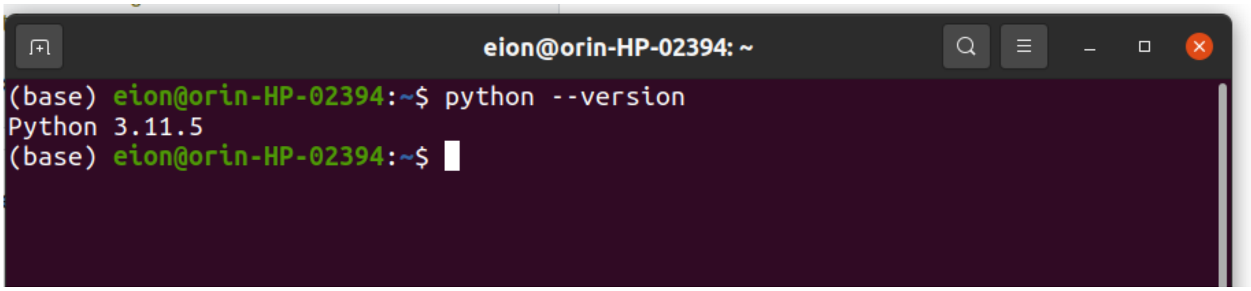
Installation Guide (Ubuntu 20.04 LTS)

0. Anaconda

- Follow the official guide https://docs.anaconda.com/free/anaconda/install/linux/

  - Python

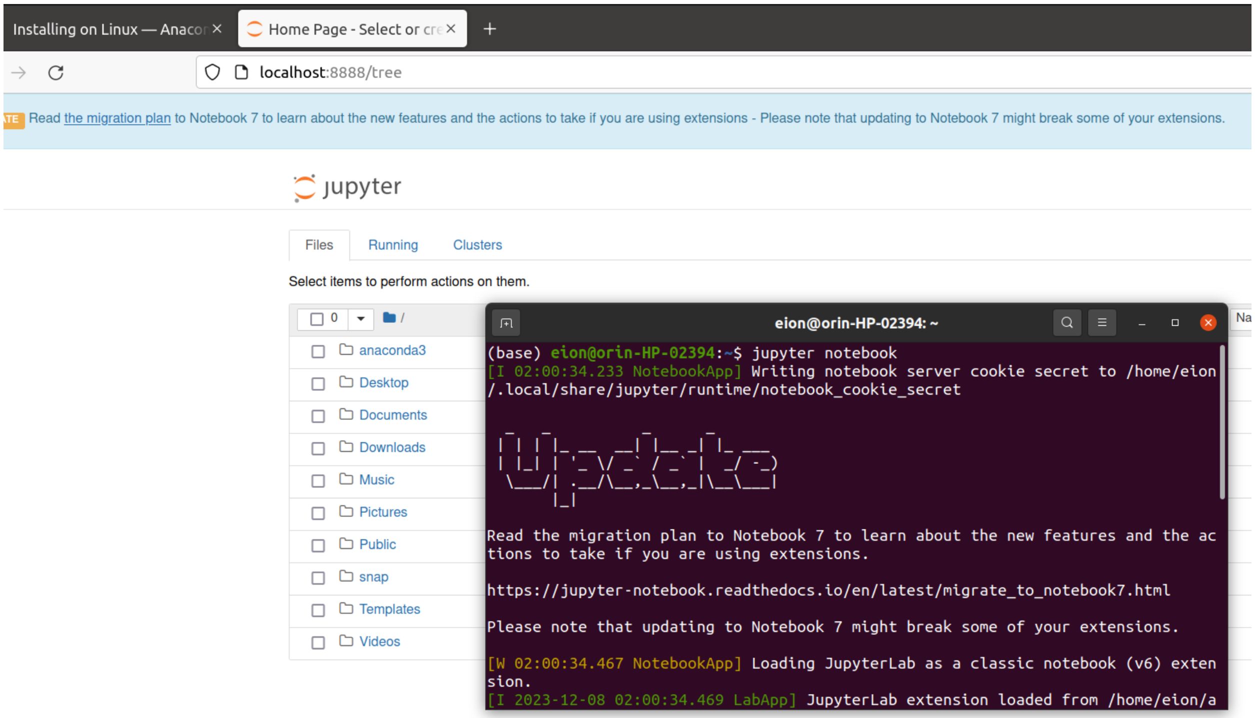


```
(base) eion@orin-HP-02394:~$ python --version
Python 3.11.5
(base) eion@orin-HP-02394:~$ 
```

Then run

```
Unset
conda update -n base conda -y
conda clean --all --yes
conda install pip -y
conda install ipykernel -y
```

- Jupyter Notebook



Read the migration plan to Notebook 7 to learn about the new features and the actions to take if you are using extensions - Please note that updating to Notebook 7 might break some of your extensions.

Select items to perform actions on them.

```
(base) eion@orin-HP-02394:~$ jupyter notebook
[I 02:00:34.233 NotebookApp] Writing notebook server cookie secret to /home/eion
/.local/share/jupyter/runtime/notebook_cookie_secret


  _   _          _      _
 | | | |_ __  __| |__ _| |_ ___
 | |_| | '_ \/ _` / _` |  _/ -_)
  \___/| .__/\__,_\__,_|\__\___|
       |_|

Read the migration plan to Notebook 7 to learn about the new features and the ac
tions to take if you are using extensions.

https://jupyter-notebook.readthedocs.io/en/latest/migrate_to_notebook7.html

Please note that updating to Notebook 7 might break some of your extensions.

[W 02:00:34.467 NotebookApp] Loading JupyterLab as a classic notebook (v6) exten
sion.
[I 2023-12-08 02:00:34.469 LabApp] JupyterLab extension loaded from /home/eion/a
```

FAQ:

1. Q: I installed anaconda, but I am not in the base environment and ‘conda activate’ does not work?
   A: You may have told conda not to modify your shell scripts, try running the following in terminal

Unset

```
eval "$(/home/$USER/anaconda3/bin/conda shell.bash hook)"
conda init
```

Now restart your terminal and you should be in the conda base environment.

Note: If you wish to not have conda activate the base environment by default when launching a new terminal:

Unset

```
conda config --set auto_activate_base false
```

1. Postgres + PgAdmin4

- PostgreSQL https://www.postgresql.org/
- PgAdmin4 https://www.pgadmin.org/download/

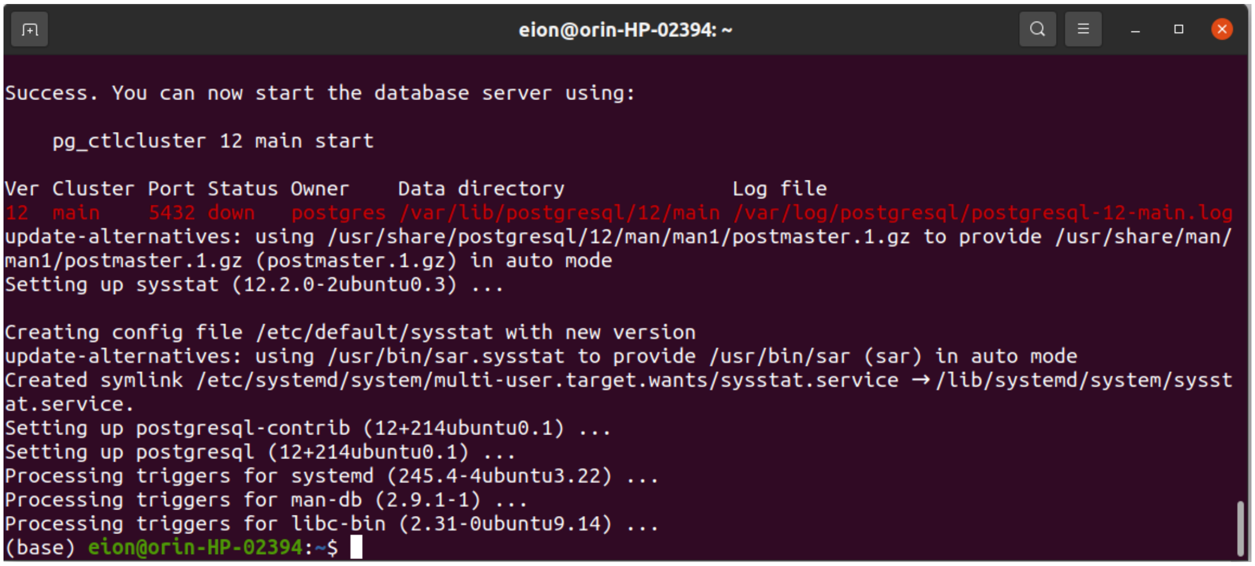
- Install PostgreSQL + PgAdmin4 Guide https://tecadmin.net/how-to-install-postgresql-in-ubuntu-20-04/
    - PostgreSQL installation is the first 3 steps.
        - Note this is not the only guide and particular PostgreSQL versions can be specified when running the install line by specifying postgresql-12, postgresql-14, etc.

      As additional confirmation in Step 1. of the guide, after you have added the PPA to your system and run the following lines in terminal:

Unset

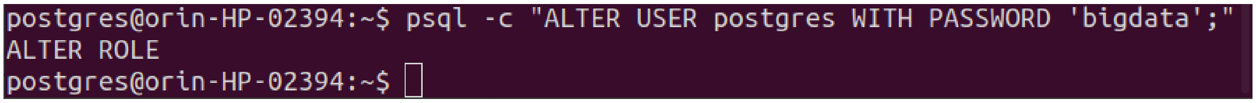
```
sudo apt update
sudo apt-get install postgresql postgresql-contrib
```

You should see something like this:



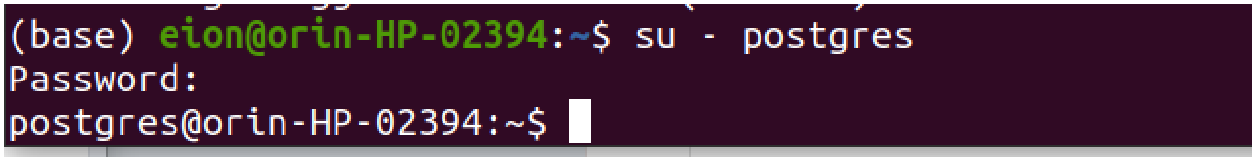
```
Success. You can now start the database server using:

    pg_ctlcluster 12 main start

Ver Cluster Port Status Owner    Data directory              Log file
12  main    5432 down   postgres /var/lib/postgresql/12/main /var/log/postgresql/postgresql-12-main.log
update-alternatives: using /usr/share/postgresql/12/man/man1/postmaster.1.gz to provide /usr/share/man/
man1/postmaster.1.gz (postmaster.1.gz) in auto mode
Setting up sysstat (12.2.0-2ubuntu0.3) ...

Creating config file /etc/default/sysstat with new version
update-alternatives: using /usr/bin/sar.sysstat to provide /usr/bin/sar (sar) in auto mode
Created symlink /etc/systemd/system/multi-user.target.wants/sysstat.service → /lib/systemd/system/sysst
at.service.
Setting up postgresql-contrib (12+214ubuntu0.1) ...
Setting up postgresql (12+214ubuntu0.1) ...
Processing triggers for systemd (245.4-4ubuntu3.22) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.14) ...
(base) eion@orin-HP-02394:~$
```

In Step 3, when setting the password, it is done from the Postgres system account an should look like the following



```
postgres@orin-HP-02394:~$ psql -c "ALTER USER postgres WITH PASSWORD 'bigdata';"
ALTER ROLE
postgres@orin-HP-02394:~$
```

Note that you are no longer at postgres=# or postgres-# .
To check that it worked, try logging back into postgres user with the new password.



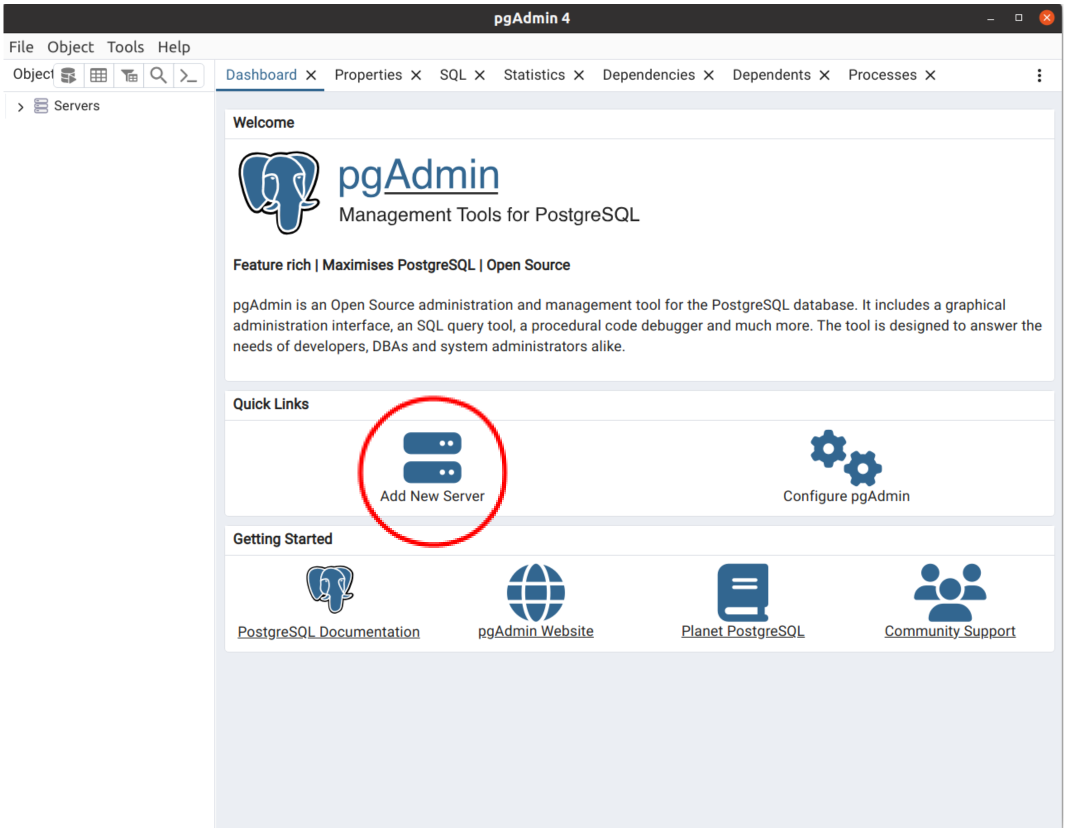
```
(base) eion@orin-HP-02394:~$ su - postgres
Password:
postgres@orin-HP-02394:~$
```

