Statistical Patter Recognition
Homework #04
Deadline: Jan 3

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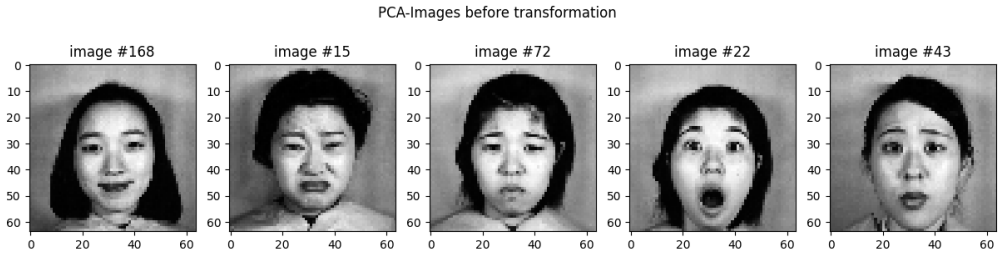
Group #15

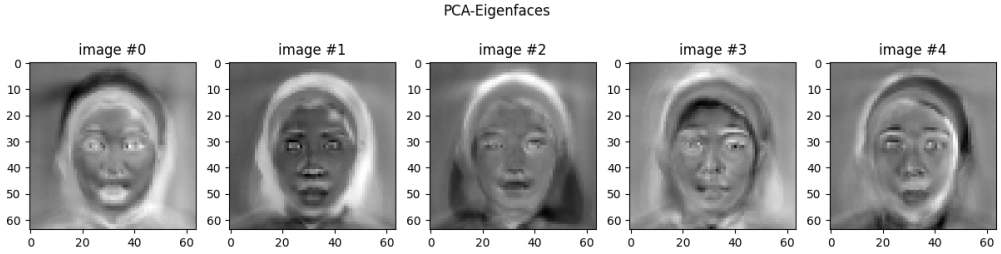
PCA

It's unsupervised method than want to find maximum variance after transformation so choose eigenvectors with maximum eigenvalues

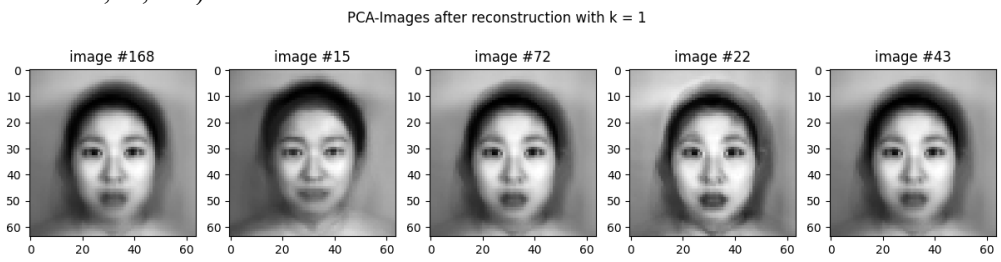
Visualize the dataset.

