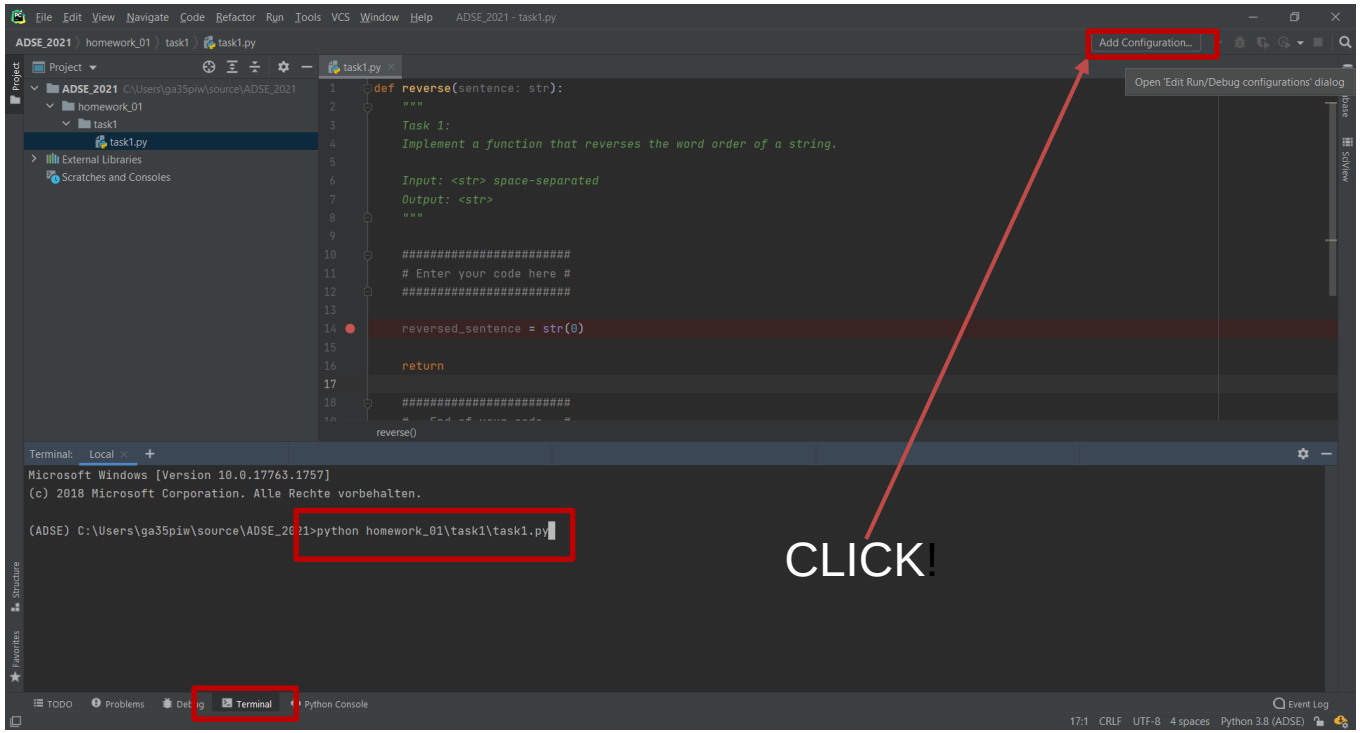




Working on your weekly homework – Code FREAK

To solve the task in PyCharm

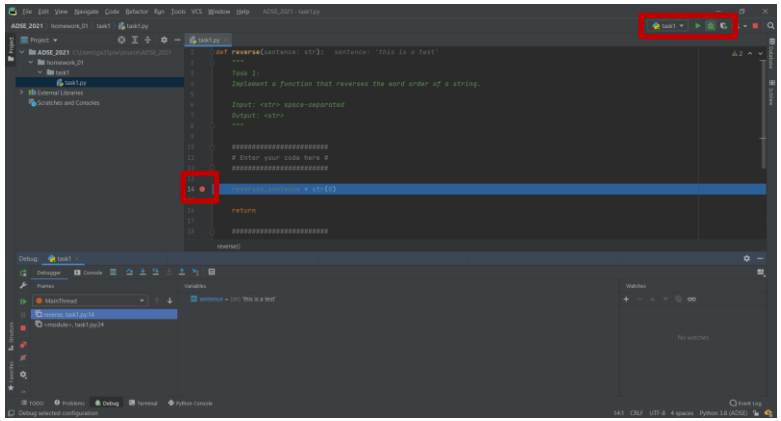
1. Either run the script via terminal command and / or create a configuration (Recommended for **debugging**)

