

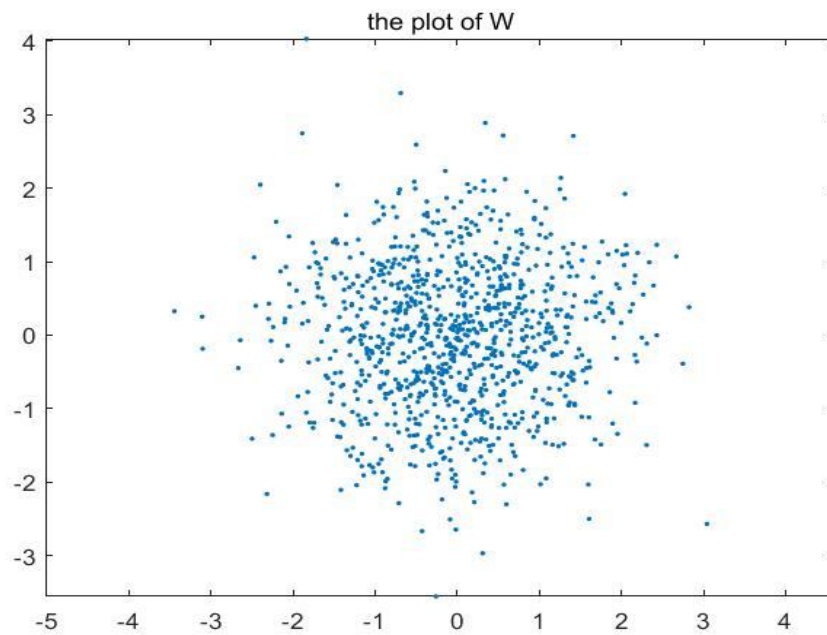
ECE637 Lab report 5
Eigen-decomposition of Images

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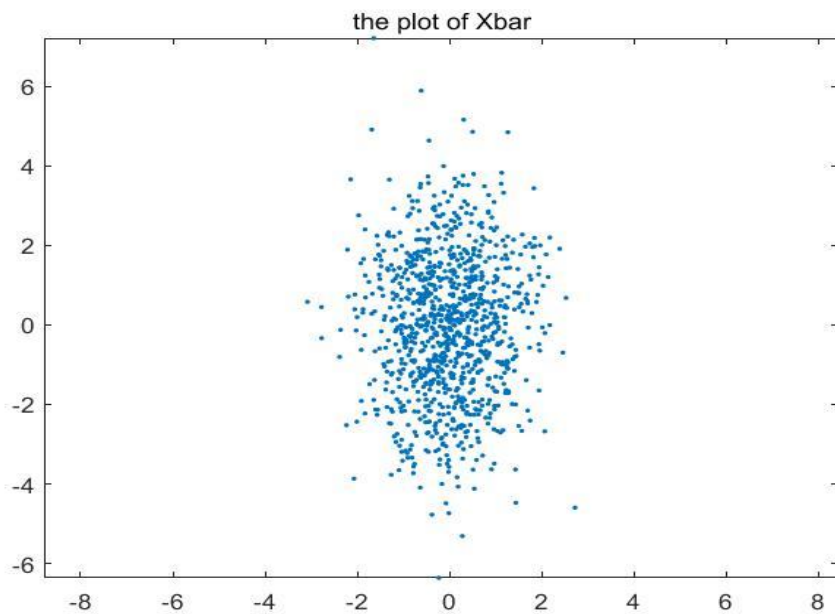
Section 2 .Multivariate Gaussian Distributions and Whitening

