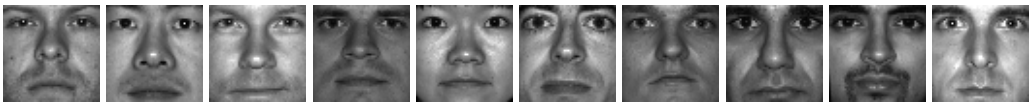
CSE 152 Assignment 4
Spring 2005
Eigenfaces & Fisherfaces
Due Friday, June 3 by 5pm



In this assignment you will implement the Eigenface and Fisherface methods for recognizing faces. You will be using face images from the Yale Face Database B where there are 10 faces under 64 lighting conditions. Using your implementation, you will evaluate the ability of the algorithm to handle lighting conditions of the probe images that differ from those in the training images.

You can download the data for this assignment at

`http://www.cs.ucsd.edu/classes/sp05/cse152/faces.zip`

For more information on the Yale Face Database, see

`http://cvc.yale.edu/projects/yalefacesB/yalefacesB.html`

PART A. RECOGNITION WITH EIGENFACES

Step 1. Take each 50×50 pixel training image and vectorize into an 2500-dimensional vector. Then perform principal component analysis (PCA) on the entire set of training image vectors, retaining the first d principal components. Note, rather than actually computing the huge covariance matrix, you can use SVD as described in class. The d eigenvectors (when converted back to images) are the Eigenfaces. Display the d eigenfaces as images in your report.

Step 2. Now, for each of your training images, project to the d-dimensional Eigenspace. Once this is done, classification will be performed by nearest neighbor with the $L2$ (Euclidean distance) metric in the Eigenspace.

Step 3. Evaluate your algorithm on the frontal pose of the ten people in the Yale Face Database B. We have already cropped and aligned these images for you. From the set of all ten individuals, we will consider 5 subsets, indexed as below:

Set 1. person*01.png to person*07.png
Set 2. person*08.png to person*19.png
Set 3. person*20.png to person*31.png
Set 4. person*32.png to person*45.png
Set 5. person*46.png to person*64.png

Train your Eigenface algorithm with $d = 9$ and $d = 30$ on all images in subset 1 (70 images). Then, evaluate your algorithm on subsets 1-5, and report the error rates in both a table and plot (error rate as a function of the subset). For subset 1, you would expect perfect recognition when evaluating on the training data.

Matlab hint: Use subplot to display multiple images/figures on the same page. You can also save intermediate results (using the "save" command) into a file in order to avoid processing the same thing twice.

PART B. RECOGNITION WITH FISHERFACES

For this part you will extend your Eigenface algorithm to perform the Fisherface algorithm discussed in class.

Step 1. Extend your Eigenface implementation by, first, projecting the training images via Eigenfaces to a $n - c$ dimensional space, and second, applying Fisher's Linear Discriminant to obtain $c - 1$ dimensional feature vector for each image.

Step 2. Evaluate the Fisherface algorithm as we did in Part A. Train your Fisherface algorithm with $c = 10$ and $c = 31$ on all images in subset 1, and classify subsets 1-5 as we did in Part A. Report the error rates in both a table and plot (error rate as a function of the subset). Does the Fisherface algorithm yield better results than the Eigenface algorithm? Report your observations.

WHAT TO HAND IN

- A report with all items described above, and comments / issues that you find relevant.
- An email entitled `CSE 152 Assignment 4` to `wychang@cs.ucsd.edu` that contains your report (with figures & images) and your code.