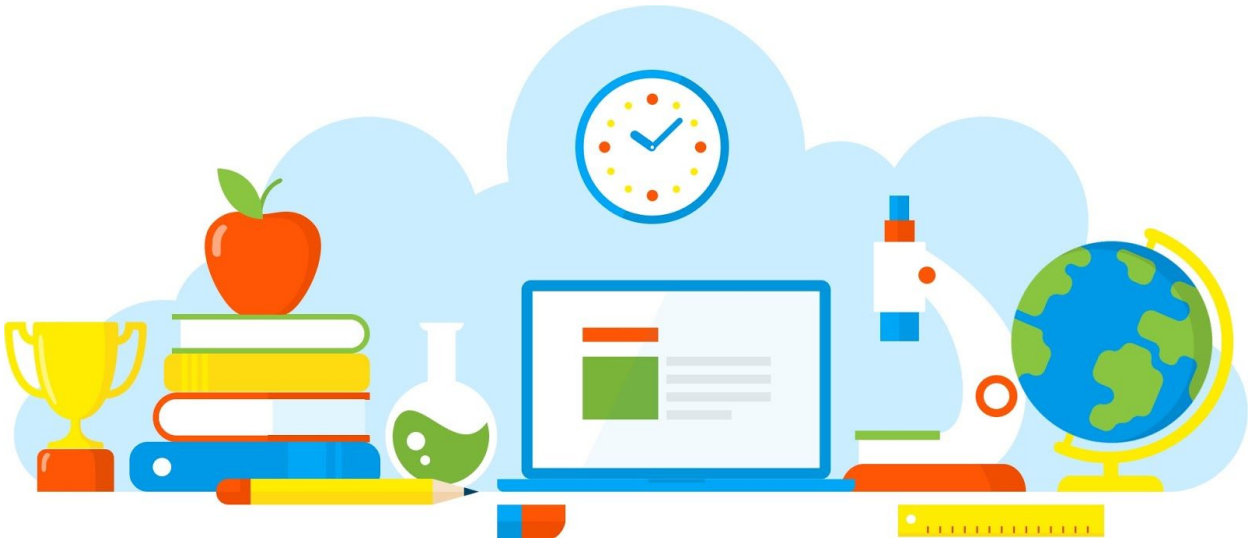


PCA Report

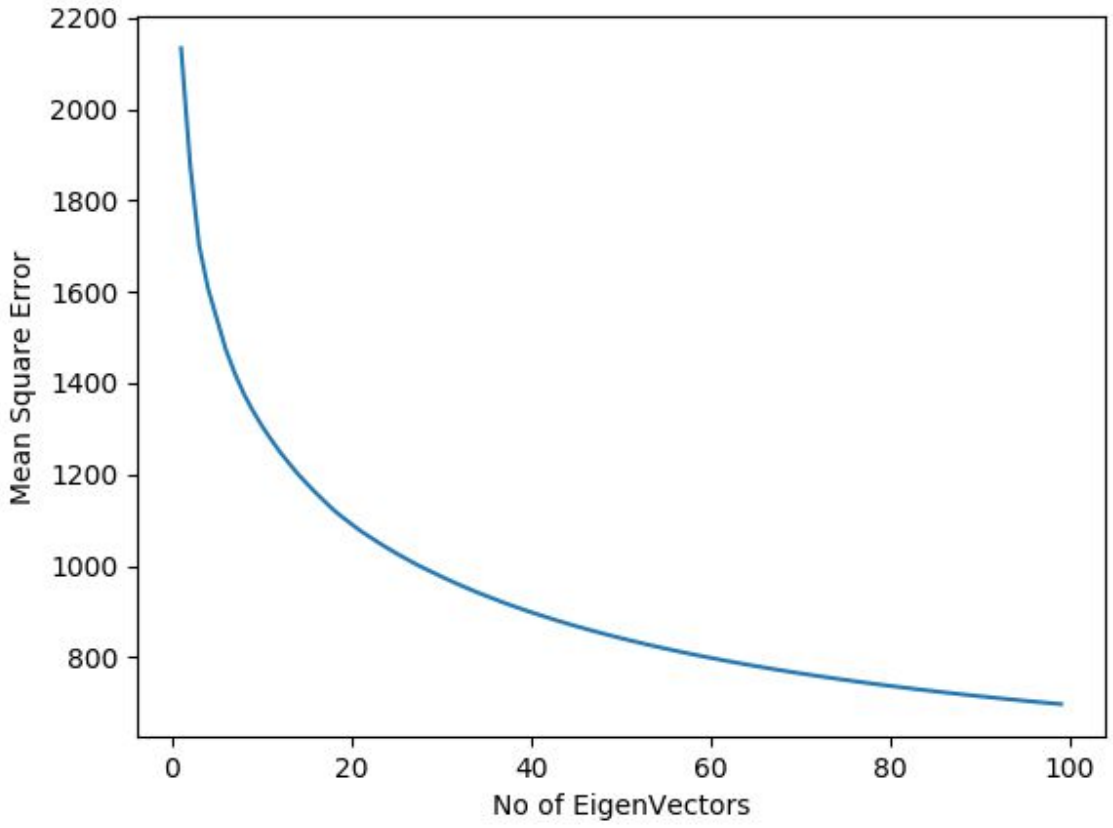
Abhishek Nalla

20161115

Minimum Square Error

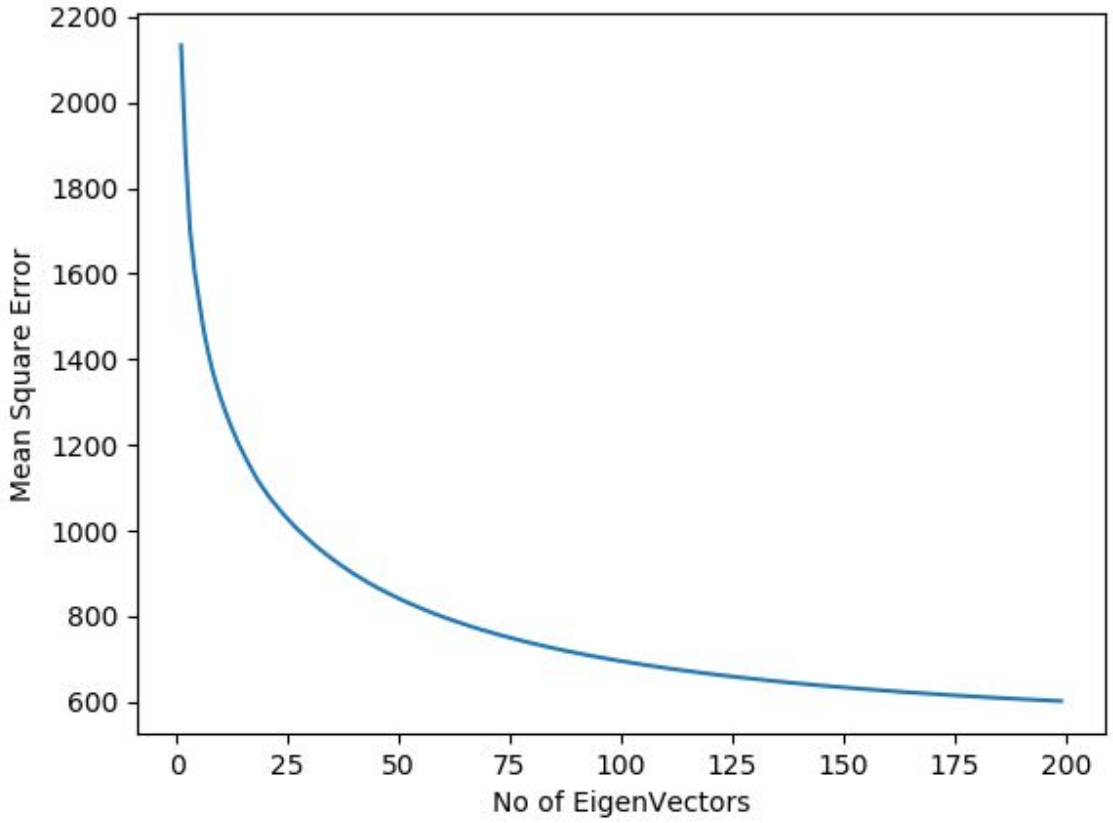
All the images were resized and stored in 520*(64*64) array “image matrix”. Then the covariance matrix was calculated and top k eigen values and vectors where k is varied, mean square error is calculated for reprojected data for different k values. This means we are calculating the square of the absolute value of difference between the original image and the reconstructed image using varying number of eigen vectors.

$$\text{Error}^2 = \| \mathbf{X} - \mathbf{X}\mathbf{W}_L\mathbf{W}_{TL} \|^2.$$



The above plot is of MSE values for k varying from 1 to 100. We get a decreasing function where MSE is very high for k=1. As we increase the number of features, we get

low MSE and the decrease is gradual.

