DIP 2019
Practical session

Docker

Jupyter

OpenCV

Keras

Tensorflow on GPU

CNN

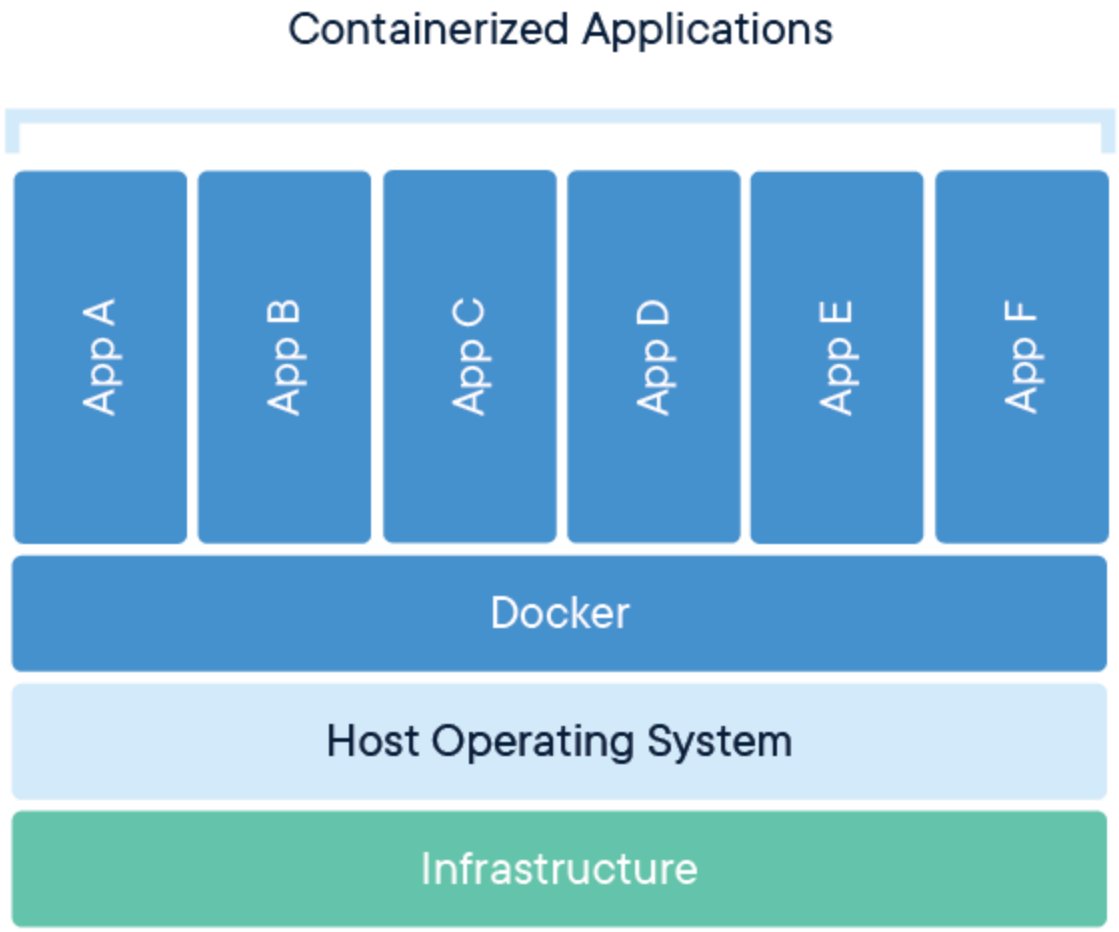
Autoencoder

What is a docker?