PgAdmin4 Installation is Step 4. Since we would like to use the PgAdmin4 gui, be sure to use either pgadmin4 for both the web and desktop versions or just pgadmin4-desktop

Unset

```
sudo apt update
sudo apt install pgadmin4   # or pgadmin4-desktop
```

Now open the PgAdmin4 desktop application, Add New Server, update the Connection tab to connect to your PostgreSQL Database server and save.


pgAdmin 4
File Object Tools Help
Object
Servers
Dashboard ✕ Properties ✕ SQL ✕ Statistics ✕ Dependencies ✕ Dependents ✕ Processes ✕

Welcome

pgAdmin

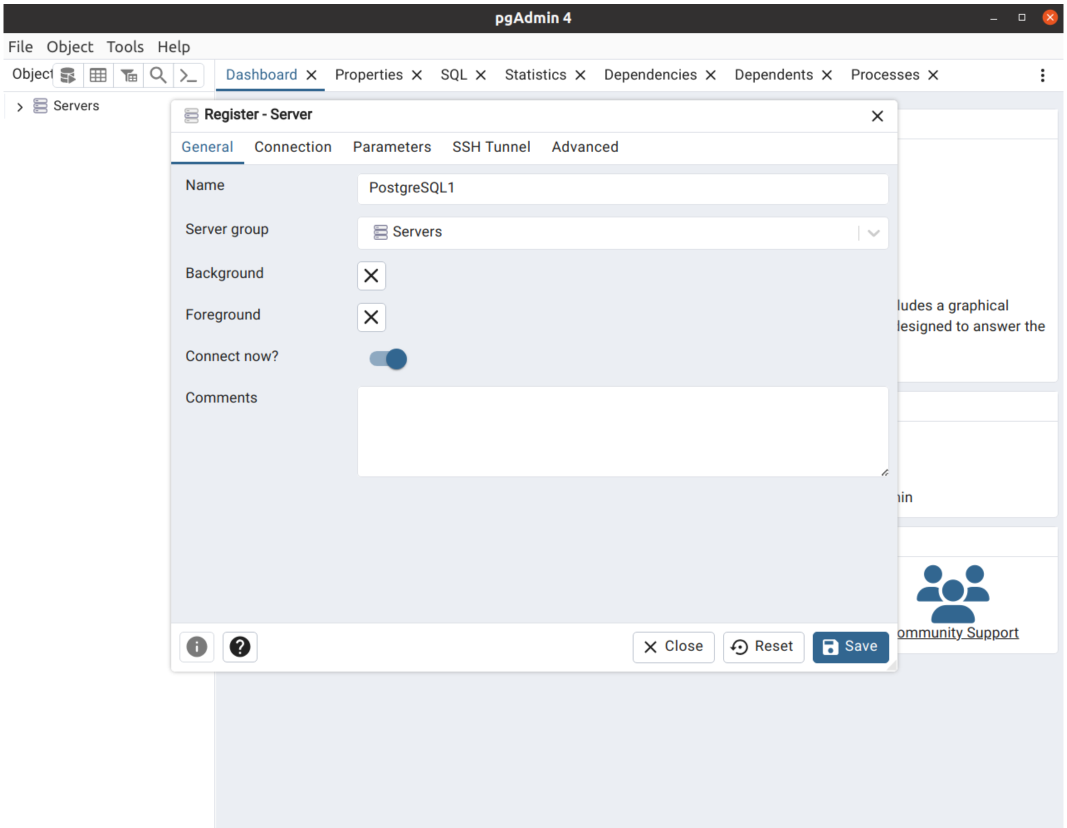
Management Tools for PostgreSQL

Feature rich | Maximises PostgreSQL | Open Source

pgAdmin is an Open Source administration and management tool for the PostgreSQL database. It includes a graphical administration interface, an SQL query tool, a procedural code debugger and much more. The tool is designed to answer the needs of developers, DBAs and system administrators alike.

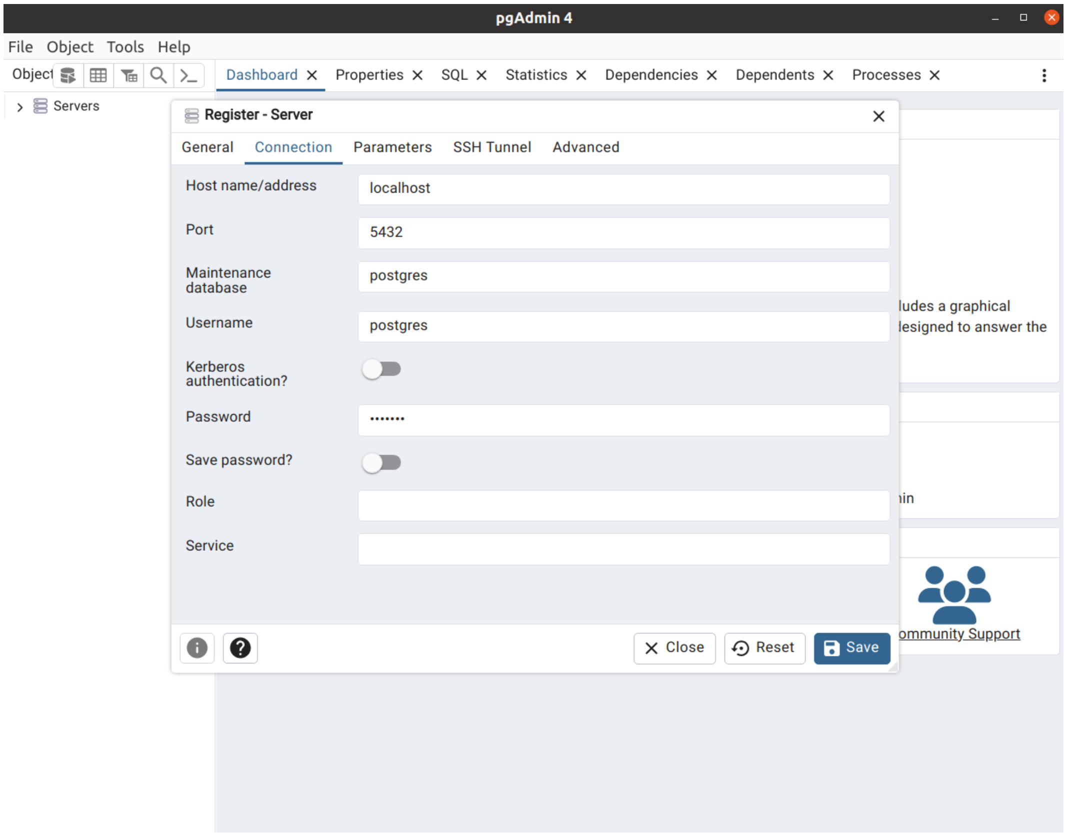
Quick Links

Getting Started



Register - Server

Name	PostgreSQL1
Server group	Servers
Background	☒
Foreground	☒
Connect now?	●
Comments	



Host name/address: localhost

Port: 5432

Maintenance database: postgres

Username: postgres

Kerberos authentication?

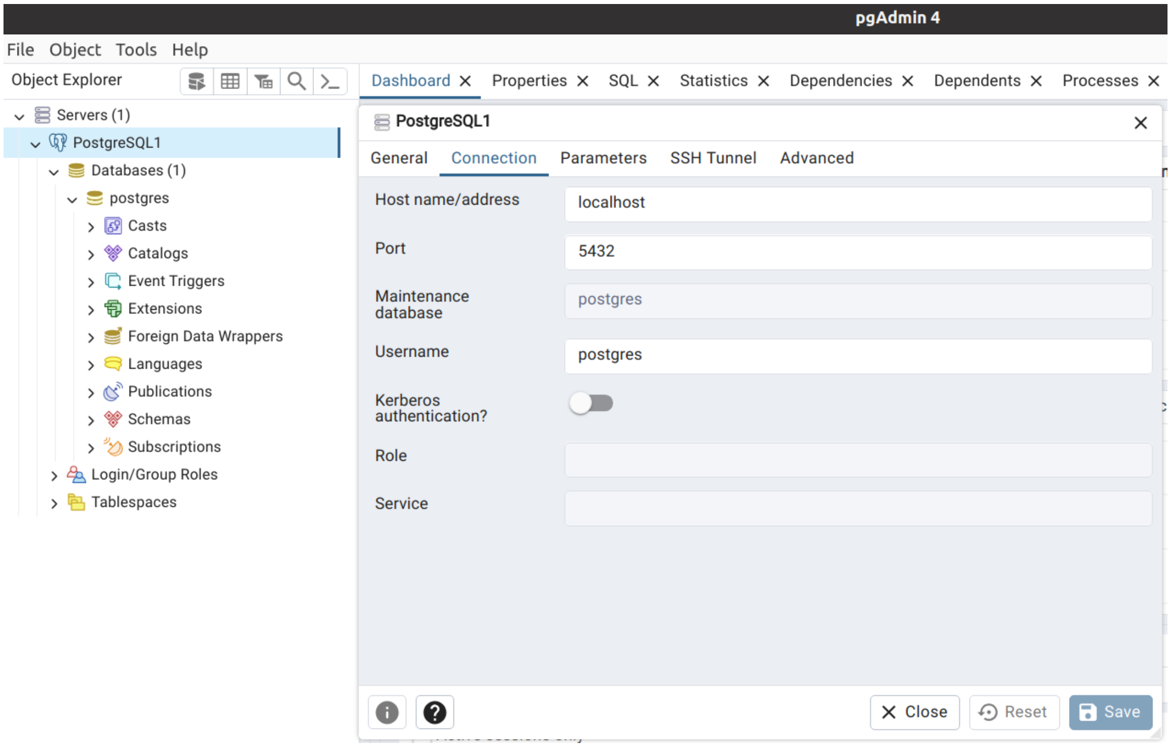
Password: •••••••

Save password?

Role:

Service:

Then right-click on your server, in my case PostgreSQL1, and view properties should look like this:



Host name/address: localhost

Port: 5432

Maintenance database: postgres

Username: postgres

Kerberos authentication?

Role:

Service:

2. Apache Spark https://spark.apache.org/

- For a detailed guide on installing Apache Spark and PySpark on Ubuntu 20.04, I recommend the following videos (Note this guide is using Python 3.7 for Apache Spark 2.4.4, the steps will be similar with other Python versions, however you will need to reference the apache docs for compatibility with your desired version/environment):
    - Apache Spark Docs [Latest]: https://spark.apache.org/docs/latest/
        - Remove latest from the url path to see all available docs
    - Part 1a https://www.youtube.com/watch?v=7tDOUrI7Aoc
    - Part 1b https://www.youtube.com/watch?v=snZvQcI2HfQ

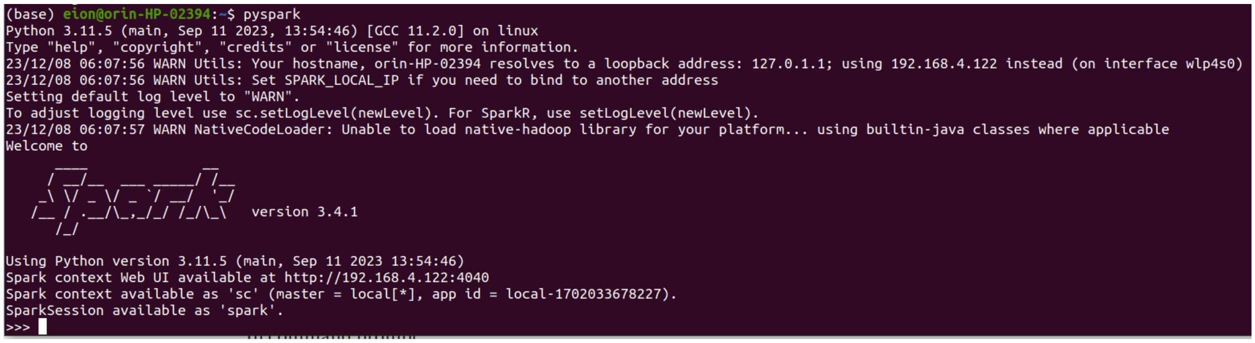
- For Python 3.8+ PySpark can also be installed using PyPi or Conda (see https://spark.apache.org/docs/latest/api/python/getting_started/install.html)
    - However, Java (openjdk) must be installed first and findspark after.
    - Since Conda was likely installed in step 0. above, a quick guide for PySpark installation in Conda with verification can be found here: https://medium.com/@divya.chandana/easy-install-pyspark-in-anaconda-e2d427b3492f

From your base Conda environment in terminal,

Unset

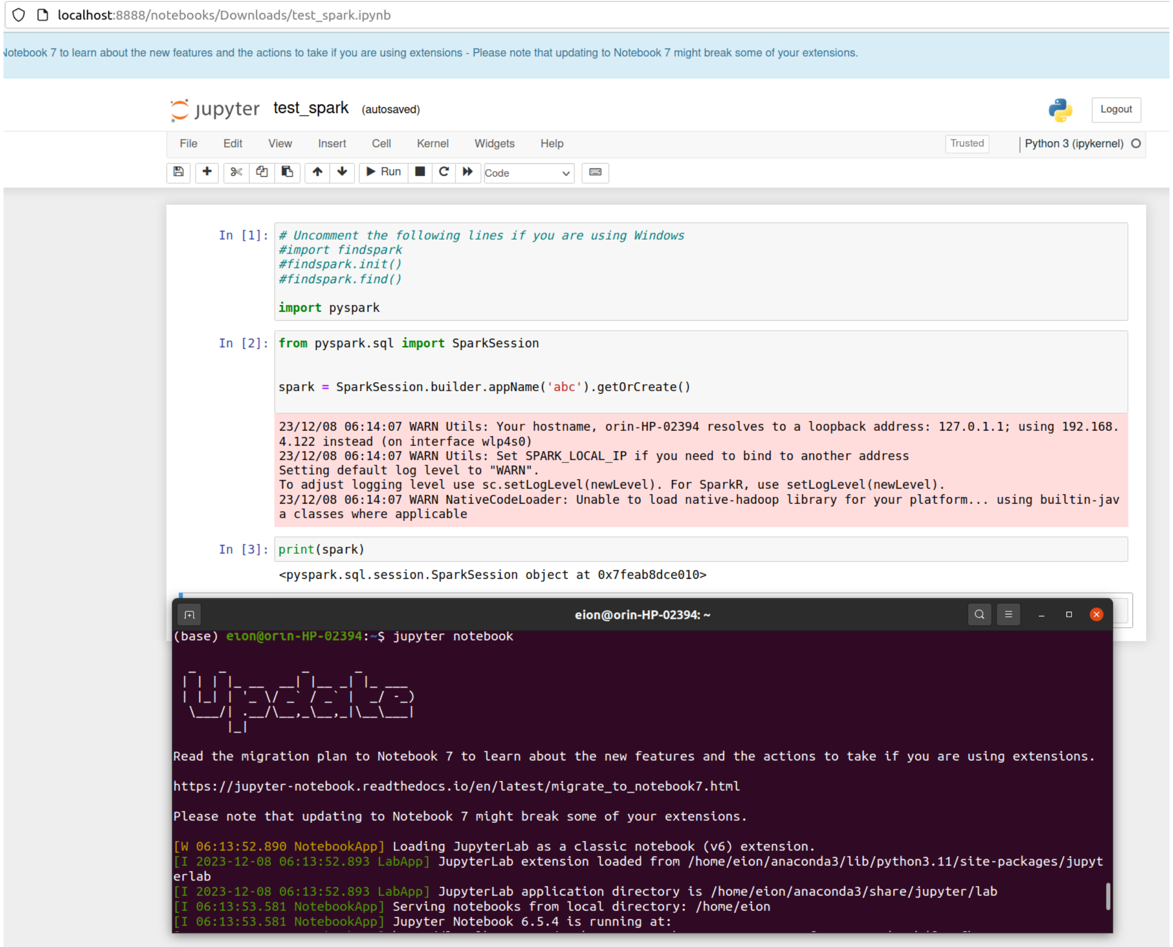
```
# From (base) Conda environment
conda install openjdk
conda install pyspark
conda install -c conda-forge findspark
```

