NOVA IMS INFORMATION MANAGEMENT SCHOOL

Data Mining

Practical Session #1

Fall Semester 2025-2026
Master in Data Science and Advanced Analytics

Ana Pedro Caleiro – acaleiro@novaims.unl.pt
Gaspar Pereira – gppereira@novaims.unl.pt
Farina Pontejos - fpontejos@novaims.unl.pt

Please download the lab materials in the meantime

Practical Session Preparation

Download Anaconda Navigator

- https://www.anaconda.com/download
- Documentation: https://docs.anaconda.com/free/anaconda/install/

Download notebook and other materials

- Moodle / Practical Sessions / Lab 01
- https://github.com/fpontejos/Data-Mining-25-26

Optional: Download GitHub Desktop

- https://desktop.github.com/
- Sign up for GitHub account: https://github.com/signup

About Us

Ana Pedro

Academic Background:

- BSc in Corporate Finance (2024)
- MSc in Data Science & Advanced Analytics (since 2024 – [Ongoing] – NOVA IMS)

Professional Experience:

- Data Consultant Junior (Ongoing)

Thesis Development:

- Large Language Models; Synthetic Population

About Us

Gaspar Pereira

Academic Background:

- BSc and MSc in Medicine (2012-2018 - NOVA Medical School)
- MSc in Data Science & Advanced Analytics (since 2024 - [Ongoing] – NOVA IMS)

Thesis Development:

- Natural Language Processing; Large Language Models;

Resources

- Bibliography
- Class slides and Jupyter Notebooks
- Data Mining Github repo:
  - https://github.com/fpontejos/Data-Mining-24-25
  - https://github.com/fpontejos/Data-Mining-25-26
- Google, Stack Overflow, documentations, Github and YouTube

Resources

Recommended DataCamp courses

*Use the **invite link** (on Moodle) to get 6 months free access to all DataCamp features.*

*Make sure to **use your university email address** to sign up.*

Introduction to Python

https://app.datacamp.com/learn/courses/intro-to-python-for-data-science

Intermediate Python

https://app.datacamp.com/learn/courses/intermediate-python

Our working environment

- We will be using Anaconda: Currently one of the most popular Python distributions.
- Sets up a data science oriented working environment in Python
- It installs a set of libraries (for now, think of libraries as programming tools – like a toolbox in a woodshop)
- But it can be used for many different purposes (all it takes is installing the necessary libraries)

Anaconda

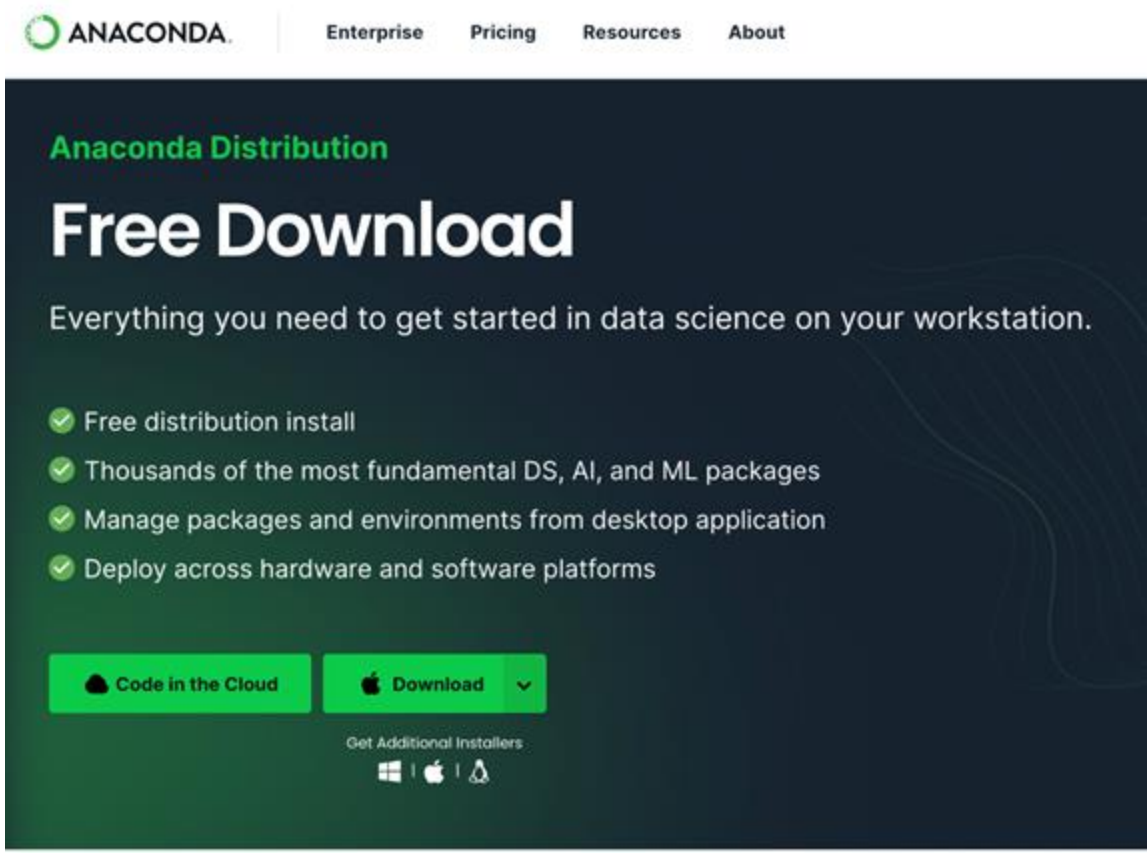
www.anaconda.org

- one of the most popular Python distributions for Data Science
- manages your packages and environments.
- reduce future issues dealing with the various libraries you will be using.
- comes with most of the main libraries for data manipulation
  - Pandas
  - Numpy
  - Matplotlib
  - Scipy
  - …
- easy to use and install

In the meantime: Download + Install Anaconda Navigator

Download:

https://www.anaconda.com/download



Install Anaconda Navigator

Please read the documentation applicable to your system:

https://docs.anaconda.com/free/anaconda/install/

> **Note**
>
> When installing Anaconda, you have the option to "Add Anaconda to my PATH environment variable." *This is not recommended* because it *appends* Anaconda to PATH. When the installer appends to PATH, it does not call the activation scripts.

Virtual Environments

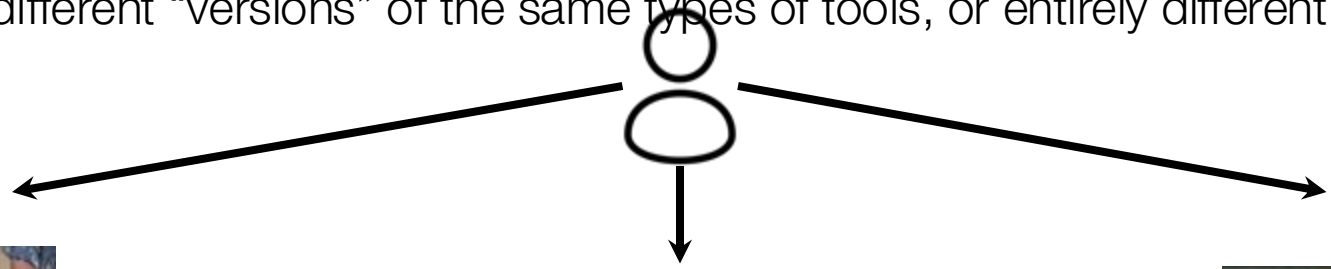
https://docs.conda.io/projects/conda/en/latest/user-guide/concepts/environments.html

https://docs.conda.io/projects/conda/en/latest/user-guide/tasks/manage-environments.html

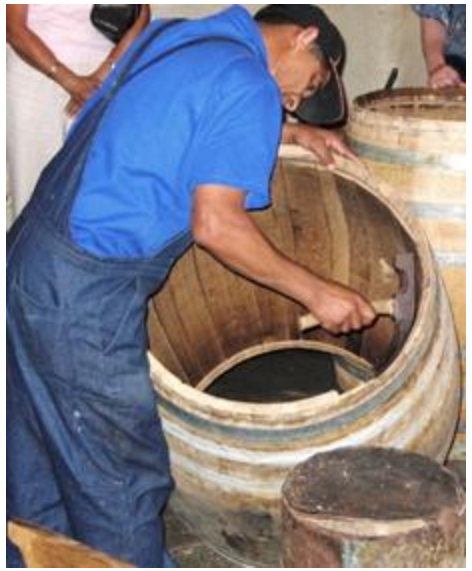
- Isolated spaces that contain per-project dependencies (specific collection of installed conda packages)
- Using conda to manage environments:
  - Create, export, list, remove, and update environments
  - Switching or moving between environments (conda activate)
  - You can also share an environment file
- You can also use pip to manage environment

In other words

you may need to use different “versions” of the same types of tools, or entirely different “environments”



Project #1



Cooper (making a barrel)

Project #2

Formwork (setting a structure)

Project #3

Luthier (making a guitar)

In other words

Suppose you will build a Caravel (a Portuguese ship from the 15th century).

However, you are also a Cooper!

To build the Caravel the way they did back then, you will need a specific set of tools, much more rudimentary than the ones you will have at your own workshop.

In other words

- You will need to get them first (i.e., “download” them)
- However, you should not mix these tools with the ones you already have!
  - They are not appropriate to build barrels, and the ones you already have are not appropriate to build Caravels
  - They will create clutter in your workshop (unnecessarily keeping unused packages)
  - You will have duplicate tools with different (version conflicts)
  - Other carpenters may want to build their own replica of you project (reproducibility)
  - If you are working with other carpenters, they will need to use the same types of tools you are using (collaboration)
- These tools (i.e., libraries) and their versions should be specified in the project’s requirements (including the Python version)!

Python Packages

Git and GitHub

https://guides.github.com/activities/hello-world/

https://docs.github.com/en/github/getting-started-with-github

- What is GitHub?
  - Code hosting platform for version control and collaboration
- What is Git?
  - At the heart of GitHub is an open source version control system (VCS) called Git. Git is responsible for everything GitHub-related that happens locally on your computer.
- Why Git and GitHub?
  - **Optional**: You can use Git and GitHub for collaborating and version control in your projects.
  - Also we have a GitHub repository with all the practical class contents:
  - https://github.com/fpontejos/Data-Mining-24-25

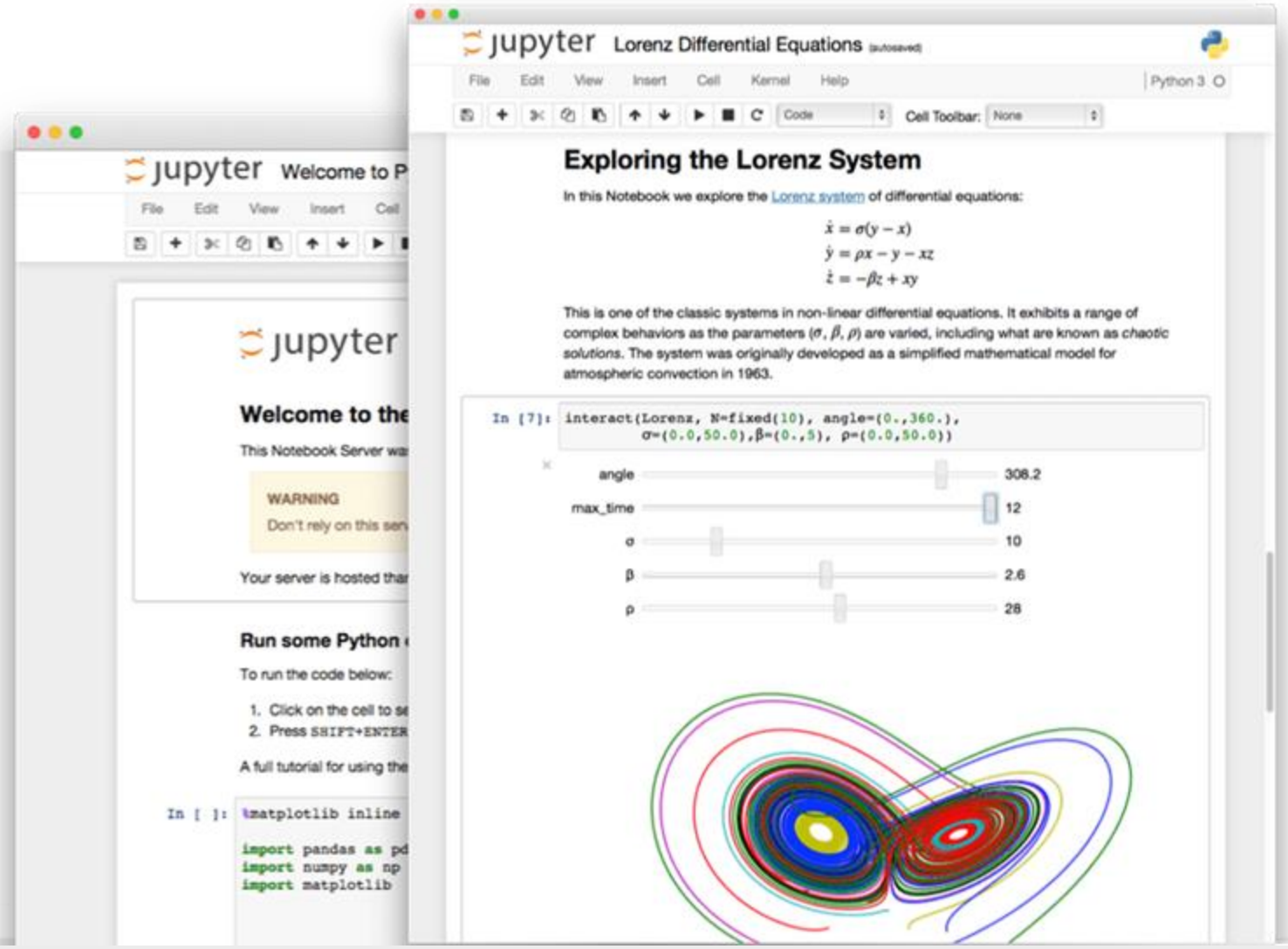
Main ways to access Python

- Python Shell and IPython
  - An interactive environment for writing and running code
- Jupyter Notebooks
  - A notebook that weaves code, data, prose, equations, analysis, and visualization
  - A tool for prototyping new code and analysis
  - A method for creating a reproducible workflow for scientific research
- IDE (Integrated Development Environment):
  - Software that helps you build code

