

## Biometrics (COMP388-002/488-002)

Loyola University Chicago, Fall 2023

Assignment 3: Face Recognition

Due date: November 14, 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 identification with a third-party library of face recognition, over a partition of the Yale Faces Database (<https://bit.ly/45TuMPS>). To do so, one zip file is being provided, which contains the dataset partition.

#### 1.1. Face dataset

The face dataset is available at <https://bit.ly/3Qb9iYY> and is a modified subset of the Yale Faces Database (<https://bit.ly/45TuMPS>). The data is organized into two folders, namely "dataset" and "queries". The "dataset" folder contains 90 images, each one depicting a single face, whose names obey the following format: "subject<ID>.<CAPTURE\_CONDITION>.png". As a consequence, two files with the same <ID> depict the same individual, hence comprising a genuine pair. Figure 2 provides a summary of the content of "dataset" with 14 images and two individuals.

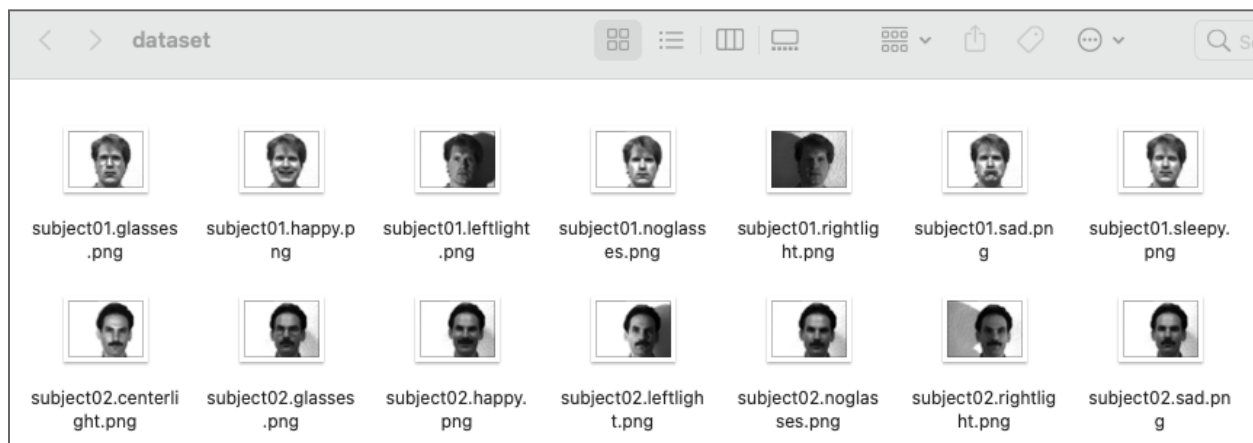
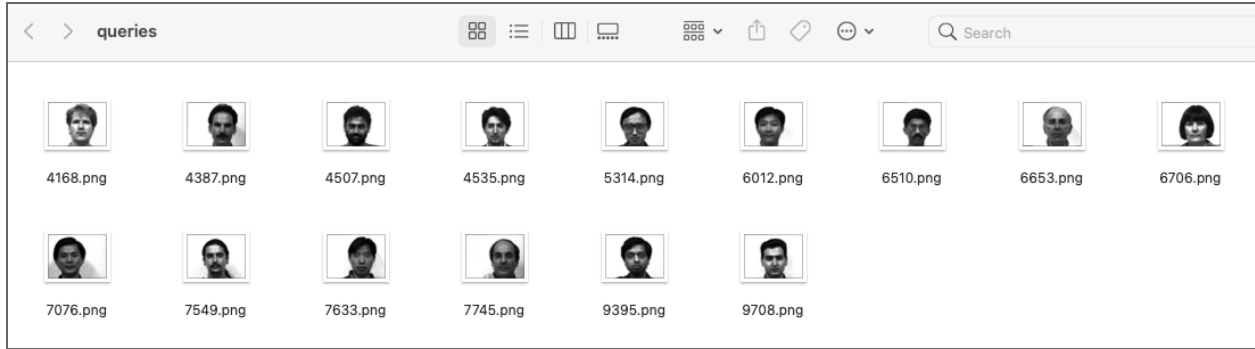


Figure 2. Example of the content of the "dataset" folder.

The "queries" folder, in turn, contains 15 image files, whose names are random numbers and have no particular meaning. These images do not have exact copies within the "dataset" folder and the depicted individuals may or may not have images with their faces within the "dataset" folder. Figure 3 depicts the full content of "queries".



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

## 1.2. Face recognition and metrics libraries

The face recognition library is available as a Google Colab notebook (<https://bit.ly/4759Kip>), which was explained in class. In addition to this implementation, you will also need either the first assignment’s notebook (metrics’ implementation, available at <https://tinyurl.com/bdjeeh5k>) or the *scikit-learn* (<https://tinyurl.com/nsyu2k9b>) library to compute the proper metrics and analyze the performance of the system.

## 1.3. Assignment directions

To complete this assignment, access the Google Colab notebook (<https://bit.ly/4759Kip>) and make your own copy. After downloading and unzipping the dataset file from Sakai to your local computer, upload them to your Google Colab notebook copy. Lastly, follow the instructions and answer the questions presented in Sec. 2.

There is no formal template for providing your answers. You may use the editor you like. The following option should work fine:

- A single PDF file or Word document containing all your answers and generated figures.

Please submit your file through the respective open assignment in Sakai by November 14, 2023, 11:59 PM ET.

## 2. Questions

2.1. As explained in class, the provided third-party face recognition library is able to extract a 512-dimensional float feature vector from a given face image, as well as calculate the angular distance between two feature vectors, using ArcFace (<https://bit.ly/3J8Tgtc>). The expected behavior for the software is to generate small distances for two face images that depict the same individual (genuine pair), and large distances for two images that depict different individuals (impostor pair).

Leveraging the content of **only** the “dataset” folder within the provided data, the third-party face recognition library, and metrics learned in class, please determine **what is a**

**good angular distance threshold to separate genuine from impostor pairs.** While providing your answer for the distance threshold, please explain in detail how you computed it. (1 point)

2.2. **What is the AUC** of the face recognition system you are using? In addition, please provide a graph with the system's **ROC curve**. (1 point)

2.3. By leveraging the face recognition system and the distance threshold previously computed, and by either capturing your face with your webcam or providing an image with your face, find within the "dataset" folder what is the individual that is the most similar to you. **Please provide the subject ID and the angular distance between your face and theirs.** In your opinion, do you have anything in common with this subject (e.g., gender, ethnicity, age, etc.)? If yes, what is it? (2 points)

2.4. By leveraging the face recognition system and the distance threshold previously computed, **please provide the subject ID** (or "**UNKNOWN**", if the individual does not have a face within the "datasets" folder), as well as **the respective angular distances** that supported your decision, for each one of the 15 images provided within the "queries" folder. (6 points)