Computer Vision

Exercises of Lab 11

Exercise 11.1: PCA projection and Eigen-Faces

The goal of this exercise is to understand the principles of subspace learning and use it to perform data classification. In this exercise we will use (pre-processed) images from the ORL face dataset. A subset of this dataset is included in the files of this exercise. These images have been centered to the human face and cropped in order to contain only the facial region. We will see how this process can be applied in a future exercise (when discussing about face detection).

Make also sure that you have downloaded the images included in this package and change the variable DATA_dir to the corresponding directory at your hard drive.

Open Exercise11.1.m and read the code. In this exercise, you will apply Principal Component Analysis (PCA) on the (vectorized) facial images and, subsequently you will apply image classification using the Nearest Neighbor classifier and the Nearest Class Centroid classifier.

On line 21 you are asked to calculate the total scatter matrix (St). This matrix is used in order to calculate the principal directions of the training data in the D-dimensional (D=1200 in this case) feature space by applying eigen-analysis. On line 34 you are asked to sort the obtained eigenvalues and eigenvectors, in order to form the data projection matrix Wpca (line 57). Given Wpca, you are asked to calculate the data representations in the PCA space (lines 58 and 59).

Given the data representations in the PCA space, Nearest Neighbor-based classification of the test images is applied in lines 63-65. You are also asked to apply Nearest Class Centroid-based classification in line 67.

Experiment with the number of PCA-space dimensions (line 40) and observe the effect of this hyper-parameter in the performance of the classifiers.

Exercise 11.2: LDA projection and Fisher-Faces

In this exercise, you will apply supervised subspace learning and compare the performance of using Linear Discriminant Analysis. After calculation of the data representations in the LDA-space, data classification is applied using the Nearest Neighbor classifier.

Open Exercise11.2.m and read the code. In this exercise, you will apply Principal Component Analysis (PCA) on the (vectorized) facial images and, subsequently you will apply image classification using the Nearest Neighbor and Nearest Class Centroid classifiers.

Compare the performance of each classifier on the two types of feature space for different data dimensionalities.