**Computer Vision, Homework 6**

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***Due in class on January 13th, 2024***

**Homework 6: Face Recognition using Eigenfaces**

The goal of this project is to help you further improve your programming skills in Matlab and give you a hands-on experience with Principal Component Analysis, an essential statistical analysis technique commonly used in Computer Vision and Machine Learning methods and applications. You will also have the opportunity to learn about one of the first methods published for face recognition in the paper:

**“Eigenfaces for Recognition”, M Turk, A Pentland - Journal of cognitive neuroscience, 1991**

**(http://www.face-rec.org/algorithms/PCA/jcn.pdf)**

**Project description:**

You will implement a multi-class classifier based on the method known as *eigenfaces*, as described in thepaper above and also in the tutorial given in class. You will first train a classifier from training images and then classify the test images. You can find the training and test images in the current folder: training images are given in “./Faces/Train” and testing the images in “./Faces/Test”. They are images containing faces of five people, numbered from 1 to 5.

Images are named <person\_id>\_<illumination\_id>.jpg . In order to perform the tasks of training and testing you would have to figure out how to read the person id from the file name. Given a test image, your method should predict a number from 1 to 5, according to the person that this image is most likely to belong to ( based, for example, on the method of Principal Components, as described in class). You are free to take any recognition approach you wish, but you could also try the one I have suggested in class, as follows:

For each person separately, use his/her training images to learn a subspace using PCA.

1. find the principal components and their eigenvalues
2. look at the eigenvalues, in decreasing order of their values, and decide how many you want to keep. You could also validate this number by trying to maximize you performance at the end.
3. for each test image, project it on the subspace learned for each person, separately, and choose the class (the person id) for which the reconstruction error is minimum. That person is likely to be the correct one, since the test image is closest, in terms of the Euclidean distance, to that person’s subspace.

You should name your higher level script “eigenFaces”. When I run this script it should do everything: training, testing and then print only the classification rate on the test image. You should write different functions for training and testing. The script and the other functions used should be in the folder“./Faces” and it should use only relative paths, so that I can easily run your code once I put it in the folder where I have “./Faces”. Implement this task exclusively in Matlab. If you have any questions or concerns I encourage you to discuss them with me.

Try to get a classification rate that is as high as possible. Also, make sure you understand the method of PCA. I will ask you questions and will also look at your code. Keep in mind that this task is doable, and fun, and take this opportunity to learn this really cool method of Principal Components Analysis and a nice application - face recognition.

**Other resources:**

http://www.vision.jhu.edu/teaching/vision08/Handouts/case\_study\_pca1.pdf

http://www.pages.drexel.edu/~sis26/Eigenface%20Tutorial.htm