Running ‘pyspark’ you should now see that you can start a SparkSession:



```
(base) eion@orin-HP-02394:~$ pyspark
Python 3.11.5 (main, Sep 11 2023, 13:54:46) [GCC 11.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
23/12/08 06:07:56 WARN Utils: Your hostname, orin-HP-02394 resolves to a loopback address: 127.0.1.1; using 192.168.4.122 instead (on interface wlp4s0)
23/12/08 06:07:56 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
23/12/08 06:07:57 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /__ / .__/\_,_/_/ /_/\_\   version 3.4.1
      /_/

Using Python version 3.11.5 (main, Sep 11 2023 13:54:46)
Spark context Web UI available at http://192.168.4.122:4040
Spark context available as 'sc' (master = local[*], app id = local-1702033678227).
SparkSession available as 'spark'.
>>> 
```

Once PySpark has been successfully installed, launch jupyter notebook and run the test_spark.ipynb. You should be able to import the pyspark module and build a SparkSession.



localhost:8888/notebooks/Downloads/test_spark.ipynb
Notebook 7 to learn about the new features and the actions to take if you are using extensions - Please note that updating to Notebook 7 might break some of your extensions.
jupyter
test_spark
(autosaved)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3 (ipykernel)
Run
Code

```
In [1]: # Uncomment the following lines if you are using Windows
        #import findspark
        #findspark.init()
        #findspark.find()

        import pyspark

In [2]: from pyspark.sql import SparkSession


        spark = SparkSession.builder.appName('abc').getOrCreate()

        23/12/08 06:14:07 WARN Utils: Your hostname, orin-HP-02394 resolves to a loopback address: 127.0.1.1; using 192.168.
        4.122 instead (on interface wlp4s0)
        23/12/08 06:14:07 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
        Setting default log level to "WARN".
        To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
        23/12/08 06:14:07 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-jav
        a classes where applicable

In [3]: print(spark)

        <pyspark.sql.session.SparkSession object at 0x7feab8dce010>
```

```
(base) eion@orin-HP-02394:~$ jupyter notebook

 _   _          _       _
| | | |_ __  __| |__ _| |_ ___
| |_| | '_ \/ _` / _` |  _/ -_)
 \___/| .__/\__,_\__,_|\__\___|
      |_|

Read the migration plan to Notebook 7 to learn about the new features and the actions to take if you are using extensions.

https://jupyter-notebook.readthedocs.io/en/latest/migrate_to_notebook7.html

Please note that updating to Notebook 7 might break some of your extensions.

[W 06:13:52.890 NotebookApp] Loading JupyterLab as a classic notebook (v6) extension.
[I 2023-12-08 06:13:52.893 LabApp] JupyterLab extension loaded from /home/eion/anaconda3/lib/python3.11/site-packages/jupyt
erlab
[I 2023-12-08 06:13:52.893 LabApp] JupyterLab application directory is /home/eion/anaconda3/share/jupyter/lab
[I 06:13:53.581 NotebookApp] Serving notebooks from local directory: /home/eion
[I 06:13:53.581 NotebookApp] Jupyter Notebook 6.5.4 is running at:
```

3, 4. PyTorch & TensorFlow

When installing PyTorch and Tensorflow, if you intend on using the gpu versions, you have several options to consider. If you don't intend on using them together you may opt for installing them in individual conda/virtual environments/docker containers to avoid conflicting CUDA and cuDNN requirements. Alternatively, you could install PyTorch and TensorFlow which have the same CUDA and cuDNN requirements, by either installing both versions you want and using the appropriate version of CUDA and cuDNN for each library by specifying the correct environment variables, or you could run both with a CUDA version of the minimum requirement like installing TensorFlow with Cuda 11.2 and PyTorch for 11.6, but running entirely on 11.2, but this is not intended and can cause problems. For now I will demonstrate installing Pytorch and TensorFlow in separate conda environments. AMD GPU and CPU versions are also available for both.

Python, CUDA/cuDNN (Nvidia), ROCm (AMD) Compatibility:

- TensorFlow
    - (Nvidia) https://www.tensorflow.org/install/source#tested_build_configurations
    - (ROCm + ROCm install) https://github.com/ROCmSoftwarePlatform/tensorflow-upstream/blob/develop-upstream/rocm_docs/tensorflow-rocm-release.md

- PyTorch https://github.com/pytorch/pytorch/blob/main/RELEASE.md

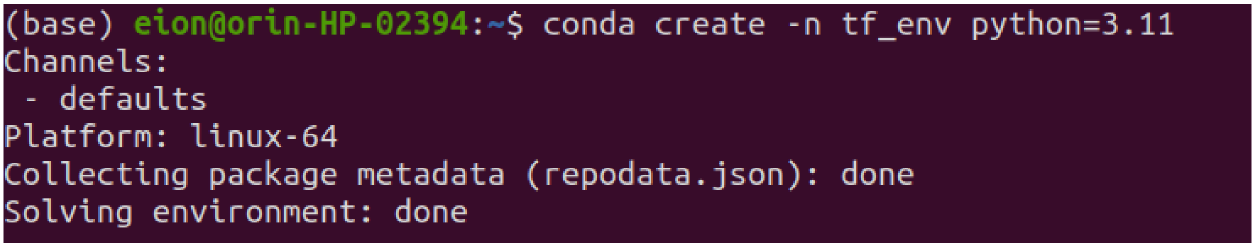
Both installations can be performed with pip, conda, or built from source. pip/pip3 is often preferred.

CPU/GPU Installation Documentation:

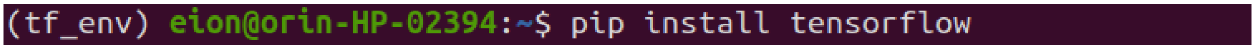
- TensorFlow https://www.tensorflow.org/install
    - https://www.tensorflow.org/install/pip#step-by-step_instructions
- PyTorch https://pytorch.org/get-started/locally/
    - https://pytorch.org/get-started/previous-versions/
- CUDA https://docs.nvidia.com/cuda/cuda-toolkit-release-notes/index.html
    - Version Specific Documentation & Downloads https://developer.nvidia.com/cuda-toolkit-archive
        - Select your desired package documentation and go to section 2. Perform Pre-installation Actions (Highly Recommended)
- cuDNN https://docs.nvidia.com/cudnn/index.html
    - Version Specific Documentation & Downloads https://developer.nvidia.com/rdp/cudnn-archive

- **CPU Version Installations**

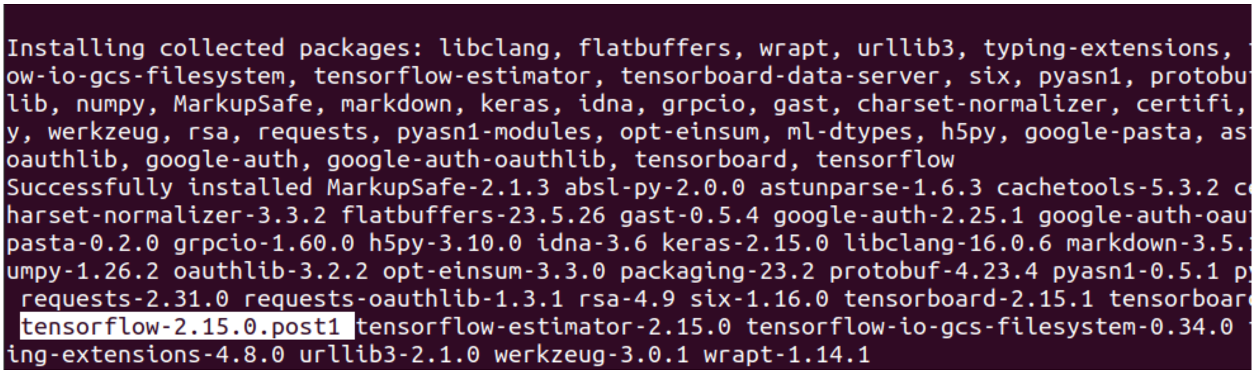
In the simplest case TensorFlow installation will look as follow:



```
(base) eion@orin-HP-02394:~$ conda create -n tf_env python=3.11
Channels:
 - defaults
Platform: linux-64
Collecting package metadata (repodata.json): done
Solving environment: done
```



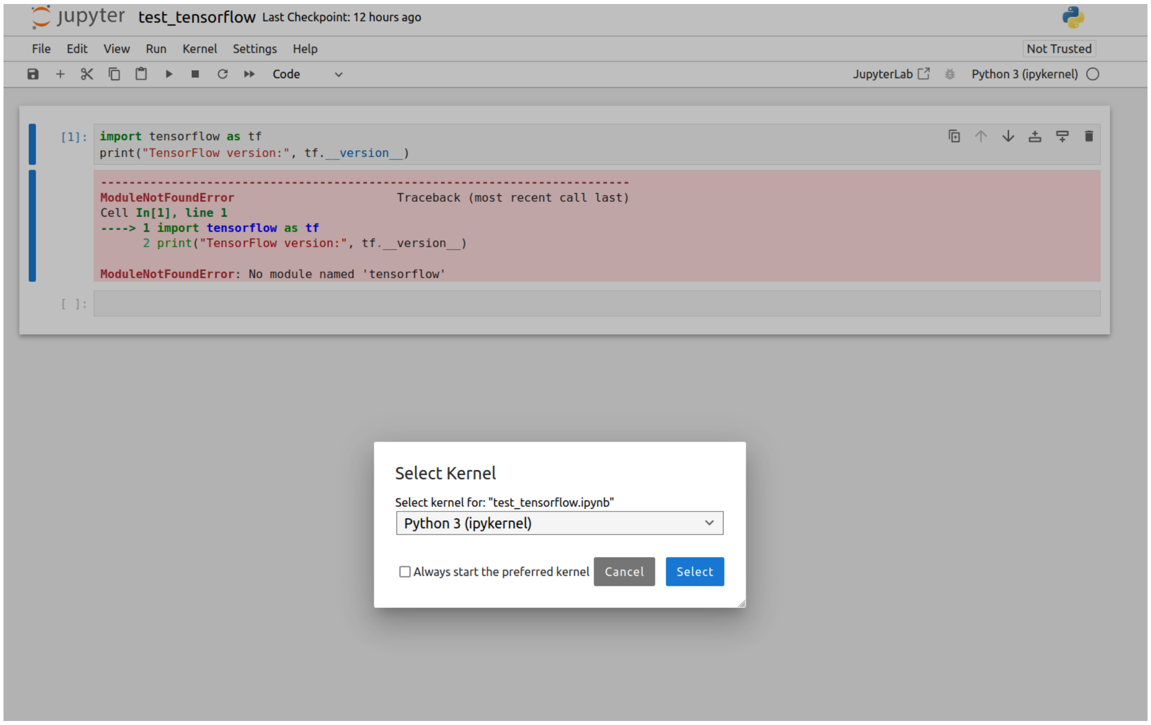
```
(tf_env) eion@orin-HP-02394:~$ pip install tensorflow
```



```
Installing collected packages: libclang, flatbuffers, wrapt, urllib3, typing-extensions,
ow-io-gcs-filesystem, tensorflow-estimator, tensorboard-data-server, six, pyasn1, protobu
lib, numpy, MarkupSafe, markdown, keras, idna, grpcio, gast, charset-normalizer, certifi,
y, werkzeug, rsa, requests, pyasn1-modules, opt-einsum, ml-dtypes, h5py, google-pasta, as
oauthlib, google-auth, google-auth-oauthlib, tensorboard, tensorflow
Successfully installed MarkupSafe-2.1.3 absl-py-2.0.0 astunparse-1.6.3 cachetools-5.3.2 c
harset-normalizer-3.3.2 flatbuffers-23.5.26 gast-0.5.4 google-auth-2.25.1 google-auth-oau
pasta-0.2.0 grpcio-1.60.0 h5py-3.10.0 idna-3.6 keras-2.15.0 libclang-16.0.6 markdown-3.5.
umpy-1.26.2 oauthlib-3.2.2 opt-einsum-3.3.0 packaging-23.2 protobuf-4.23.4 pyasn1-0.5.1 p
 requests-2.31.0 requests-oauthlib-1.3.1 rsa-4.9 six-1.16.0 tensorboard-2.15.1 tensorboar
 tensorflow-2.15.0.post1 tensorflow-estimator-2.15.0 tensorflow-io-gcs-filesystem-0.34.0
ing-extensions-4.8.0 urllib3-2.1.0 werkzeug-3.0.1 wrapt-1.14.1
```

You can now run the following to use this conda environment in your jupyter notebook,

Unset
```
conda install -c anaconda ipykernel
python -m ipykernel install --user --name=tf_env
```



jupyter test_tensorflow Last Checkpoint: 12 hours ago
File Edit View Run Kernel Settings Help
Not Trusted
Code
JupyterLab
Python 3 (ipykernel)

```
[1]: import tensorflow as tf
     print("TensorFlow version:", tf.__version__)

     ---------------------------------------------------------------------------
     ModuleNotFoundError                       Traceback (most recent call last)
     Cell In[1], line 1
     ----> 1 import tensorflow as tf
           2 print("TensorFlow version:", tf.__version__)

     ModuleNotFoundError: No module named 'tensorflow'
[ ]:
```

