



# PPCES 2021: GPU / ML / DL Exercise Instructions

HPC.NRW Competence Network



THE COMPETENCE NETWORK FOR HIGH PERFORMANCE COMPUTING IN NRW.

# Course Organization

HPC.NRW Competence Network

## PPCES 2021: How to start the exercise environment

# Background: Connection to RWTH Cluster

- Connect to login18-x-1 or login18-x-2
- For this exercise we need
  - Command line (Start a job on our cluster)
  - Firefox Browser (Jupyter Lab)



- **Note:** If you are using FastX webapp:
  - Copy & Paste might not work
  - Open PDF inside Firefox on frontend

1. Download the course material and exercises

2. Request and start a new interactive job

3. Run a Singularity container & Jupyter Lab

4. Connect to Jupyter Lab

5. Close the browser & stop Jupyter Lab, container and job

6. Logout



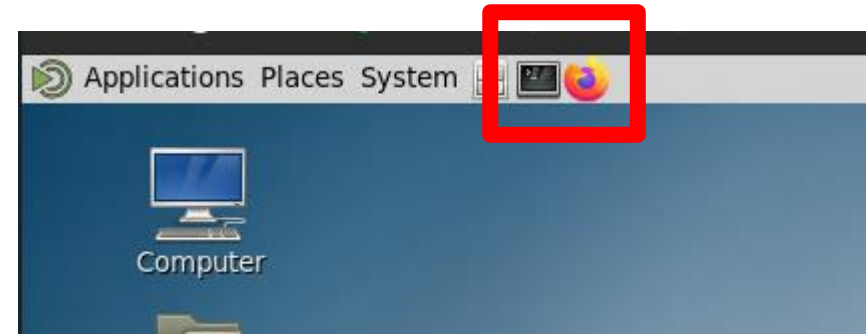
Singularity containers available:

**scikit-learn**

**TensorFlow + Horovod**

# 1. Download the course material and exercises

– Start a terminal session



– Download the course material

```
# Change to the directory where you want to save your material
cd <working directory>

# Download this slide deck
wget https://doc.itc.rwth-aachen.de/download/attachments/59867285/2021-ppces-ML-DL-instructions.pdf

# Download exercises & scripts
wget https://doc.itc.rwth-aachen.de/download/attachments/59867285/2021-ppces-exercises-ML-DL.tar

# Unpack the exercises
tar -xvf 2021-ppces-exercises-ml-dl.tar
```

## 2. Request and start a new interactive job using SLURM

## 3. Run a Singularity container & Jupyter Lab

### – For **scikit-learn** exercises:

```
# start interactive job and container  
zsh batch-scikit.sh
```

### – For **TensorFlow + Horovod** exercises:

```
# start interactive job and container  
zsh batch-tensorflow.sh
```

## – What is happening inside?

```
srun      --time=01:00:00      \  
          --partition=c18g    \  
          --gres=gpu:volta:1  \  
          --reservation=ppces \  
          ./jupyter-tensorflow.sh
```

## – **Note:** You might wait a bit to get a node assigned depending on the load on the system

```
srun: [I] No output file given, set to: output_%j.txt  
srun: job 20040570 queued and waiting for resources
```