Jupyter notebooks

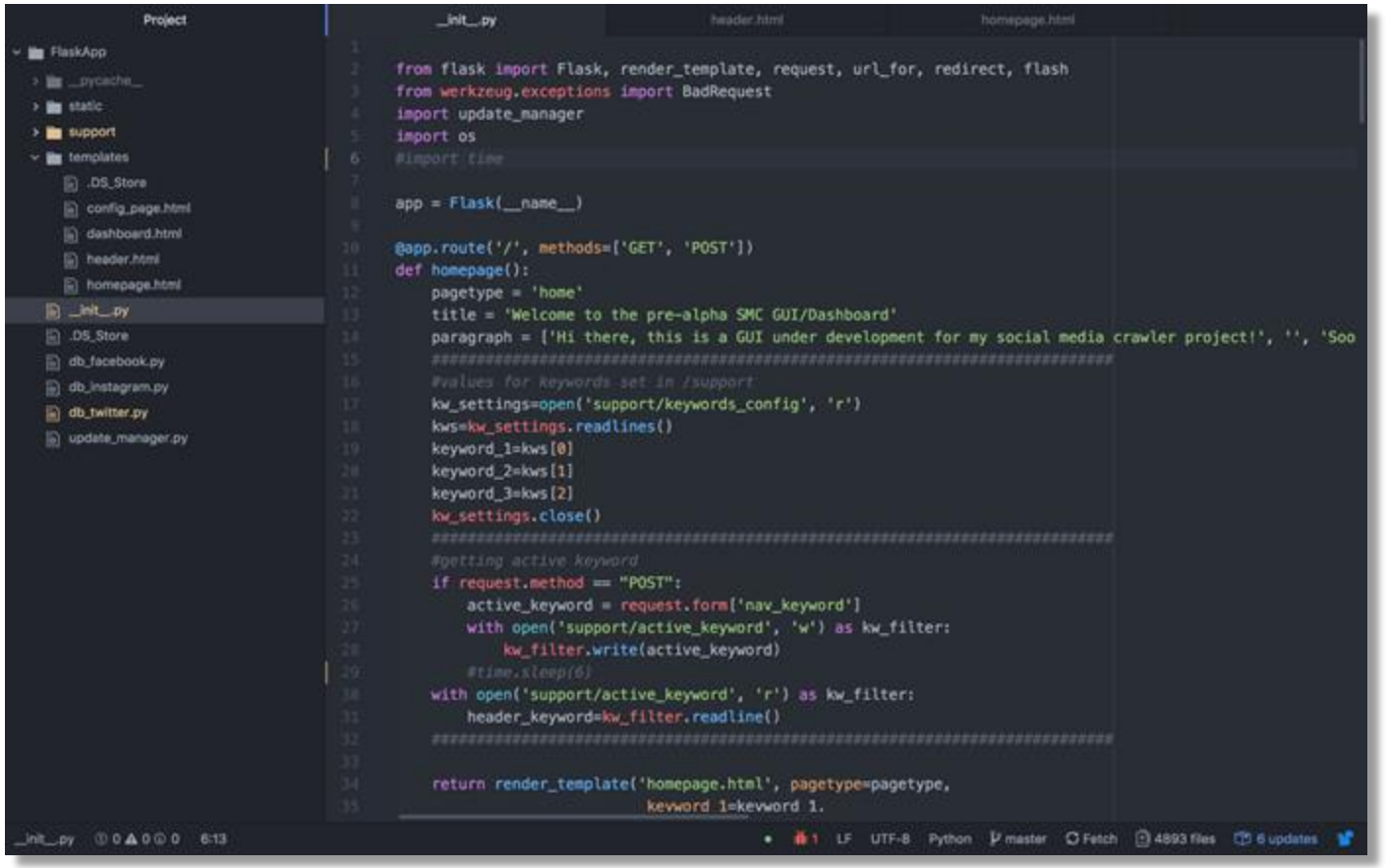
https://jupyter.org/

We will be using Jupyter notebooks for our practical sessions.



Text Editors

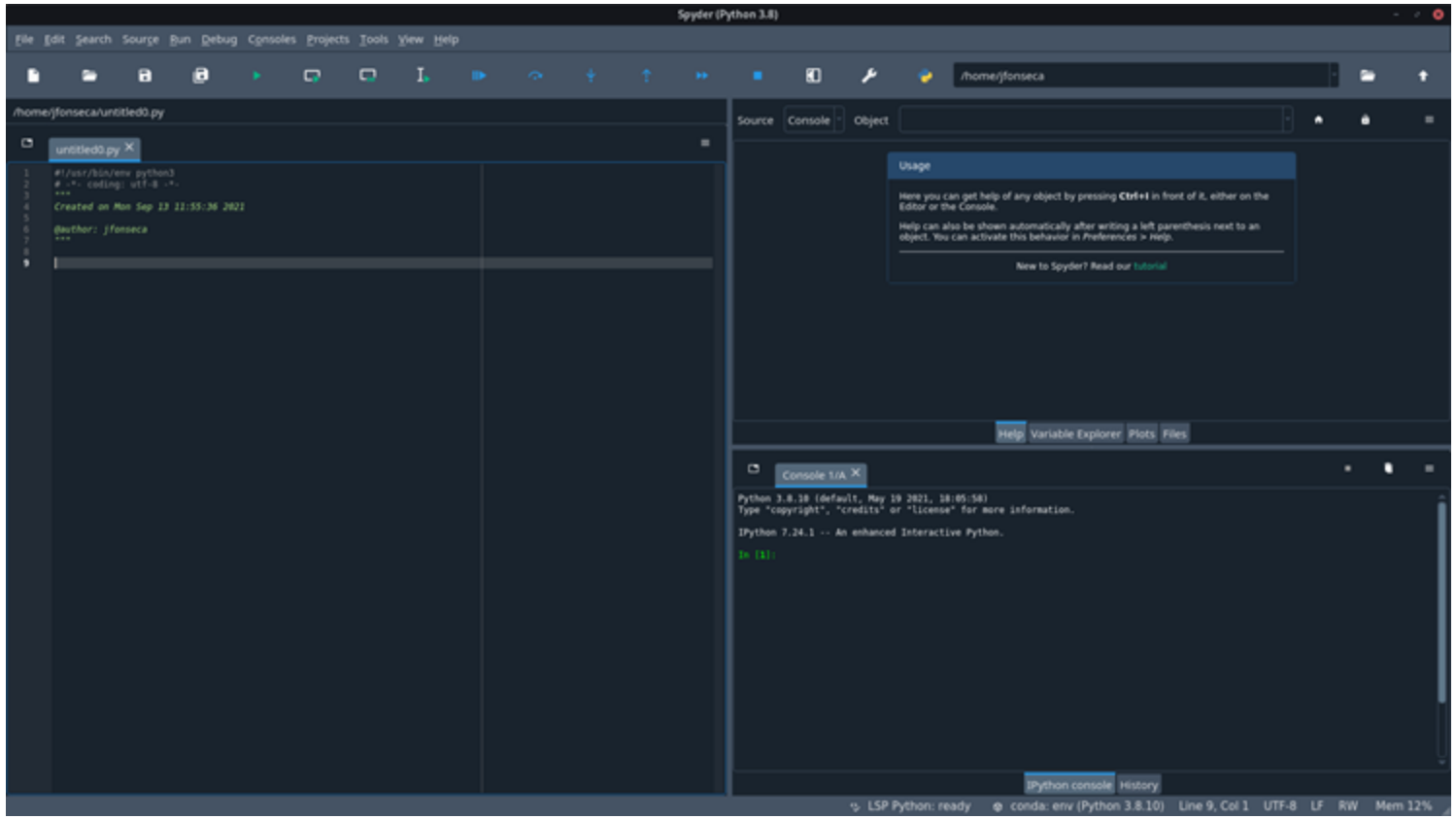
- Another method to write python scripts is using text editors
- Some popular text editors:
  - Vim (Linux terminal text editor)
  - Atom (popular open source editor)
  - Sublime Text (popular proprietary text editor)
  - Notepad ++ (Windows only)
- Usually highly customizable



Atom Text Editor

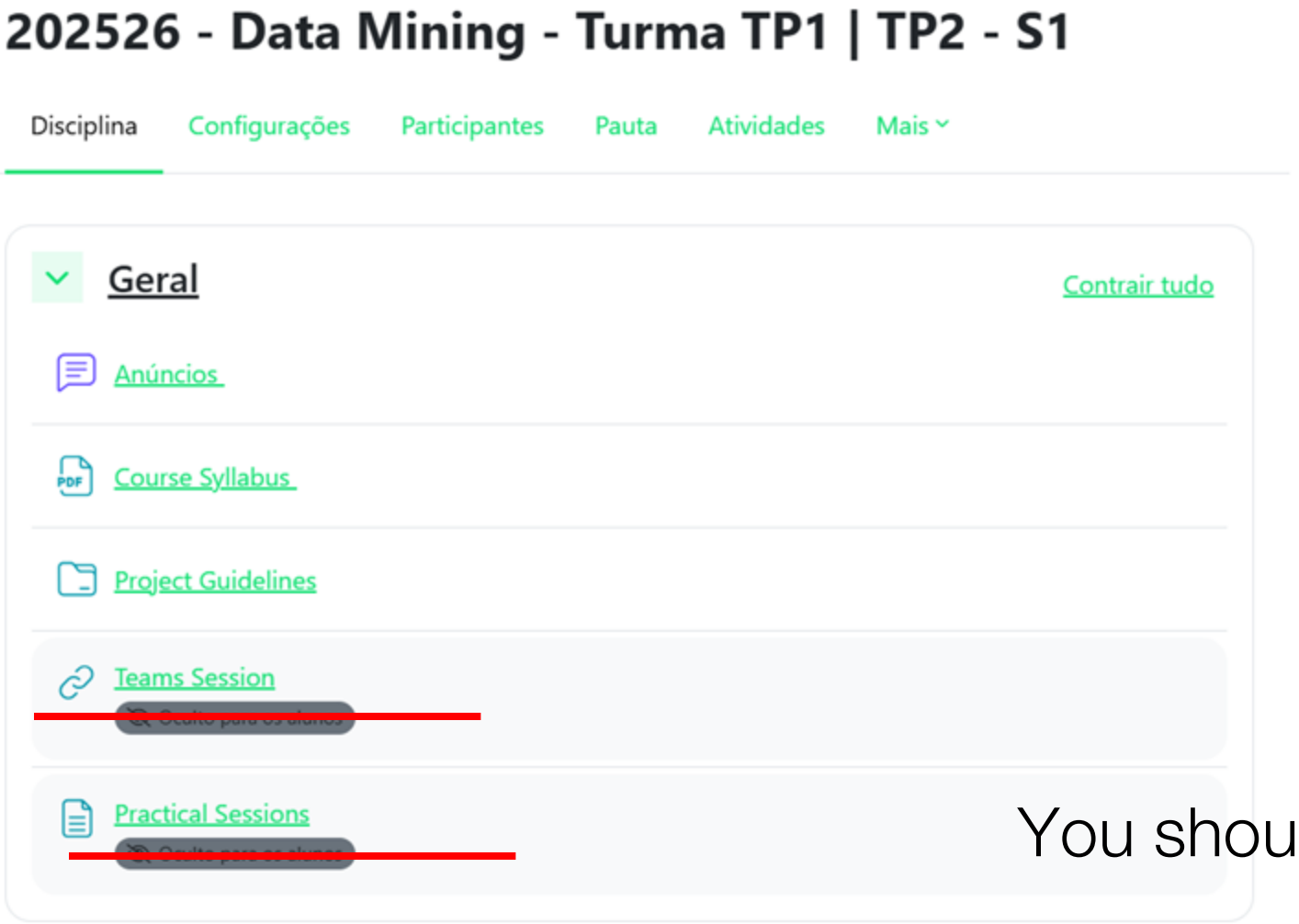
Integrated Development Environment (IDE)

- Popular IDE's:
  - Spyder
  - PyCharm
  - **VSCode**
  - Rodeo
- Anaconda comes with Spyder and VSCode



Usage of IDE and/or Text editor (and which ones to use) comes down to personal preference

Everything is on Moodle



You should be able to see this now :)

Please read the guidelines

Project Guidelines

Pasta | Configurações | Mais

Funcionalidades da IA

Editar

- data
  - DM_MAA_Report_Template.docx
  - DM2526_ProjectGuidelines_slides.pdf
  - DM2526_ProjectGuidelines_v3.pdf

Amazing International Airlines Inc.

Data Mining Project Guidelines

Fall Semester 2025-2026

Last Updated: 25 August 2025

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1 Introduction

Amazing International Airlines Inc. (AIAI) is facing the challenge of designing personalized services and marketing strategies for its diverse customer base. In today's highly competitive airline industry, leveraging data-driven approaches to understand customer segments is crucial for improving satisfaction, increasing retention, and maximizing revenue potential.

Customer segmentation [4, 1] enables AIAI to identify distinct groups within their loyalty program. For instance, some customers may prioritize premium services and convenience, while others may be more cost-conscious and focused on basic travel needs. Additionally, certain groups may display seasonal travel patterns or specific route preferences. By uncovering these patterns, AIAI can tailor services, loyalty rewards, and marketing communications to meet the unique needs and behaviors of each segment.

Project Part 1: EDA

4 Deliverable 1: Exploratory Data Analysis (30 points)

This deliverable lays the groundwork for segmentation by examining the airline loyalty dataset in detail. The focus is on uncovering meaningful patterns, identifying limitations, and generating initial hypotheses about customer groups.

Key Tasks:

- Conduct descriptive statistics and visualizations to highlight distributions, trends, and anomalies, while noting which variables appear most relevant for segmentation.
- Assess data quality issues and evaluate how these may affect clustering reliability.
- Identify preliminary behavioral signals that suggest distinct types of customers.
- Develop and justify engineered features. Show how these derived variables capture richer aspects of customer behavior and explain their potential contribution to clustering models.

In presenting results, consider addressing the following:

1. Which findings were most unexpected or insightful, and what do they reveal about likely customer clusters?
2. What data limitations pose the greatest risks for clustering, and how might they be mitigated?
3. Which patterns in customer activity, including those revealed by engineered features, suggest natural groupings, and what cluster characteristics do you anticipate?
4. How would you communicate these insights to non-technical stakeholders? Include a clear explanation of the expected number of clusters, the most important differentiating features, and any anticipated challenges.

Submission Deadline

November 4th

Project Part 1: EDA

Academic paper example:

M. Maphosa, W. Doorsamy and B. S. Paul, "Student Performance Patterns in Engineering at the University of Johannesburg: An Exploratory Data Analysis," in *IEEE Access*, vol. 11, pp. 48977-48987, 2023, doi: 10.1109/ACCESS.2023.3277225.

https://ieeexplore.ieee.org/abstract/document/10128127

Project Part 2: Final Report

5 Deliverable 2: Clustering Analysis (60 points)

This phase applies clustering techniques to the airline loyalty dataset in order to generate meaningful customer segments. The emphasis is on experimenting with multiple perspectives, validating results, and merging insights into a comprehensive solution that supports business objectives.