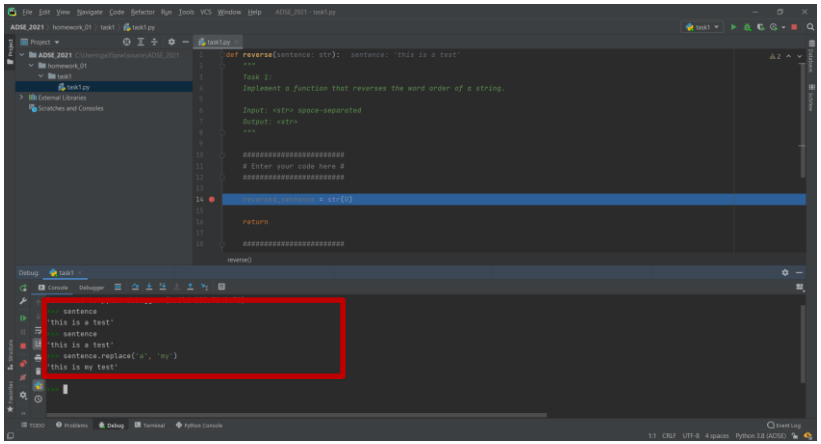


Working on your weekly homework – Code FREAK

To solve the task in PyCharm

2. Set a debug point, where the script should stop. Then run your script in the -mode and try things around until you think your solution is correct.

