PR&ML Project Description –Project 1

Note: This document contains the description of Project 1. You can use any programming languages (e.g. C/C++, Java, Matlab, Python, etc) for the project.

The actual project is 100 points. You are encouraged to work on the extra credits after finishing the actual project. The project will be graded based on three aspects: Implementation (60%), accuracy (20%) and the report (20%).

If you use the built-in PCA & FLD functions in Matlab or Python, or codes published online (please don't forget to announce the actual ownership in the beginning of your submitted source code), you will only get at most 60 points (over 100) for this project.

This is an individual project, which means that you should finish it ALONE.

Project 1: Face Recognition and Detection

In this project, you are asked to implement two algorithms, Eigenfaces and Fisherfaces, for face recognition and detection with the Yale face database.

(1) Data: `project1-data-Recognition.zip` . This is the normalized Yale face database, containing the manually cropped and aligned images of the original Yale face database (credit goes to Prof. Deb Roy, MIT Media Lab). This dataset has 165 images of 15 subjects (subject01, subject02, etc.). There are 11 images per subject, one for each of the following facial expressions or configurations: center-light, w/glasses, happy, left-light, w/no glasses, normal, right-light, sad, sleepy, surprised, and wink.
Let N be the number of images randomly selected from each subject ($N < 11$). For each experiment, take $15N$ images from the database as training samples, and the rest as testing samples.

(2) Let $N = 3$. Implement Eigenfaces algorithm to the training samples, and then perform face recognition to the testing samples using nearest neighbor classifier. Plot the average misclassification rate vs. the dimensions of Eigenspace (e.g. the dimension $K = 10, 20, 30, ...$).
Hint: In order to obtain the average misclassification rate, you have to conduct 10 experiments for each K. In each experiment, you should randomly select $15N$ images as training samples, where N denotes the number of images randomly selected from each subject.

(3) Let $N = 5$ and 7, respectively. Repeat (2) for each N.

(4) Repeat (2) and (3) for Fisherfaces. Compare the simulation results of Eigenfaces and Fisherfaces, and describe your findings.

(5) Data: `project1-data-Detection.zip` (Downloaded from Flickr). In this problem, you are asked to develop an algorithm for face detection based on the intermediate or final results of (2)-(4). Please use a rectangle (or square) to indicate the detected faces in the given images. In the report, you should illustrate your algorithm clearly, discuss the challenges of face detection, and the strategies adopted in your algorithm to overcome these challenges.

Useful References for Project 1 :

1. P. Belhumeur, J. Hespanha and D. Kriegman, "Eigenfaces vs. fisherfaces: recognition using class specific linear projection," *IEEE PAMI*, 1997 (A local copy: `ref1.pdf`).

2. Harry Chao's slides on Eigenfaces and Fisherfaces (A local copy: `ref2.pdf`).