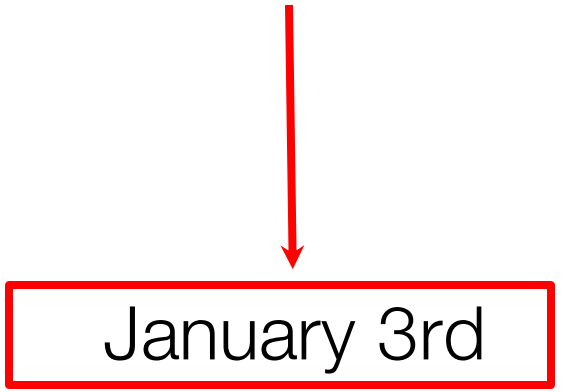
Key Tasks:

- Prepare the dataset for modeling.
- Analyze available features to determine which segmentation perspectives can be meaningfully applied.
- Perform segmentation using the identified perspectives.
- Apply at least two clustering approaches within each perspective and compare results.
- Propose a final merged segmentation solution that integrates the most important insights across perspectives into a coherent framework.

When presenting results, consider addressing the following:

1. Which clustering method(s) produced the most interpretable and stable results for each perspective?
2. How many clusters best represent the customer base overall, and what evidence supports this decision?
3. What differentiating features emerged as most important within each perspective, and how do they complement one another in the merged solution?
4. How would you describe the final set of customer segments to a business audience? Summarize defining traits, potential marketing opportunities, and any challenges encountered when integrating perspectives.

Submission Deadline



Project Part 3: Discussion

Deliverable 3: Discussion	**10**	**Date TBA**
Individual Assessment	10	In Person

Project Bonus **(Optional)**

7 Optional Bonus Components

Each deliverable can include an optional bonus component up to 20% of that deliverable's points. Bonus components are designed to reward exceptional work while maintaining core assignment focus.

Check Guidelines to learn about the options ;)

Let’s get started!

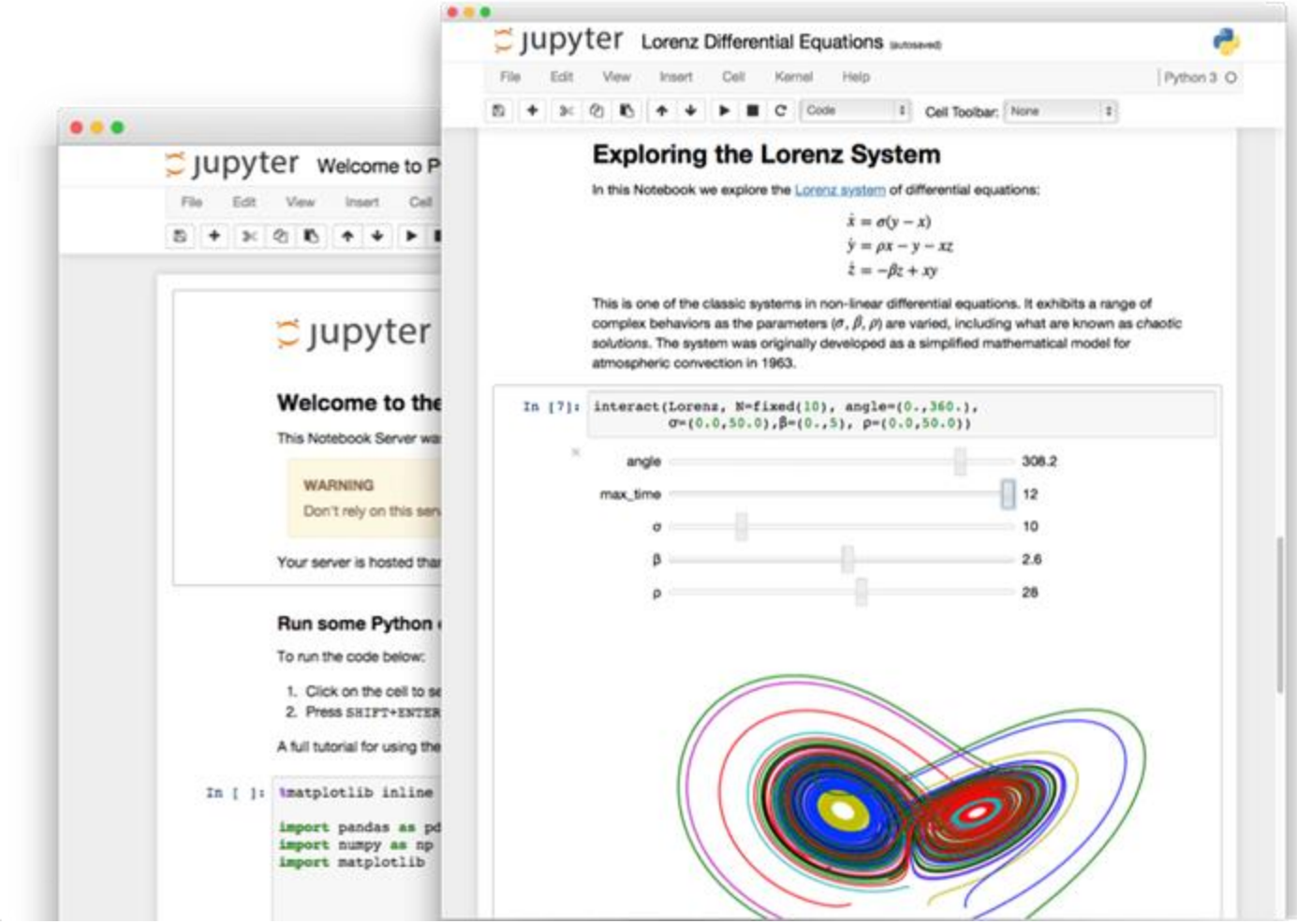
Next: Setting up our tools

The Jupyter Notebook

http://jupyter.org/

Let's try it out!

- Install and Open Anaconda Navigator
- Start Jupyter Notebook



Setting up our tools

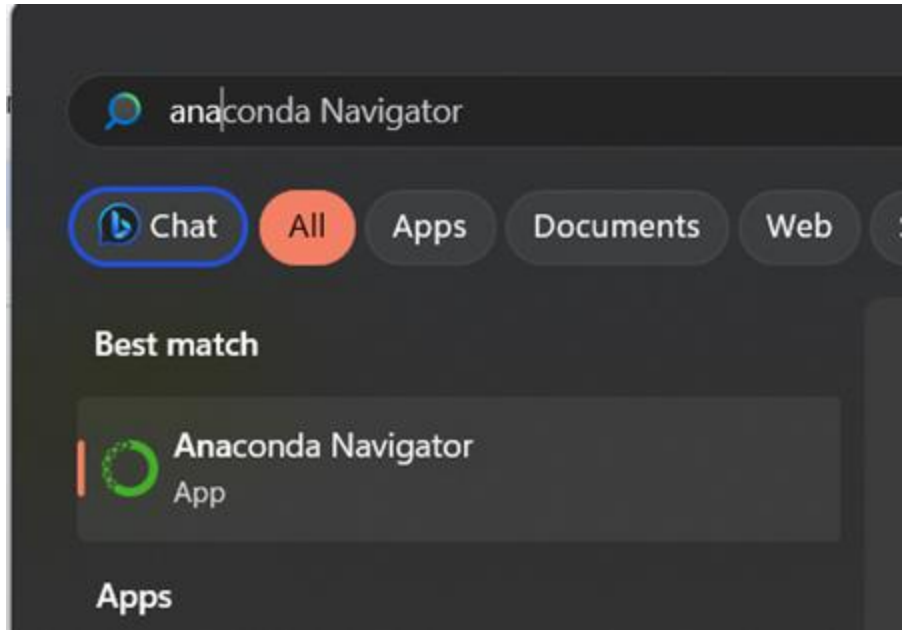
Two options:

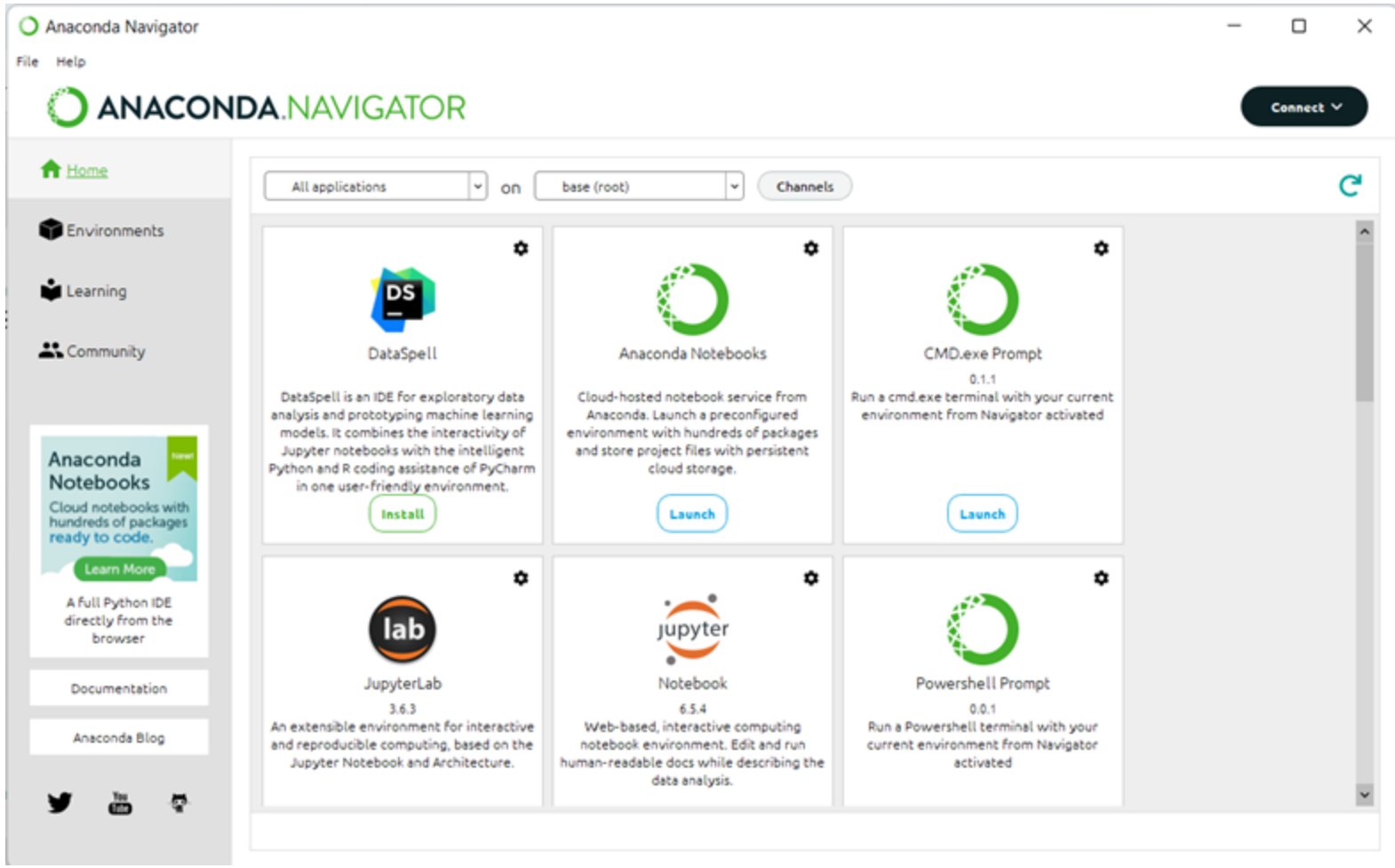
1. **With GUI (Anaconda Navigator)**

1. Command line (miniconda) (skip to slide 62)

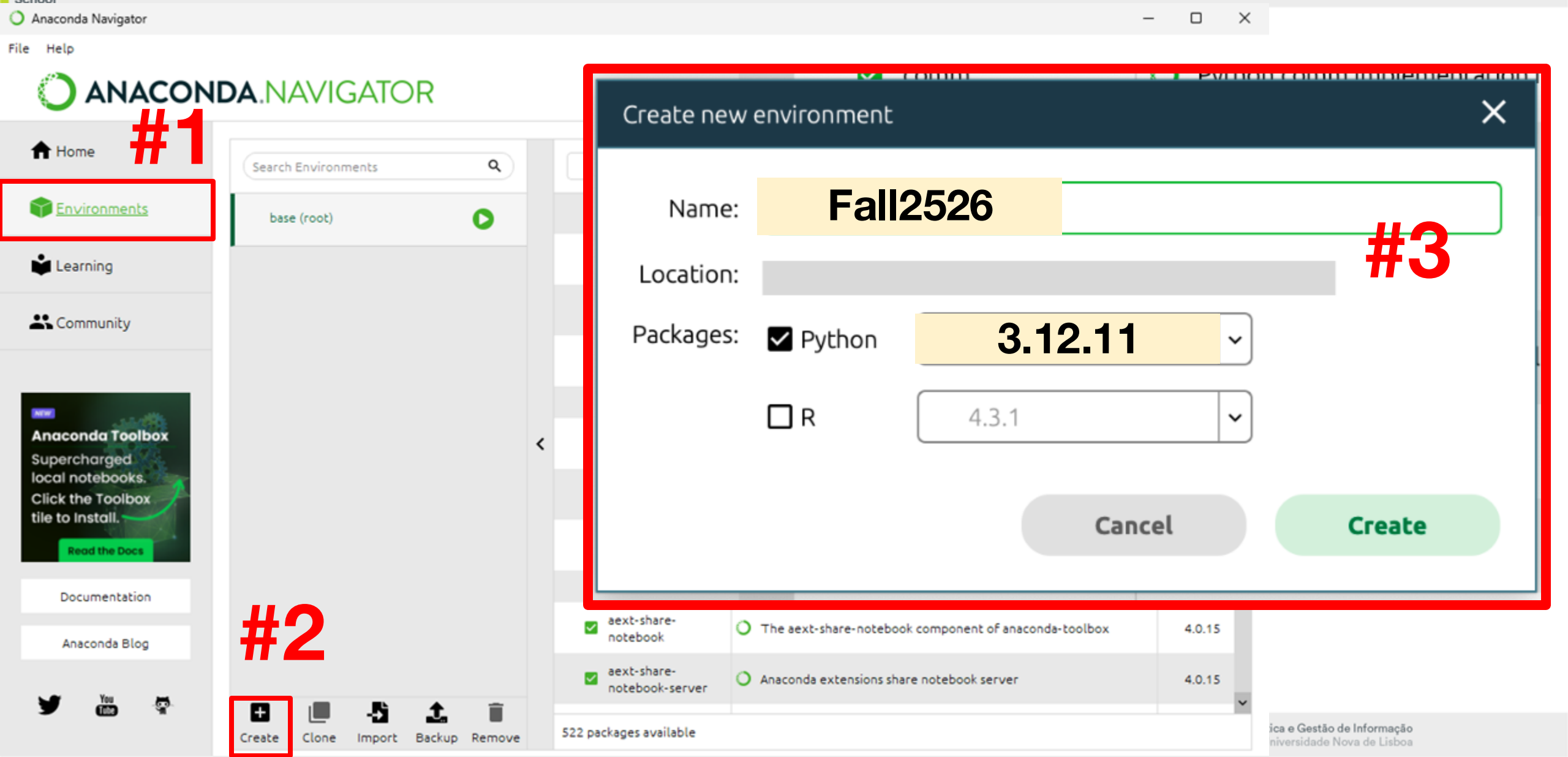
Setting up our tools

Load Anaconda Navigator

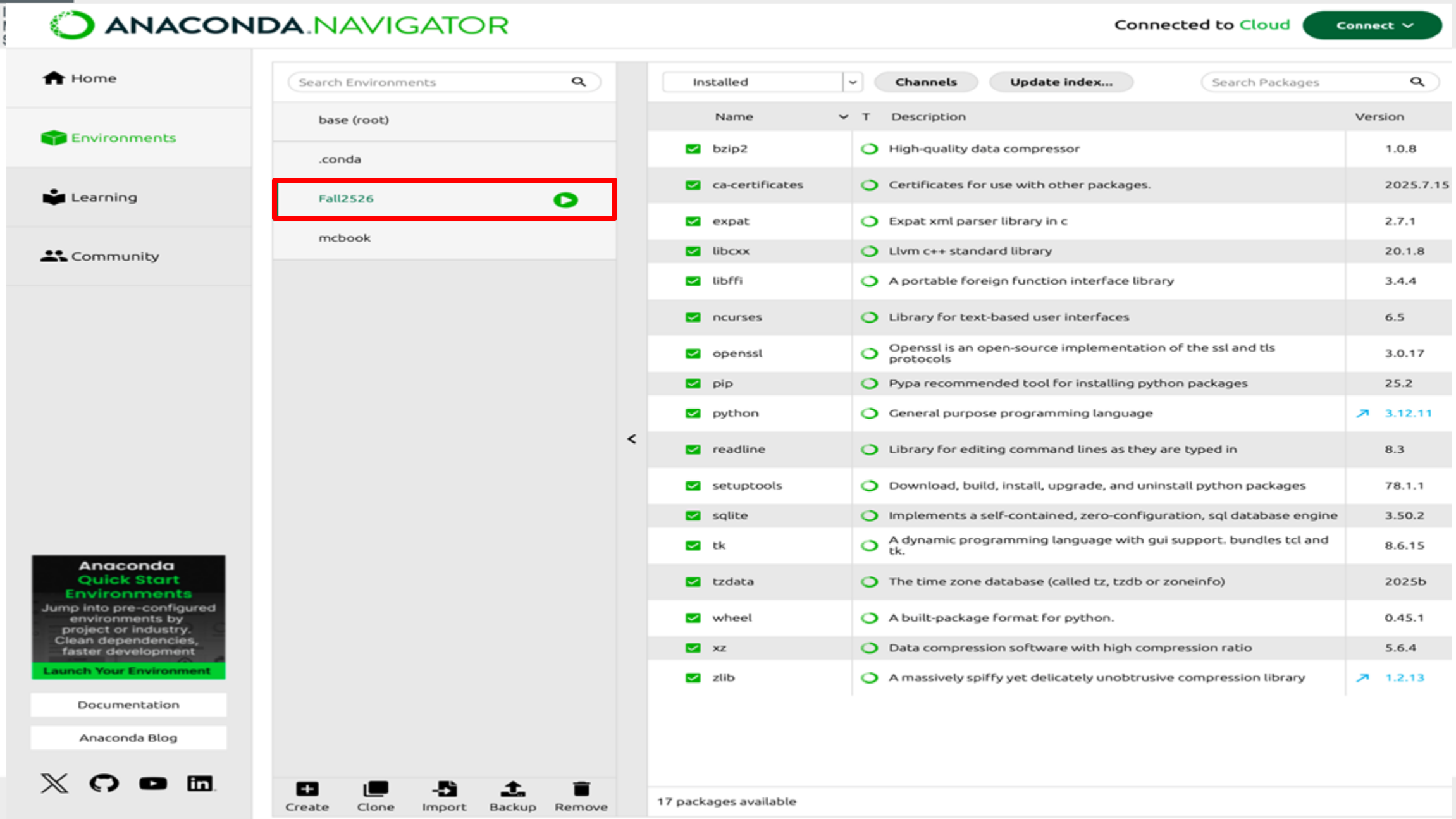




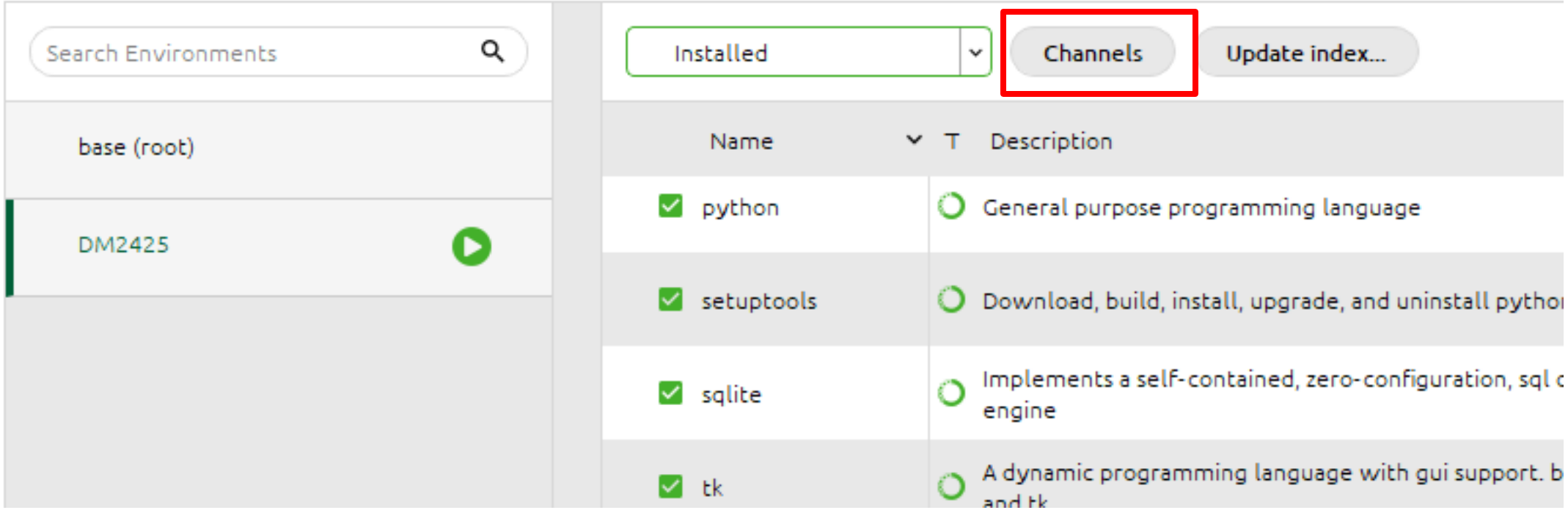
Create a new environment: Fall2526



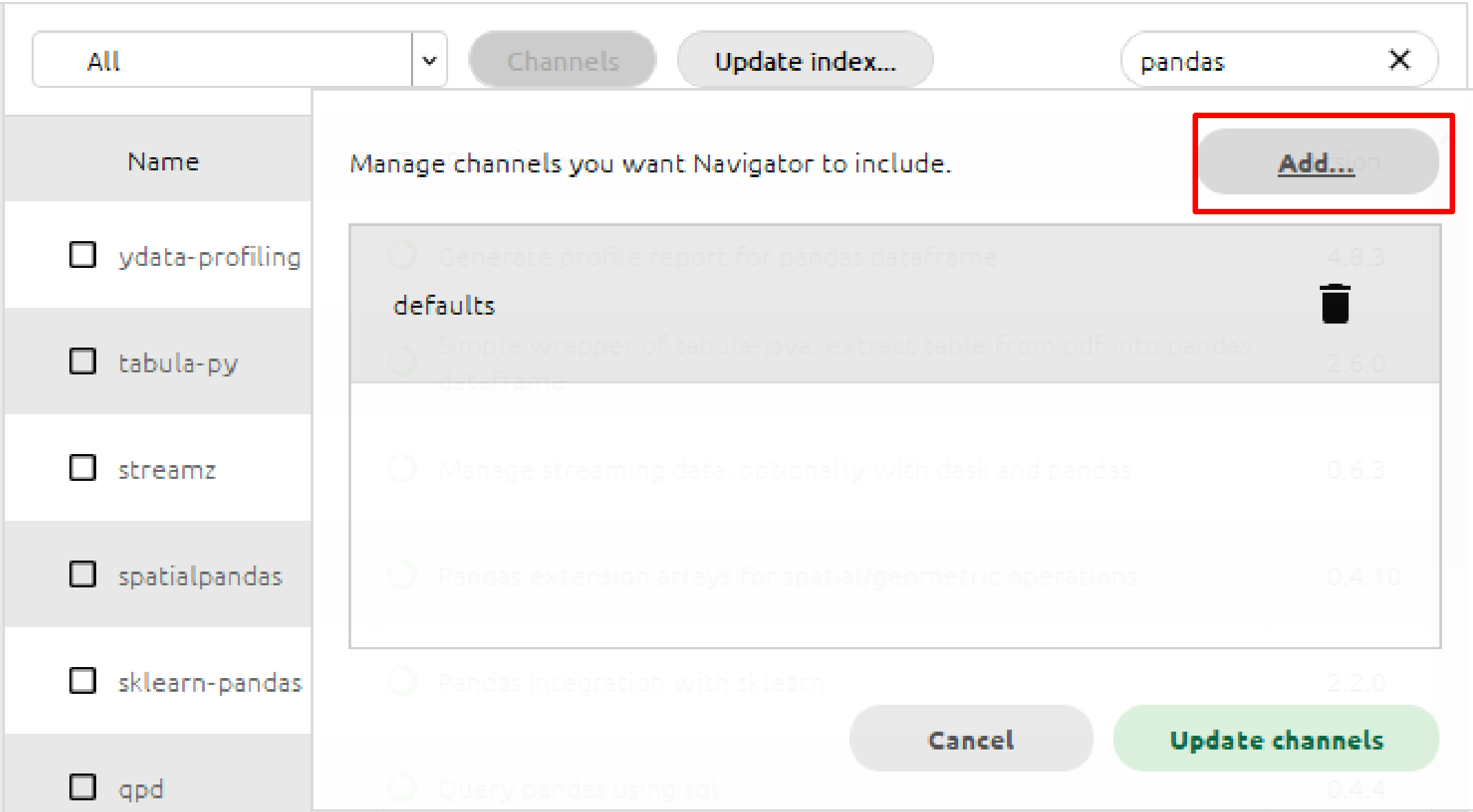
Create a new environment: Fall2526



Add conda channel: conda-forge



Add conda channel: conda-forge



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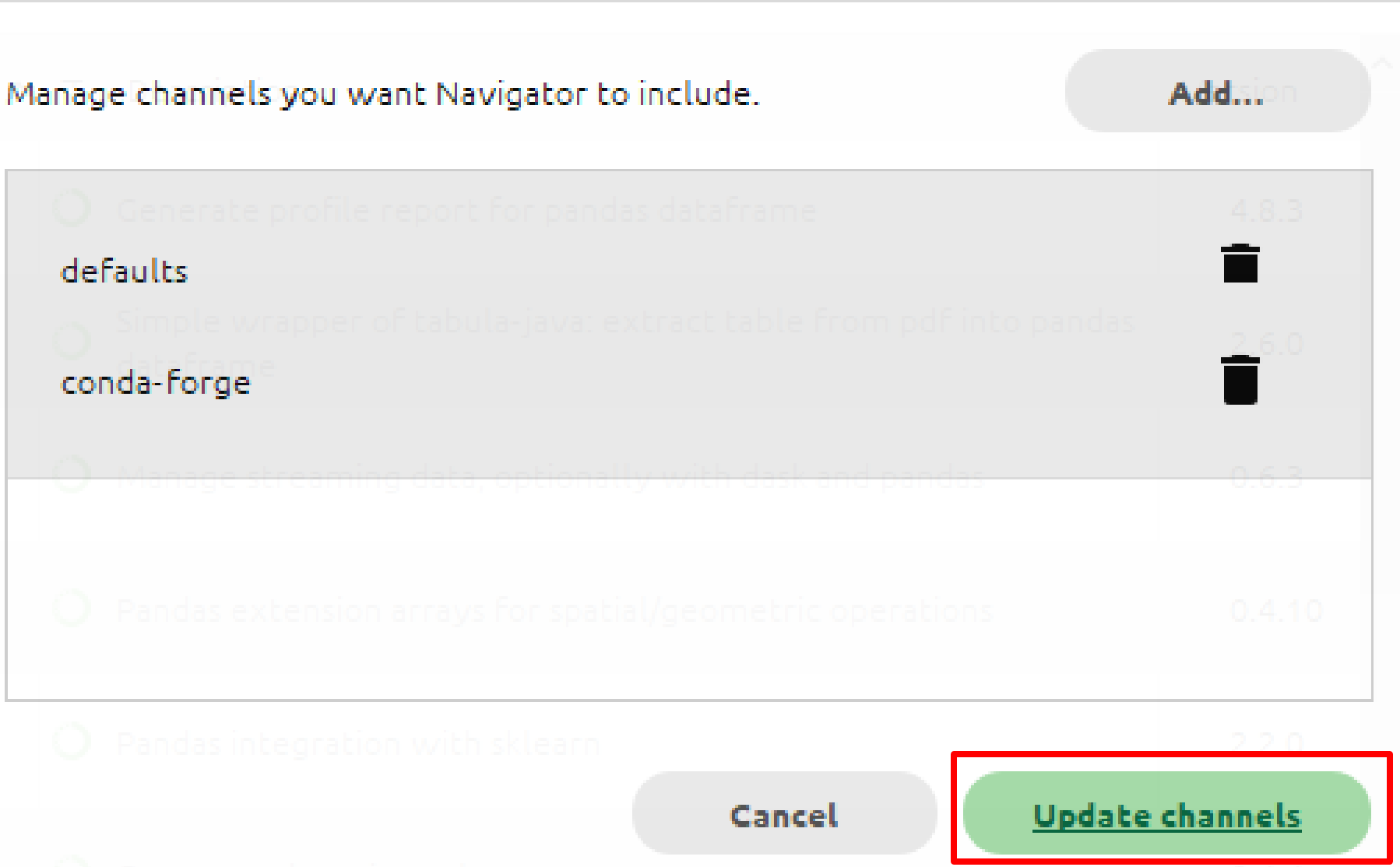