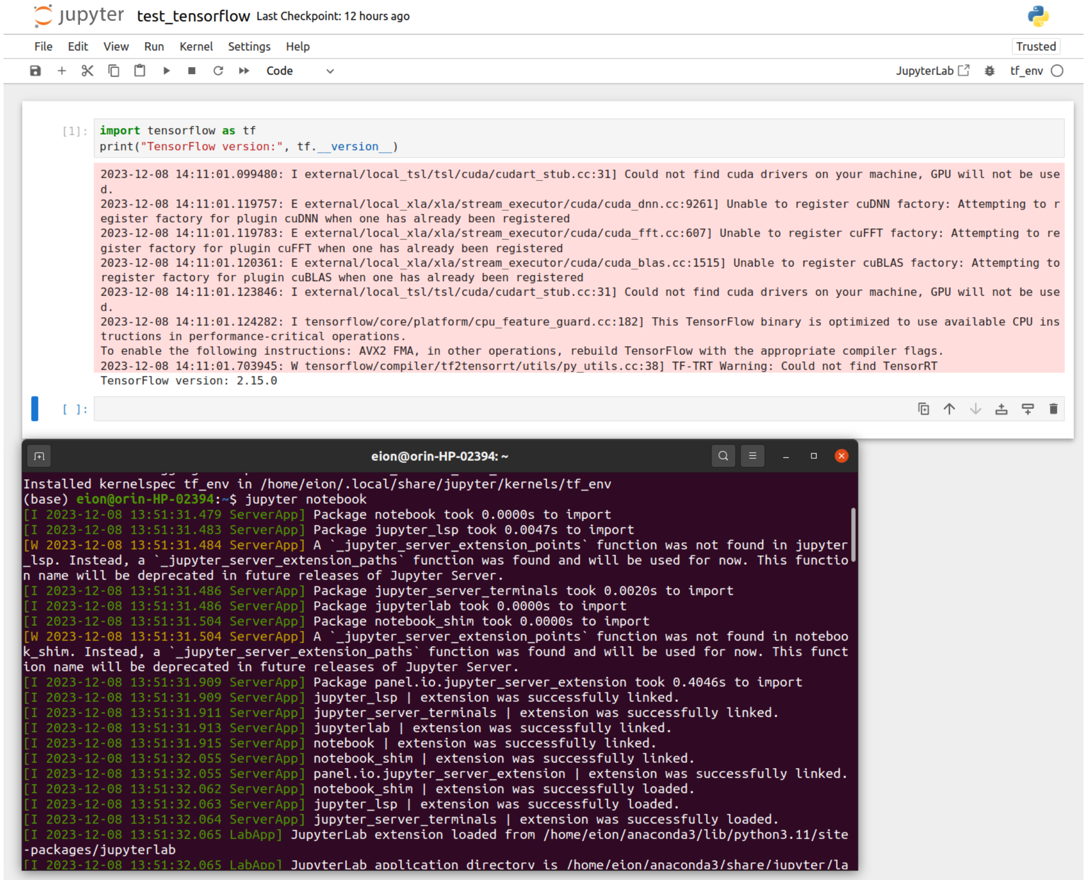
Select Kernel

Select kernel for: "test_tensorflow.ipynb"

Python 3 (ipykernel)

□ Always start the preferred kernel

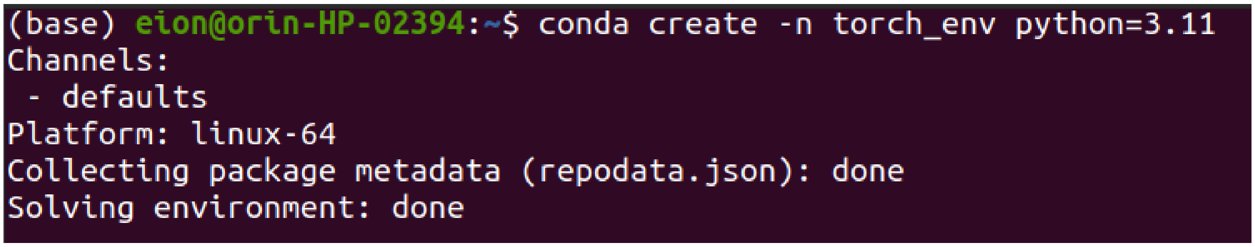
Then you can launch jupyter notebook and select the ipykernel on the top right of the notebook and select the conda env associated with your tensorflow installation:


jupyter test_tensorflow Last Checkpoint: 12 hours ago
File Edit View Run Kernel Settings Help
Trusted
Code
JupyterLab
tf_env
eion@orin-HP-02394: ~

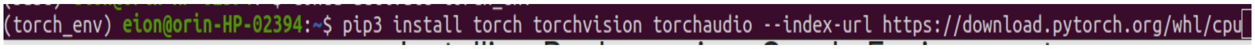
```
[1]: import tensorflow as tf
     print("TensorFlow version:", tf.__version__)

2023-12-08 14:11:01.099480: I external/local_tsl/tsl/cuda/cudart_stub.cc:31] Could not find cuda drivers on your machine, GPU will not be use
d.
2023-12-08 14:11:01.119757: E external/local_xla/xla/stream_executor/cuda/cuda_dnn.cc:9261] Unable to register cuDNN factory: Attempting to r
egister factory for plugin cuDNN when one has already been registered
2023-12-08 14:11:01.119783: E external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:607] Unable to register cuFFT factory: Attempting to re
gister factory for plugin cuFFT when one has already been registered
2023-12-08 14:11:01.120361: E external/local_xla/xla/stream_executor/cuda/cuda_blas.cc:1515] Unable to register cuBLAS factory: Attempting to
register factory for plugin cuBLAS when one has already been registered
2023-12-08 14:11:01.123846: I external/local_tsl/tsl/cuda/cudart_stub.cc:31] Could not find cuda drivers on your machine, GPU will not be use
d.
2023-12-08 14:11:01.124282: I tensorflow/core/platform/cpu_feature_guard.cc:182] This TensorFlow binary is optimized to use available CPU ins
tructions in performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild TensorFlow with the appropriate compiler flags.
2023-12-08 14:11:01.703945: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not find TensorRT
TensorFlow version: 2.15.0

[ ]:
```

```
Installed kernelspec tf_env in /home/eion/.local/share/jupyter/kernels/tf_env
(base) eion@orin-HP-02394:~$ jupyter notebook
[I 2023-12-08 13:51:31.479 ServerApp] Package notebook took 0.0000s to import
[I 2023-12-08 13:51:31.483 ServerApp] Package jupyter_lsp took 0.0047s to import
[W 2023-12-08 13:51:31.484 ServerApp] A `_jupyter_server_extension_points` function was not found in jupyter
_lsp. Instead, a `_jupyter_server_extension_paths` function was found and will be used for now. This functio
n name will be deprecated in future releases of Jupyter Server.
[I 2023-12-08 13:51:31.486 ServerApp] Package jupyter_server_terminals took 0.0020s to import
[I 2023-12-08 13:51:31.486 ServerApp] Package jupyterlab took 0.0000s to import
[I 2023-12-08 13:51:31.504 ServerApp] Package notebook_shim took 0.0000s to import
[W 2023-12-08 13:51:31.504 ServerApp] A `_jupyter_server_extension_points` function was not found in noteboo
k_shim. Instead, a `_jupyter_server_extension_paths` function was found and will be used for now. This funct
ion name will be deprecated in future releases of Jupyter Server.
[I 2023-12-08 13:51:31.909 ServerApp] Package panel.io.jupyter_server_extension took 0.4046s to import
[I 2023-12-08 13:51:31.909 ServerApp] jupyter_lsp | extension was successfully linked.
[I 2023-12-08 13:51:31.911 ServerApp] jupyter_server_terminals | extension was successfully linked.
[I 2023-12-08 13:51:31.913 ServerApp] jupyterlab | extension was successfully linked.
[I 2023-12-08 13:51:31.915 ServerApp] notebook | extension was successfully linked.
[I 2023-12-08 13:51:32.055 ServerApp] notebook_shim | extension was successfully linked.
[I 2023-12-08 13:51:32.055 ServerApp] panel.io.jupyter_server_extension | extension was successfully linked.
[I 2023-12-08 13:51:32.062 ServerApp] notebook_shim | extension was successfully loaded.
[I 2023-12-08 13:51:32.063 ServerApp] jupyter_lsp | extension was successfully loaded.
[I 2023-12-08 13:51:32.064 ServerApp] jupyter_server_terminals | extension was successfully loaded.
[I 2023-12-08 13:51:32.065 LabApp] JupyterLab extension loaded from /home/eion/anaconda3/lib/python3.11/site
-packages/jupyterlab
[I 2023-12-08 13:51:32.065 LabApp] JupyterLab application directory is /home/eion/anaconda3/share/jupyter/la
```

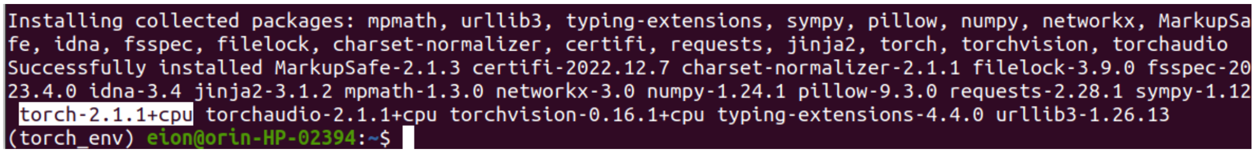
Likewise PyTorch can simply be installed in the following manner,



```
(base) eion@orin-HP-02394:~$ conda create -n torch_env python=3.11
Channels:
 - defaults
Platform: linux-64
Collecting package metadata (repodata.json): done
Solving environment: done
```



```
(torch_env) eion@orin-HP-02394:~$ pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/whl/cpu
```

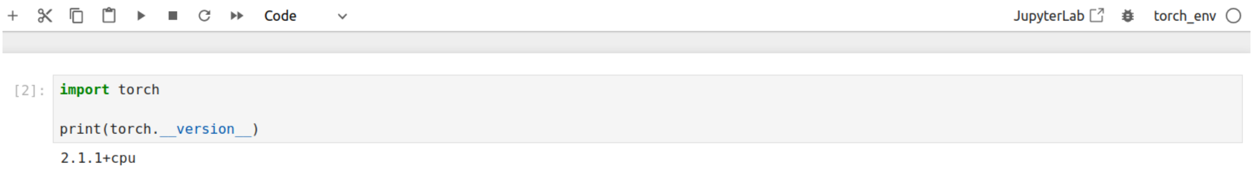


```
Installing collected packages: mpmath, urllib3, typing-extensions, sympy, pillow, numpy, networkx, MarkupSa
fe, idna, fsspec, filelock, charset-normalizer, certifi, requests, jinja2, torch, torchvision, torchaudio
Successfully installed MarkupSafe-2.1.3 certifi-2022.12.7 charset-normalizer-2.1.1 filelock-3.9.0 fsspec-20
23.4.0 idna-3.4 jinja2-3.1.2 mpmath-1.3.0 networkx-3.0 numpy-1.24.1 pillow-9.3.0 requests-2.28.1 sympy-1.12
 torch-2.1.1+cpu torchaudio-2.1.1+cpu torchvision-0.16.1+cpu typing-extensions-4.4.0 urllib3-1.26.13
(torch_env) eion@orin-HP-02394:~$
```

As before, the conda environment can be made accessible to the jupyter notebook,

```
Unset
conda install -c anaconda ipykernel
python -m ipykernel install --user --name=torch_env
```

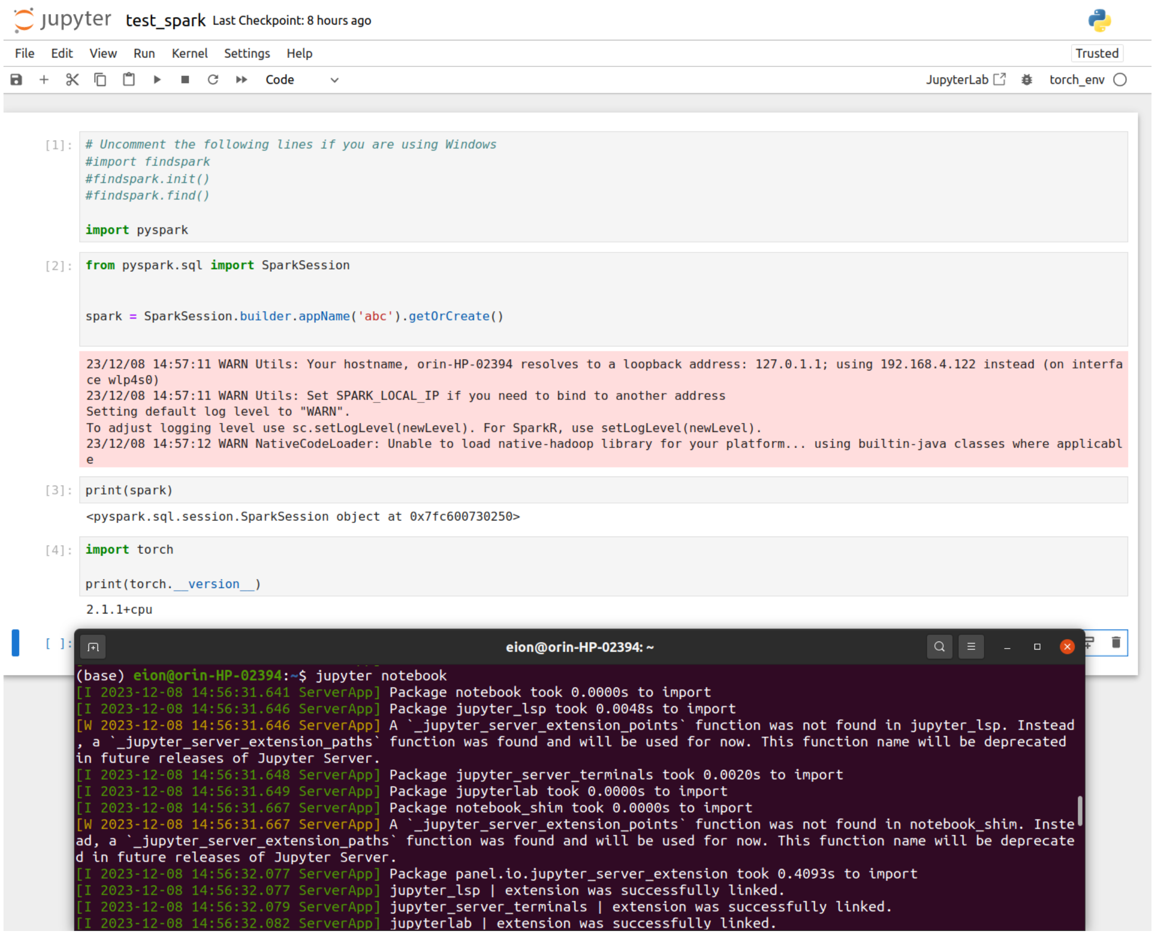
Then you can launch jupyter notebook and select the ipykernel on the top right of the notebook and select the conda env associated with your pytorch installation:



```
[2]: import torch

     print(torch.__version__)

     2.1.1+cpu
```

Note: If you require to have both PySpark and PyTorch in the same environment, you may choose to do so either in the (base) or another environment like the (torch) environment we have already made. The important thing to keep in mind here is that each environment has its own python and libraries, so if PySpark is installed in (base) and PyTorch is installed in (torch_env) they will not be able to work together.