## – Content of `jupyter-tensorflow.sh`

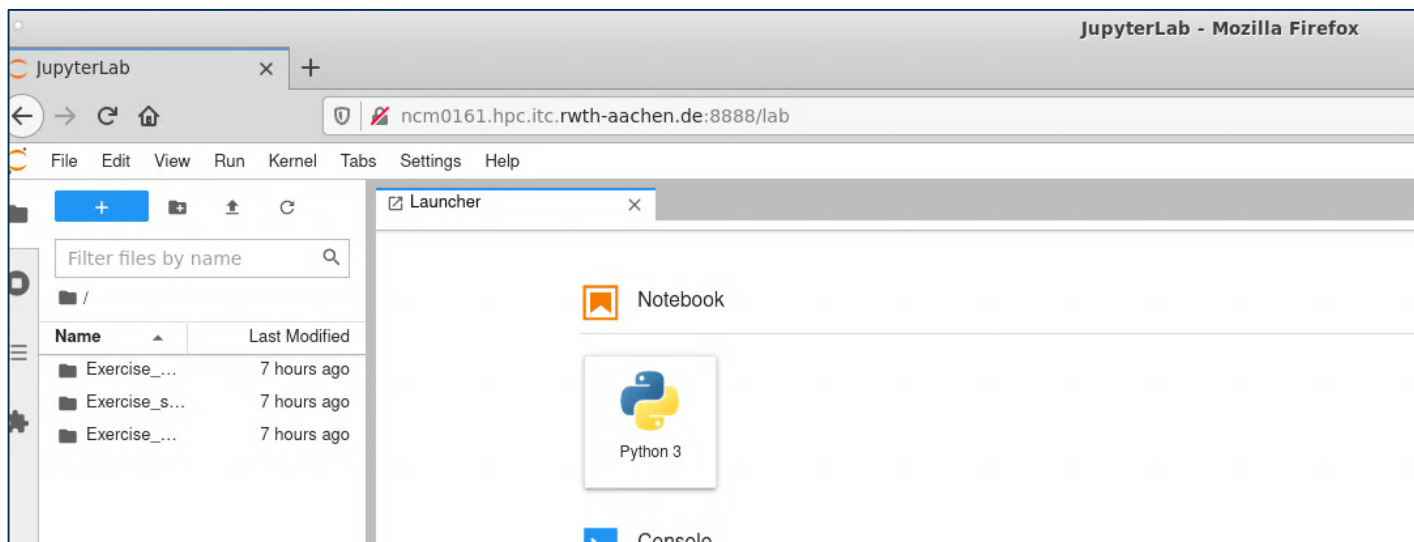
- Load required modules for NVIDIA GPUs (cuda and cudnn)
- Start the desired Singularity container + map the exercise directory
- Within that container start Jupyter Lab

## 4. Connect to Jupyter Lab

- After launching Jupyter Lab you will see something like

```
[I 2021-03-23 17:32:08.087 ServerApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).  
[W 2021-03-23 17:32:08.179 ServerApp] No web browser found: could not locate runnable browser.  
[C 2021-03-23 17:32:08.180 ServerApp]  
  
To access the server, open this file in a browser:  
  file:///project/.local/share/jupyter/runtime/jpserver-231459-open.html  
Or copy and paste one of these URLs:  
  http://ncm0161.hpc.itc.rwth-aachen.de:8888/lab?token=1e6362b6a777c8420daf678462c9f36092518eabd5af329d  
  or http://127.0.0.1:8888/lab?token=1e6362b6a777c8420daf678462c9f36092518eabd5af329d
```

- Open Firefox and enter the link



### Note:

Jupyter Lab might output several warnings on the command line.

Ignore it as far as everything is working in the browser



## 5. Close the browser & stop Jupyter Lab and container

- Open the terminal where you started Jupyter Lab

```
[I 2021-03-23 17:32:08.087 ServerApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).  
[W 2021-03-23 17:32:08.179 ServerApp] No web browser found: could not locate runnable browser.  
[C 2021-03-23 17:32:08.180 ServerApp]
```

To access the server, open this file in a browser:

`file:///project/.local/share/jupyter/runtime/jpserver-231459-open.html`

Or copy and paste one of these URLs:

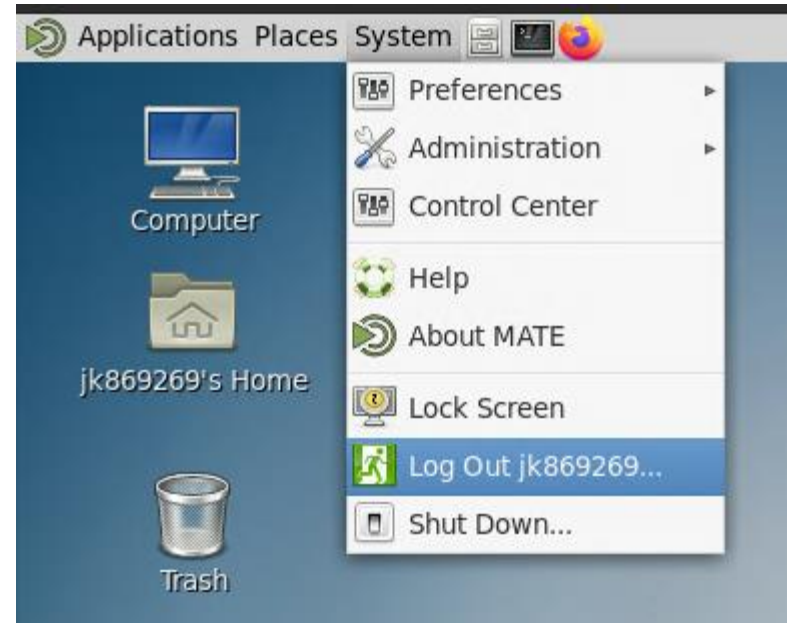
`http://ncm0161.hpc.itc.rwth-aachen.de:8888/lab?token=1e6362b6a777c8420daf678462c9f36092518eabd5af329d`

or `http://127.0.0.1:8888/lab?token=1e6362b6a777c8420daf678462c9f36092518eabd5af329d`