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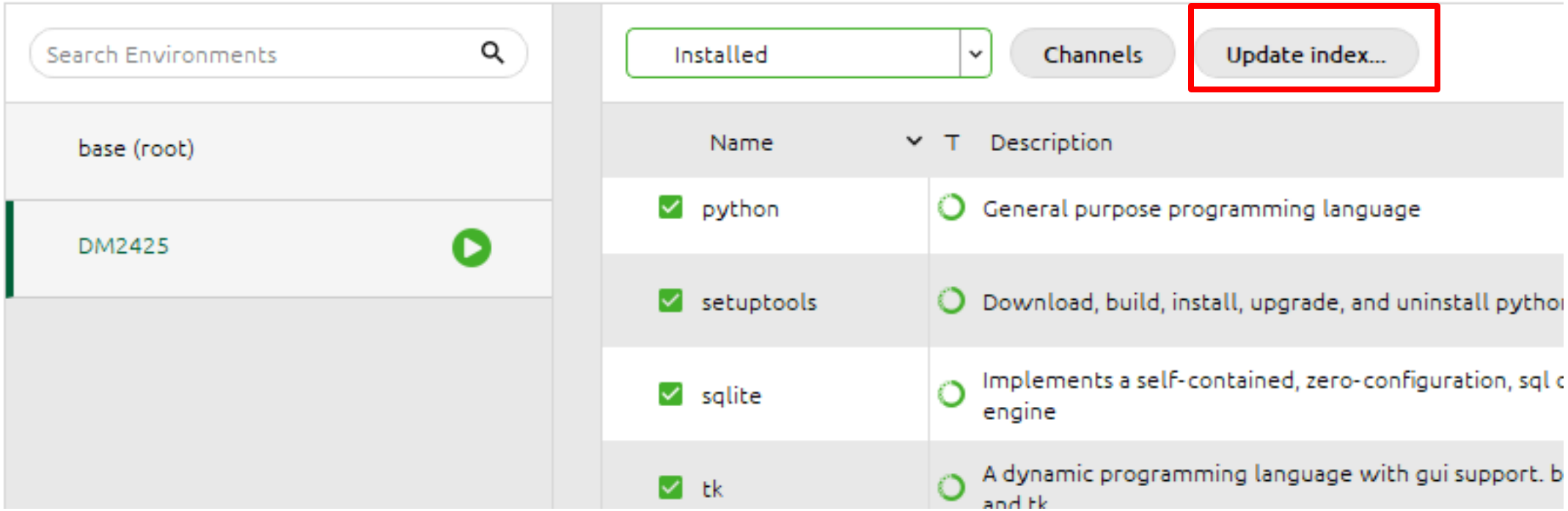
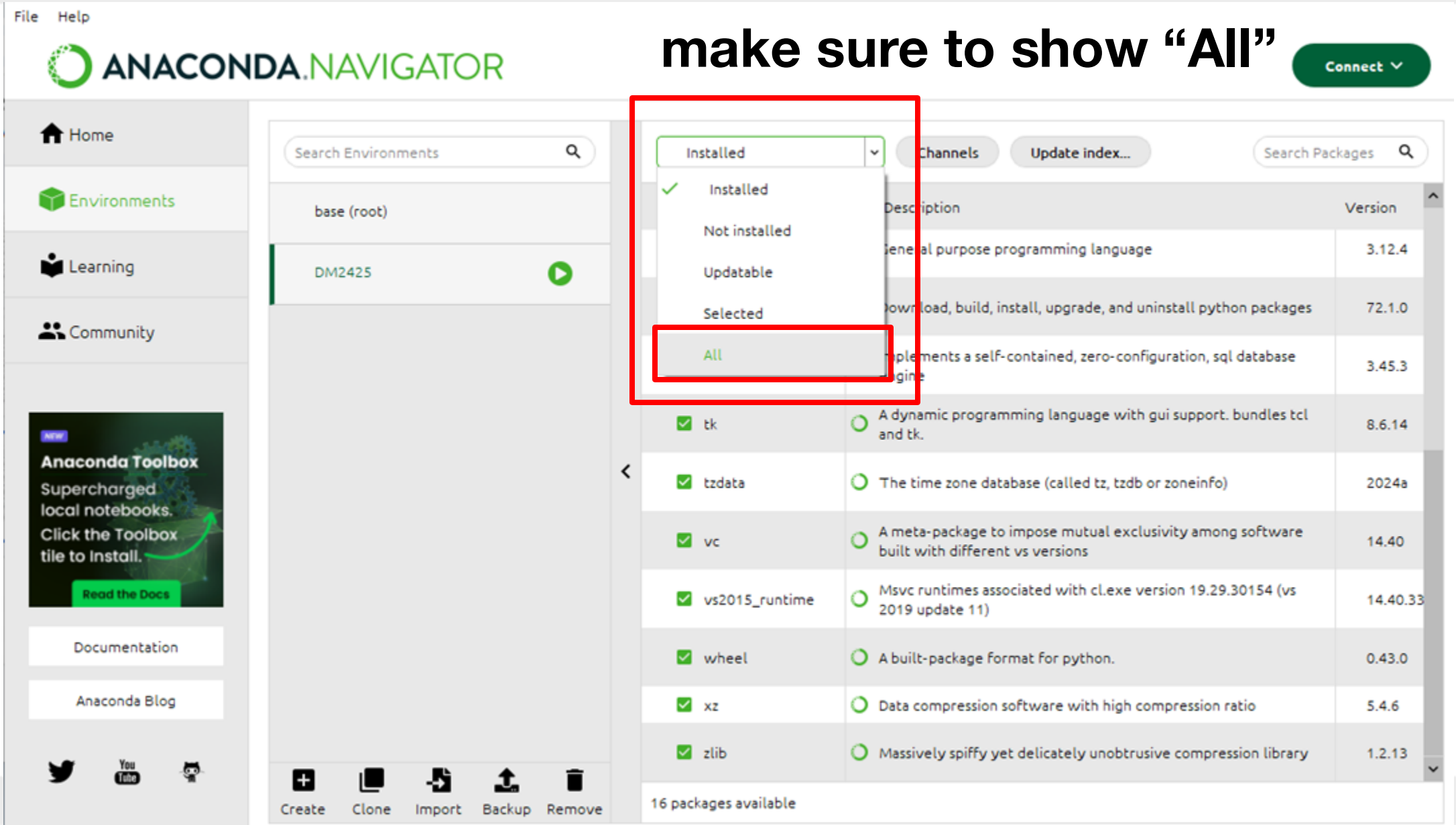
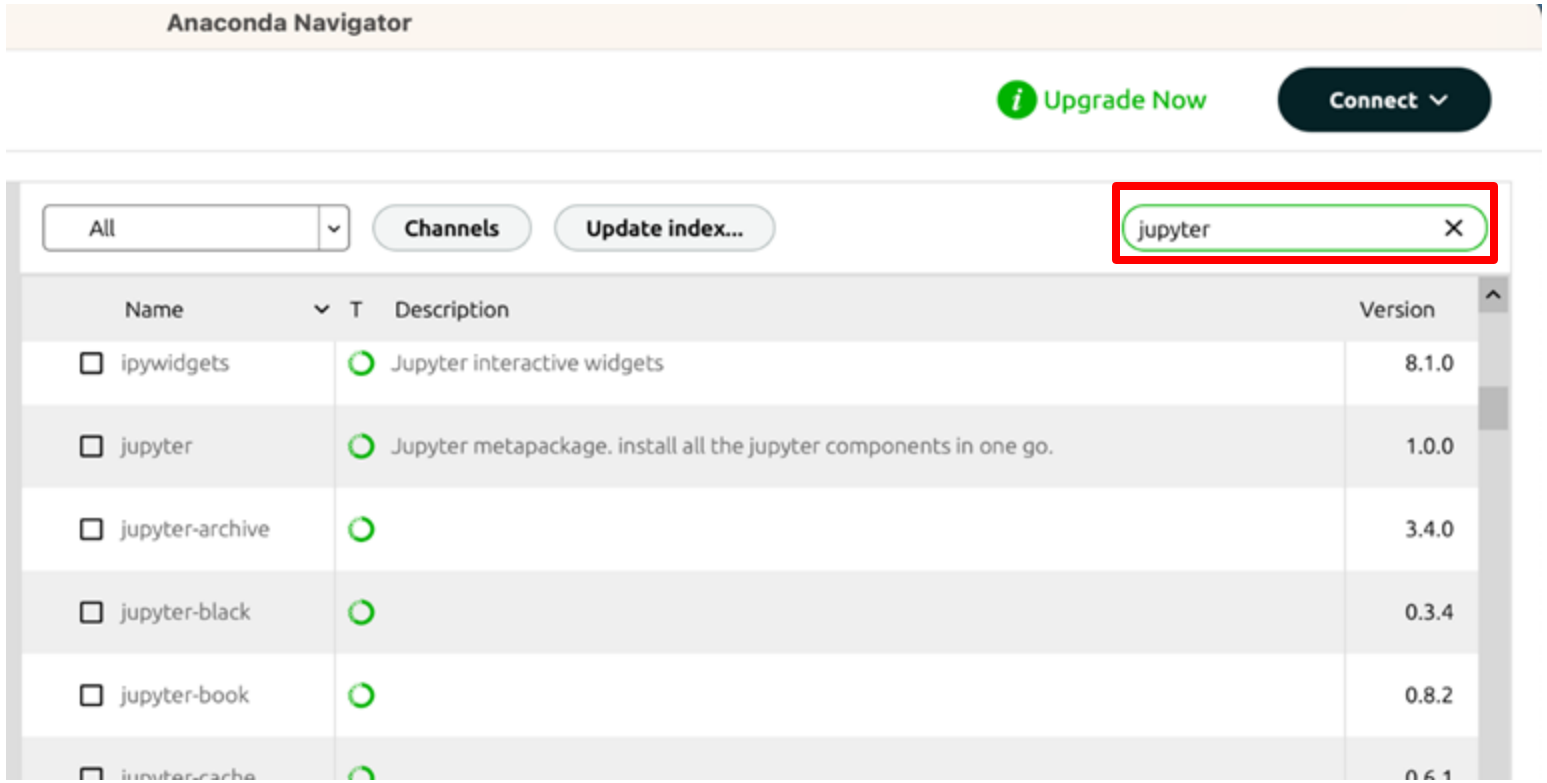


Install libraries



Install libraries

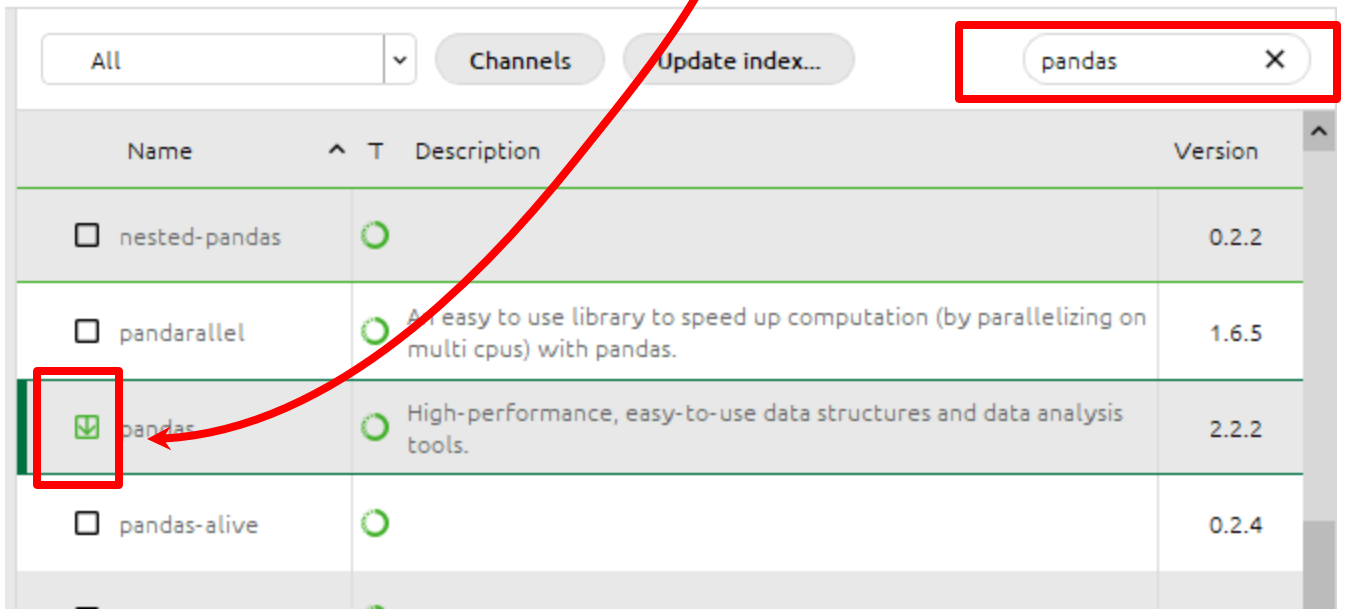
search for the libraries we need



Install libraries

search for the libraries we need

- search package name, then select the check box on the left of the name



- after selecting, you can search the next library name, then select that, and so on

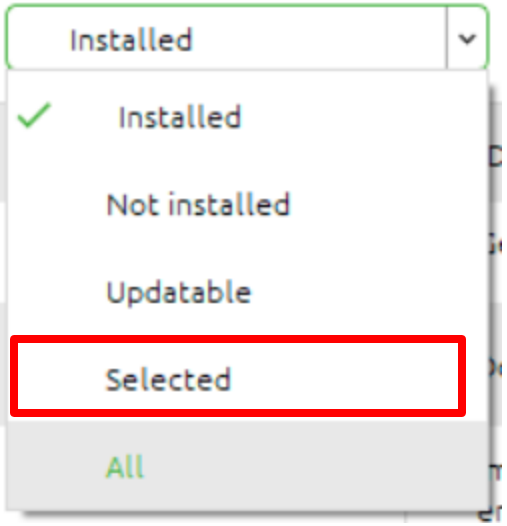
1. jupyter
2. scikit-learn
3. scikit-image
4. numpy
5. pandas
6. ipywidgets
7. matplotlib
8. seaborn
9. minisom
10. ydata-profiling