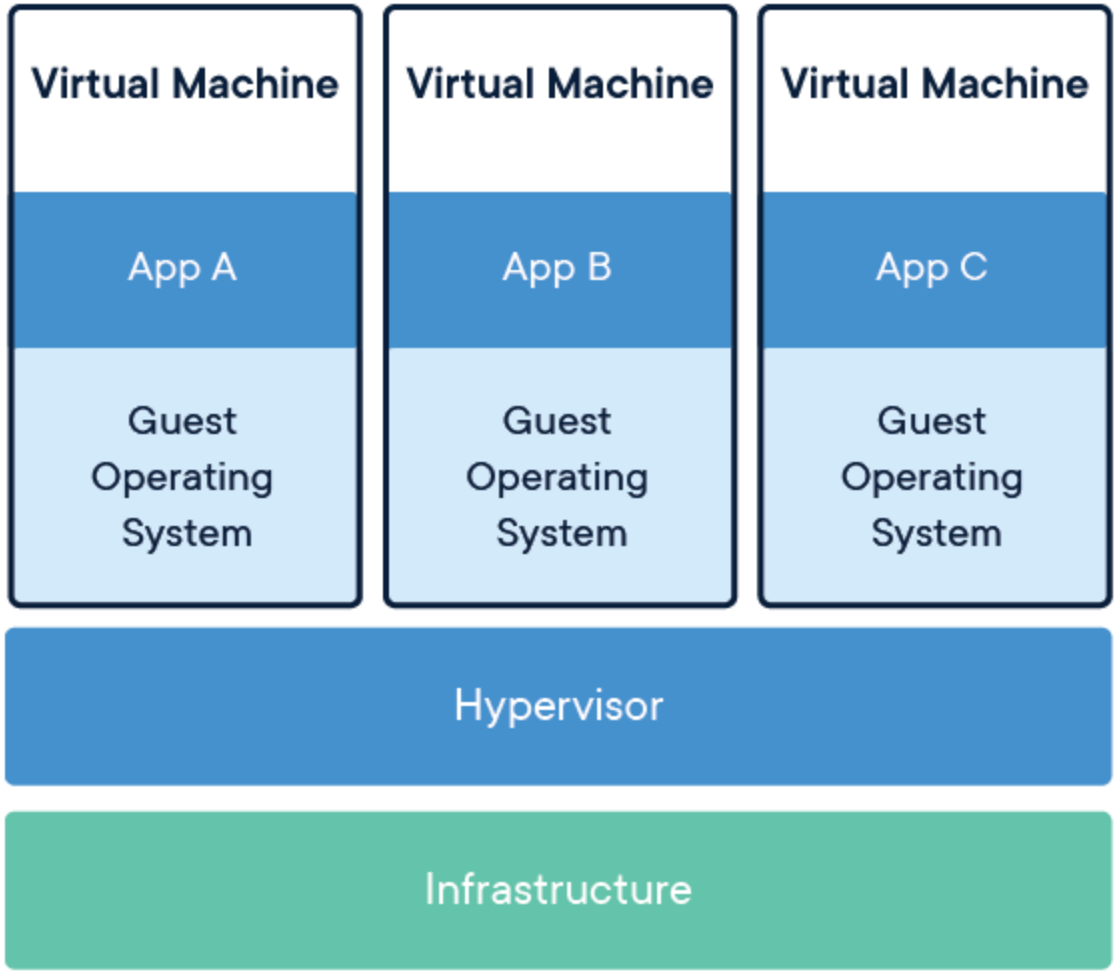
- **Docker** is a tool that makes easier to run programs by using containers.
- A **container** is an instance of a docker image.
- A **docker image** is a standalone and executable package of software.
- Docker image contains everything needed to run a program: code, libraries and settings.

Docker versus VM

Docker



VM



Some docker commands

- See list of existing images:

```
docker images
```

- Create a container from an image:

```
nvidia-docker run -v
/DATA/berat/dip_cont:/root/dip_cont --name dip_cont
-it dl-image bash
```

- See list of existing containers:

```
docker ps --all
```

Some docker commands

- Stop a running container:

```
docker stop dip_cont
```

- Make an image of the container:

```
docker commit dip_cont dip_image
```

- Delete an image:

```
docker rmi dip_image
```

- Delete a container:

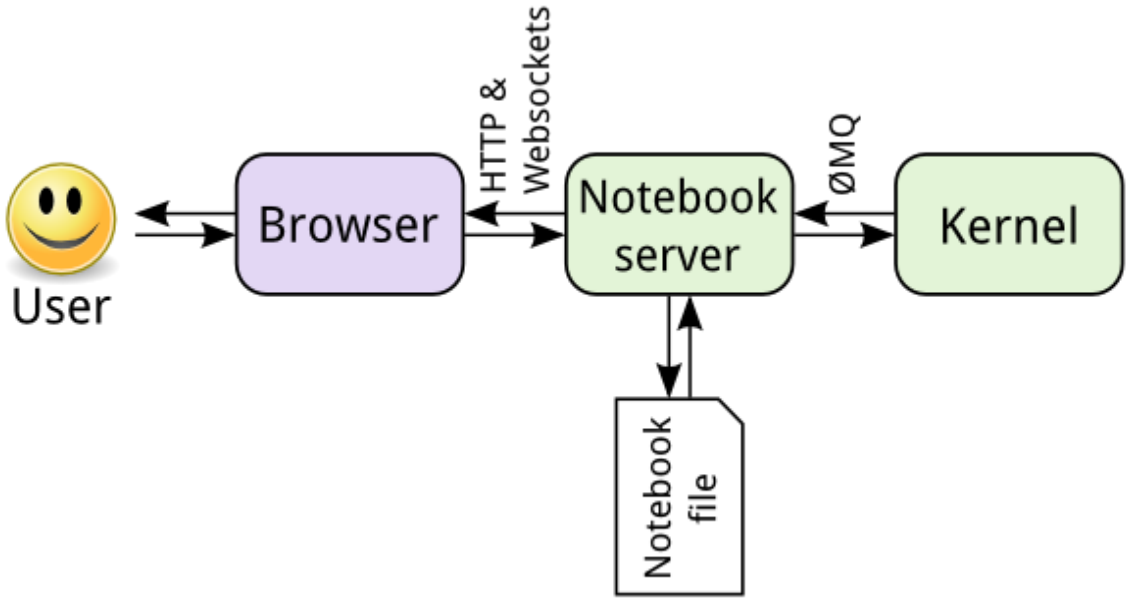
```
docker rm dip_cont
```

Python notebook

- Jupyter python notebook is an interactive computational environment
- Combines code execution with explanatory data in the form of text, plot and images.
- Help scientists to demonstrate their work easily.

Jupyter notebook structure

- Jupyter notebook is based on server-client structure.
- Server executes the code chunks.
- User receives the results from server via an internet browser.



Python notebook user interface

jupyter Lecture-2B-Single-Atom-Lasing (unsaved changes)

File Edit View Insert Cell Kernel Help Python 3

Markdown CellToolbar

In [1]:
```
# setup the matplotlib graphics library and configure it to show
# figures inline in the notebook
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
```

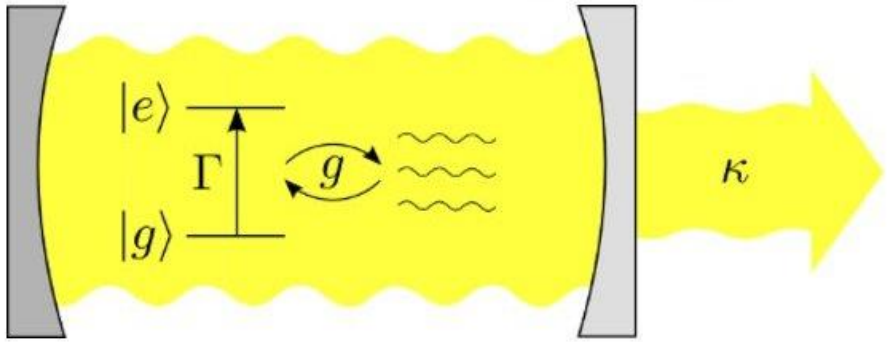
In [2]:
```
# make qutip available in the rest of the notebook
from qutip import *

from IPython.display import Image
```

Introduction and model

Consider a single atom coupled to a single cavity mode, as illustrated in the figure below. If there atom excitation rate Γ exceeds the relaxation rate, a population inversion can occur in the atom, and if coupled to the cavity the atom can then act as a photon pump on the cavity.

In [3]:
```
Image(filename='images/schematic-lasing-model.png')
```

Out[3]:



Jupyter commands in server side

- Create a docker container with a port to Jupyter server:

```
nvidia-docker run -p 8080:8080 -v
/DATA/berat/dip_cont:/root/dip_cont --name dip_cont -
it dl-image bash
```

- Change privileges on the mounted folder:

```
chown 1013:1013 dip_cont
```

- Start Jupyter server from inside docker:

```
cd dip_cont
jupyter notebook --no-browser --port=8080
```

Jupyter commands in user side

- Open port between server and localhost:

```
ssh csdlsrv1 -L 8080:localhost:8080
```

- In an internet browser:

```
http://localhost:8080
```

- In server, start docker:

```
nvidia-docker start dip_cont -ai
```

There is a problem!

Jupyter commands in user side

- In server, start docker:

`nvidia-docker start dip_cont -ai`

There is a problem!

