Biometrics (CSE 40537 / 60537)
University of Notre Dame, Spring 2022
Assignment 3: Iris Verification
Due date: March 25, 11:59 PM ET
Total: 10 points

1. Introduction

The purpose of this assignment is to train and evaluate the students' capabilities to use, set the operating point, and perform biometric verification with a third-party library of iris recognition, leveraging the NIR irises collected in class. To do so, two zip files are being provided, one containing the third-party library (which was presented in class), and the other containing the dataset of collected irises.

1.1. Iris recognition library

The iris recognition library is available at https://bit.ly/35Sl73s. To use it and complete this assignment, you will need a computer with *Python 3* (https://www.python.org/downloads/), plus the *numpy* (https://numpy.org/), *SciPy* (https://scipy.org/), and *OpenCV* (https://opencv.org/) libraries. A quick install of these libraries can be done through *PyPI* (https://pypi.org/), see Figure 1:

```
user@host:~$ pip3 install numpy opencv-contrib-python scipy
```

Figure 1. Command line leveraging *PyPI* to install the needed libraries.

A good starting point to solve this assignment is the *Python* program implemented as *main.py*, within the iris recognition library. It currently works by providing the file paths of two iris images and the extension to solve this assignment should be straightforward to the students (and it is indeed expected from them).

1.2. Iris dataset

The iris dataset is available at https://bit.ly/3q3atgQ and is password protected. To obtain the password, please contact the instructor (Daniel Moreira) through either Slack https://bit.ly/3H8kajL, *@dmoreira*) or e-mail (daniel.moreira@nd.edu). **This dataset must not be shared by the students with anybody and must be deleted right before the end of the course. Anyone breaking these rules will automatically fail the course.** Please refer to Prof. Moreira if you have any questions.

The iris dataset is organized into two folders, namely "dataset" and "queries". The "dataset" folder contains 66 NIR images depicting 33 unique irises (two images per iris), whose names obey the following format: "`<IRIS_ID>_<CAPTURE>.png`". As a consequence, two files with the same `<IRIS_ID>` depict the same eye and comprise a genuine pair. Figure 2 provides a summary of the content of "dataset" with 12 images and six distinct eyes.

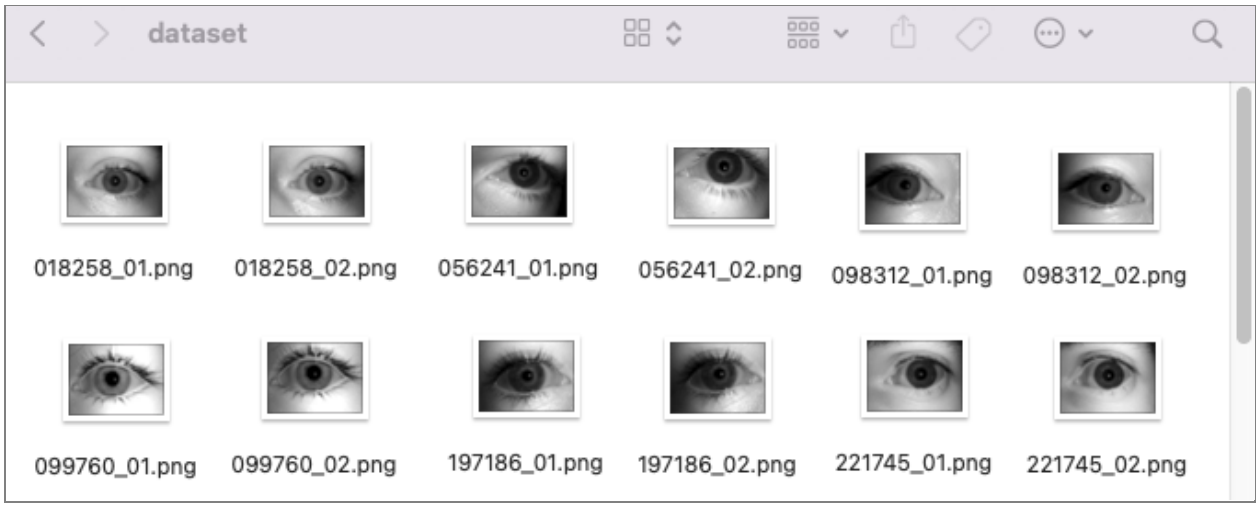

Figure 2. Example of the content of the folder “dataset”.

