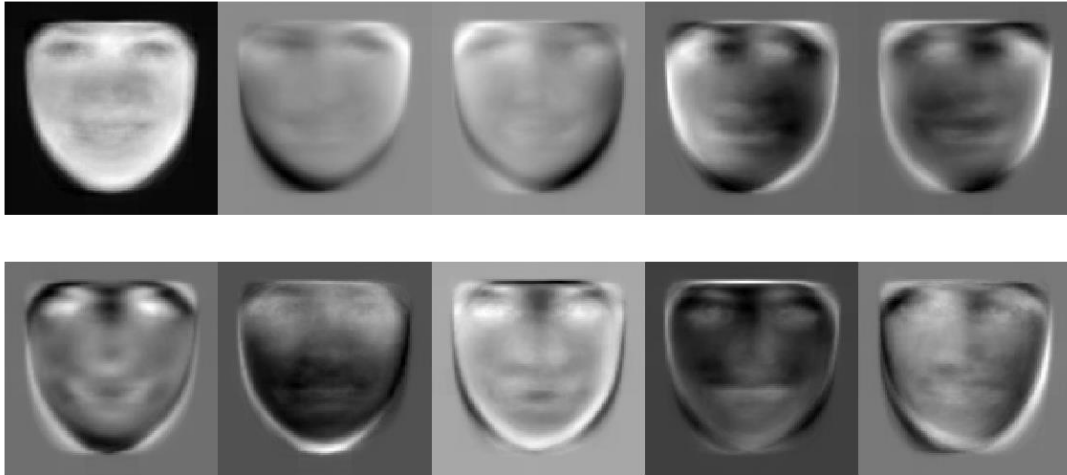


Project1: PCA, Autoencoder and FLD for Analyzing Human Faces

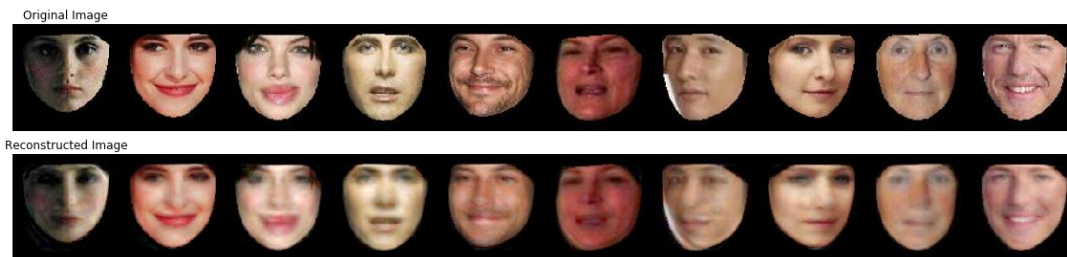
1. PCA

1.1 Compute the mean and first $K = 50$ eigen-faces for the training images with no landmark alignment, and use them to reconstruct the remaining 200 test faces

