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## Exercise 1: Filtering, Derivatives, Edges and Hough Transform

due **before** 2020-05-12

### Important information regarding the exercises:

- The goal of exercise is to provide you with hands-on experience with the algorithms covered in class.
- Each exercise question is a self-contained Jupyter notebook (.ipynb), with some missing implementations to be filled by you (you can modify the other parts, too). (What is a Jupyter notebook? See below).
- Solving the exercises is **not mandatory** and does not count towards your grade.
- When the deadline has passed, we will release an example implementation.
- We encourage you to work on the exercises in teams of up to 4 students.

## Software Setup

Python will be the language we use for the exercises (version  $\geq 3.6$ ). Primarily because Python has an extensive and lively ecosystem of libraries for data science, machine learning and computer vision. Specifically, we will use extensively these libraries:

- NumPy, and SciPy for matrix manipulation
- OpenCV for image processing
- TensorFlow for deep learning (later)

Do not worry if you are not familiar with these libraries (or with Python in general). Working through the exercises will help you to master these tools. If you do not know what a function does, simply search online for its documentation. There are also plenty of good tutorials. For example, here is a short introduction to NumPy: <http://cs231n.github.io/python-numpy-tutorial/>.

We recommend using Anaconda to manage Python libraries. Download it here and follow the instructions: <https://www.anaconda.com/distribution/>. Jupyter Notebook is already included in Anaconda distribution. If you choose not to use Anaconda, follow the instruction here to install Jupyter Notebook <https://jupyter.org/install>.

If you have not already installed OpenCV, we recommend you use the pre-built package for Python, instead of compiling it from source. There are several versions available, see below for an example.

We recommend using Linux (Ubuntu is a good first choice if you're getting started with Linux), but other platforms are also supported by Anaconda.

In a Linux command line, you can do all necessary setup using the following commands:

```
1 wget https://repo.anaconda.com/miniconda/Miniconda3-latest-Linux-x86_64.sh
   sh
2 bash ./Miniconda3-latest-Linux-x86_64.sh -b
3 eval "$(($HOME/miniconda3/bin/conda shell.bash hook))"
```

```
4
5 conda create --yes --name cv2020 python=3.6 numpy scipy scikit-image
   scikit-learn imageio matplotlib jupyter notebook
   jupyter_contrib_nbextensions jupyter_nbextensions_configurator
6 conda activate cv2020
7 conda install --yes opencv3 -c menpo
8
9 # Now download and extract the exercisel.zip file somewhere
10 # Navigate to that folder and then start the Jupyter Notebook server as
   follows:
11 jupyter notebook
```

It can be a good idea to collaborate with your fellow group members to make sure that everyone manages to set up their environment. Use the Moodle forum created for this purpose.

## Questions

This first exercise contains five questions:

1. Gaussian Filtering
2. Fourier Transform
3. Image Derivatives
4. Edge Detection
5. Hough Transform

We recommend completing these questions in the order listed above. The corresponding Jupyter notebooks contain the actual questions.