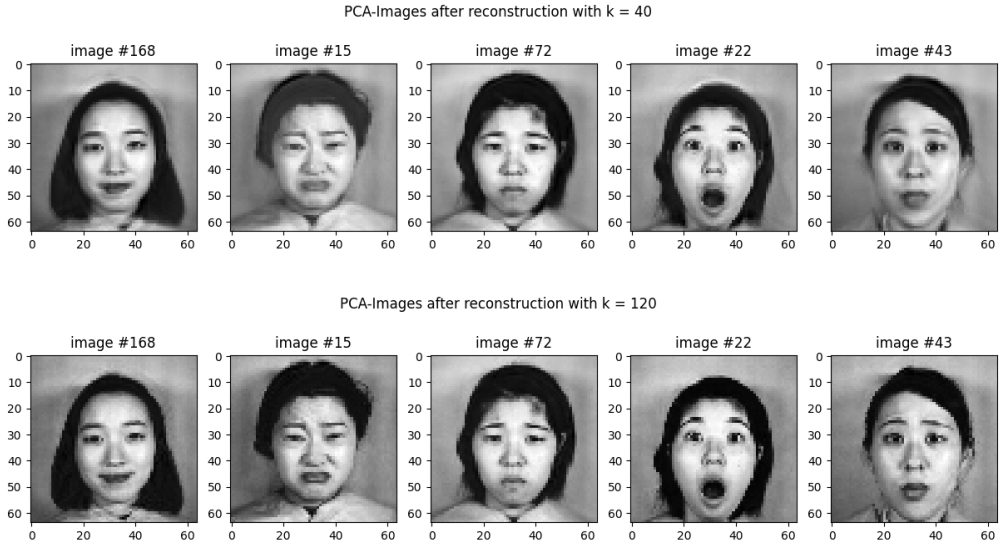


Visualize some of the first principal components.

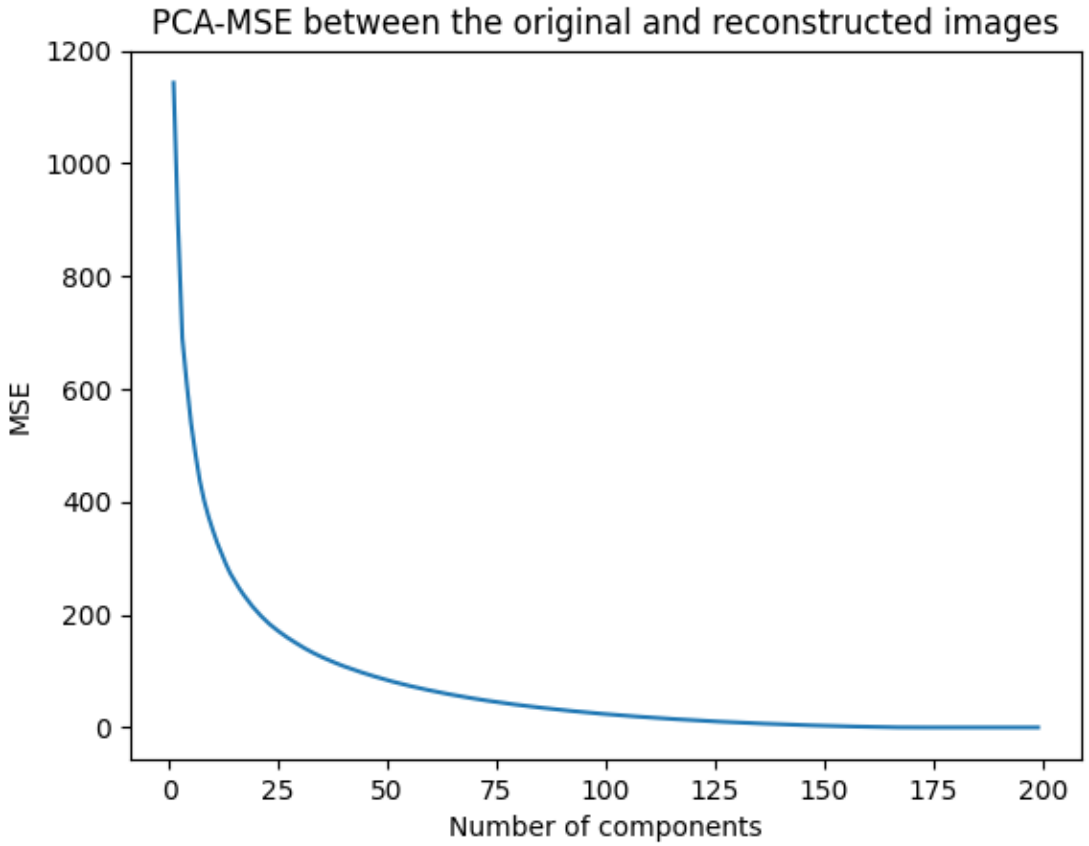


Reconstruct the original data using K principle components (Show reconstructed images of each individual for K=1,40,120).