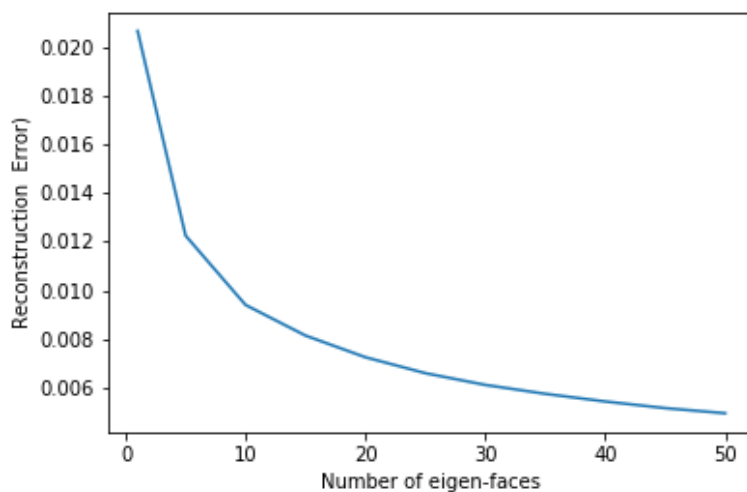
i) Display the first 10 eigen-faces



ii) Plot 10 reconstructed faces and the corresponding original faces

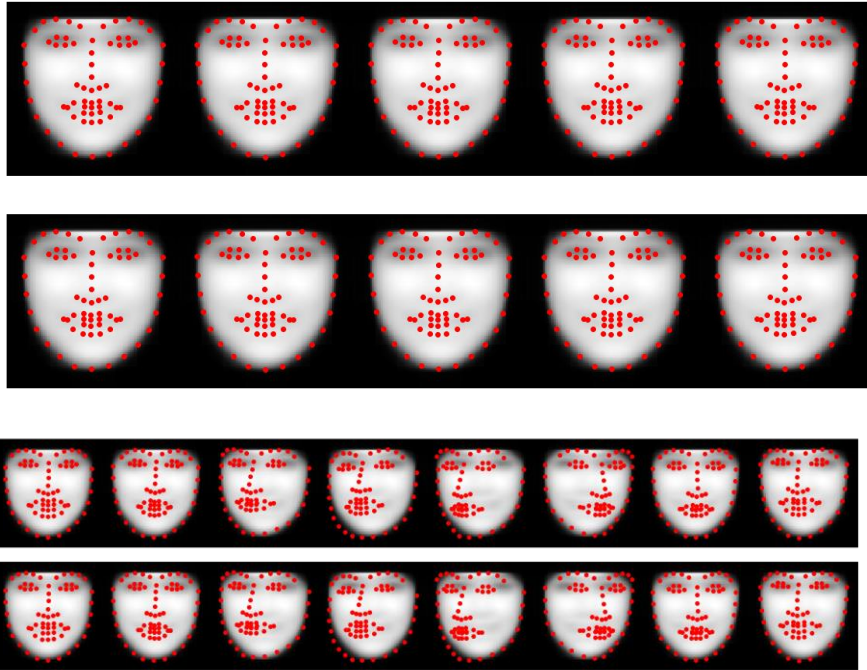


iii) Plot the total reconstructed error over the number of eigen-faces $K=1,5,10,15,\dots,50$

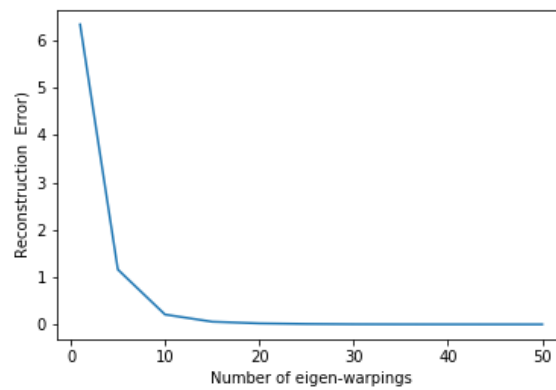


1.2 Compute the mean and first $K=50$ eigen-warping of the landmarks for the training faces.

i) Display the first 10 eigen-warps and use them to reconstruct the landmarks, compare the original landmarks and the reconstructed landmarks

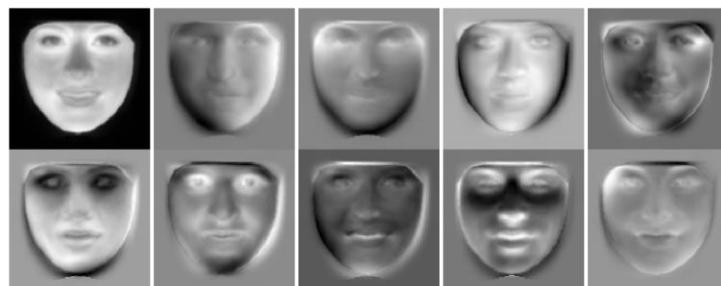


ii) Plot the reconstruction error over the number of eigen-warps $K=1, 5, 10, 15, \dots, 50$



1.3 Combine the two steps above, firstly align the images by warping their landmarks into the mean position, and then compute the eigen-faces from these aligned images.

