Installation

Install Python

Note: *If you already have a working version of python3 on your machine, you might be able to skip this step. However, if you are facing incompatibilities consider installing 3.8.10 for this tutorial.*

Navigate to https://www.python.org/downloads/ and download Python 3.8.10 for your OS. Follow the installation instructions and make sure Python is located on your path before continuing with the next step.

Windows only: Make sure to tick the box “Add Python to your path” during the installation process.

To check that python is on your path, open a console and run the command

```
python --version
```

Which should give you the output:

```
Python 3.8.10
```

Install the Requirements

Once finished, you will have to install Jupyter and the required python packages on your machine. For this you will have to download the **Requirements.txt** from Studium (it contains the correct versions for each package) and then execute the lines

```
pip install -r requirements.txt
pip install -U git+https://github.com/usr-lab/imageio.git@IIS2021#egg=imageio[ffmpeg]
jupyter nbextension install --py widgetsnbextension –user
jupyter nbextension enable --py widgetsnbextension
jupyter nbextension enable --py ipywebrtc
jupyter nbextension enable --py ipymp
```

Note: `pip install -U git+https://github.com/usr-lab/imageio.git@IIS2021#egg=imageio[ffmpeg]` *can fail on some console environments. If that happens, try quoting the URI:* `pip install -U "git+https://github.com/usr-lab/imageio.git@IIS2021#egg=imageio[ffmpeg]"`

Download the files for Lab 1, Lab 2 & Assignment 1

After installing all the requirements, download the .zip files for lab 1, lab 2, and assignment 1 from Studium. Then, unzip the file(s), navigate into the respective folder, open a terminal in that location, and open the notebook inside via

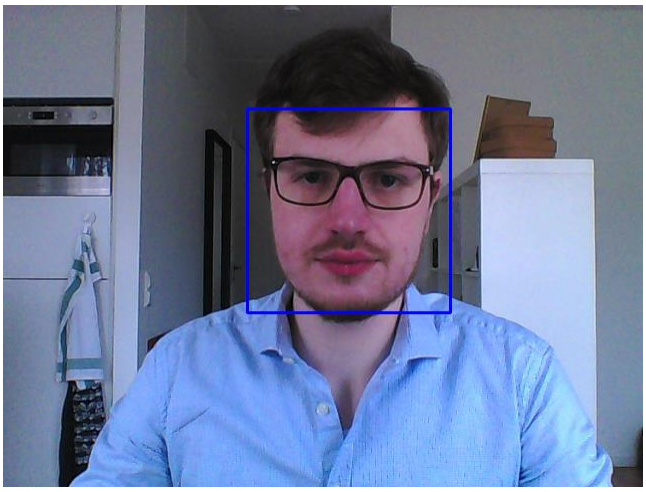
```
jupyter notebook
```

This should open a new tab in your browser and show a file tree. For Lab 1 (CV), find the file "*Lab_1_Computer_Vision.ipynb"* in this tree and open it. In it, you will find further instructions on how to complete Lab 1. Use the same procedure for Lab 2 and Assignment 1.

Lab 1 - Computer Vision

This lab introduces foundational concepts of image processing. You will learn how to capture images and video in python, and how to process both forms of data. You will be introduced to *color thresholding* for object detection, *contour analysis* for visualizing object boundaries, and *face detection* using Haar-cascade classifiers. You will use this to build two small applications that are able to process video data and produce output similar to the images below. The first is a program that performs *color thresholding*, and the second is a program that performs *face detection*. You will use what you learn here during Assignment 1 to create a dataset for the final project and visualize it. Below are two screenshots of the programs you will build in the lab.

Color thresholding of a banana.

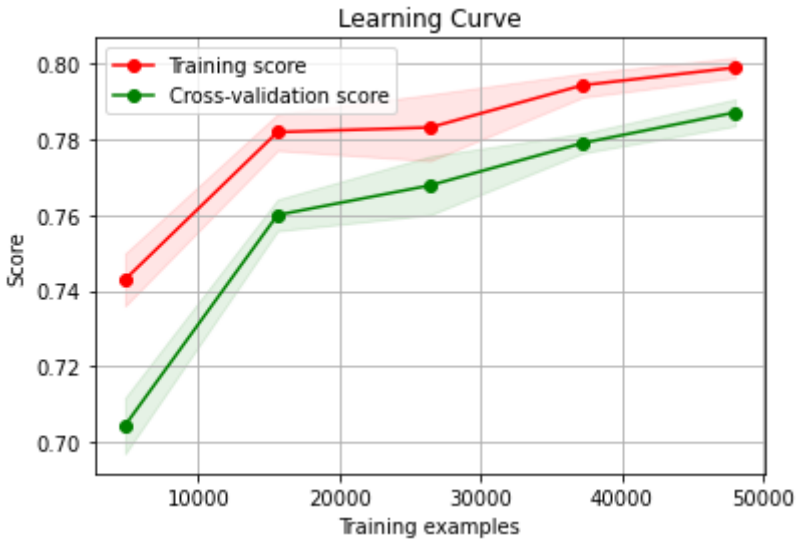


Face detection using Haar cascades.

