EE5907R PATTERN RECOGNITION PROJECT (CA 2)

20% of Final Grade
Project Deadline: 11:59pm, Monday, November 23, 2015

The Cross-Age Face Recognition Database

In this project, please use all the images from **380** subjects submitted by all our students of EE5907R course, and download the database at the IVLE/Assignments folder with the name **face_database.zip**. The dataset includes the training set and the testing set in different folders. Each subject's photos are located in a separate folder. The subject's class ID is its own folder name. The image file name format is the same as described in lecture ppt. All photos have the same size 160 x 128.

Project Requirements

In this project, you will explore the feature extraction and GMM learning problems. The pixel grey-level values are used as features.

1. Perform **Principal Component Analysis (PCA)** on the **training set**, a) display the first **10** Eigenfaces (PCs, rescale to 0-255 values), b) display with figure the face recognition accuracies of the testing set over different dimension-reduced feature dimensions (based on **Nearest Neighbour** approach, and dimensions from **1-200 (for example: 1, 5, 10, 50, 100, 150, 200)**). Note that for PCA, you need to use SVD for speedup; otherwise it will be very slow to use "eig" directly.

2. For the **whole database** (training set and testing set), learn the **Nonnegative Matrix Factorization (NMF)**, a) display the **50** bases (rescale to 0-255 values, and set the lower feature dimension as **50**), b) rerun twice more with random initializations, compare the bases for all these three runs, and see whether the results are the same. If different, explain the reasons.

3. Perform the **Linear Discriminant Analysis (LDA)** on the **training set**, a) display the first 10 Fisherfaces (bases, rescale to 0-255 values), b) calculate the face recognition accuracy of the testing set over different dimension-reduced feature dimensions (based on **Nearest Neighbour** approach, and dimension is set as **1-379 (for example: 1, 2, 3, 5, 10, 20, 50, 100, 150, 200, 250, 300, 350, 379)**). Compare the accuracies from PCA and LDA, which is better? Please explain the reasons. Note that to avoid singular issue, you may first conduct PCA before LDA and reduce the feature dimension to **1000**, but for Fisherface display, you need reconstruct back to original dimension.

4. For the **whole database**, a) learn the general **Gaussian Mixture Model (GMM)** on the whole database with the component number set as **10**, and display the **10** centres/means of the components, b) observe these **10** centres, and report what you may observe from the obtained centres/means. Note that, to avoid singular issue, you may first conduct PCA (consider each image as one sample) before GMM to reduce the feature dimension to **50**, but for centres display, you need reconstruct back to original dimension.

Programming Language

There is no restriction on programming language. You may use any language of your preference, i.e., MATLAB, VC++, Java, Python, etc.

What to Submit using IVLE tools (student submission folder)

In the submission folder (named after your **student ID**), please include the following.

1. A well-documented program that implements your project. You must submit your program source code and executable if any, and a readme file containing instructions to run your programs.
2. A well-written, concise project report.
3. A **statement of academic integrity**: "This report and the work reported therein represent my own intellectual efforts, and that I have not used any unacknowledged sources".

Finally, the **submission folder must be zipped** and upload to IVLE before the deadline.

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