- Jupyter server is running and we can't use bash.
- Stop Jupyter server (**`ctrl+c`**)
- Stop and exit docker (**`ctrl+d`**)
- Start docker without bash (**`nvidia-docker start dip_cont`**)
- Start jupyter server without bash

`nvidia-docker exec dip_cont jupyter-server -no-browser -port=8080`

- Start docker again with bash (**`nvidia-docker start dip_cont -ai`**)

Basic image processing using opencv

- Install opencv (open source for computer vision)

`pip install opencv-python`

- Install numpy (array library for scientific computing)

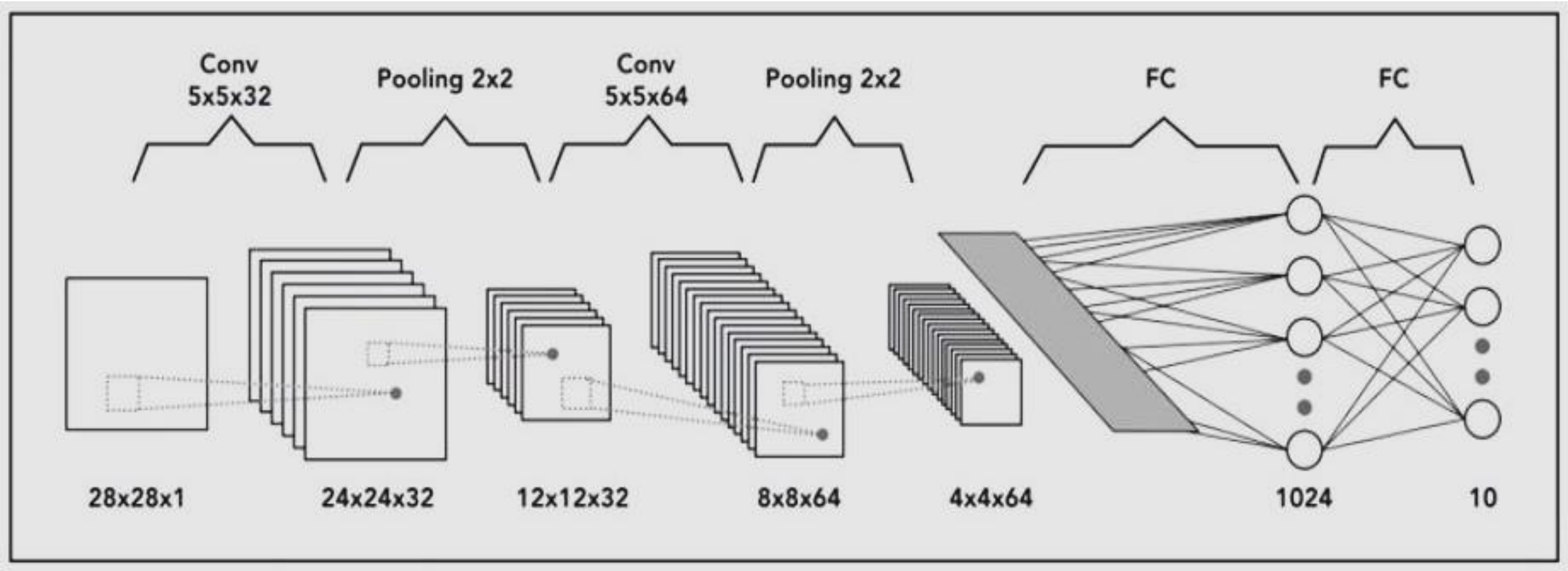
`pip install numpy`

- **`pip uninstall python-dateutil`**
- **`pip install python-dateutil`**

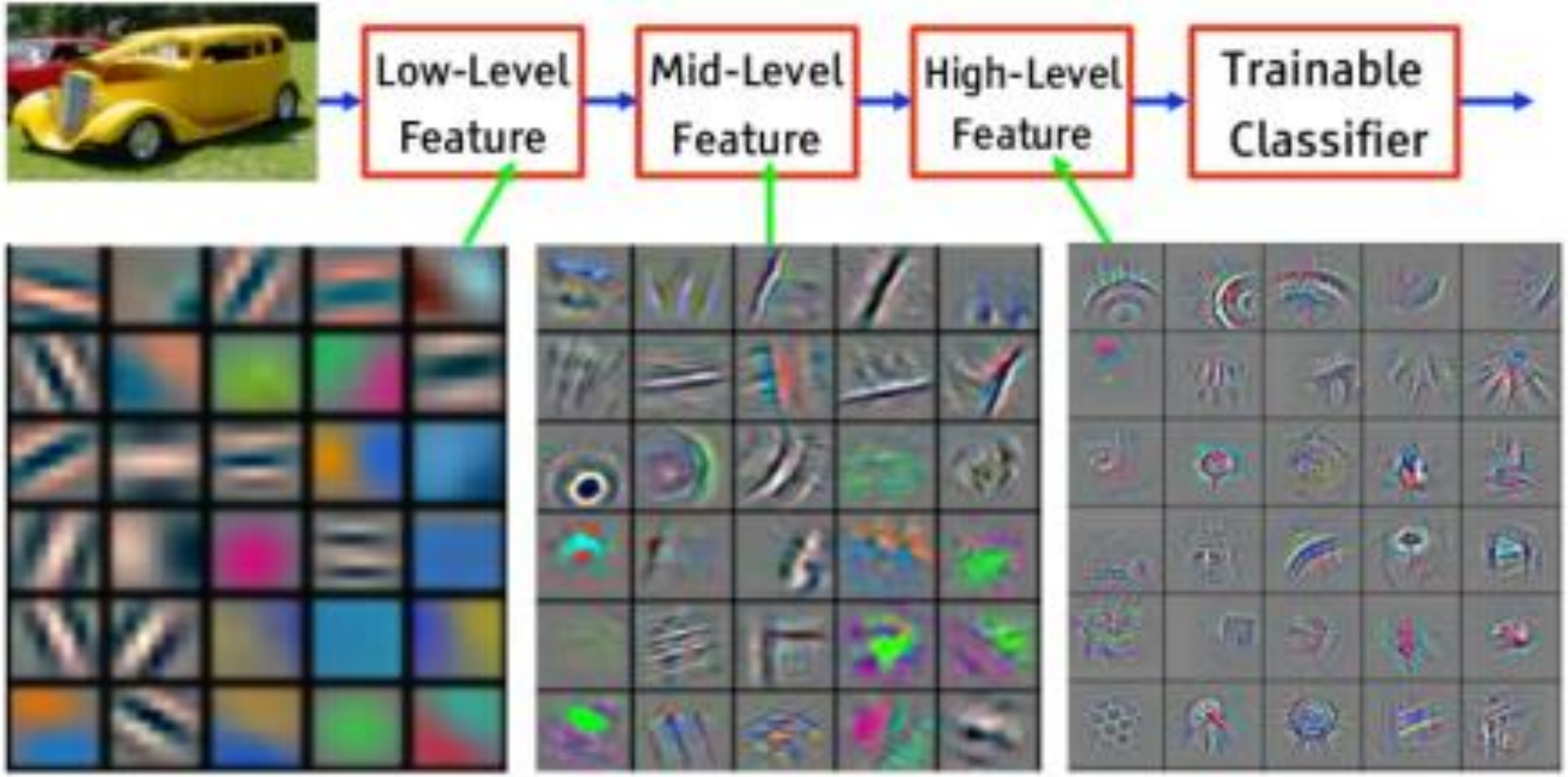
- Refer to the following jupyter notebook:

image_processing.ipynb

Convolutional neural network (CNN)