The “queries” folder, in turn, contains six image files, whose names obey the format: “`<CLAIMED_IRIS_ID>.png`”. These six images do not have exact copies within the “dataset” folder and `<CLAIMED_IRIS_ID>` expresses their respective claimed eye in a biometric verification scenario over the content of the “dataset” folder. Figure 3 depicts the full content of “queries”.

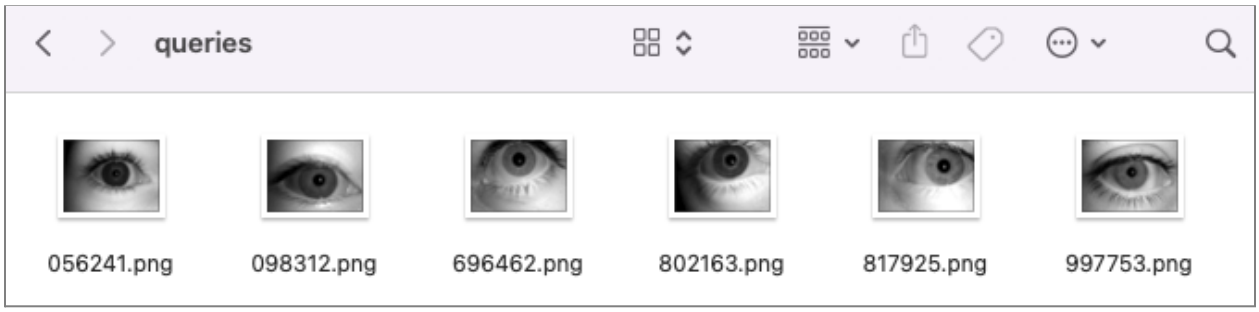

Figure 3. Example of the content of the folder “queries”.

1.3. Assignment directions

After downloading and unzipping the contents of the iris recognition library and iris dataset, follow the instructions and answer the questions presented in Section 2.

There is no formal template for providing your answers. You may use the editor you like. The following submission is expected:

- A single PDF file or Word document containing your answers.

Please share your answers through Slack (https://bit.ly/3H8kajL, *@dmoreira*) or send them to daniel.moreira@nd.edu by March 25, 2022, 11:59 PM ET.

2. Questions

2.1. As explained in class, the provided third-party iris recognition library is able to extract the binary code from a given NIR iris image, as well as to calculate the distance between two computed iris binary codes. The expected behavior for the software is to generate small distances for two iris images that depict the same eye (genuine pair), and large distances for two iris images that depict different eyes (impostor pair).

Leveraging the content of **only** the "dataset" folder within the iris dataset, the third-party iris recognition library, and metrics learned on class, please determine **what is a good binary iris code distance threshold to separate genuine from impostor pairs**. While providing your answer for the distance threshold, please explain in details how you computed it. (4 points)

Answer tips: good answers will describe what you did, such as "I generated *x* genuine and *y* impostor pairs, and observed FNMR and FMR at EER…", etc.

2.2. By leveraging the distance threshold computed above, please classify each one of the six iris images provided within the "queries" folder of the iris dataset as either **genuine** (i.e., the `<CLAIMED_IRIS_ID>` is correct) or **impostor** (i.e., the `<CLAIMED_IRIS_ID>` is incorrect). Please justify your answer for each case by providing the distances obtained with the iris recognition library and comparing them to the distance threshold. In the occasion of being possible to obtain more than one iris code distance for a particular `<CLAIMED_IRIS_ID>`, please base your decision on the minimum distance as the best effort to perform biometric verification. (6 points)