Lab 2 - Machine Learning

In Lab 2, you will learn the basis of how to build machine learning models. It starts by introducing basic TensorFlow and how to express arbitrary functions as graphs. It then teaches you how to implement classic gradient descent and walks you through using it to estimate model parameters and train a model using a dataset. This is extended to the Keras API, a powerful library that builds on top of TensorFlow and allows you to write clean code when training models. In the process, you will learn about *support vector machines* (SVMs), *linear regression*, *logistic regression*, and *multi-layer perceptrons* (MLPs), and will implement all of these in TensorFlow. The tutorial stops just shy of deep learning, because we do not know how powerful the computer you have at home is. Finally, you will learn how to integrate the Keras API with scikit-learn, a machine learning library with a strong testing and evaluation component. You will look at a model's *confusion matrix* and learn how to check if you have enough data to train it.

Note: *Depending on your previous knowledge, this tutorial will likely take you more time than one lab session to complete. It covers quite a lot of ground. The notebook is completely self contained, so you can start before and use the lab to ask questions, or you can start in the lab and continue afterwards. While the lab is optional, we do recommend you work through everything, because it will help you during the final project.*



The effect of data on a logistic regression model.

Assignment 1 - Data Collection and Cleaning

In Assignment 1 you will generate a dataset that will be used during the project. Like the two labs, there is a Jupyter notebook that guides you through the assignment. You will record a total of 6 videos and annotate this data to track the skeleton of a hand. The position values will be stored in a .csv file. For more details about Assignment 1, such as the requirements for passing, exact content of the videos, and how to annotate them, please refer to the description of Assignment 1 on Studium.

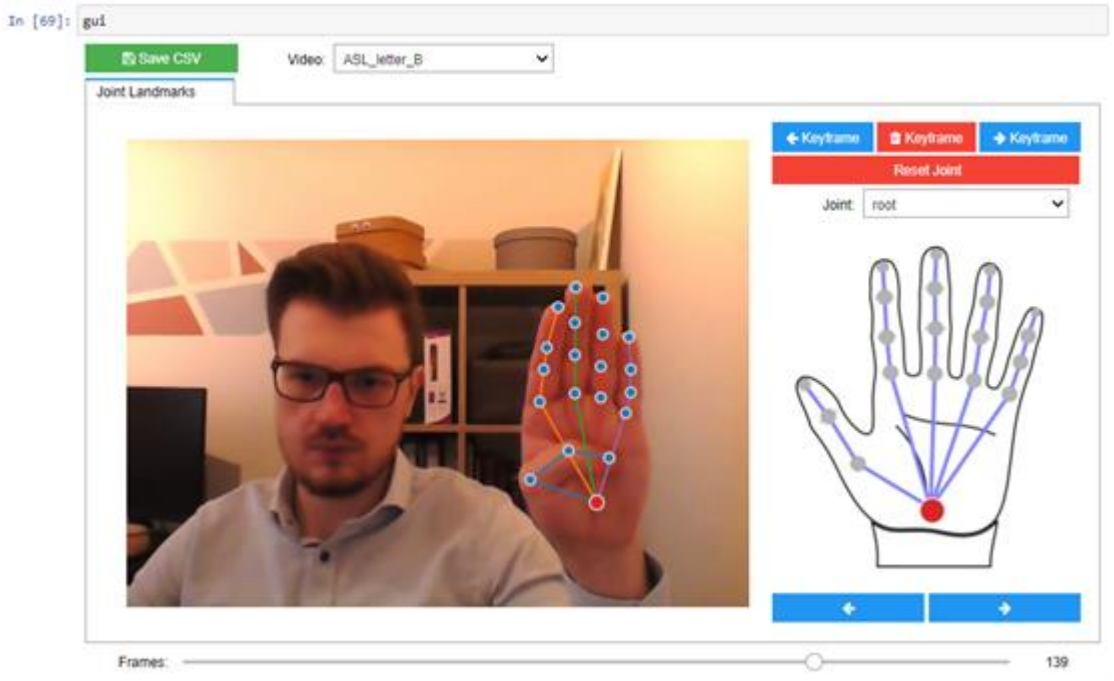


Image of the interface used for annotation of the data.