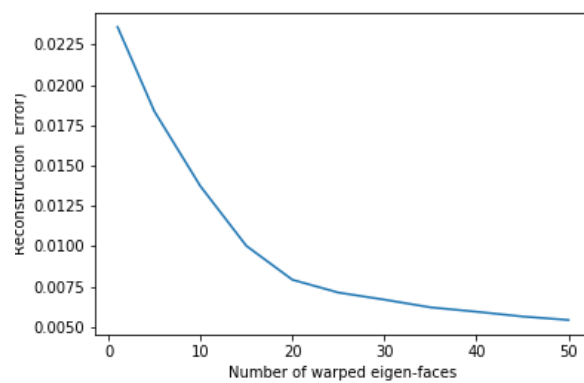
New eigen-faces:



i) Project the testing face's landmarks to the 10 eigen-warps and get the reconstructed landmarks.

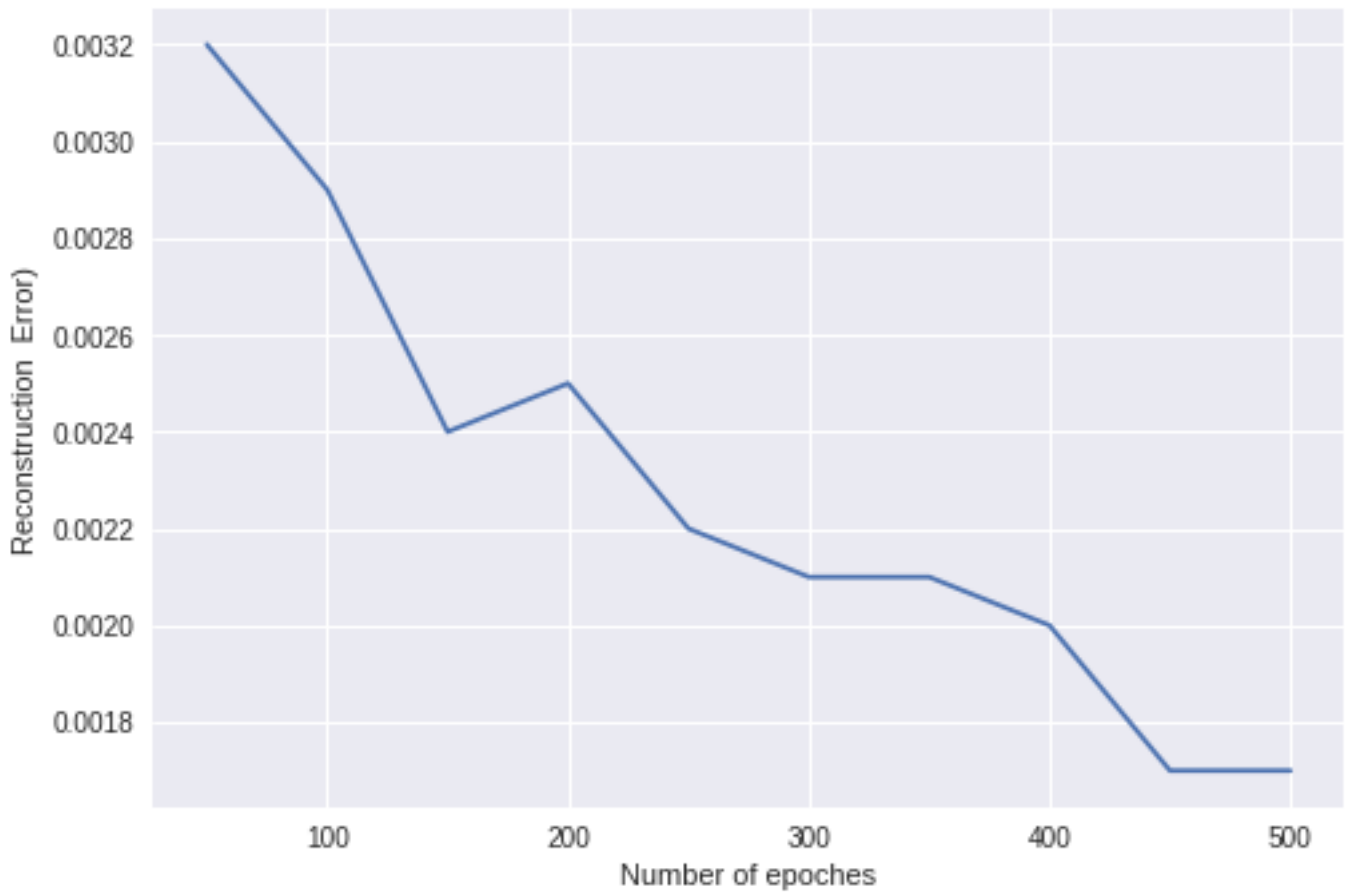
ii) Warp the face image to the mean position and project to the top 50 eigen-faces