After performing the PySpark installation in my torch_env, I can now use both PySpark and PyTorch in the same notebook:

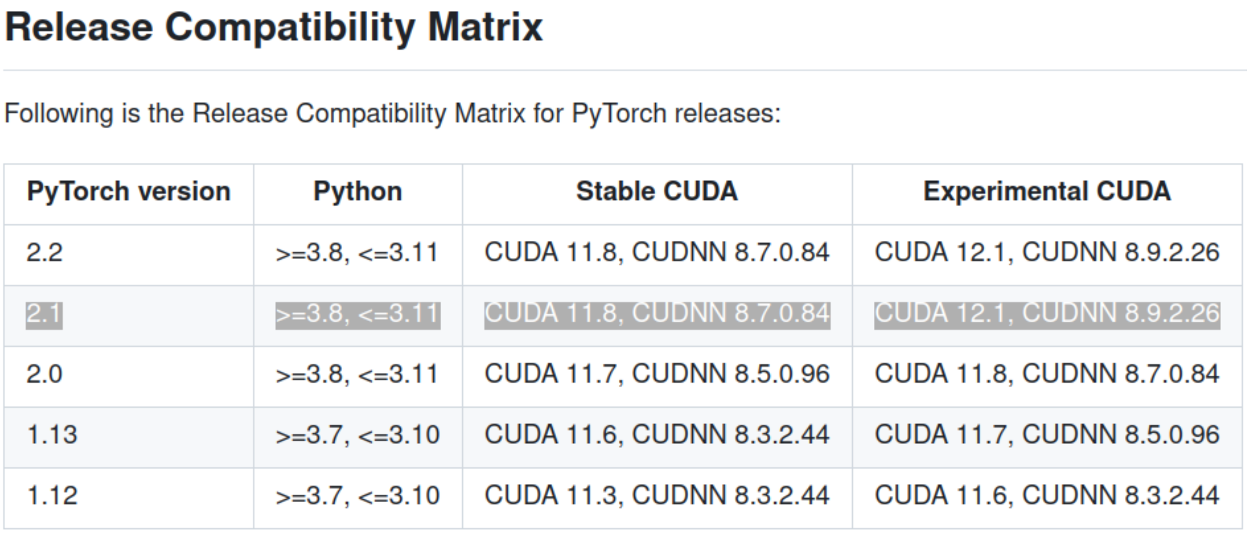


```
[1]: # Uncomment the following lines if you are using Windows
     #import findspark
     #findspark.init()
     #findspark.find()

     import pyspark

[2]: from pyspark.sql import SparkSession


     spark = SparkSession.builder.appName('abc').getOrCreate()

     23/12/08 14:57:11 WARN Utils: Your hostname, orin-HP-02394 resolves to a loopback address: 127.0.1.1; using 192.168.4.122 instead (on interfa
     ce wlp4s0)
     23/12/08 14:57:11 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
     Setting default log level to "WARN".
     To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
     23/12/08 14:57:12 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicabl
     e

[3]: print(spark)

     <pyspark.sql.session.SparkSession object at 0x7fc600730250>

[4]: import torch

     print(torch.__version__)

     2.1.1+cpu

[ ]:
```

```
(base) eion@orin-HP-02394:~$ jupyter notebook
[I 2023-12-08 14:56:31.641 ServerApp] Package notebook took 0.0000s to import
[I 2023-12-08 14:56:31.646 ServerApp] Package jupyter_lsp took 0.0048s to import
[W 2023-12-08 14:56:31.646 ServerApp] A `_jupyter_server_extension_points` function was not found in jupyter_lsp. Instead
, a `_jupyter_server_extension_paths` function was found and will be used for now. This function name will be deprecated
in future releases of Jupyter Server.
[I 2023-12-08 14:56:31.648 ServerApp] Package jupyter_server_terminals took 0.0020s to import
[I 2023-12-08 14:56:31.649 ServerApp] Package jupyterlab took 0.0000s to import
[I 2023-12-08 14:56:31.667 ServerApp] Package notebook_shim took 0.0000s to import
[W 2023-12-08 14:56:31.667 ServerApp] A `_jupyter_server_extension_points` function was not found in notebook_shim. Inste
ad, a `_jupyter_server_extension_paths` function was found and will be used for now. This function name will be deprecate
d in future releases of Jupyter Server.
[I 2023-12-08 14:56:32.077 ServerApp] Package panel.io.jupyter_server_extension took 0.4093s to import
[I 2023-12-08 14:56:32.077 ServerApp] jupyter_lsp | extension was successfully linked.
[I 2023-12-08 14:56:32.079 ServerApp] jupyter_server_terminals | extension was successfully linked.
[I 2023-12-08 14:56:32.082 ServerApp] jupyterlab | extension was successfully linked.
```

- **GPU Version Installations**

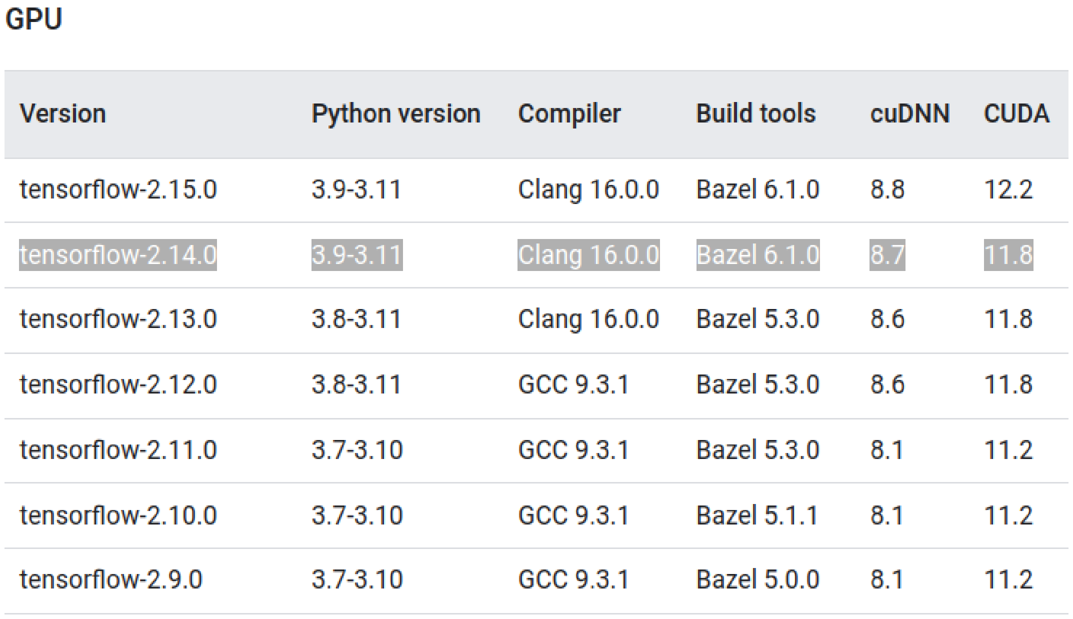
Since I don’t want to have to manage multiple CUDA versions I have Identified TensorFlow and PyTorch versions which share the same CUDA and cuDNN requirements:



Release Compatibility Matrix

Following is the Release Compatibility Matrix for PyTorch releases:

PyTorch version	Python	Stable CUDA	Experimental CUDA
2.2	>=3.8, <=3.11	CUDA 11.8, CUDNN 8.7.0.84	CUDA 12.1, CUDNN 8.9.2.26
2.1	>=3.8, <=3.11	CUDA 11.8, CUDNN 8.7.0.84	CUDA 12.1, CUDNN 8.9.2.26
2.0	>=3.8, <=3.11	CUDA 11.7, CUDNN 8.5.0.96	CUDA 11.8, CUDNN 8.7.0.84
1.13	>=3.7, <=3.10	CUDA 11.6, CUDNN 8.3.2.44	CUDA 11.7, CUDNN 8.5.0.96
1.12	>=3.7, <=3.10	CUDA 11.3, CUDNN 8.3.2.44	CUDA 11.6, CUDNN 8.3.2.44

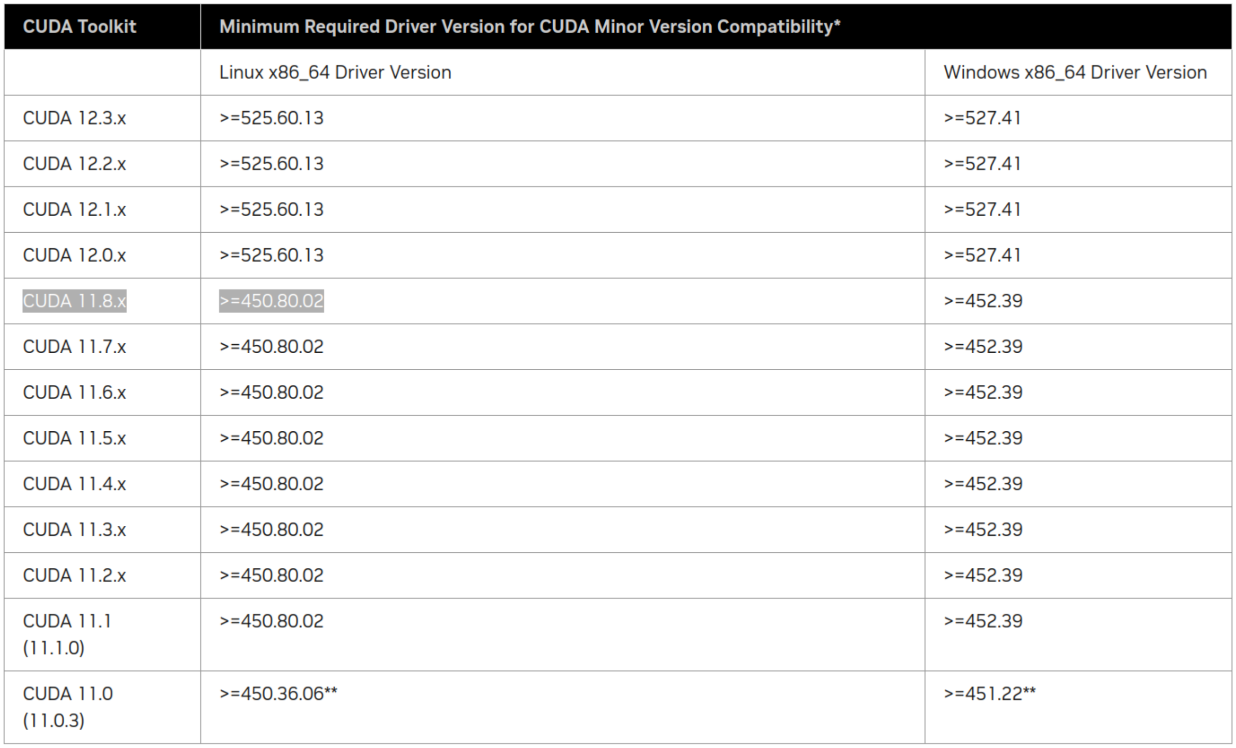


GPU

Version	Python version	Compiler	Build tools	cuDNN	CUDA
tensorflow-2.15.0	3.9-3.11	Clang 16.0.0	Bazel 6.1.0	8.8	12.2
tensorflow-2.14.0	3.9-3.11	Clang 16.0.0	Bazel 6.1.0	8.7	11.8
tensorflow-2.13.0	3.8-3.11	Clang 16.0.0	Bazel 5.3.0	8.6	11.8
tensorflow-2.12.0	3.8-3.11	GCC 9.3.1	Bazel 5.3.0	8.6	11.8
tensorflow-2.11.0	3.7-3.10	GCC 9.3.1	Bazel 5.3.0	8.1	11.2
tensorflow-2.10.0	3.7-3.10	GCC 9.3.1	Bazel 5.1.1	8.1	11.2
tensorflow-2.9.0	3.7-3.10	GCC 9.3.1	Bazel 5.0.0	8.1	11.2

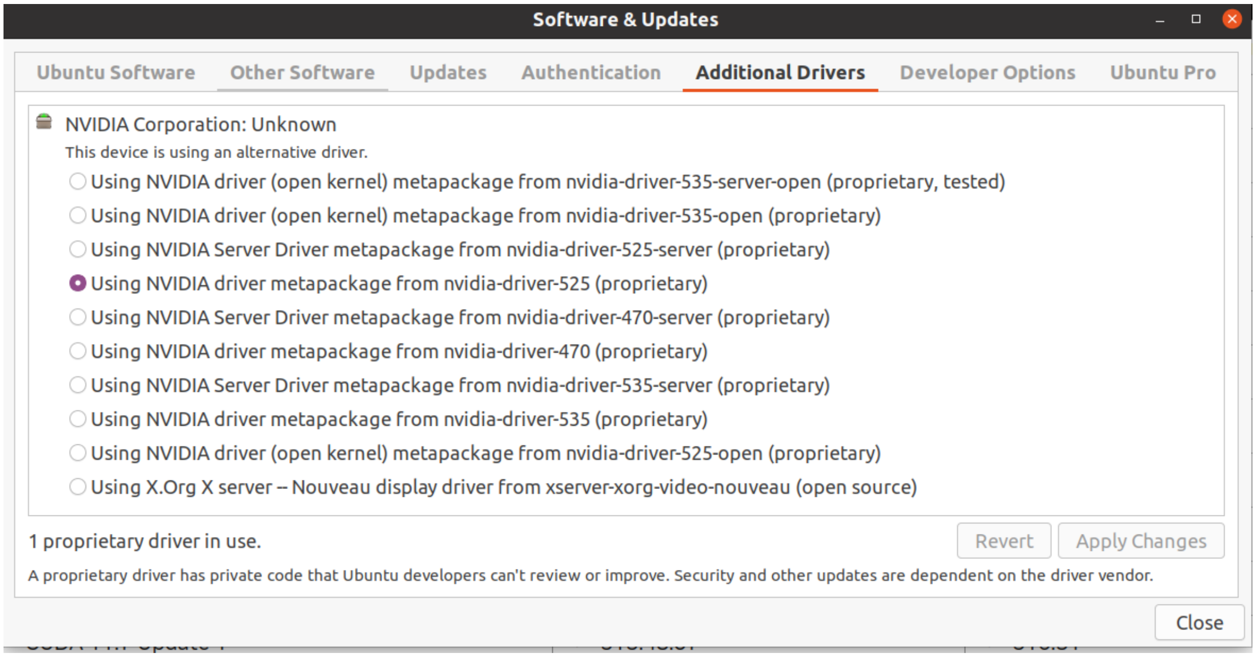
Once you have selected your desired framework versions you must first check whether your GPU driver is compatible with your selected framework’s CUDA requirement.

