Programming Exercise 2

Face Recognition (8 Pts)

Deadline: 10th February 2017 - 11:59 p.m.

Methods of User Authentication

Research Group: Mobile Security

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Task: Write a program that implements a Principal Component Analysis-based (PCA) face recognition for the „Database of Faces“ (ORL)[1].

- We encourage you to implement it in Java
- We provide a Java framework (Eclipse project) with a GUI as one can see in Figure 1
- The framework includes all necessary files (the faces, *jblas* library, class skeletons)
- Only submit your code, i. e., please do not submit the image catalog nor the *jblas* library
- Naming: `PCA_<Team-xx>.zip`
  (Example: Team 1, `PCA_Team-01.zip`)

Just upload your submission to the Moodle course.

Hints for Grading 2.1 Get Familiar With *jblas*, 0 Points

jblas is a fast linear algebra library for Java. jblas is based on BLAS and LAPACK and it wraps all sophisticated function calls in an easy to use interface. You should use this library to operate on matrices and to compute the eigenvalues and eigenvectors. A short introduction was given during the programming tutorial, please refer to the slides provided via Moodle.

Hints for Grading 2.2 Read Portable Graymap (*PGM*) Images Into Matrices, 2 Points

The PCA operates on images of faces which are stored in the portable graymap (PGM) file format. Your task is to read the PGM files from disk, interpret them and save them in matrices. The framework will provide a list of file handels of all images in the face database. You should iterate over this list to read, process, and store the faces in matrices. Based on these matrices the PCA can easily be applied.

Please use the provided class `PGM.java` for this task. You can find more information on the file format structure online[2] and in the programming tutorial slides.

Hints for Grading 2.3 Face Recognition via PCA, 6 Points

Apply the principal component analysis (PCA) to implement a face recognition that works with the „Database of Faces“ (ORL). Please use the provided class `PCA.java` for this task.

[1] `http://www.cl.cam.ac.uk/research/dtg/attarchive/facedatabase.html` – The ORL Database of Faces, as of December 21, 2016.

[2] `http://netpbm.sourceforge.net/doc/pgm.html` – PGM Format Specification, as of December 21, 2016.

Hint: Do not try to develop the PCA with the provided images, instead use the numbers from the example that was shown during the lecture. The example can also be found in the lecture notes. This way you can easily debug your code and find your mistake. If everything is working fine, use the real images from the database.

Make sure that you get at least an output like the following before submitting your solution:

```
You have selected s08-02.pgm as probe image
A similar image to s08-02.pgm is s08-04.pgm, which got a distance of 12477823.04
A similar image to s08-02.pgm is s08-09.pgm, which got a distance of 22007940.05
A similar image to s08-02.pgm is s08-07.pgm, which got a distance of 25685679.21
```

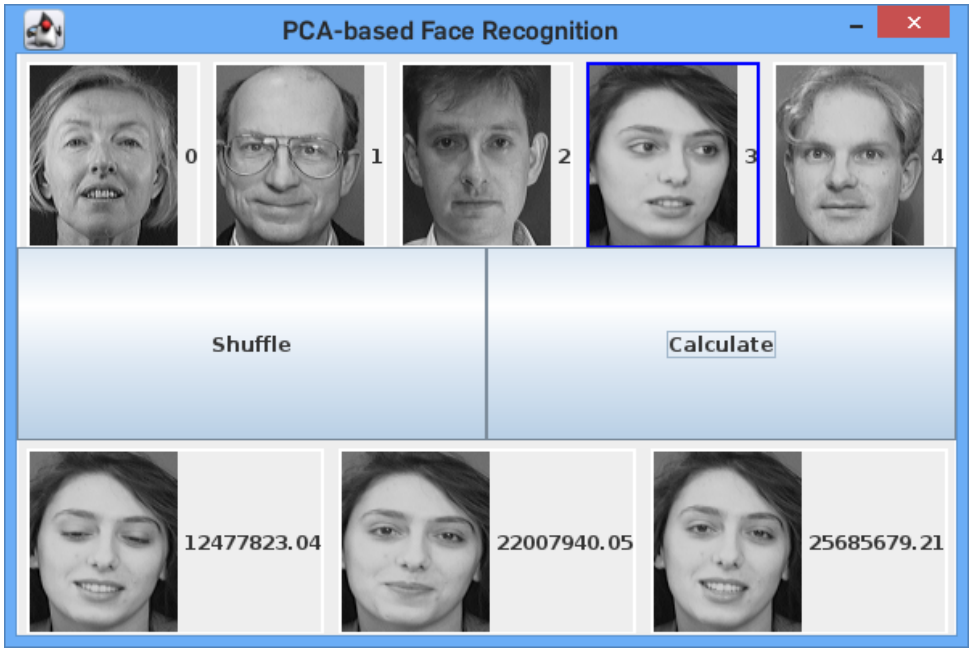

Figure 1: Screenshot of the *PCA-based Face Recognition* framework. Face photographs are taken from the „ORL Database of Faces“ (Cambridge University).