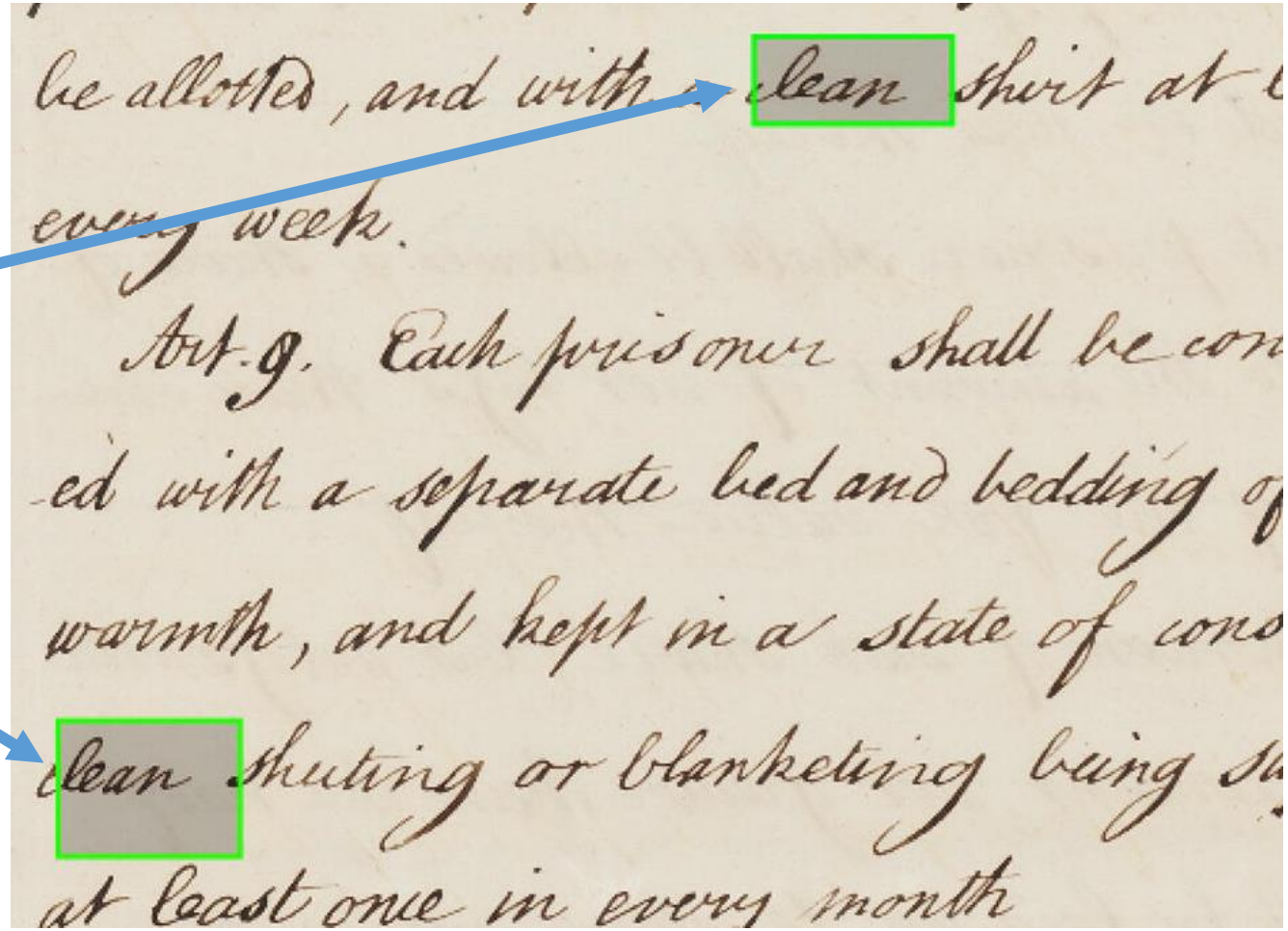


CNN extracts features automatically



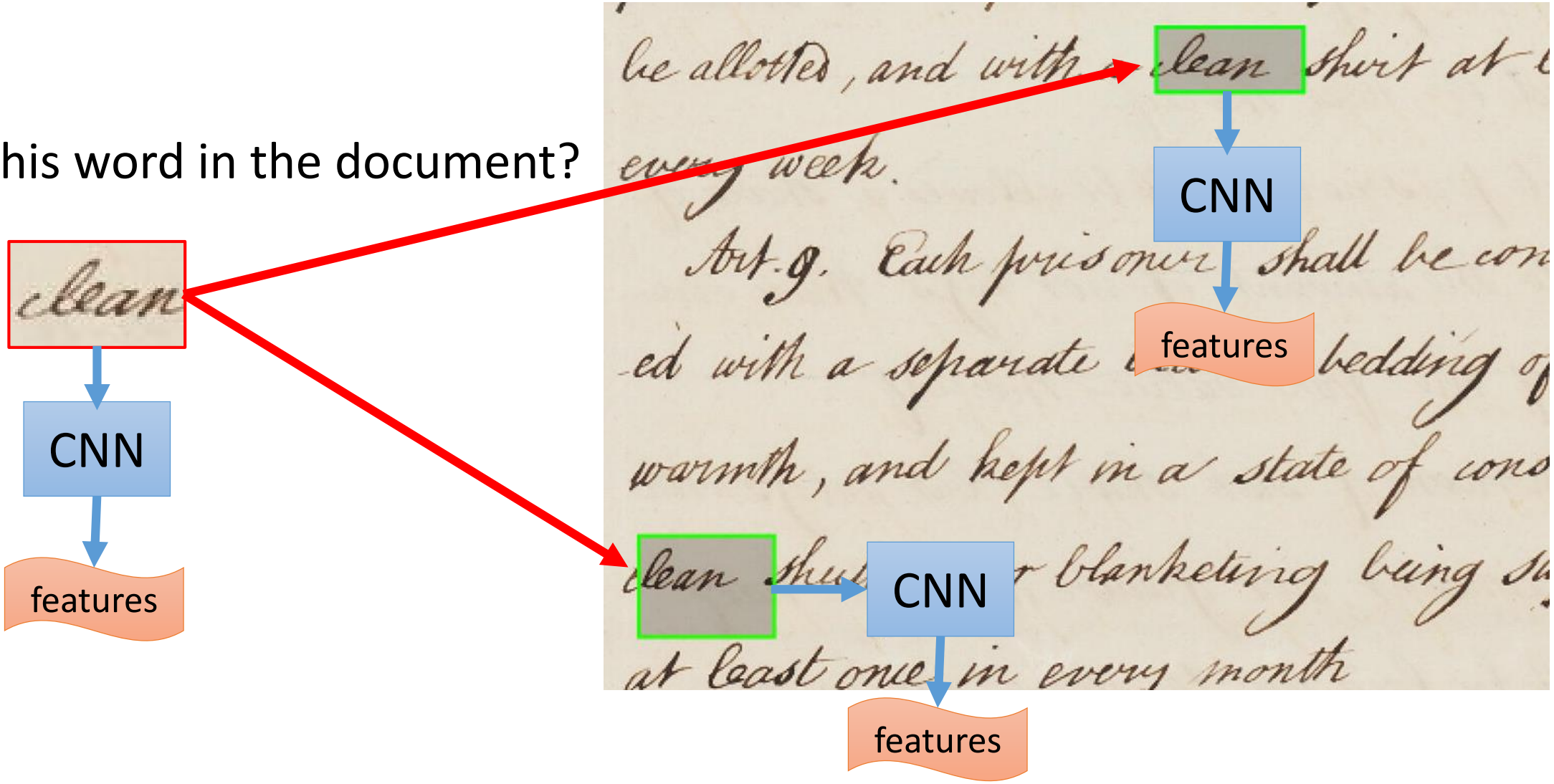
Word spotting

Where is this word in the document?



Word spotting using off-the-shelf CNN features

Where is this word in the document?



Keras