Table 2: CUDA Toolkit and Minimum Required Driver Version for CUDA Minor Version Compatibility



CUDA Toolkit	Minimum Required Driver Version for CUDA Minor Version Compatibility*	
	Linux x86_64 Driver Version	Windows x86_64 Driver Version
CUDA 12.3.x	>=525.60.13	>=527.41
CUDA 12.2.x	>=525.60.13	>=527.41
CUDA 12.1.x	>=525.60.13	>=527.41
CUDA 12.0.x	>=525.60.13	>=527.41
CUDA 11.8.x	>=450.80.02	>=452.39
CUDA 11.7.x	>=450.80.02	>=452.39
CUDA 11.6.x	>=450.80.02	>=452.39
CUDA 11.5.x	>=450.80.02	>=452.39
CUDA 11.4.x	>=450.80.02	>=452.39
CUDA 11.3.x	>=450.80.02	>=452.39
CUDA 11.2.x	>=450.80.02	>=452.39
CUDA 11.1 (11.1.0)	>=450.80.02	>=452.39
CUDA 11.0 (11.0.3)	>=450.36.06**	>=451.22**

If your Nvidia driver is not compatible, consider selecting a different framework version or updating your GPU driver. You can check Additional Drivers in Software & Updates to confirm that your driver supports the CUDA toolkit version you would like.



NVIDIA Corporation: Unknown

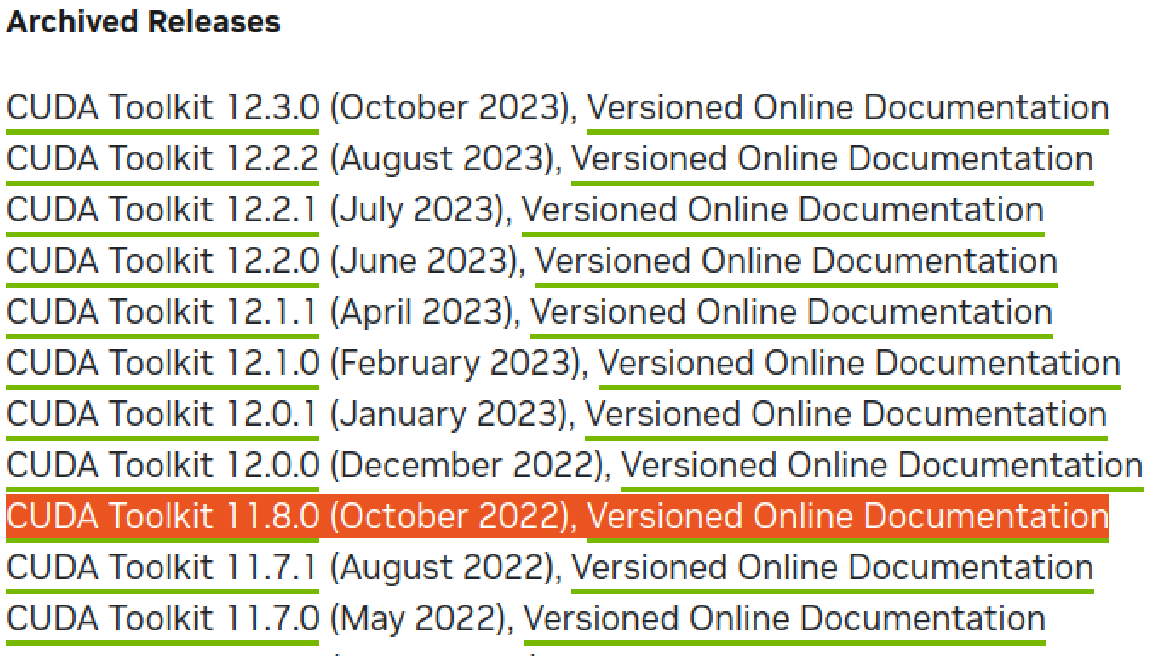
This device is using an alternative driver.

○ Using NVIDIA driver (open kernel) metapackage from nvidia-driver-535-server-open (proprietary, tested)
○ Using NVIDIA driver (open kernel) metapackage from nvidia-driver-535-open (proprietary)
○ Using NVIDIA Server Driver metapackage from nvidia-driver-525-server (proprietary)
● Using NVIDIA driver metapackage from nvidia-driver-525 (proprietary)
○ Using NVIDIA Server Driver metapackage from nvidia-driver-470-server (proprietary)
○ Using NVIDIA driver metapackage from nvidia-driver-470 (proprietary)
○ Using NVIDIA Server Driver metapackage from nvidia-driver-535-server (proprietary)
○ Using NVIDIA driver metapackage from nvidia-driver-535 (proprietary)
○ Using NVIDIA driver (open kernel) metapackage from nvidia-driver-525-open (proprietary)
○ Using X.Org X server – Nouveau display driver from xserver-xorg-video-nouveau (open source)

1 proprietary driver in use.

A proprietary driver has private code that Ubuntu developers can't review or improve. Security and other updates are dependent on the driver vendor.

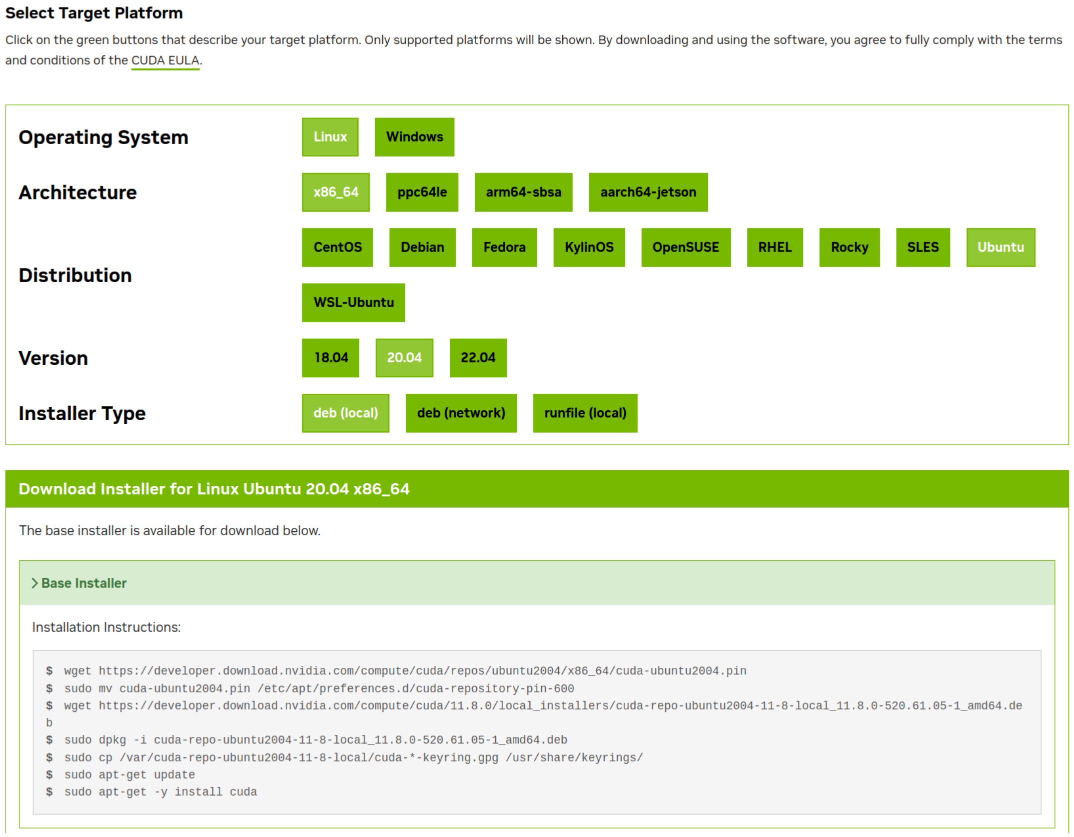
Now navigate to your desired release in the CUDA Toolkit archive:
https://developer.nvidia.com/cuda-toolkit-archive



Archived Releases

CUDA Toolkit 12.3.0 (October 2023), Versioned Online Documentation
CUDA Toolkit 12.2.2 (August 2023), Versioned Online Documentation
CUDA Toolkit 12.2.1 (July 2023), Versioned Online Documentation
CUDA Toolkit 12.2.0 (June 2023), Versioned Online Documentation
CUDA Toolkit 12.1.1 (April 2023), Versioned Online Documentation
CUDA Toolkit 12.1.0 (February 2023), Versioned Online Documentation
CUDA Toolkit 12.0.1 (January 2023), Versioned Online Documentation
CUDA Toolkit 12.0.0 (December 2022), Versioned Online Documentation
CUDA Toolkit 11.8.0 (October 2022), Versioned Online Documentation
CUDA Toolkit 11.7.1 (August 2022), Versioned Online Documentation
CUDA Toolkit 11.7.0 (May 2022), Versioned Online Documentation

By clicking your desired version, you can navigate to the correct download for your system:



Select Target Platform

Click on the green buttons that describe your target platform. Only supported platforms will be shown. By downloading and using the software, you agree to fully comply with the terms and conditions of the CUDA EULA.

Operating System: Linux | Windows
Architecture: x86_64 | ppc64le | arm64-sbsa | aarch64-jetson
Distribution: CentOS | Debian | Fedora | KylinOS | OpenSUSE | RHEL | Rocky | SLES | Ubuntu | WSL-Ubuntu
Version: 18.04 | 20.04 | 22.04
Installer Type: deb (local) | deb (network) | runfile (local)

Download Installer for Linux Ubuntu 20.04 x86_64

The base installer is available for download below.

> Base Installer

Installation Instructions:

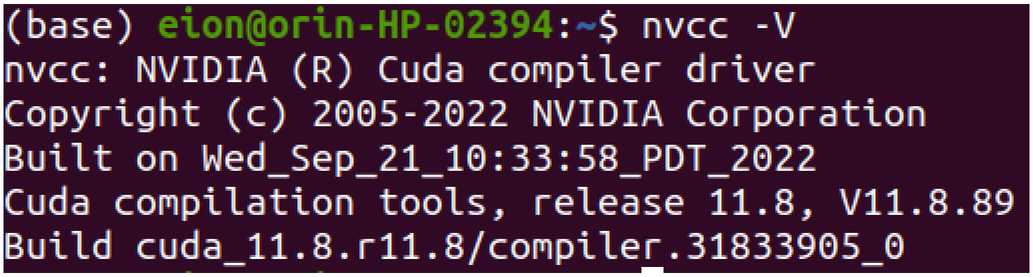
```
$  wget https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2004/x86_64/cuda-ubuntu2004.pin
$  sudo mv cuda-ubuntu2004.pin /etc/apt/preferences.d/cuda-repository-pin-600
$  wget https://developer.download.nvidia.com/compute/cuda/11.8.0/local_installers/cuda-repo-ubuntu2004-11-8-local_11.8.0-520.61.05-1_amd64.de
b
$  sudo dpkg -i cuda-repo-ubuntu2004-11-8-local_11.8.0-520.61.05-1_amd64.deb
$  sudo cp /var/cuda-repo-ubuntu2004-11-8-local/cuda-*-keyring.gpg /usr/share/keyrings/
$  sudo apt-get update
$  sudo apt-get -y install cuda
```

Once installed, you will be prompted to reboot.
After rebooting add your CUDA version binaries to PATH and LD_LIBRARY_PATH in your '~/.bashrc'

Unset

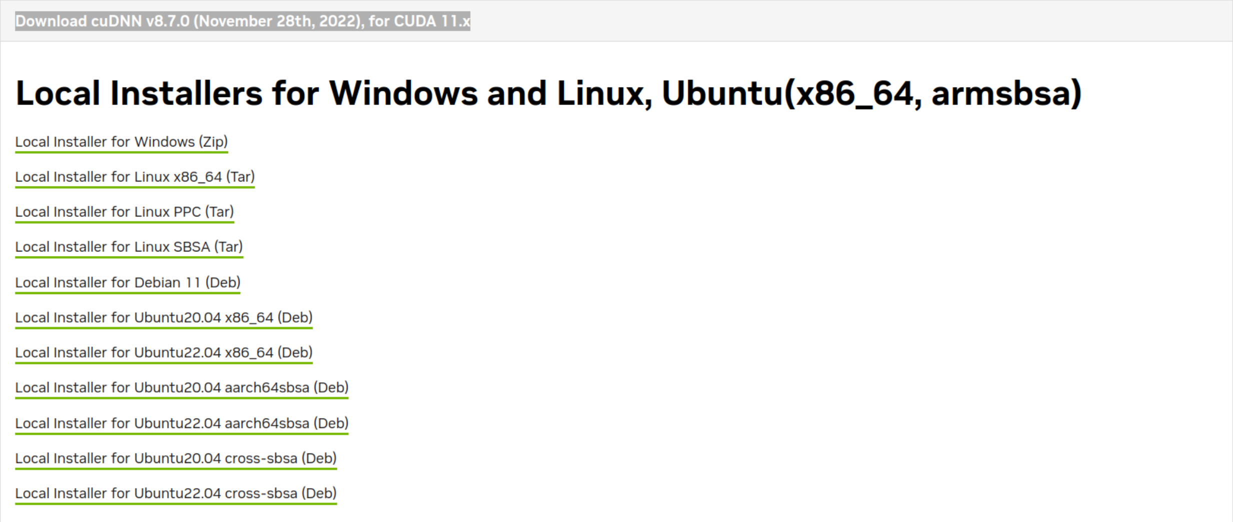
```
export PATH=/usr/local/cuda-11.8/bin${PATH:+:${PATH}}
export
LD_LIBRARY_PATH=/usr/local/cuda-11.8/lib64${LD_LIBRARY_PATH:+:${LD_LIBRARY_PATH
}}
```

Now run 'source ~/.bashrc' and check your CUDA version with 'nvcc -V' to confirm that CUDA was properly installed and matches the version you need:



```
(base) eion@orin-HP-02394:~$ nvcc -V
nvcc: NVIDIA (R) Cuda compiler driver
Copyright (c) 2005-2022 NVIDIA Corporation
Built on Wed_Sep_21_10:33:58_PDT_2022
Cuda compilation tools, release 11.8, V11.8.89
Build cuda_11.8.r11.8/compiler.31833905_0
```

Now it is time to install our desired version of cuDNN corresponding to both the version necessary for your selected framework and compatible with your CUDA version from the cuDNN archive.