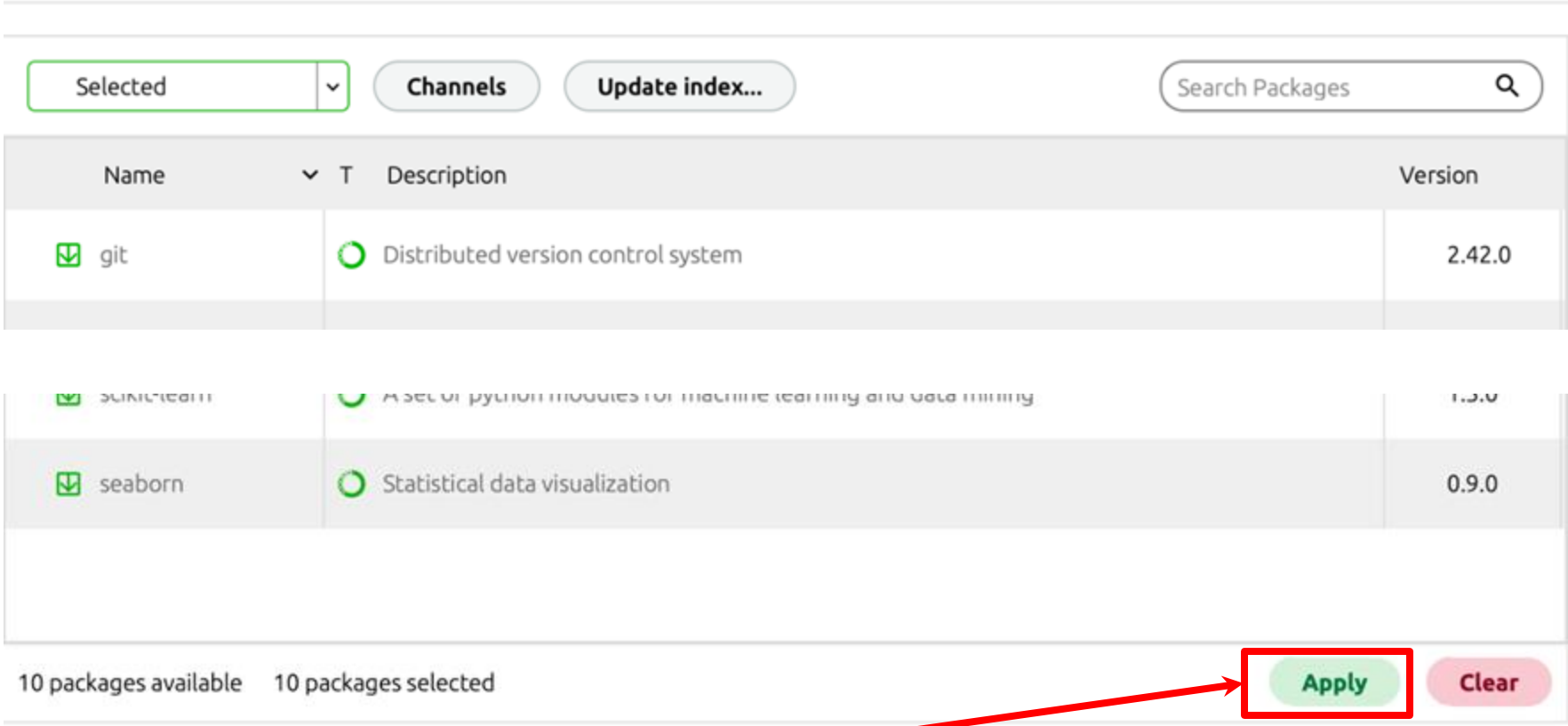
Install libraries

after searching and selecting everything on the list,

you can clear the search bar by clicking the ‘x’

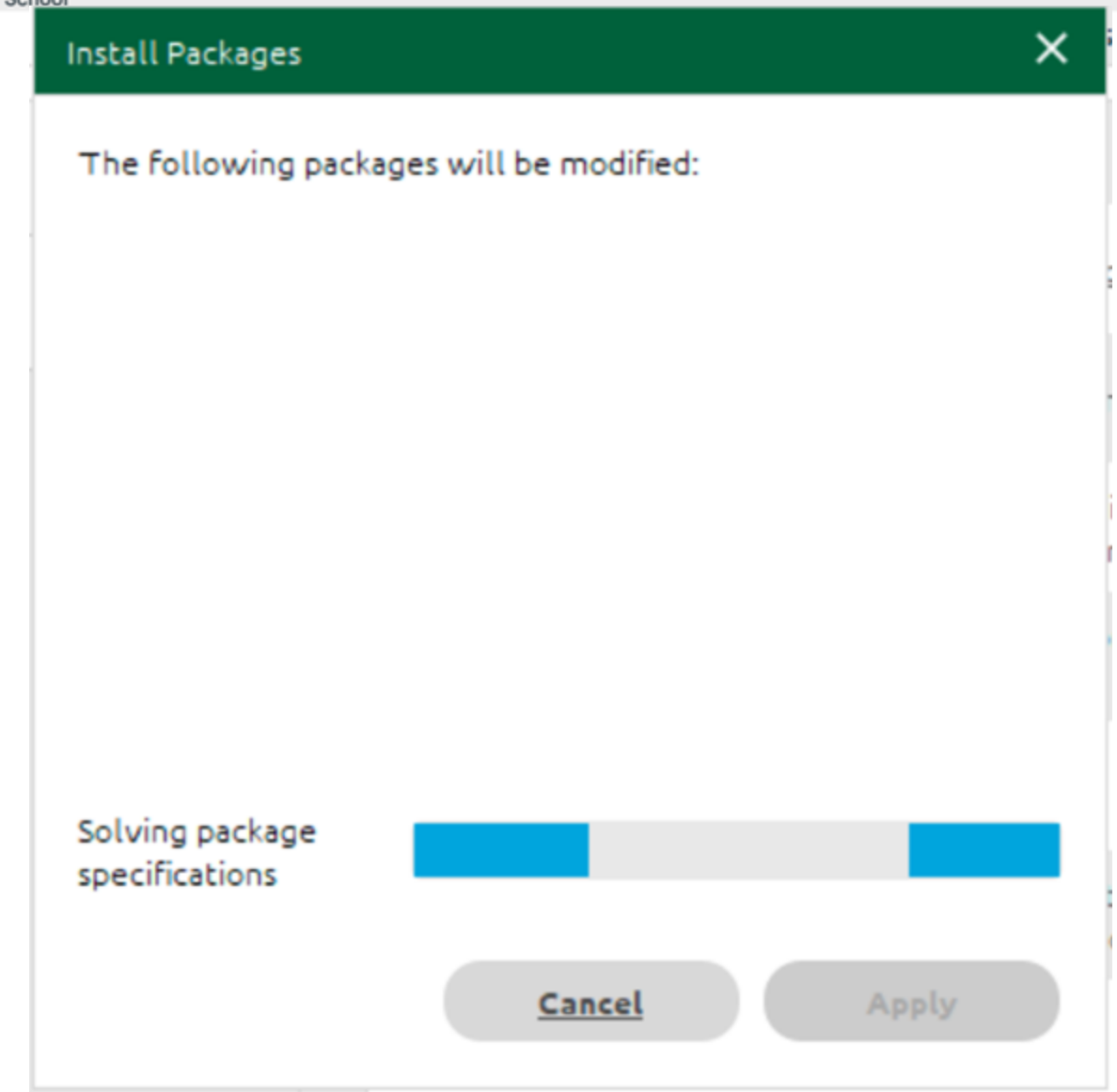
then filter the “Selected” option to see if you got everything