- Keras is a high level API that can run on top of:

1. Tensorflow
2. Theano

- We will run it on top of tensorflow.

Keras on tensorflow

- **nvidia-docker run -v /DATA/berat/dip_cont:/root/dip_cont --name dip_cont -it dl-image bash**
- **pip install --upgrade pip**
- **pip install opencv-python**
- **pip uninstall keras pip install keras==2.1.2**
- **pip uninstall python-dateutil**
- **pip install python-dateutil**
- **vi ~/.keras/keras.json**

Tensorflow on GPU

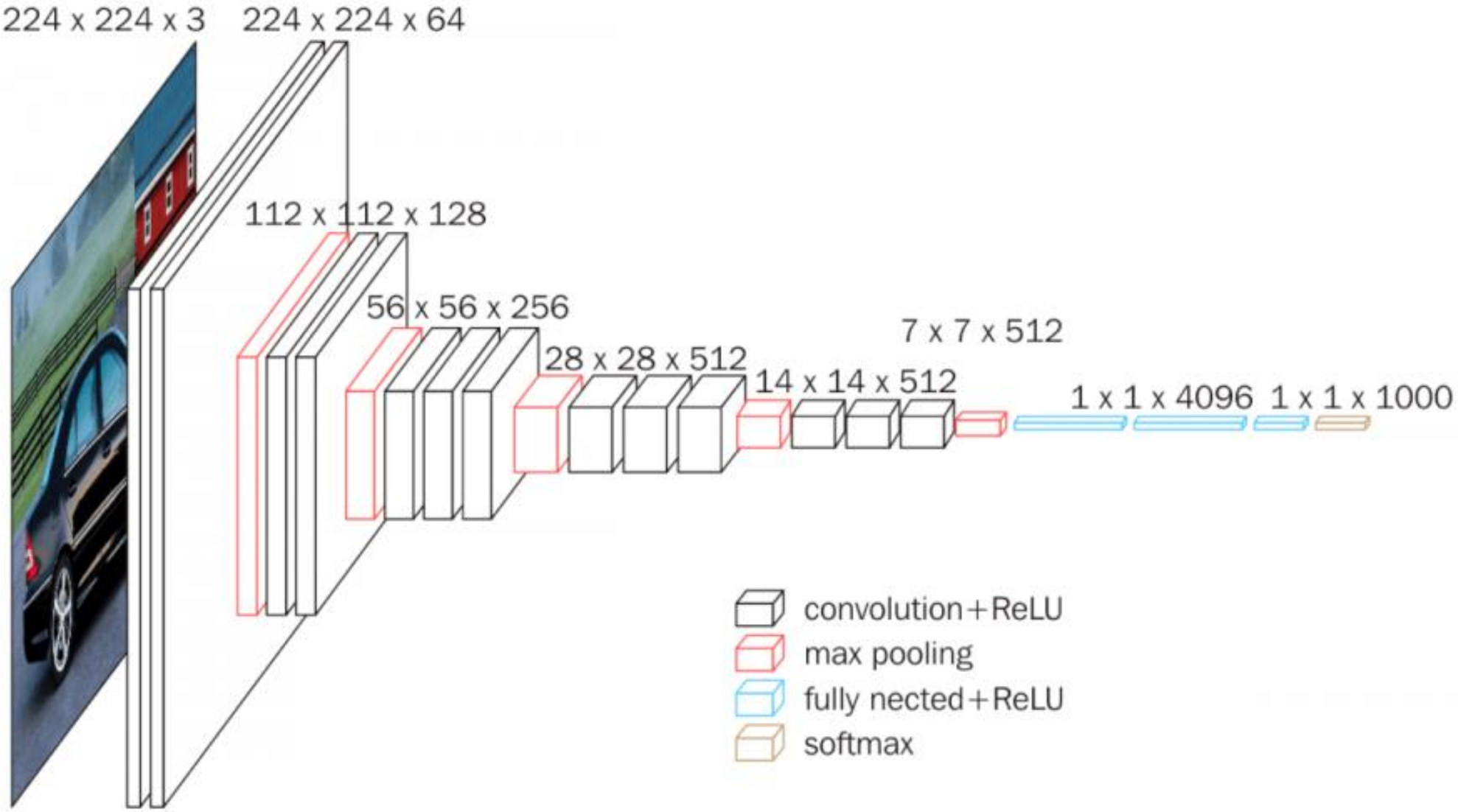
- **`pip uninstall tensorflow`**
- **`pip install tensorflow-gpu==1.2`**

