**Lab 01**

# **Introduction**

**Why is Computer Vision Used?**

Computer Vision (CV) is a field of Artificial Intelligence (AI) that enables machines to see, interpret, and understand visual data like images and videos. It is widely used in various industries to automate tasks, improve accuracy, and enhance user experiences.

**Real-World Applications of Computer Vision**

**Healthcare:** Medical Image Analysis – Detect diseases in X-rays, MRIs, CT scans (e.g., cancer detection). Surgical Assistance – AI-powered vision systems guide robotic surgeries. Patient Monitoring – Detects abnormal movements in ICU patients.

**Security & Surveillance:** Facial Recognition – Used for authentication (e.g., phone unlock, access control). Anomaly Detection – Identifies suspicious activity in public places. License Plate Recognition – Monitors traffic violations.

**Autonomous Vehicles:** Object Detection – Detects pedestrians, vehicles, and road signs. Lane Detection – Helps self-driving cars stay in their lanes. Collision Avoidance – Prevents accidents using real-time vision data.

**Retail & E-commerce:** Automated Checkout – Amazon Go stores use CV for cashier-less payments. Virtual Try-Ons – AR-based apps let users "try on" clothes, glasses, or makeup. Product Recommendation – Image search and visual similarity detection.

**Agriculture & Farming:** Crop Monitoring – Identifies diseases and suggests treatments. Livestock Monitoring – Tracks the health of animals. Automated Harvesting – Robots pick fruits based on ripeness detection.

**Industrial & Manufacturing:** Quality Inspection – Detects defects in products. Assembly Line Automation – Guides robotic arms in assembling parts. Inventory Management – Uses cameras to track stock levels.

**Social Media & Entertainment:** Image & Video Filters – Snapchat, Instagram use CV for face filters. Content Moderation – Detects inappropriate content on platforms. Deepfake Detection – Identifies manipulated media.

**Why is Computer Vision Important?**

* Computer Vision is transforming industries and making AI see the world like humans.
* Automates repetitive tasks **→** Saves time & costs.
* Improves accuracy **→** Reduces human error in medical, security, and industrial tasks.
* Enables real-time decision-making **→** Essential for self-driving cars & surveillance.
* Enhances user experience → AR, VR, and AI-powered applications.

**The Future of Computer Vision**

AI-powered real-time surveillance for smart cities.

AI doctors for diagnosing diseases from medical images.

More advanced robotics with vision-based object manipulation.

**Working with Computer Vision**

The practical assignment of the course on Computer Vision consists of a number of exercises from the following sessions.

## **Procedure**

To qualify for the practical assignment there are the following requirements:

1. Reports of all sessions (except of the first session in which you will work with the image processing package ImageJ) with a concise explanation of each problem. All questions posed have to be answered.

2. All requested examples must have the name as used in this document; a header of the form /∗ Author(s): .... \*/ /∗ Date: .... \*/ /∗ NAME:.... DESCRIPTION:.... etc.∗/ containing the name(s) of the author(s), and the date.

## **Getting Started with Python Programming in Google Colab**

Now we have to start programming in Python, but you don’t want installing software, setting up environments, or dealing with compatibility issues? Google Colab will work for you as a hardware as a service.

Google Colab (short for "Colaboratory") is like a **free, online Jupyter Notebook** that runs in your browser. It’s perfect for beginners because: **No installation needed** – Just open a browser and start coding. **Runs on Google’s servers** – No need for a powerful computer. **Free access to GPUs** – If you work with AI or machine learning. And **Works anywhere** – PC, Mac, Linux, or even a tablet.

## **Step-by-Step Guide to Start Coding in Colab**

### **Step 1: Open Google Colab**

1. Go to Google Colab in your web browser.
2. Sign in with your **Google account** if you aren’t already logged in.

### **Step 2: Create a New Notebook**

1. Click on **"File" > "New notebook"**
2. A blank notebook opens. This is where you’ll write your Python code.

### **Step 3: Write Your First Python Program**

In the first cell, type:

print("Hello, world!")

Then, press **Shift + Enter** or click the **Run button (▶)** to execute the code

## **Running Python with Built-in Libraries**

Google Colab comes with useful libraries pre-installed. Let’s try them:

### Example 1: **Basic Math in Python**

python

a = 5

b = 10

sum = a + b

print("The sum is:", sum)

### Example 2: **Using NumPy for Math Operations**

python

import numpy as np

arr = np.array([1, 2, 3, 4, 5])

print("Array:", arr)

print("Mean:", np.mean(arr))

No need to install NumPy—it’s already there!

## **Working with Google Drive**

You can **connect Colab to Google Drive** to save and load files.  
Run this command in a Colab cell:

python

from google.colab import drive

drive.mount('/content/drive')

It will ask for permission—grant it, and now you can access your Drive files!

Once mounted, your Google Drive files are available at:

python

!ls /content/drive/MyDrive

This lists all files in your **Google Drive → My Drive** folder.

## **Load & Display the Imag using OpenCV**

python

import cv2

import matplotlib.pyplot as plt

# Set the correct file path

image\_path = "/content/drive/MyDrive/image.jpg" # Change this to your image path

# Load the image

image = cv2.imread(image\_path)

# Convert from BGR to RGB (OpenCV loads images in BGR format)

image = cv2.cvtColor(image, cv2.COLOR\_BGR2RGB)

# Display the image

plt.imshow(image)

plt.axis("off") # Hide axes

plt.show()

## **Save Your Work**

Colab **automatically saves** your work, but you can manually save it too:  
Click **File → Save a copy in Drive** to keep it safe.

Exercise C**onvert the image into grayscale**

**Draw the histogram**

## **Unmount Google Drive (Optional)**

If you want to disconnect Google Drive, run:

python

drive.flush\_and\_unmount()

## **Home Assignment**

Now that you know the basics, you can:

* Learn **loops, functions, and data structures** in Python
* Compute 4 x4 **matrix computation**, e.g. addition, subtraction, multiplication and division.