Part 1. Generating Gaussian random vectors

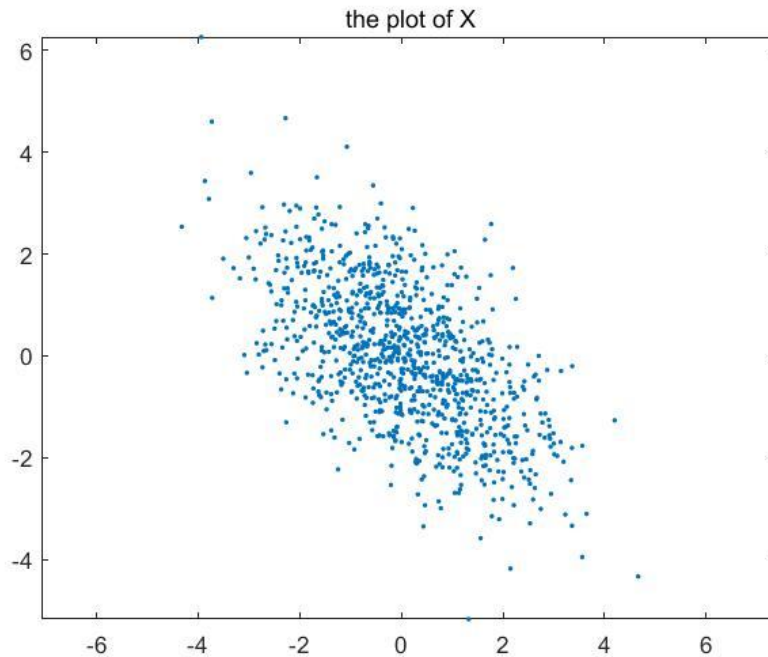
1. The plot for W



2. The plot for \tilde{X}



3. The plot for X.



Part 2. Covariance Estimation and Whitening

Theoretical value of the covariance matrix R_x

$$R_x = \begin{bmatrix} 2 & -1.2 \\ -1.2 & 1 \end{bmatrix}$$

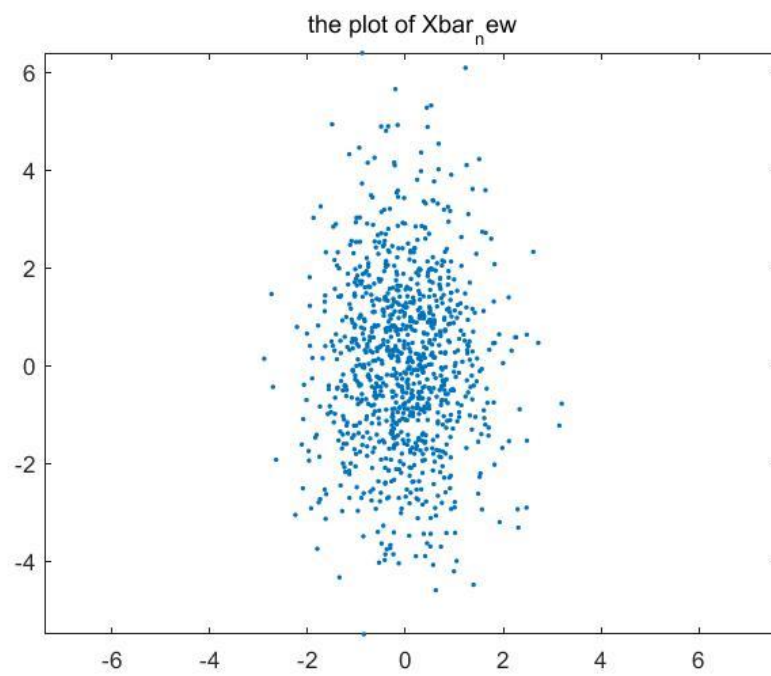
A numerical listing of your covariance estimate \hat{R}_x

$$\hat{R}_x = \begin{bmatrix} 1.979874252492913 & 1.196340271026404 \\ 1.196340271026404 & 2.009497035151474 \end{bmatrix}$$

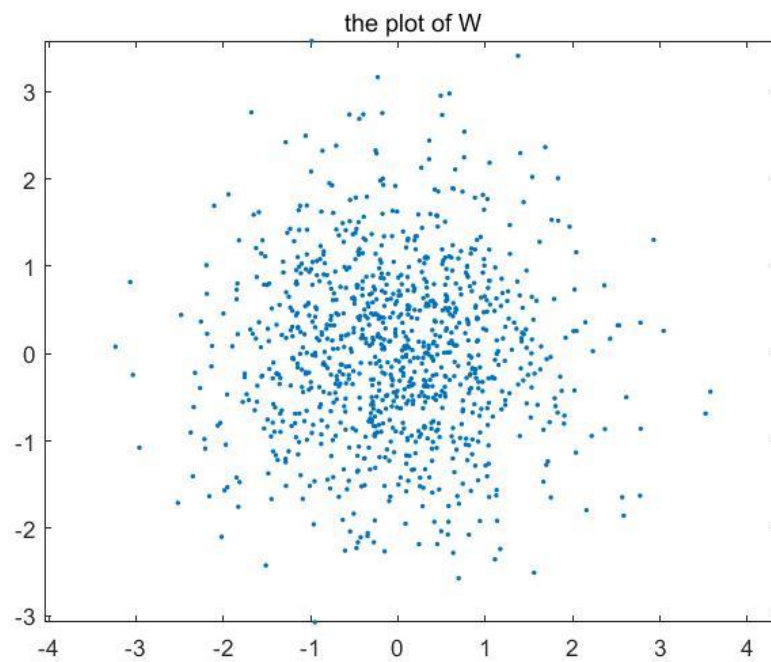
A numerical listing of the covariance estimate \hat{R}_w

