Assignment 5

SUBMIT ASSIGNMENT

Due Feb 23 by 11:59pm **Points** 16 **Submitting** a file upload

Eigenfaces

If a machine can distinguish between a human, animal, tree, or a car, then its software uses eigenfaces to identify individual class. In this assignment, we will find eigenfaces of a human face. Eigenfaces capture the essential components from multiple images and map it into few images with rich information. Principal Component Analysis (PCA) can be used to extract such essential features.

To find eigenfaces of a human, we need images of multiple human beings of different race and color. You are given images of 800 different people such that each image has 85 x 60 pixels or a total of 5100 pixels. Each such pixel can be regarded as a feature. The images has been converted into a matrix format where each row represent a feature and each column represent a sample image. This data can be found in Assignment 5 folder in 'Files' with the name "my_data_pca.txt".

a) Import the data into your workspace and store it in a variable $\boldsymbol{X}$. Print the dimensions of the matrix $\boldsymbol{X}$. (2 points)

b) Compute the mean of each feature and subtract this mean from each column(samples). Let this matrix be $\boldsymbol{Y}$. The dimension of $\boldsymbol{Y}$ should be same as $\boldsymbol{X}$, and each row of Y has mean 0. (3 points)

c) Calculate the covariance of Y given by $\boldsymbol{C = Y^T Y}$. (1 point)

d) Find the eigenvalues and eigenvectors of the matrix $\boldsymbol{C}$. (3 points)

e) Order the eigenvalues of the matrix $\boldsymbol{C}$ from the largest to smallest, and plot the ordered eigenvalues. (4 points)

f) We wish to keep only 12 eigenvectors corresponding to 12 largest eigenvalues. Stack these 12 eigenvectors as columns of a matrix V. (2 point)

g) Find $\boldsymbol{E = Y * V}$. The eigenfaces are given by the resultant matrix $\boldsymbol{E}$. What is the dimension of $\boldsymbol{E}$. (1 points)

h) (Optional) Convert $\boldsymbol{E}$ into 12 images where each image is of dimension 85 x 60, and use image(.) function in R to display each of the 12 images. (0 points)