CS6406 Assignment 6

Due on March 20th 2018 at 11:59PM.
Submit your code and short report by Canvas.

March 12, 2018

Datasets
Two datasets of beautiful faces are provided. Don't distribute them beyond this class!!!
You can use one of them as the references and the other one to be recognized.

Implementation
Implement the eigenface approach based on the following steps:

1. Read in the M reference images and convert them into vectors: $\mathbf{I}_m$.
2. Compute the mean face $\mu = \sum_{m=1}^{M} \mathbf{I}_m / M$.
3. $\mathbf{I}_m \leftarrow \mathbf{I}_m - \mu$
4. Define $\mathbf{A} = [\mathbf{I}_1, \mathbf{I}_2, ..., \mathbf{I}_M]$, perform eigen-decomposition on $\mathbf{A}^T\mathbf{A}$, i.e., $\mathbf{A}^T\mathbf{A}\mathbf{v} = \lambda\mathbf{v}$.
5. Find the K eigenvectors corresponding to the top K largest eigenvalues, denote them as $\mathbf{v}_1, \mathbf{v}_2, ..., \mathbf{v}_K$.
6. The eigenfaces, $\mathbf{u}_k$, are computed by $\mathbf{u}_k = \mathbf{A}\mathbf{v}_k$ where $k \in [1, K]$.
7. Given a reference image, $\mathbf{I}_m$, project it to the subspace defined by the eigenfaces ($\mathbf{u}_k$'s), i.e., obtain the weighting coefficient of each basis vector as $\alpha_k = \mathbf{u}_k^T\mathbf{I}_m$.
8. Each person in the reference image is represented by a feature vector $[\alpha_1, \alpha_2, ..., \alpha_K]^T$.
9. Given an image to be recognized,
   subtract it by the meanface,
   project it to the subspace to obtain its feature vector,
   compare this feature vector with the feature vectors of reference images using the Euclidian distance. The one with the smallest distance is the matched image (recognized identity).

Check the accuracy of the eigenface approach.

Out of the entire pool of testing images, how many of them are correctly recognized?

Out of the subjects of the testing dataset, how many persons are correctly recognized?

Something to try (required):

1. Choose different K's to compare the performance (how many of the faces are correctly recognized).
2. Choose different distance metrics to compare the vectors in step 9 such as norm 1 or norm 2 (Euclidean).
3. Try to convert the images into different color spaces or gradient domain.

Upload running Matlab codes and a written report to Canvas by the due date & time including a) Brief summary of what you think the project was about, b) Brief outline of the algorithmic approach, c) Pictures of intermediate & final results that convince us that the program does what you think it does. d) Any design decisions you had to make and your experimental observations. What do you observe about the behavior of your program when you run it? Does it seem to work the way you think it should? Play around a little with different setting to see what happens. Note, your open-ended exploration is highly valued.

Note: zip all your files in a folder and provide a readme file so our TA can know how to run your codes.