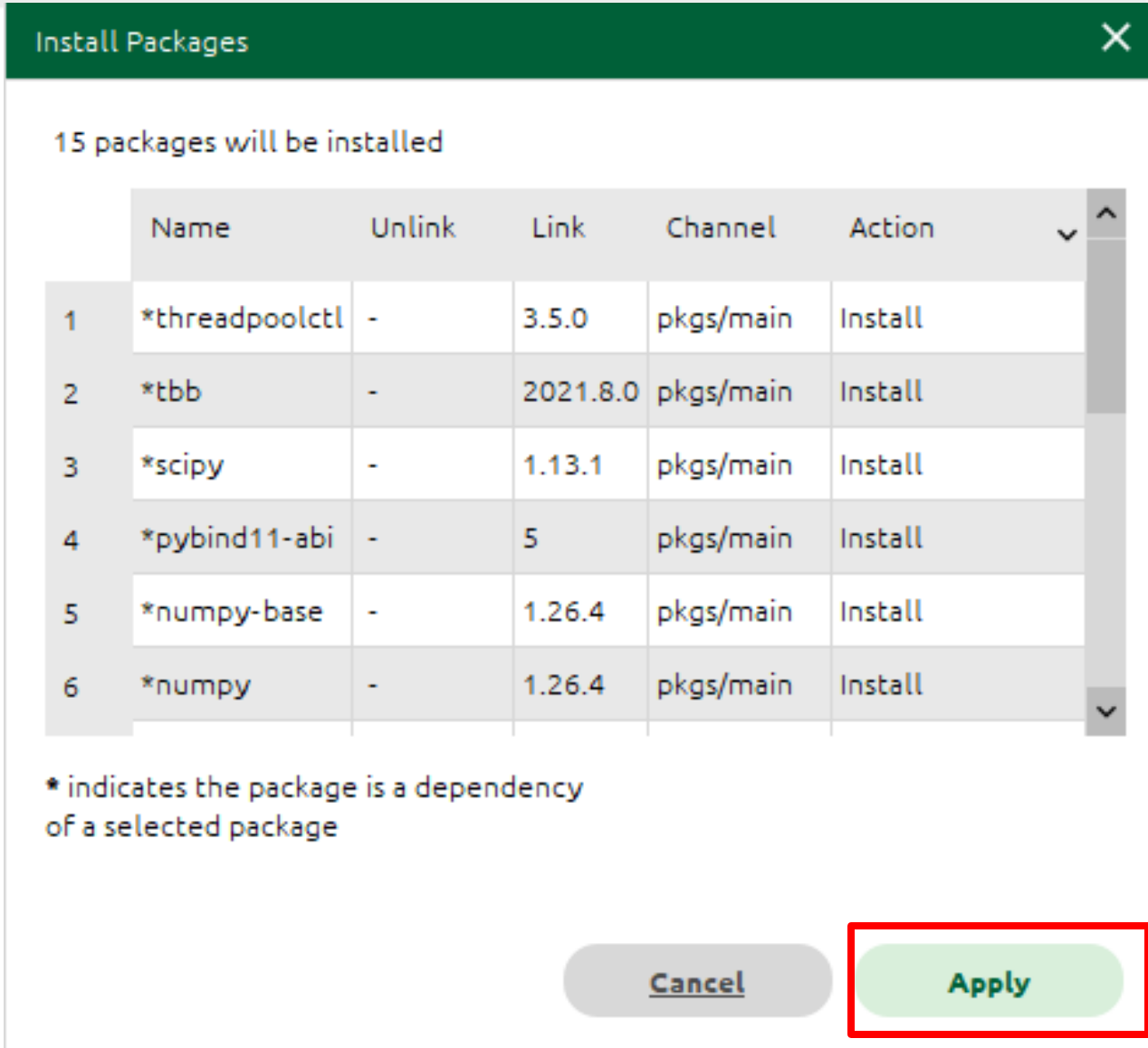




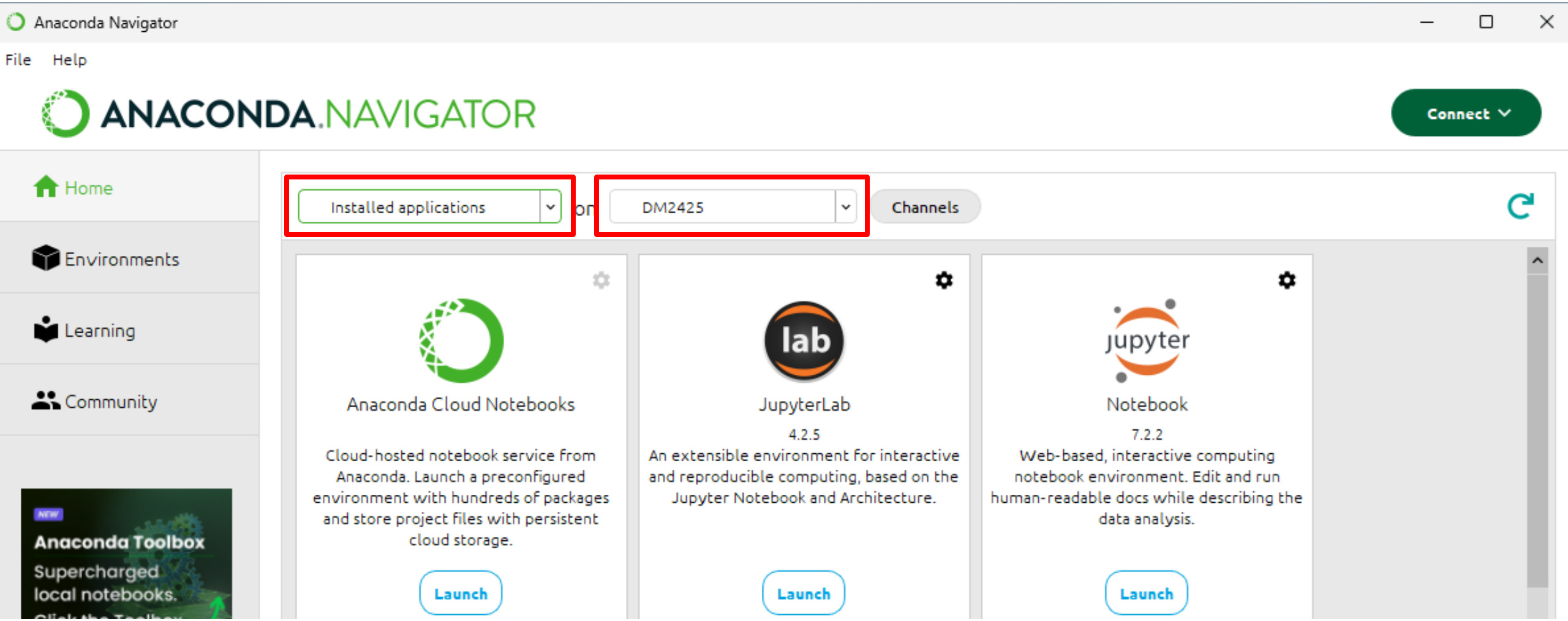
then click Apply

Install libraries





Go back to home



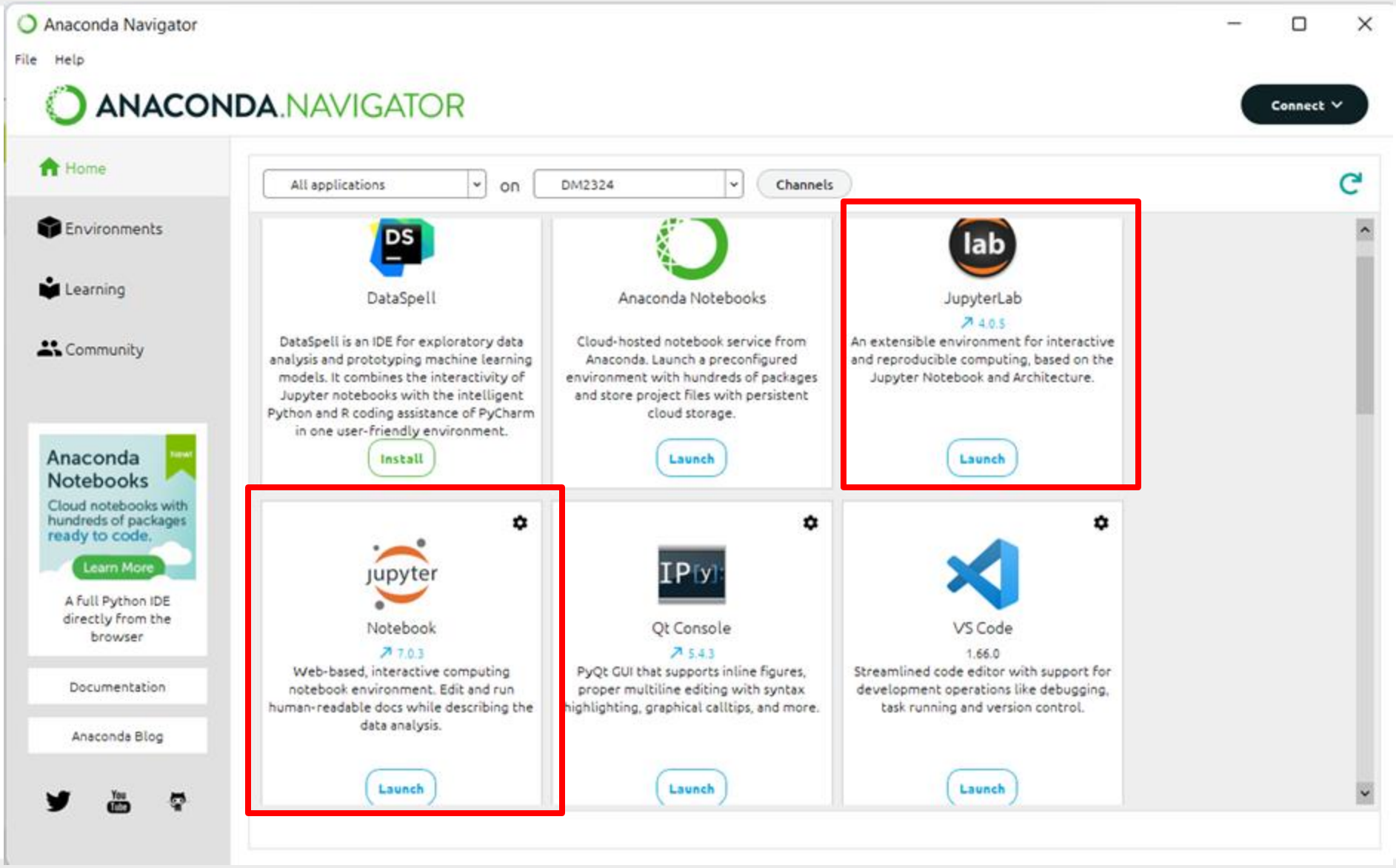
NOVA IMS Information Management School

Test Jupyter Notebook

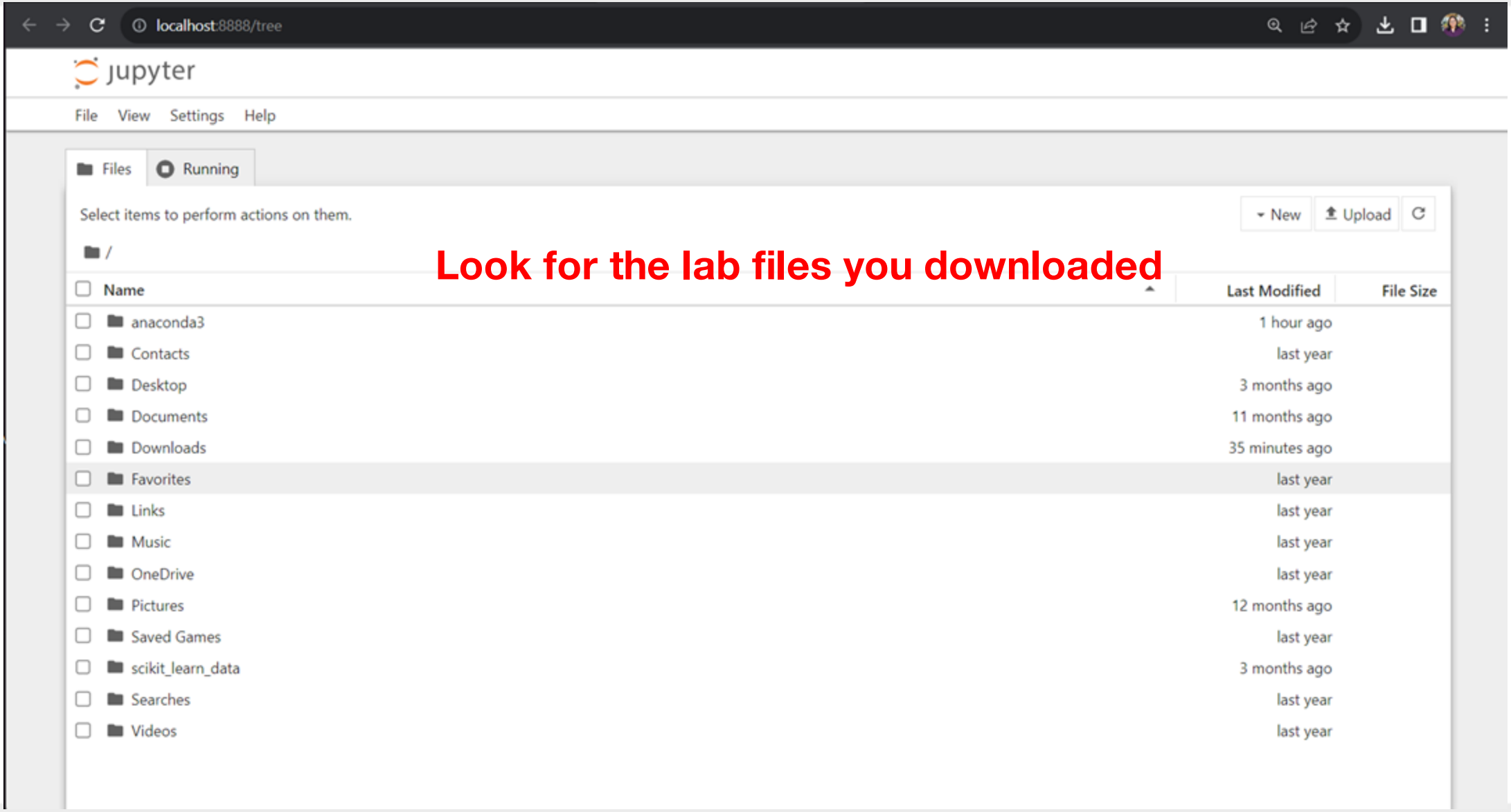
Test Jupyter notebook

Close all Terminal windows / Anaconda Navigator / Anaconda Prompt

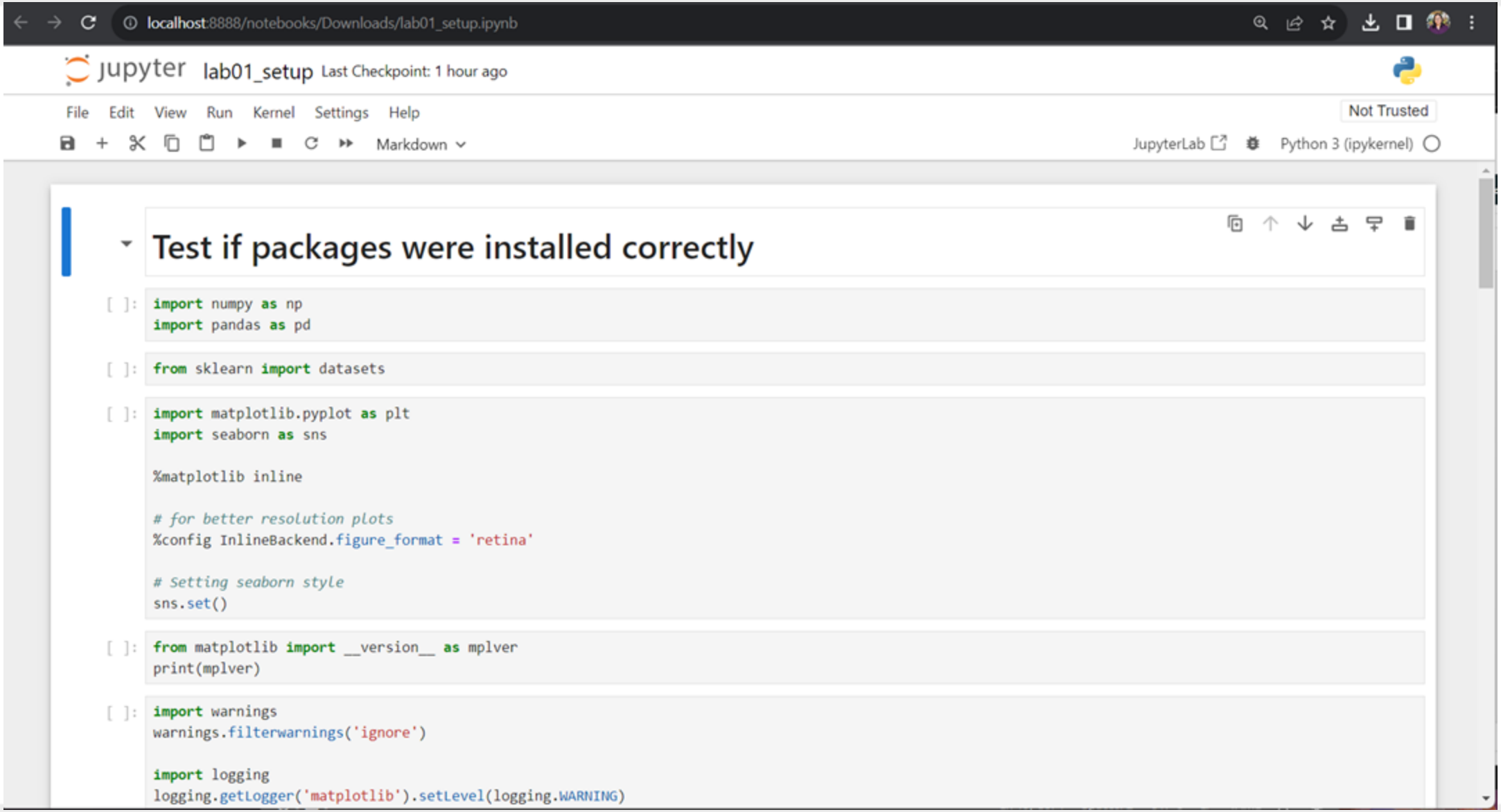
Test loading Jupyter notebook



Test loading Jupyter notebook



Load the lab01_setup.ipynb notebook file



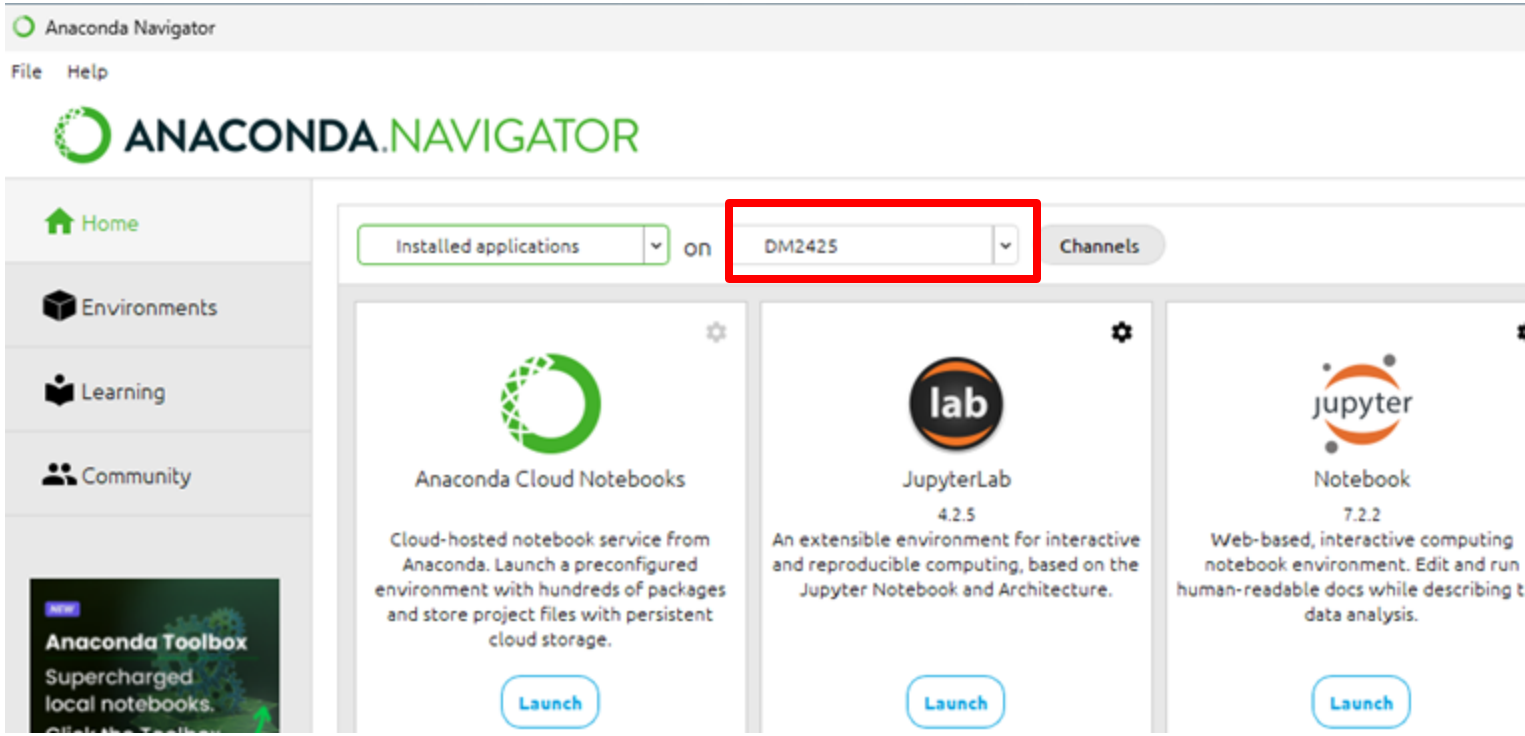
Don’t worry about understanding the code at this point

Right now we just want to make sure that all the packages we need are installed and work correctly