iii) Warp the reconstructed faces to the reconstructed landmarks, plot 20 reconstructed faces and their corresponding original faces. Then plot the reconstruction errors per pixel against the number of eigen-faces $K=1, 5, 10, 15, \dots, 50$



1.4 Synthesize random faces.

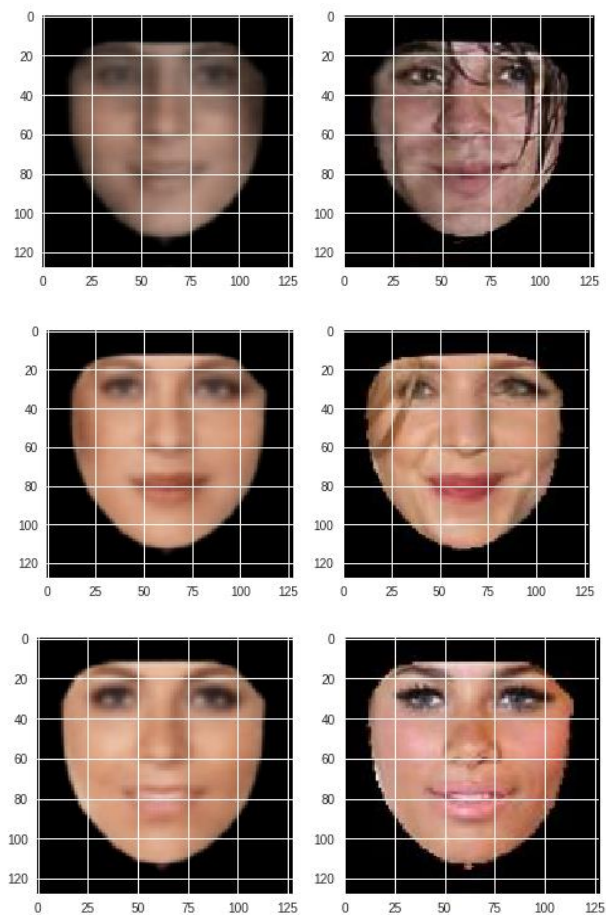


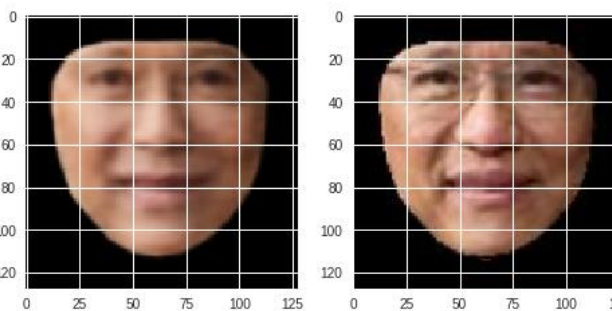