Download cuDNN v8.7.0 (November 28th, 2022), for CUDA 11.x

Local Installers for Windows and Linux, Ubuntu(x86_64, armsbsa)

Local Installer for Windows (Zip)

Local Installer for Linux x86_64 (Tar)

Local Installer for Linux PPC (Tar)

Local Installer for Linux SBSA (Tar)

Local Installer for Debian 11 (Deb)

Local Installer for Ubuntu20.04 x86_64 (Deb)

Local Installer for Ubuntu22.04 x86_64 (Deb)

Local Installer for Ubuntu20.04 aarch64sbsa (Deb)

Local Installer for Ubuntu22.04 aarch64sbsa (Deb)

Local Installer for Ubuntu20.04 cross-sbsa (Deb)

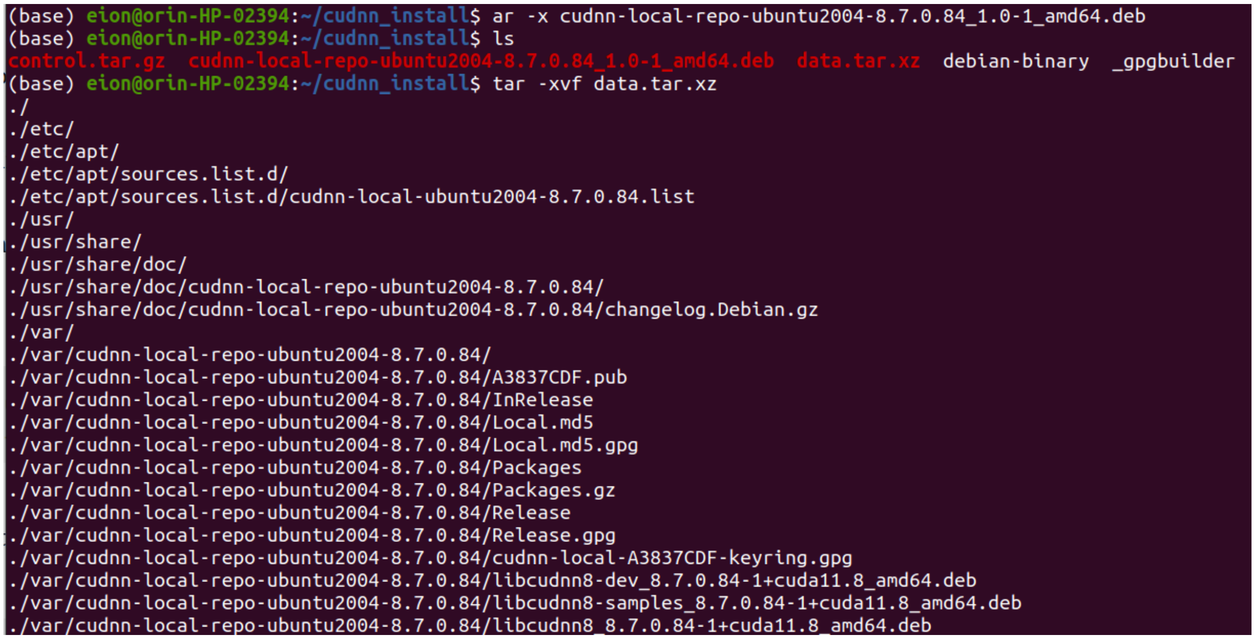
Local Installer for Ubuntu22.04 cross-sbsa (Deb)

Then, following section 3 of this guide https://medium.com/@zhanwenchen/build-pytorch-from-source-with-cuda-11-8-565ab737bfc8 you should download the appropriate Deb file for your system, in my case this is Ubuntu20.04 x86_64 (Deb) .

Note: The file names seen below will differ based on your selection.

```
Unset
mkdir cudnn_install
mv cudnn-local-repo-ubuntu2004-8.7.0.84_1.0-1_amd64.deb cudnn_install
cd cudnn_install
ar -x cudnn-local-repo-ubuntu2004-8.7.0.84_1.0-1_amd64.deb
```

```
Unset
tar -xvf data.tar.xz
```



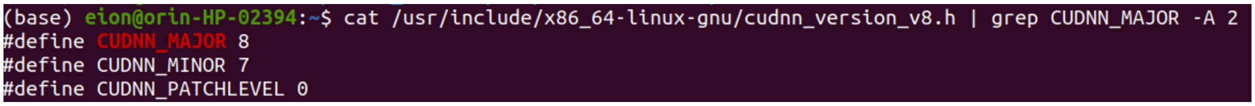
```
(base) eion@orin-HP-02394:~/cudnn_install$ ar -x cudnn-local-repo-ubuntu2004-8.7.0.84_1.0-1_amd64.deb
(base) eion@orin-HP-02394:~/cudnn_install$ ls
control.tar.gz  cudnn-local-repo-ubuntu2004-8.7.0.84_1.0-1_amd64.deb  data.tar.xz  debian-binary  _gpgbuilder
(base) eion@orin-HP-02394:~/cudnn_install$ tar -xvf data.tar.xz
./
./etc/
./etc/apt/
./etc/apt/sources.list.d/
./etc/apt/sources.list.d/cudnn-local-ubuntu2004-8.7.0.84.list
./usr/
./usr/share/
./usr/share/doc/
./usr/share/doc/cudnn-local-repo-ubuntu2004-8.7.0.84/
./usr/share/doc/cudnn-local-repo-ubuntu2004-8.7.0.84/changelog.Debian.gz
./var/
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/A3837CDF.pub
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/InRelease
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Local.md5
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Local.md5.gpg
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Packages
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Packages.gz
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Release
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/Release.gpg
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/cudnn-local-A3837CDF-keyring.gpg
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/libcudnn8-dev_8.7.0.84-1+cuda11.8_amd64.deb
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/libcudnn8-samples_8.7.0.84-1+cuda11.8_amd64.deb
./var/cudnn-local-repo-ubuntu2004-8.7.0.84/libcudnn8_8.7.0.84-1+cuda11.8_amd64.deb
```

The following should be installed in order

```
Unset
cd var/cudnn-local-repo-ubuntu2004-8.7.0.84/
sudo dpkg -i libcudnn8_8.7.0.84-1+cuda11.8_amd64.deb
sudo dpkg -i libcudnn8-dev_8.7.0.84-1+cuda11.8_amd64.deb
sudo dpkg -i libcudnn8-samples_8.7.0.84-1+cuda11.8_amd64.deb
```

Then verify the cuDNN installation with the following:

```
Unset
cat /usr/include/x86_64-linux-gnu/cudnn_version_v8.h | grep CUDNN_MAJOR -A 2
```

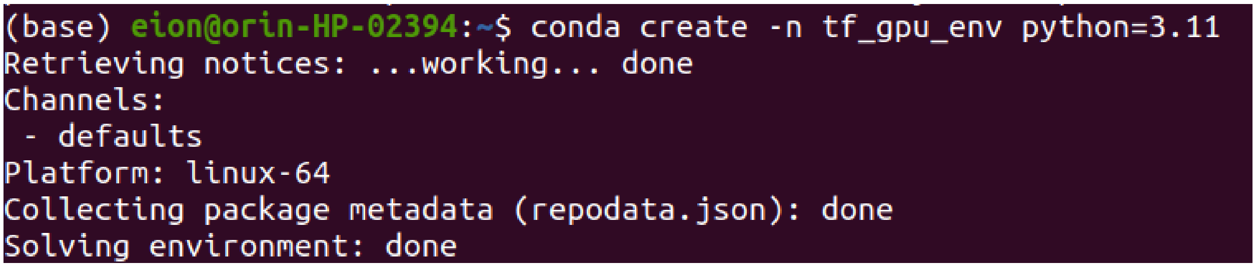


```
(base) eion@orin-HP-02394:~$ cat /usr/include/x86_64-linux-gnu/cudnn_version_v8.h | grep CUDNN_MAJOR -A 2
#define CUDNN_MAJOR 8
#define CUDNN_MINOR 7
#define CUDNN_PATCHLEVEL 0
```

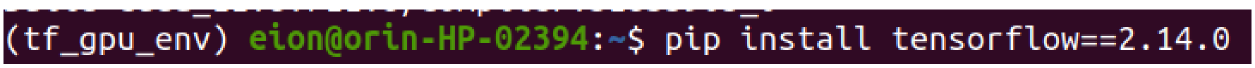
Finally we can install our desired frameworks

- tensorflow 2.14

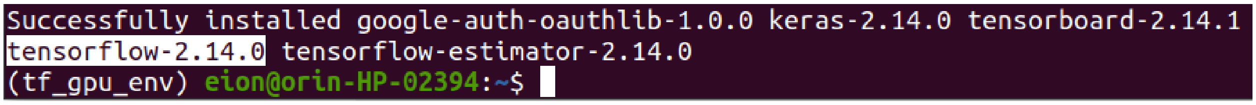
I will install TensorFlow in a new conda environment:



```
(base) eion@orin-HP-02394:~$ conda create -n tf_gpu_env python=3.11
Retrieving notices: ...working... done
Channels:
 - defaults
Platform: linux-64
Collecting package metadata (repodata.json): done
Solving environment: done
```



```
(tf_gpu_env) eion@orin-HP-02394:~$ pip install tensorflow==2.14.0
```



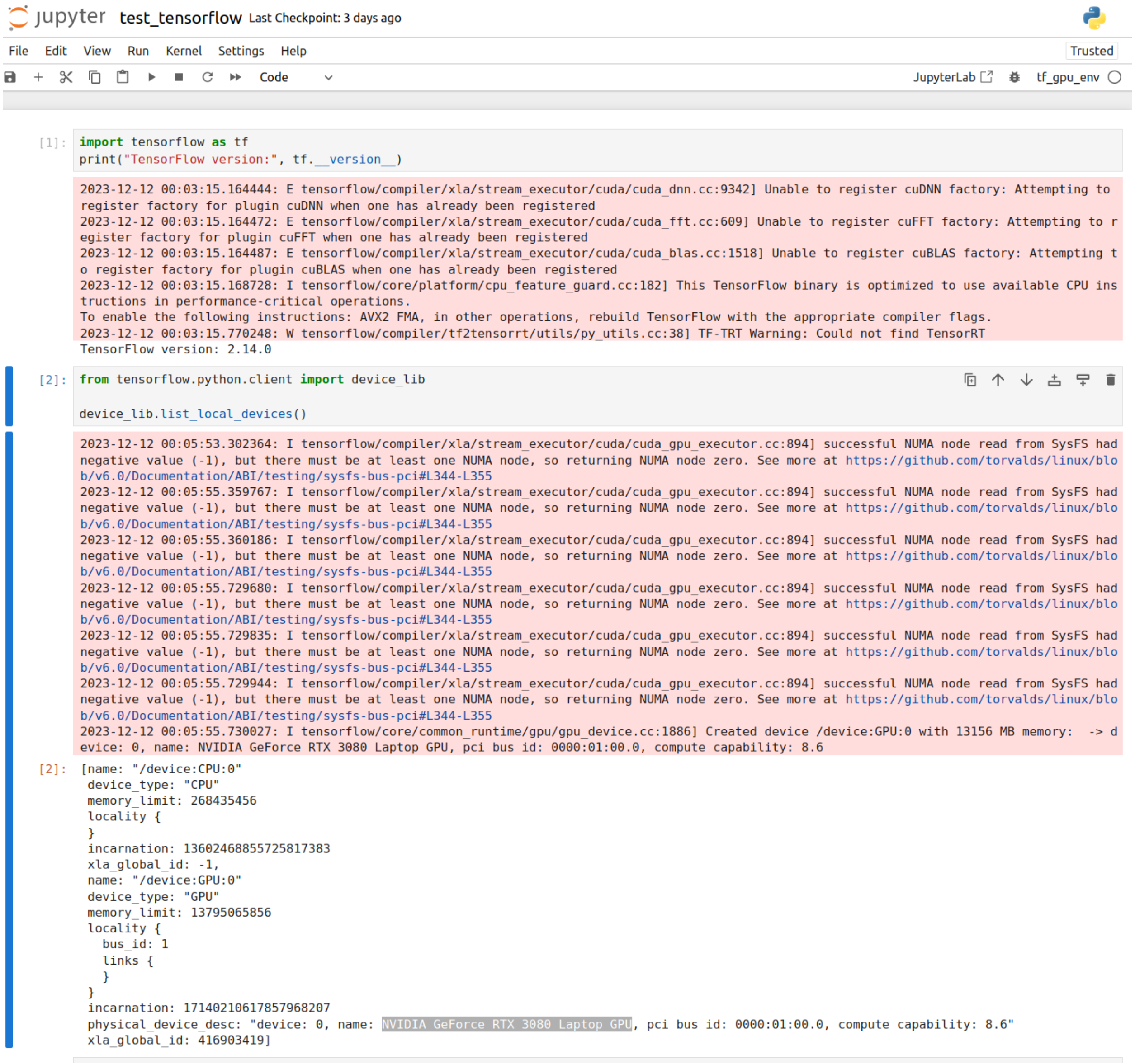
```
Successfully installed google-auth-oauthlib-1.0.0 keras-2.14.0 tensorboard-2.14.1
tensorflow-2.14.0 tensorflow-estimator-2.14.0
(tf_gpu_env) eion@orin-HP-02394:~$
```

You can now run the following to use this conda environment in your jupyter notebook,

Unset

```
conda install -c anaconda ipykernel
python -m ipykernel install --user --name=tf_gpu_env
```

Then you can launch jupyter notebook and select the ipykernel on the top right of the notebook and select the conda env associated with your tensorflow installation. In my case the environment is ‘tf_gpu_env’:


jupyter
test_tensorflow Last Checkpoint: 3 days ago
File Edit View Run Kernel Settings Help
Trusted
Code
JupyterLab
tf_gpu_env

```
[1]: import tensorflow as tf
     print("TensorFlow version:", tf.__version__)
```

```
2023-12-12 00:03:15.164444: E tensorflow/compiler/xla/stream_executor/cuda/cuda_dnn.cc:9342] Unable to register cuDNN factory: Attempting to
register factory for plugin cuDNN when one has already been registered
2023-12-12 00:03:15.164472: E tensorflow/compiler/xla/stream_executor/cuda/cuda_fft.cc:609] Unable to register cuFFT factory: Attempting to r
egister factory for plugin cuFFT when one has already been registered
2023-12-12 00:03:15.164487: E tensorflow/compiler/xla/stream_executor/cuda/cuda_blas.cc:1518] Unable to register cuBLAS factory: Attempting t
o register factory for plugin cuBLAS when one has already been registered
2023-12-12 00:03:15.168728: I tensorflow/core/platform/cpu_feature_guard.cc:182] This TensorFlow binary is optimized to use available CPU ins
tructions in performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild TensorFlow with the appropriate compiler flags.
2023-12-12 00:03:15.770248: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not find TensorRT
TensorFlow version: 2.14.0
```