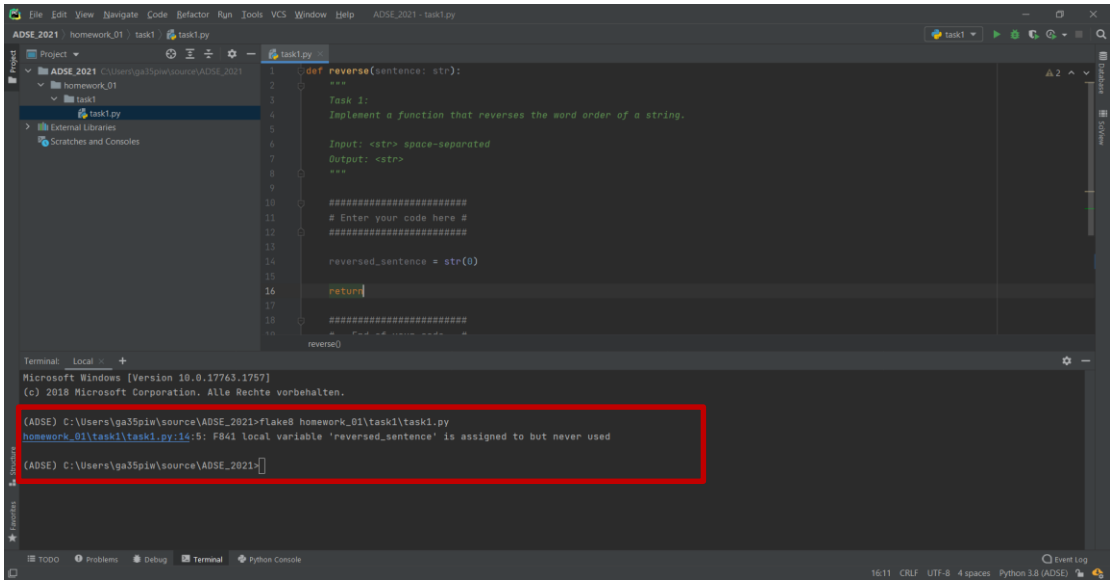




Working on your weekly homework – Code FREAK

To solve the task in PyCharm

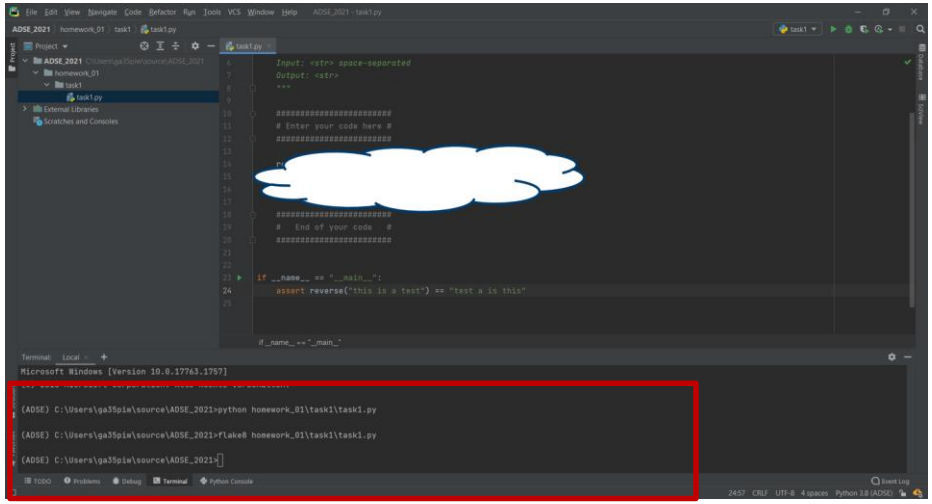
3. To check your Code-Style, run the following commands:
   `cd homework_<XYZ>\task<XYZ>`
   `flake8 task<XYZ>.py`
   → You will also get a point for pretty code, so do the Code-Style Checking

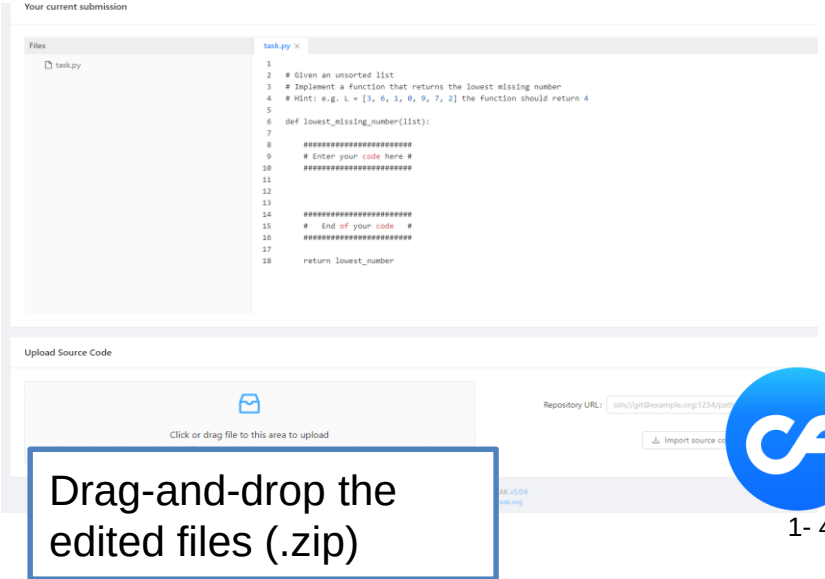


Working on your weekly homework – Code FREAK

To solve the task in PyCharm

4. When you are ready to go, you shouldn't get any more errors. If so, compress your edited files to a .zip and upload it back to Code FREAK (Just where you downloaded them.
   .. But, be aware: The final evaluation will be done in Code FREAK