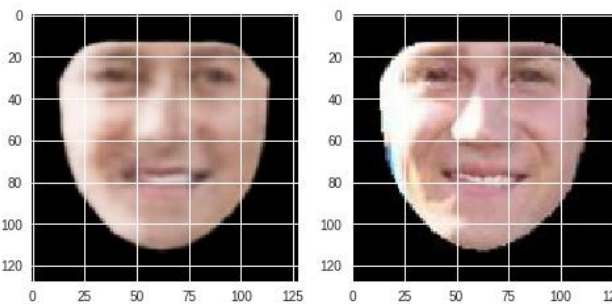
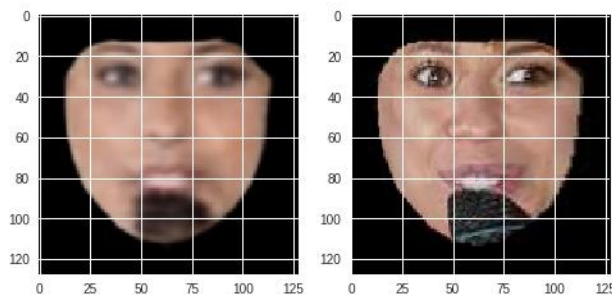
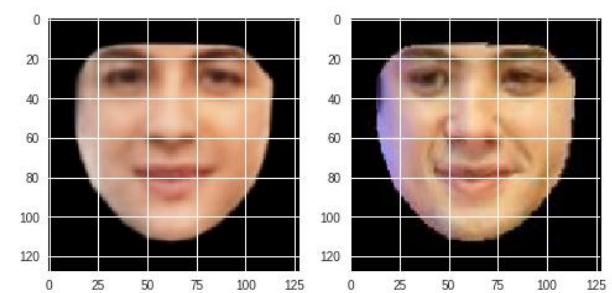
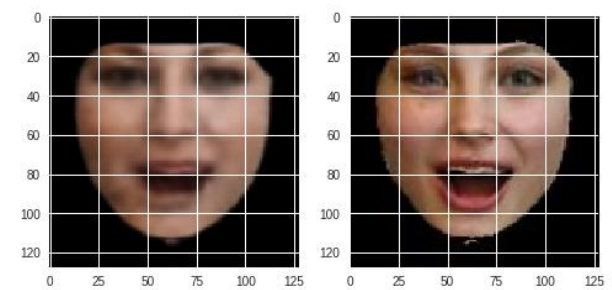
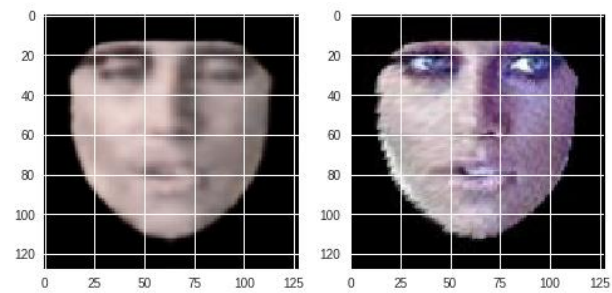


2. Autoencoder

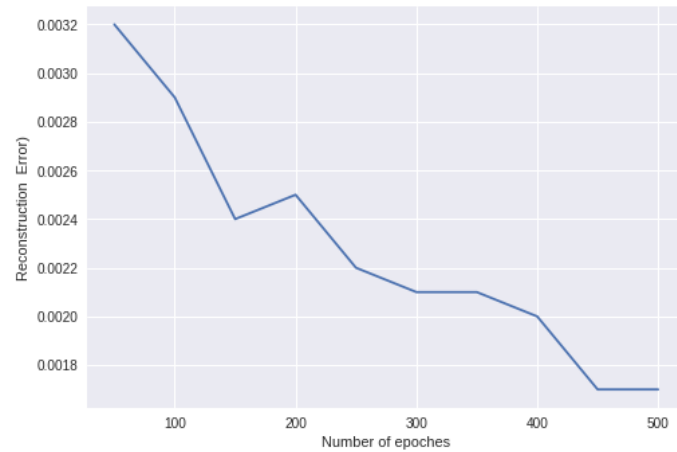
2.1 Re-perform the experiments by replacing PCA with auto-encoder