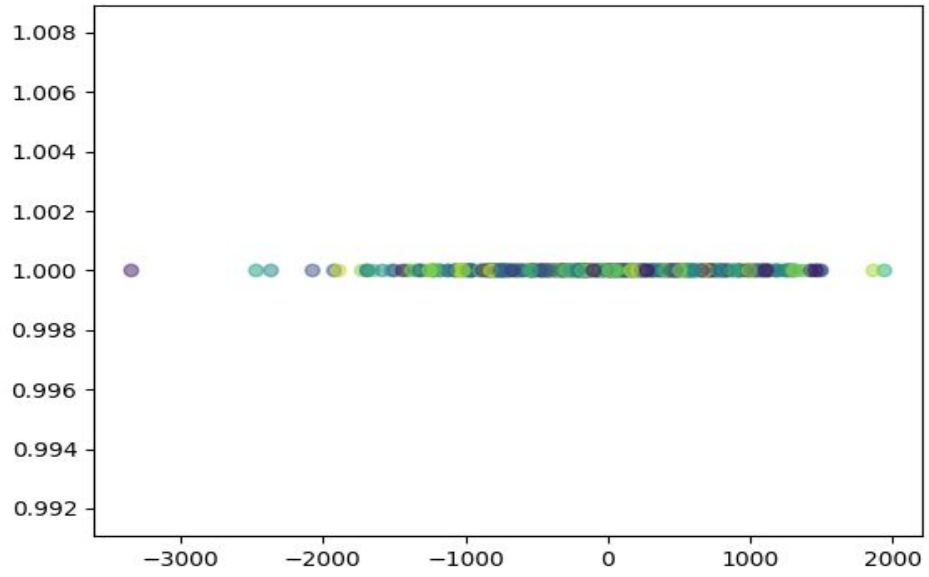


For a larger range, the curve appears smoother and the value of MSE approaches lower values.

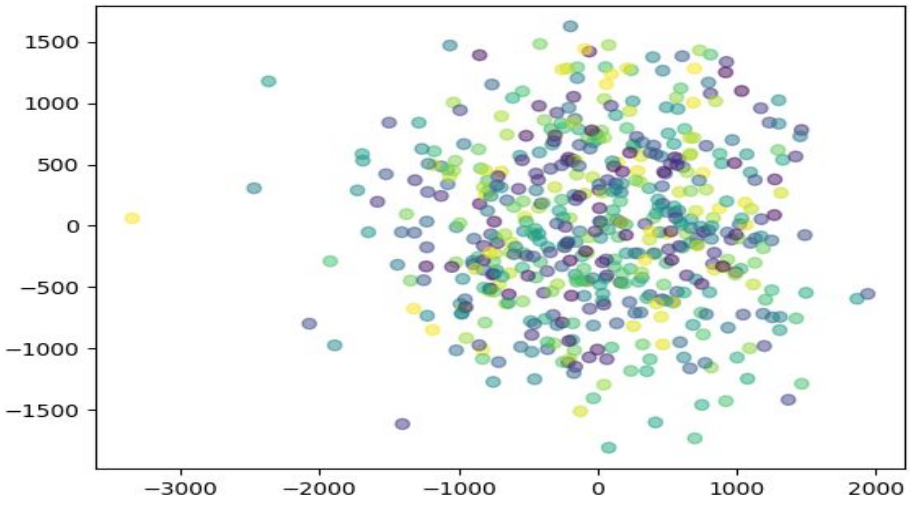
Scatter Plots

Now we will see how images are clustered in 1D, 2D, 3D spaces using scatterplots. These are plots showing the projected data when the images are projected onto one, two and three eigenvectors respectively. These eigenvectors are sorted in descending order.

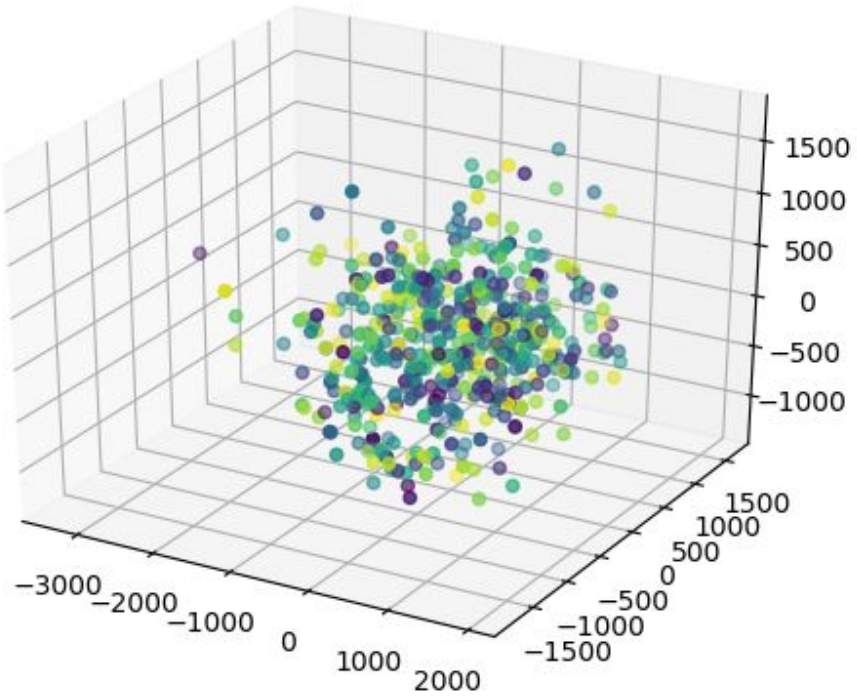
1D Scatter Plot



2D Scatter Plot



3D Scatter Plot



Reconstructed Image

Example of a reconstructed image created by projecting the data on sorted eigenvectors followed by reshaping the projected data into a 2D image.

Eigen Faces

These are the eigen faces that are generated using the first 32 Eigenvectors by reshaping them form 1D to 2D after Eigenvector decomposition.