Plot the MSE between the original and reconstructed images in terms of the number of eigenvectors.

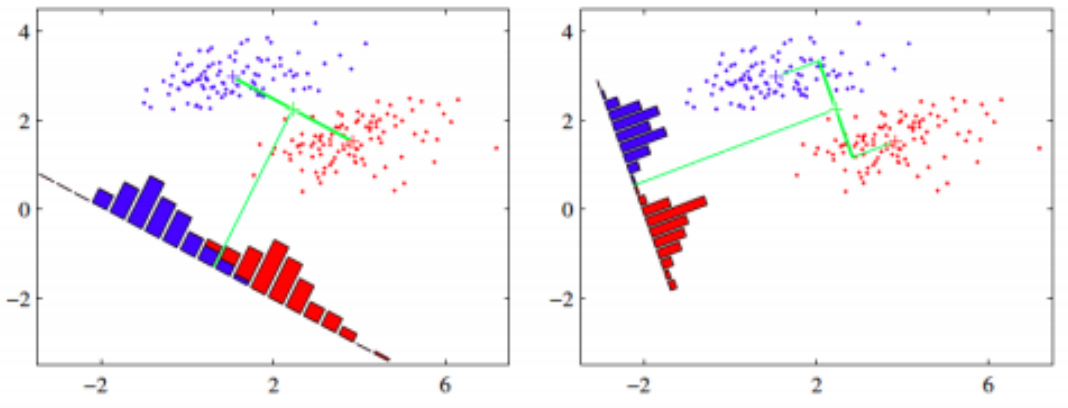


How many principal components are enough so that you have acceptable reconstruction? How do you select them?

50 was enough because fist 50 maximum eigenvalues have sum more than 98% of total sum of eigenvalues

Fisher-LDA

Linear Discriminant Analysis (LDA) is a dimensionality reduction which reduce the number of dimensions while contain as much as information possible and find transform parameters w ∈ R(d×d′) that project data from d-dimension to d′-dimension



our goal is to find such a parameters that maximize the distance between two mean class (between class covariance) and minimize the class separatable of classes (within-class covariance)

$$S_b = \sum_{k=1}^{K} (m_k - m) N_k (m_k - m)^{\mathsf{T}}$$

$$J(w) = \frac{w^{\mathsf{T}} S_b w}{w^{\mathsf{T}} S_w w} \qquad S_w = \sum_{k=1}^{K} \sum_{n=1}^{N_k} (X_{nk} - m_k)(X_{nk} - m_k)^{\mathsf{T}}$$

where $S_b \in R(d \times d')$ is between-class covariance and $S_w \in R(d \times d')$ is within-class covariance matrices

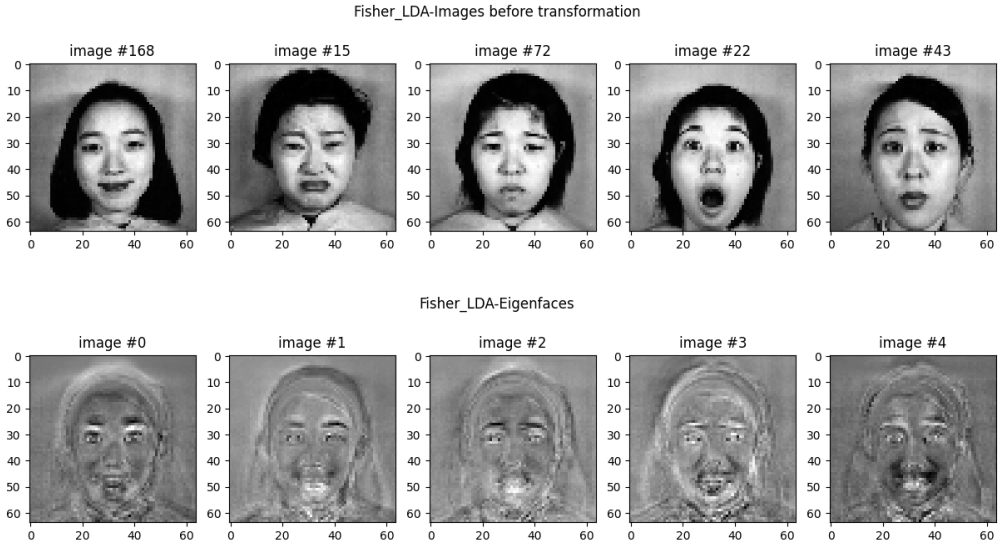
By using Lagrangian, maximizing J transformed into solution