1. Epoch from (50 to 500) totally 10 output for appearance, comparing with the original image in the right

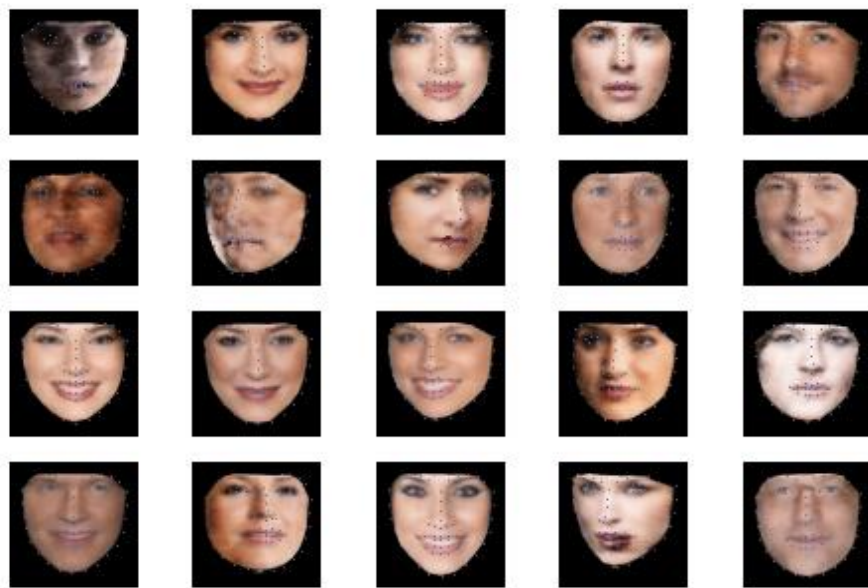




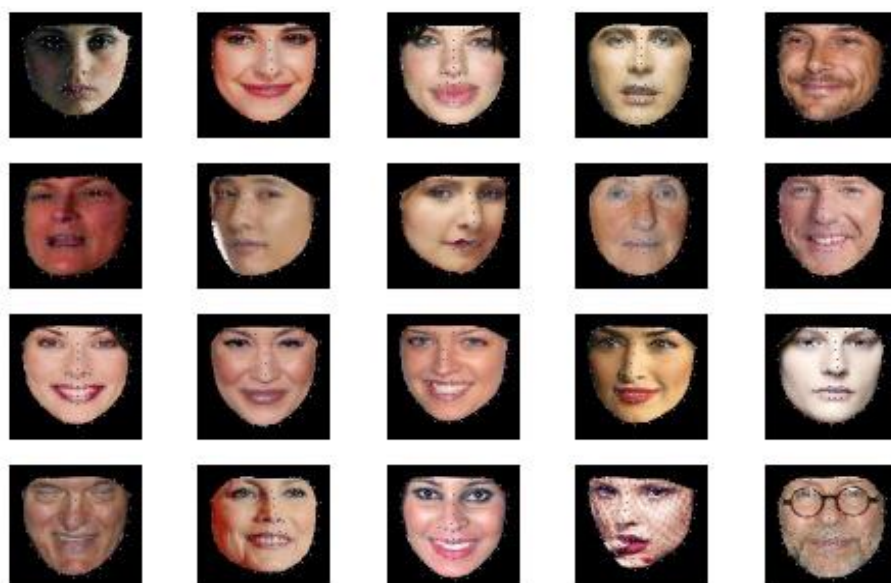
From the images, we can see that the reconstructed images are getting closer to the original image in the right after a couple of epochs. And the reconstruction error plot is shown below:



2. Reconstruction for 10 testing images



Compare the original images:



3. FDA

1. Report the error rate for both training data and testing data:

Training accuracy: 0.96125

Training accuracy on male faces: 0.9695121951219512

Training accuracy on male faces: 0.9555084745762712

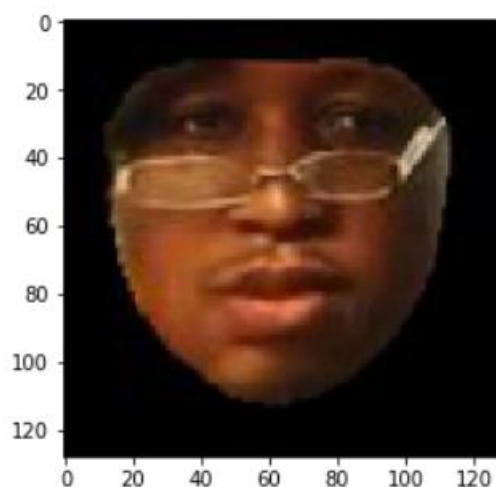
Testing accuracy: 0.83

Test accuracy on male faces: 0.8214285714285714

Test accuracy on male faces: 0.8362068965517241

2. Perform FDA Based on 2.2 and 2.3

Show a random testing image:



male

Training accuracy: 0.96

Training accuracy on male faces: 0.9541284403669725

Training accuracy on female faces: 0.9640591966173362

Testing accuracy: 0.935

Testing accuracy on male faces: 0.9058823529411765

Testing accuracy on female faces: 0.9565217391304348