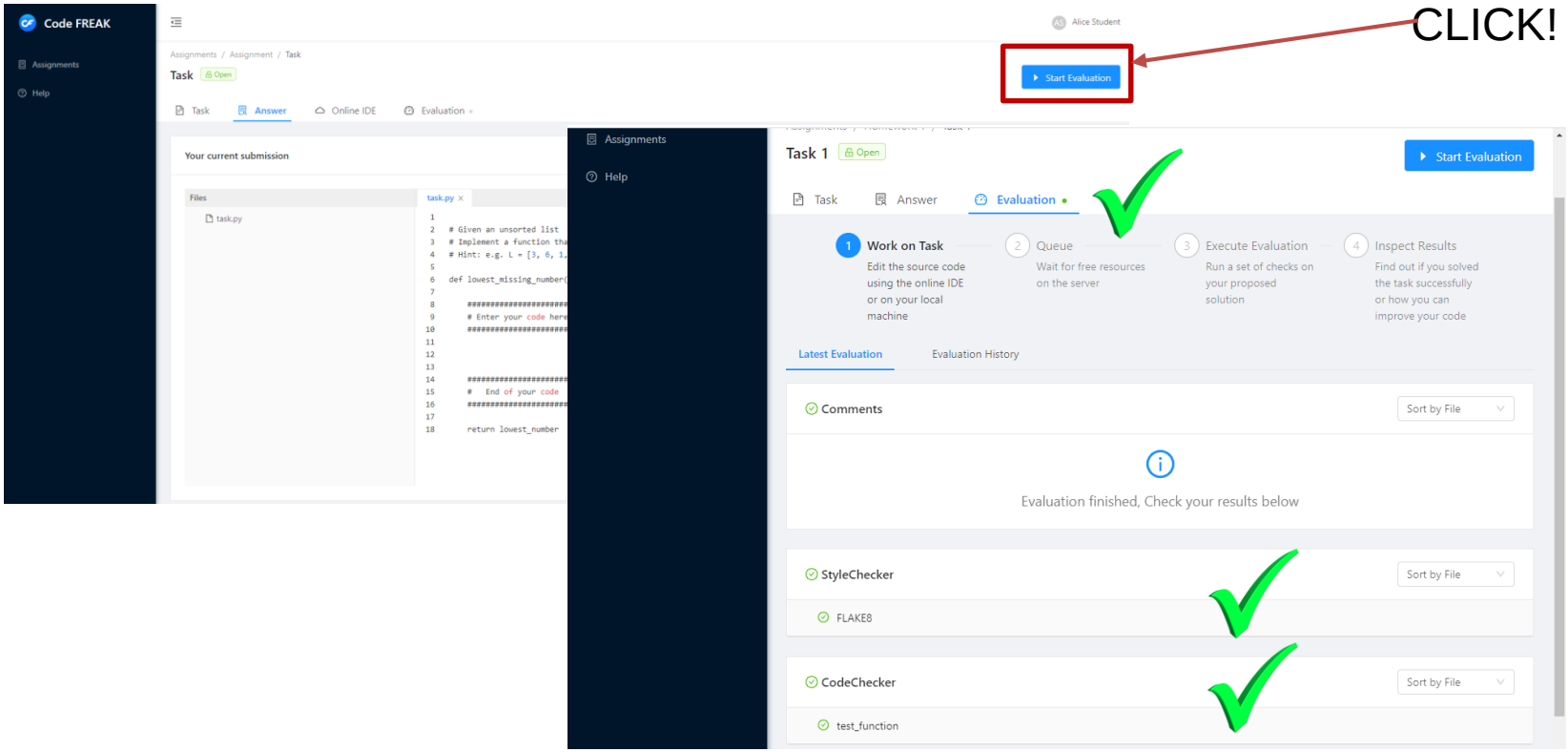


Drag-and-drop the edited files (.zip)

Working on your weekly homework – Code FREAK

Submission

Evaluate the task, check your results and (if everything is correct) go on with the next task



Working on your weekly homework – Code FREAK

Reset your code

In case, you totally messed your code up, you can reset a task completely.

WARNING: All your previous upload are lost after the reset!