$$S_w^{-1} S_b w = \lambda w$$

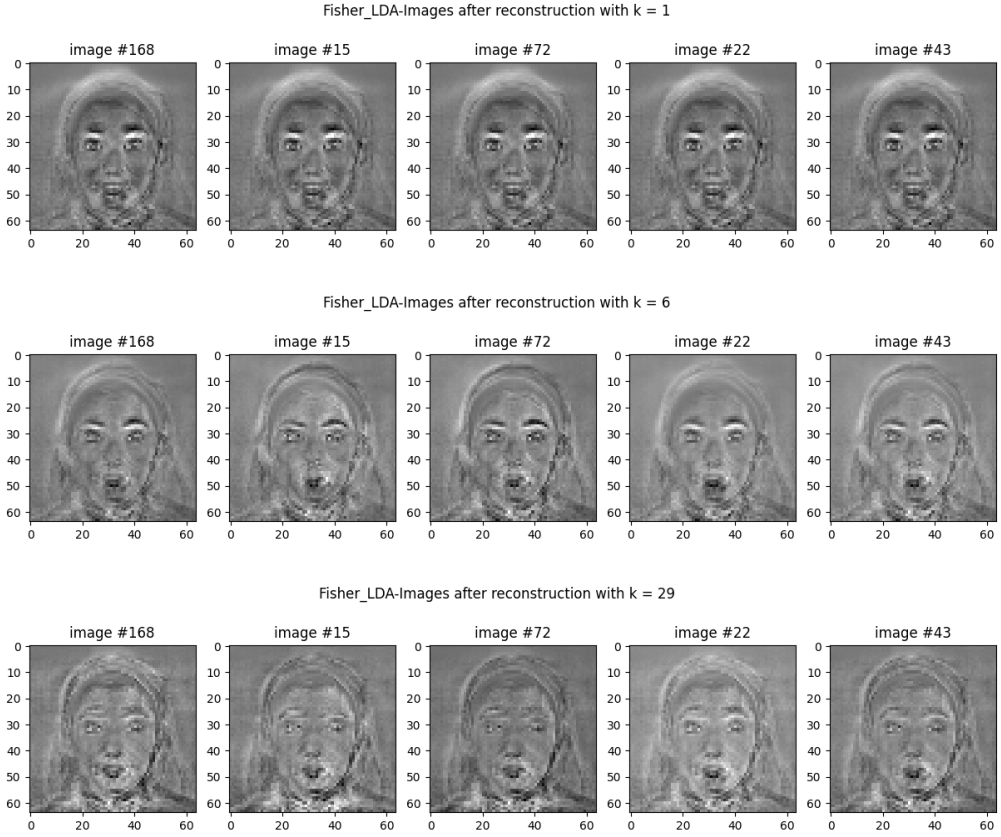
Which is eigenvector of this equation

- What is the problem of applying Fisher LDA to the dataset?

  Sw is not positive definite that can be fixed with adding small values to it's diagonal element



Reconstruct the original data by using K basis vectors obtained from LDA. (Show reconstructed images of one person for k=1, 6, 29).



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