- Press **CTRL + C** to stop Jupyter Lab, container and the job
  - **Note:** You might need to confirm with “Y” or press CTRL + C several times

## 6. Logout

- If you are done with the exercises
  - Log out of the cluster front end
  - Otherwise session will remain active



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## PPCES 2021: Troubleshooting

– **Problem:** Images not shown in Jupyter Lab

– **Solution:**

- Select cell again
- Execute it again using the “Run” button

```
-----  
Predicting color indices on the full image (random)  
done in 0.731s.
```

Original image (96,615 colors)



Quantized image (64 colors, K-Means)

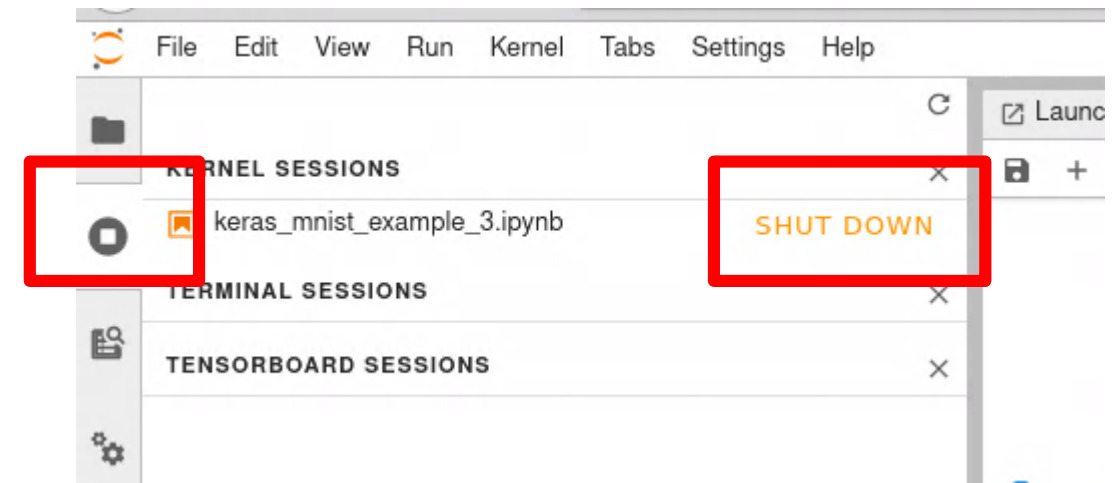
```
plt.axis('off')  
plt.title('Quantized image (64 colors, Random)')  
plt.imshow(recreate_image(codebook_random, labels_random, w, h))  
plt.show()
```

```
Automatically created module for IPython interactive environment  
Fitting model on a small sub-sample of the data  
done in 0.267s.
```

```
Predicting color indices on the full image (k-means)  
done in 0.190s.
```

```
Predicting color indices on the full image (random)  
done in 0.790s.  
<Figure size 640x480 with 1 Axes>  
<Figure size 640x480 with 1 Axes>  
<Figure size 640x480 with 1 Axes>
```

- **Problem:** “InternalError: CUDA runtime implicit initialization on GPU:0 failed. Status: all CUDA-capable devices are busy or unavailable”
- **Reasons:**
  - You are either working on a GPU frontend
    - All available GPUs are currently in use
    - GPUs are configured in “Exclusive\_Process” computation mode
  - Jupyter kernels might still be running on a GPU
    - Solution: stop your running kernels



## – Problem: Tensorboard is not working

```
jo
jo
Start Tensorboard
[8]: log_dir = "logs/"
os.makedirs(log_dir, exist_ok=True)

%reload_ext tensorboard
%tensorboard --logdir {log_dir} --host 0.0.0.0 --port 6006

# Alternative way to display Tensorboard
#from tensorboard import notebook
#notebook.list() # View open TensorBoard instances
#notebook.display(port=6006, height=1000)

ERROR: Failed to launch TensorBoard (exited with 255).
Contents of stderr:
2021-03-25 15:47:33.737073: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcudart.so.11.0
E0325 15:47:39.313171 47139581884224 program.py:311] TensorBoard could not bind to port 6006, it was already in use
ERROR: TensorBoard could not bind to port 6006, it was already in use
```

- Reason: There is already some instance or program using the port
  - Don't worry. This will not stop you from testing the rest of the exercises