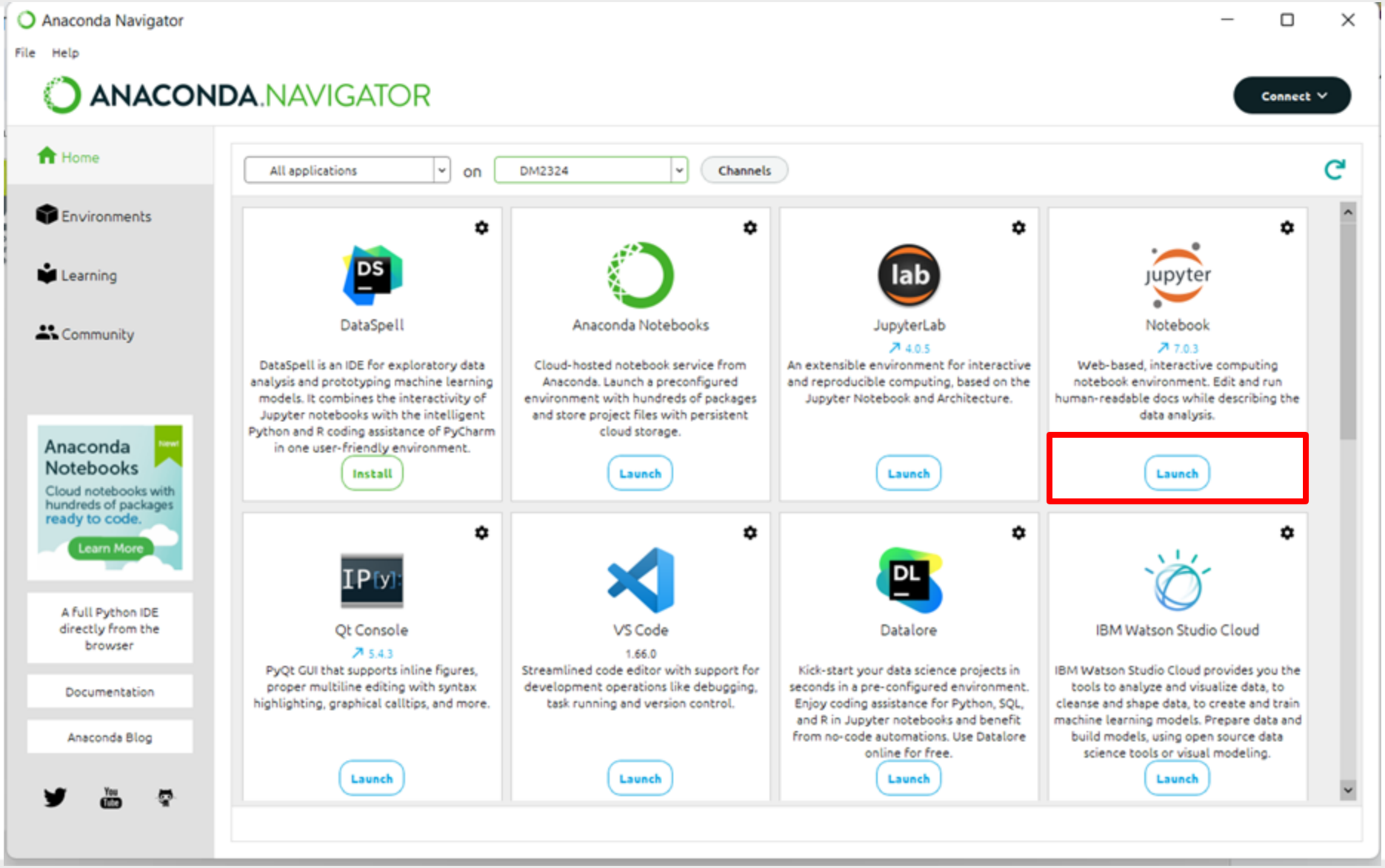
Test Jupyter notebook

Open Anaconda Navigator

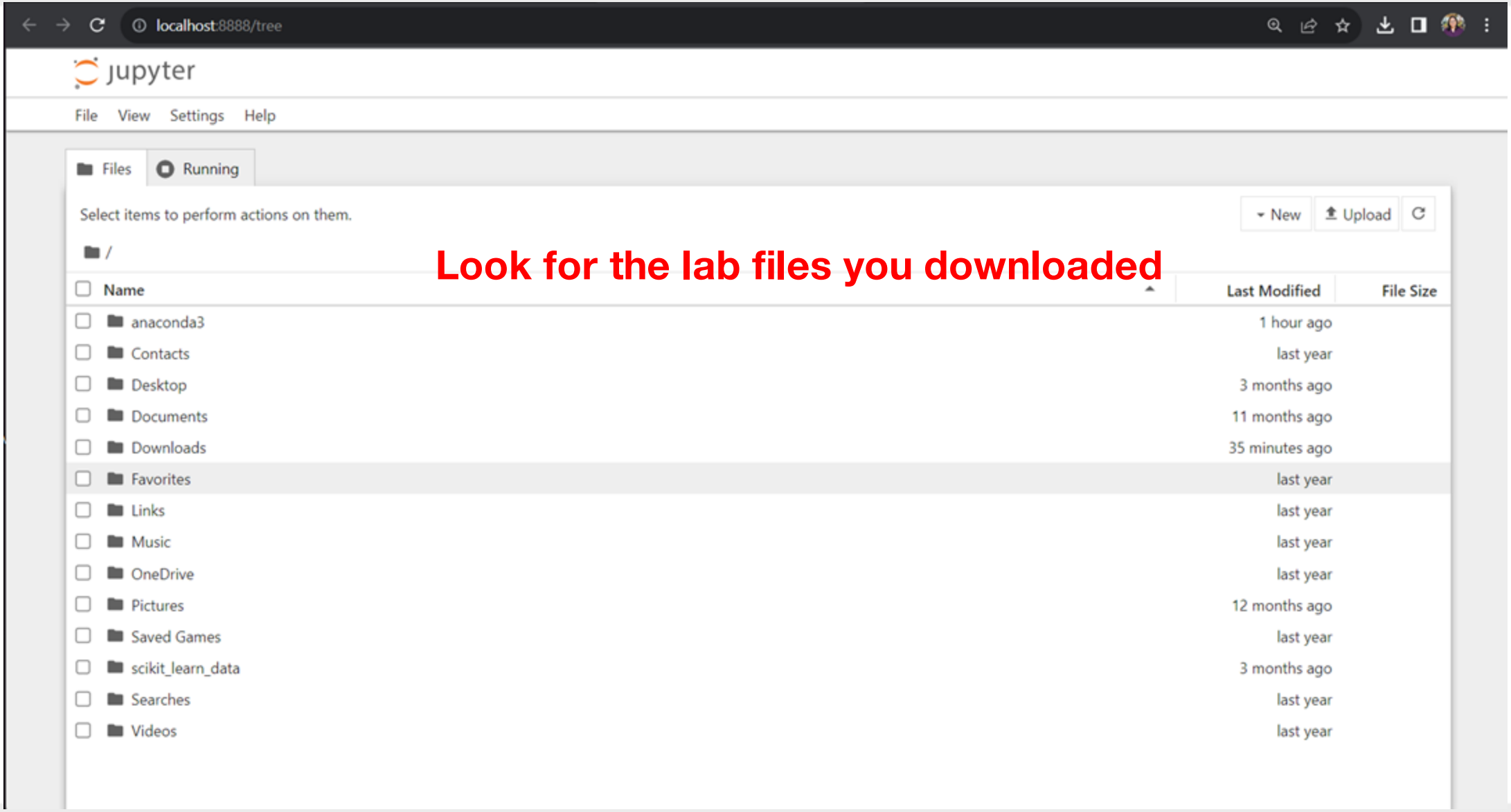
Make sure you select the environment we created



Test Jupyter notebook



Test Jupyter notebook



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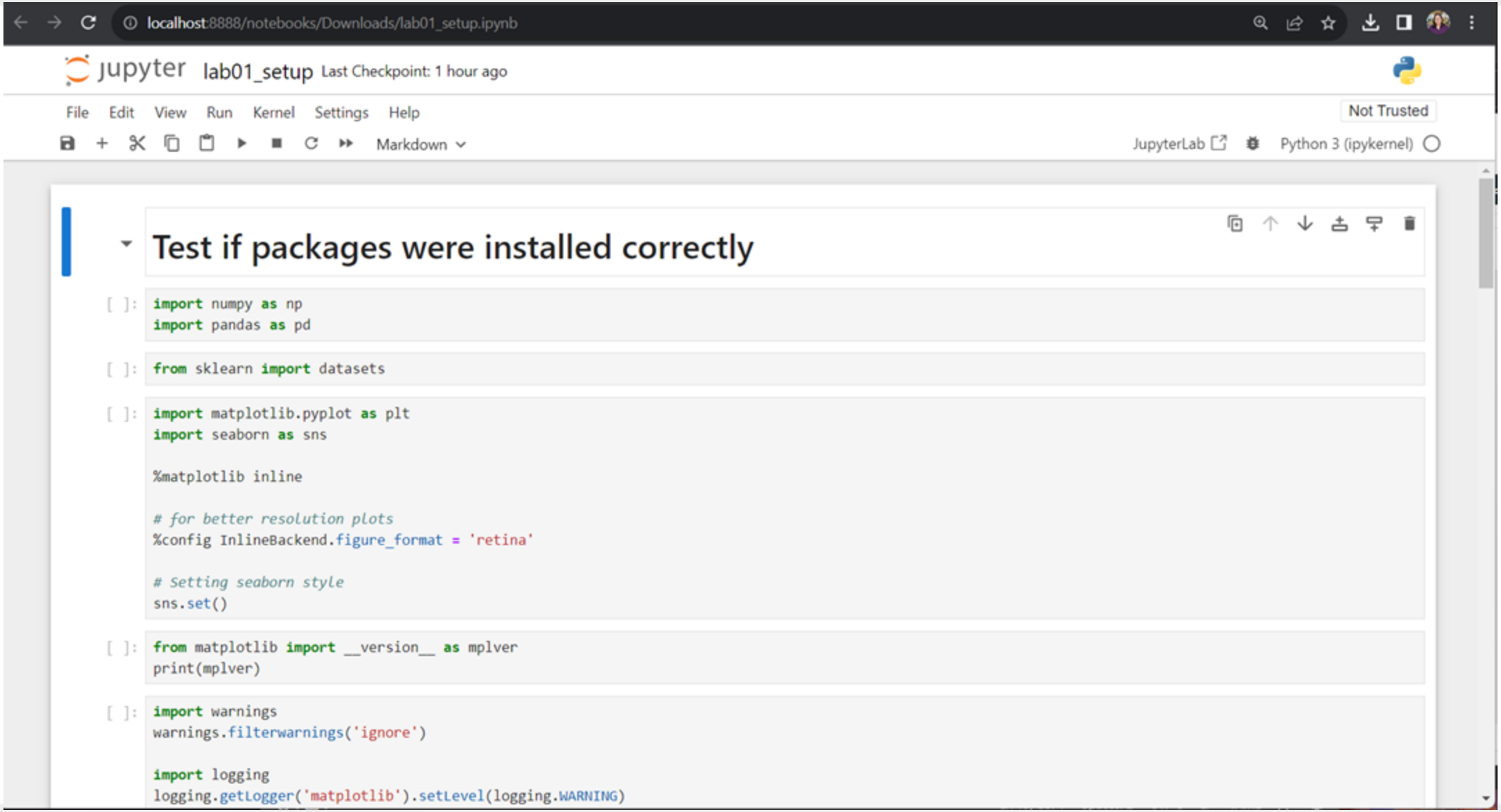
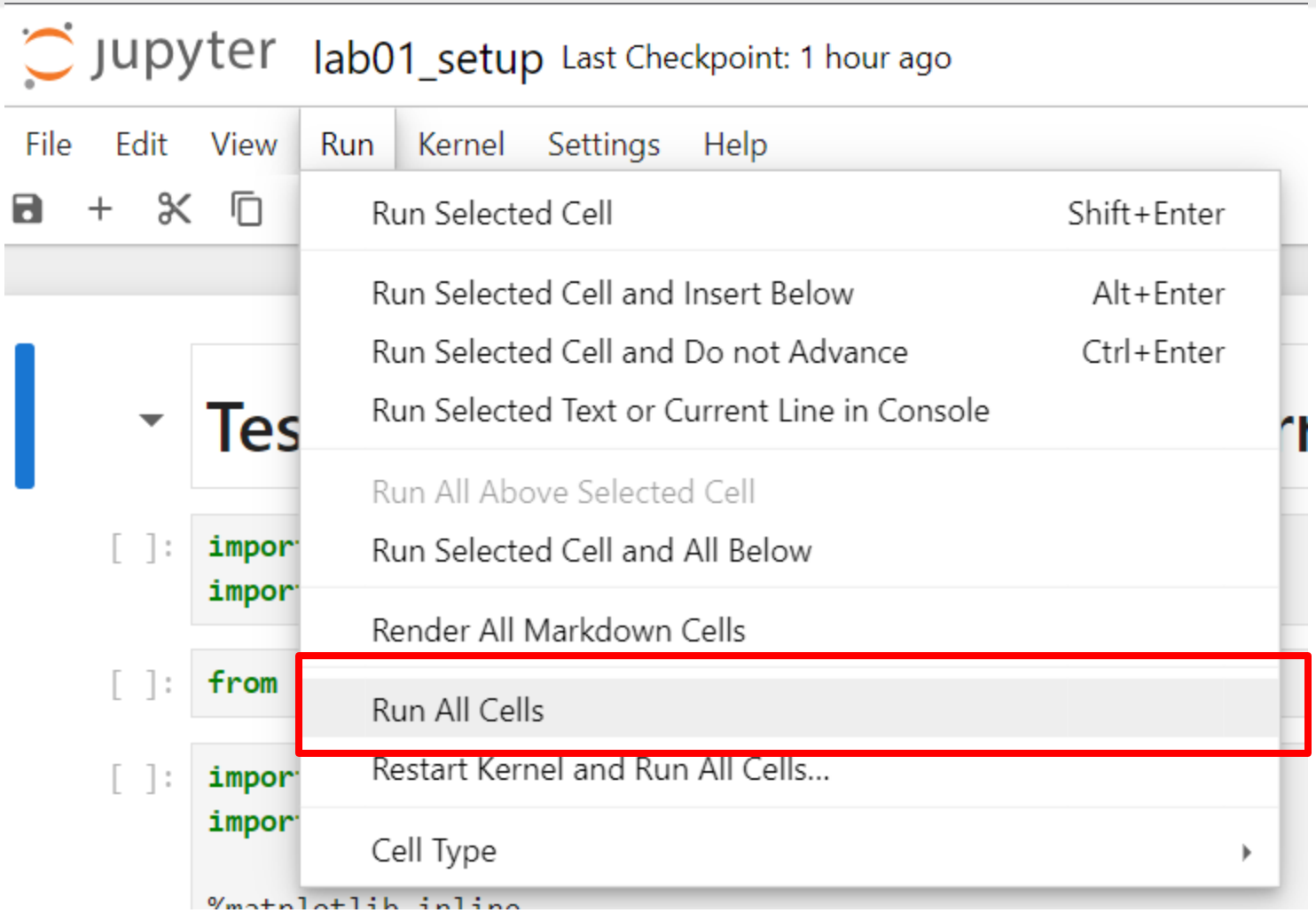
Right now we just want to make sure that all the packages we need are installed and work correctly

Load the notebook file



Run all cells



Does anyone still have any errors in the notebook?

Installing using command line

You can also use miniconda

instead of Anaconda Navigator

https://docs.anaconda.com/free/anaconda/getting-started/distro-or-miniconda/

Installing using the command line

Install miniconda

https://docs.conda.io/projects/miniconda/en/latest/#quick-command-line-install

Create environment using the command line

Windows: Open Anaconda Prompt (miniconda3)

Linux/Mac: Open Terminal

```
cd Downloads
conda env create -f fall2526_env.yml
conda activate Fall2526
```

Test Jupyter notebook + install other packages

Windows: Open Anaconda Prompt (miniconda3)

Linux/Mac: Open Terminal

```
conda activate Fall2526
jupyter notebook
```

Follow the instructions in previous slides for testing Jupyter notebook and installing additional packages

Let’s get started!
(for real)

Next:

Jupyter notebook

Distance Matrix

Questions?

Morada: Campus de Campolide, 1070-312 Lisboa, Portugal
Tel: +351 213 828 610 | Fax: +351 213 828 611

Acreditações e Certificações da NOVA IMS

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