- Run python on a specific GPU

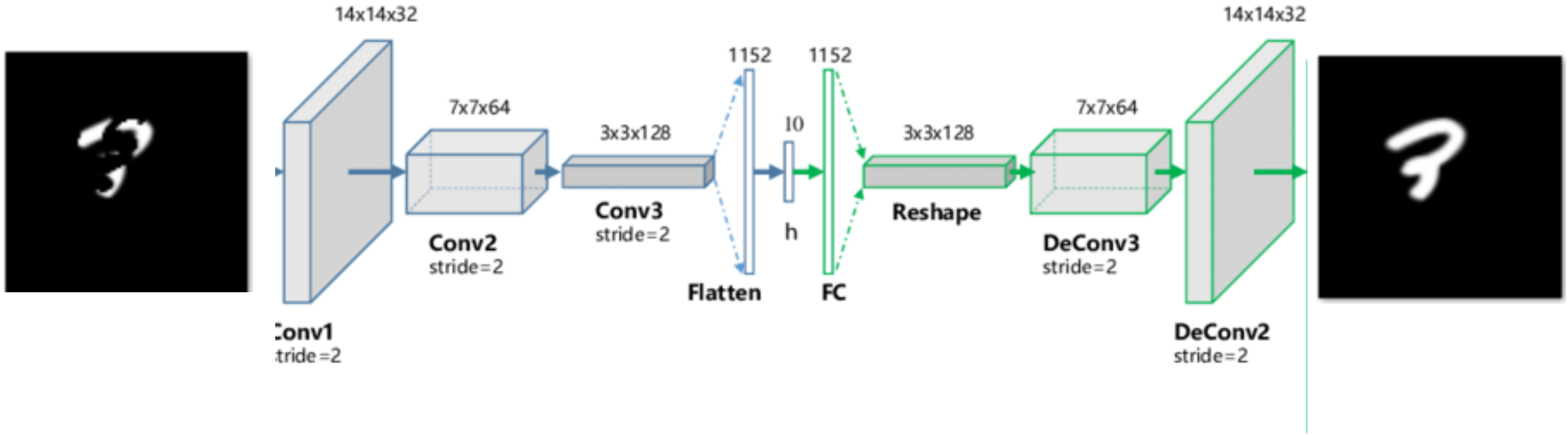
```
import os os.environ["CUDA_VISIBLE_DEVICES"]="2"
```

- Use nvidia-smi to see idle GPUs

VGG net


224 x 224 x 3
224 x 224 x 64
112 x 112 x 128
56 x 56 x 256
28 x 28 x 512
14 x 14 x 512
7 x 7 x 512
1 x 1 x 4096
1 x 1 x 1000
convolution+ReLU
max pooling
fully nected+ReLU
softmax

Autoencoder



Restoring Hebrew characters using autoencoder