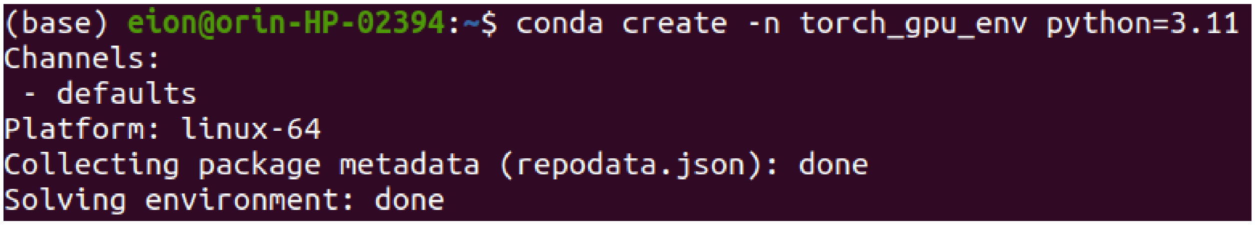
```
[2]: from tensorflow.python.client import device_lib

     device_lib.list_local_devices()
```

```
2023-12-12 00:05:53.302364: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.359767: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.360186: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.729680: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.729835: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.729944: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894] successful NUMA node read from SysFS had
negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero. See more at https://github.com/torvalds/linux/blo
b/v6.0/Documentation/ABI/testing/sysfs-bus-pci#L344-L355
2023-12-12 00:05:55.730027: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1886] Created device /device:GPU:0 with 13156 MB memory:  -> d
evice: 0, name: NVIDIA GeForce RTX 3080 Laptop GPU, pci bus id: 0000:01:00.0, compute capability: 8.6
```

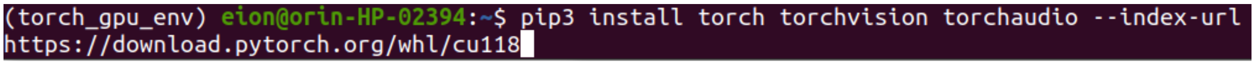
```
[2]: [name: "/device:CPU:0"
      device_type: "CPU"
      memory_limit: 268435456
      locality {
      }
      incarnation: 13602468855725817383
      xla_global_id: -1,
      name: "/device:GPU:0"
      device_type: "GPU"
      memory_limit: 13795065856
      locality {
        bus_id: 1
        links {
        }
      }
      incarnation: 17140210617857968207
      physical_device_desc: "device: 0, name: NVIDIA GeForce RTX 3080 Laptop GPU, pci bus id: 0000:01:00.0, compute capability: 8.6"
      xla_global_id: 416903419]
```

- torch 2.1

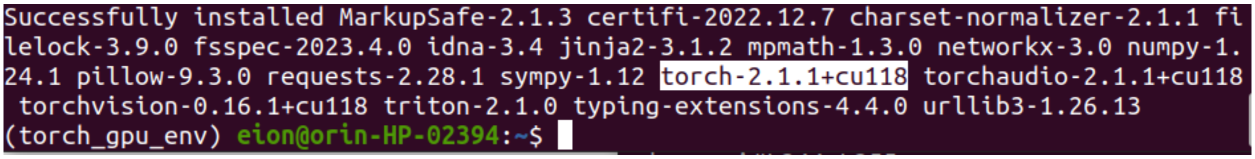
Likewise, I will install PyTorch in a new conda environment:



```
(base) eion@orin-HP-02394:~$ conda create -n torch_gpu_env python=3.11
Channels:
 - defaults
Platform: linux-64
Collecting package metadata (repodata.json): done
Solving environment: done
```



```
(torch_gpu_env) eion@orin-HP-02394:~$ pip3 install torch torchvision torchaudio --index-url
https://download.pytorch.org/whl/cu118
```

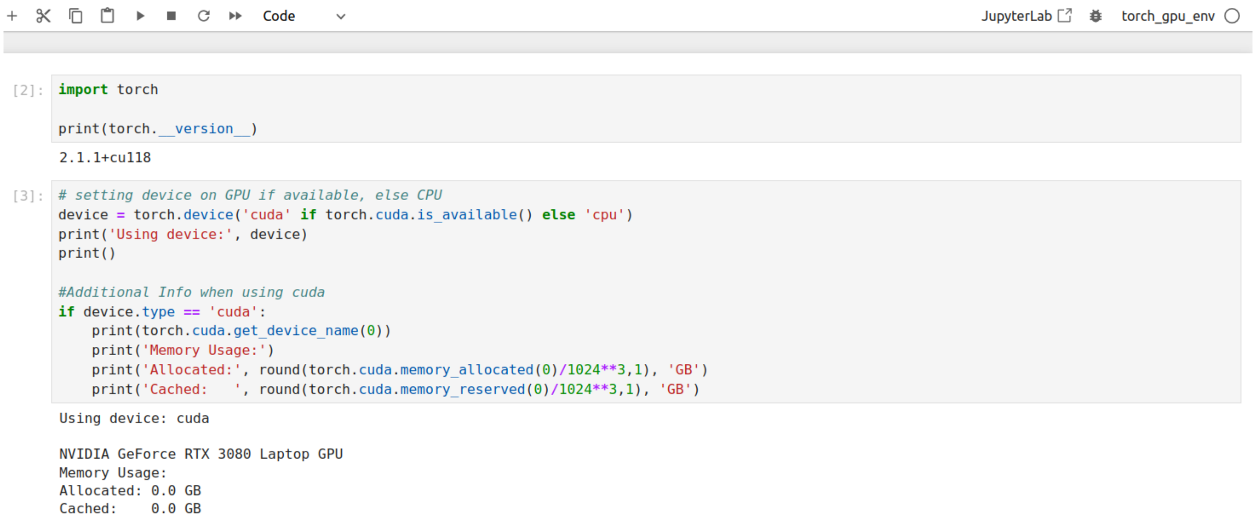


```
Successfully installed MarkupSafe-2.1.3 certifi-2022.12.7 charset-normalizer-2.1.1 fi
lelock-3.9.0 fsspec-2023.4.0 idna-3.4 jinja2-3.1.2 mpmath-1.3.0 networkx-3.0 numpy-1.
24.1 pillow-9.3.0 requests-2.28.1 sympy-1.12 torch-2.1.1+cu118 torchaudio-2.1.1+cu118
 torchvision-0.16.1+cu118 triton-2.1.0 typing-extensions-4.4.0 urllib3-1.26.13
(torch_gpu_env) eion@orin-HP-02394:~$
```

As before, the conda environment can be made accessible to the jupyter notebook,

```
Unset
conda install -c anaconda ipykernel
python -m ipykernel install --user --name=torch_gpu_env
```

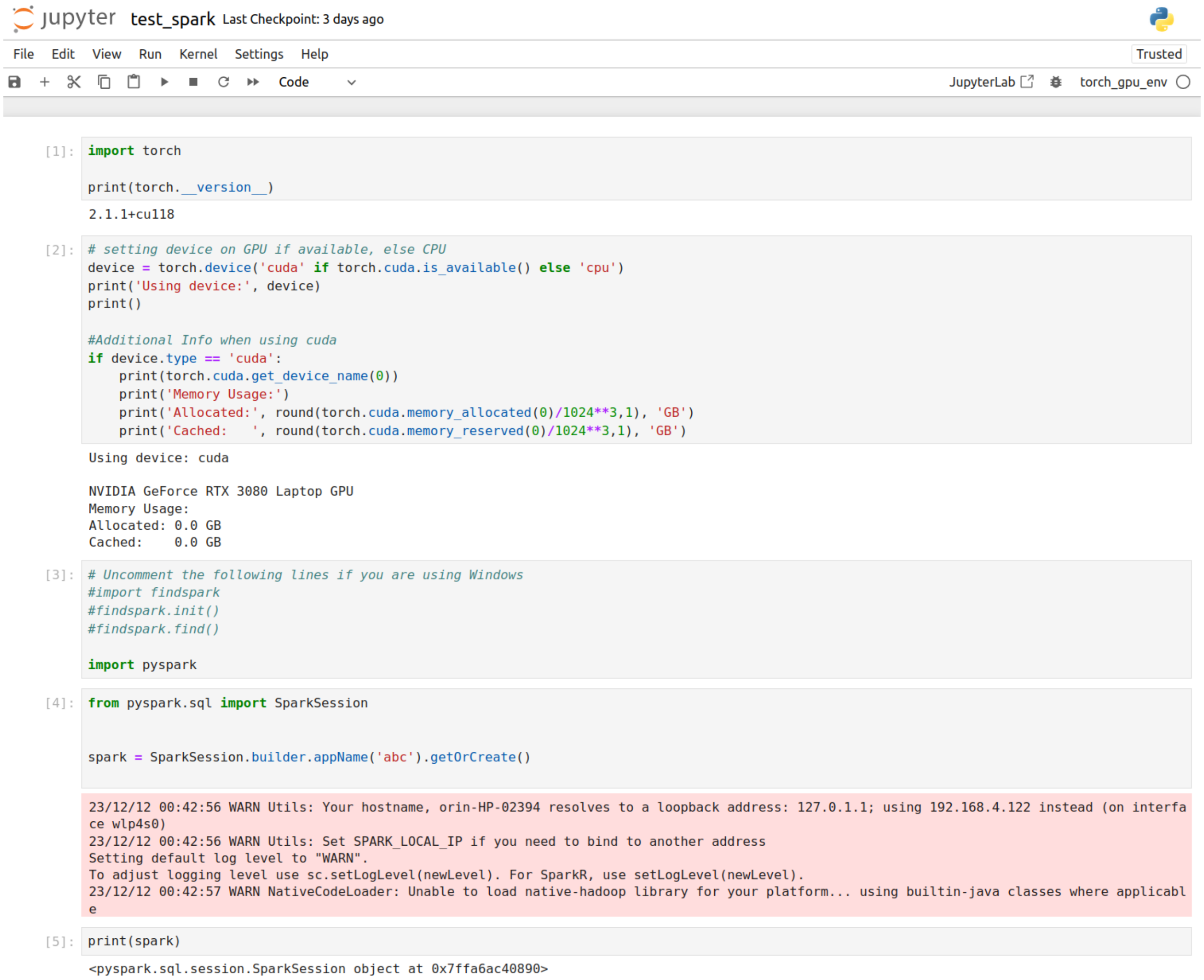
Then you can launch jupyter notebook and select the ipykernel on the top right of the notebook and select the conda env associated with your pytorch installation:



```
[2]: import torch

     print(torch.__version__)

     2.1.1+cu118

[3]: # setting device on GPU if available, else CPU
     device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
     print('Using device:', device)
     print()

     #Additional Info when using cuda
     if device.type == 'cuda':
         print(torch.cuda.get_device_name(0))
         print('Memory Usage:')
         print('Allocated:', round(torch.cuda.memory_allocated(0)/1024**3,1), 'GB')
         print('Cached:   ', round(torch.cuda.memory_reserved(0)/1024**3,1), 'GB')

     Using device: cuda

     NVIDIA GeForce RTX 3080 Laptop GPU
     Memory Usage:
     Allocated: 0.0 GB
     Cached:    0.0 GB
```

Note: If you require to have both PySpark and PyTorch in the same environment, you may choose to do so either in the (base) or another environment like the (torch) environment we have already made. The important thing to keep in mind here is that each environment has its own python and libraries, so if PySpark is installed in (base) and PyTorch is installed in (torch_gpu_env) they will not be able to work together.

After performing the PySpark installation in my torch_gpu_env, I can now use both PySpark and PyTorch in the same notebook:



[1]:
```
import torch

print(torch.__version__)
```
```
2.1.1+cu118
```

[2]:
```
# setting device on GPU if available, else CPU
device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
print('Using device:', device)
print()

#Additional Info when using cuda
if device.type == 'cuda':
    print(torch.cuda.get_device_name(0))
    print('Memory Usage:')
    print('Allocated:', round(torch.cuda.memory_allocated(0)/1024**3,1), 'GB')
    print('Cached:   ', round(torch.cuda.memory_reserved(0)/1024**3,1), 'GB')
```
```
Using device: cuda

NVIDIA GeForce RTX 3080 Laptop GPU
Memory Usage:
Allocated: 0.0 GB
Cached:    0.0 GB
```

[3]:
```
# Uncomment the following lines if you are using Windows
#import findspark
#findspark.init()
#findspark.find()

import pyspark
```

[4]:
```
from pyspark.sql import SparkSession


spark = SparkSession.builder.appName('abc').getOrCreate()
```
```
23/12/12 00:42:56 WARN Utils: Your hostname, orin-HP-02394 resolves to a loopback address: 127.0.1.1; using 192.168.4.122 instead (on interfa
ce wlp4s0)
23/12/12 00:42:56 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
23/12/12 00:42:57 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicabl
e
```

[5]:
```
print(spark)
```
```
<pyspark.sql.session.SparkSession object at 0x7ffa6ac40890>
```

5. Docker https://docs.docker.com/

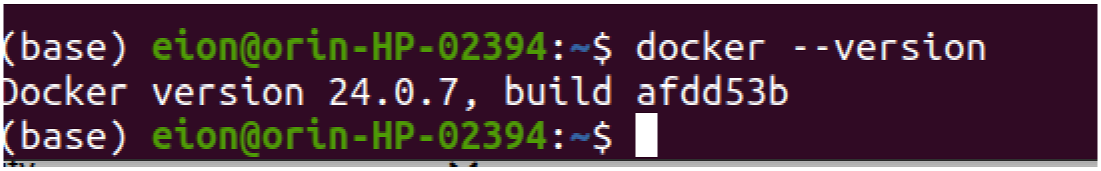
Uninstall any conflicting packages from previous docker installations (Optional if no previous installations):

Unset

```
for pkg in docker.io docker-doc docker-compose docker-compose-v2 podman-docker containerd runc; do sudo apt-get remove $pkg; done
```

Then follow the 3 steps for Install using the apt repository https://docs.docker.com/engine/install/ubuntu/#install-using-the-repository

Once complete you should be able to check your docker version:



```
(base) eion@orin-HP-02394:~$ docker --version
Docker version 24.0.7, build afdd53b
(base) eion@orin-HP-02394:~$ 
```