$$\hat{R}_w = \begin{bmatrix} 1.001038503988224 & -0.001194570927191 \\ -0.001194570927191 & 1.001374091689846 \end{bmatrix}$$

1. The plot for \tilde{X}

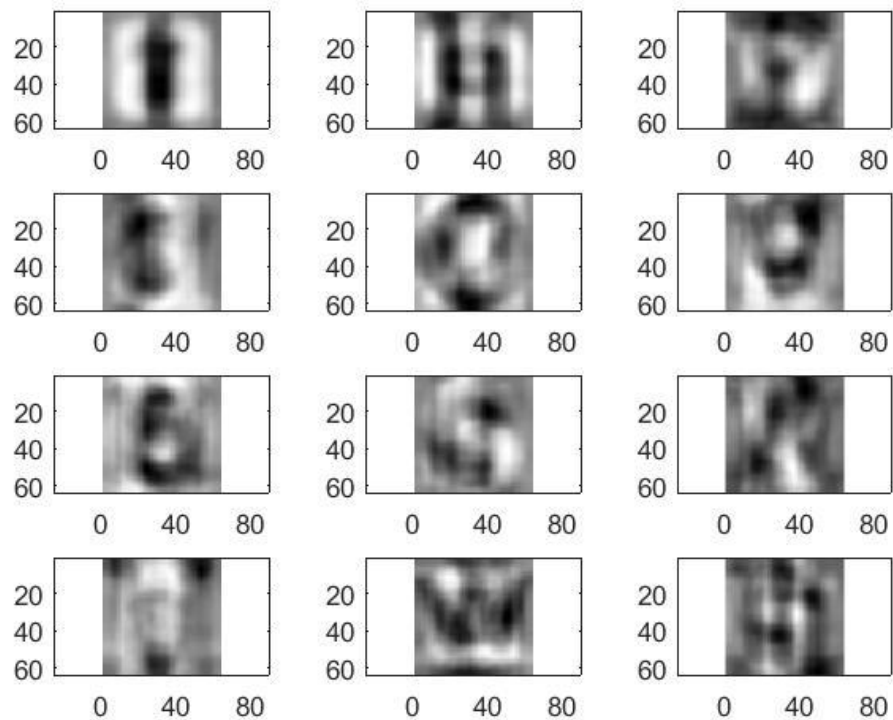


2. The plot for W

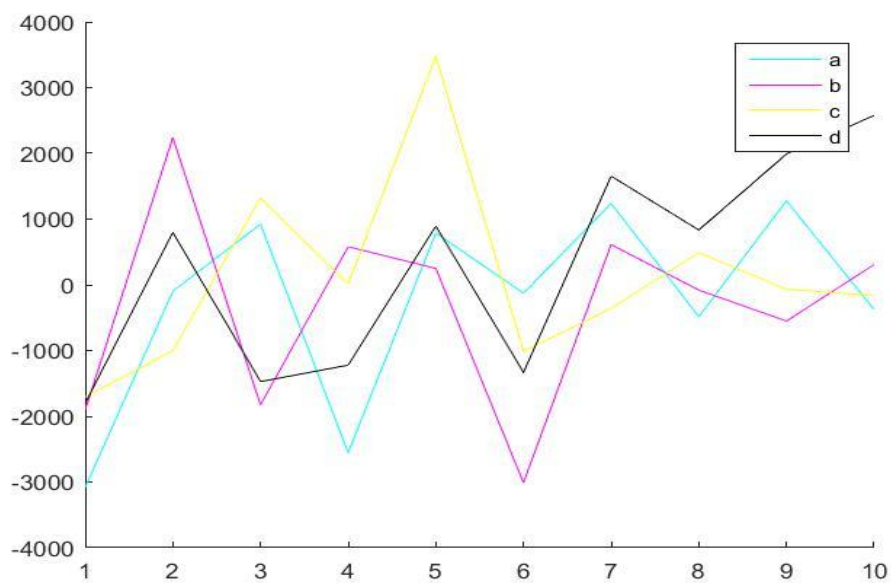


Session 4. Eigenimages, PCA, and Data Reduction

1. The first 12 eigen images

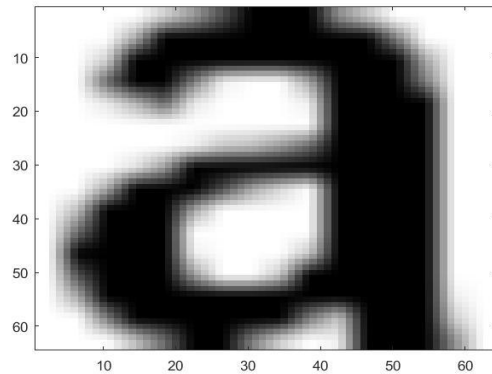


2. plots of projection coefficients vs. eigenvector number

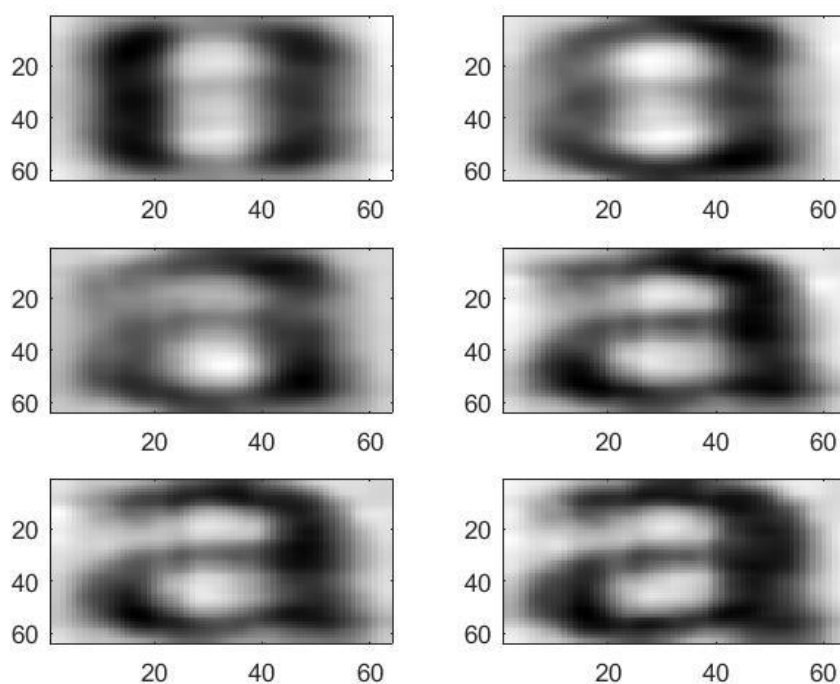


3. the original image, and the 6 resynthesized versions

Original:



6 resynthesized versions:



Section 5. Classification and PCA

1. The original B_k

input sequence: **abcdefghijklmnopqrstuvwxyz**

Output sequence: **abcaefghi**y**kim**v**oearst**a**vw**xv**z**

Result: There exists mistakes for d,j,i,n,p,q,u,y, totally 8 mistakes.

2. For $B_k = \Lambda_k$

input sequence: **abcdefghijklmnopqrstuvwxyz**

Output sequence: **abcdefghijklmn**o**pqrstuvwxyz**v**z**

Result: There exists mistakes for i,y totally 2 mistakes.

3. For $B_k = R_{wc}$

input sequence: **abcdefghijklmnopqrstuvwxyz**

Output sequence: **abc**d**efghijklmnopqrstuvwxyz**v**z**

Result: There exists mistakes for g,y totally 2 mistakes.

4. For $B_k = \Lambda$

input sequence: **abcdefghijklmnopqrstuvwxyz**

Output sequence: **abc**d**efghijklmnopqrstuvwxyz**v**z**

Result: There exists mistakes for f,y totally 2 mistakes.

5. For $B_k = I$

input sequence: **abcdefghijklmnopqrstuvwxyz**

Output sequence: **abcde**t**ghijklmnopqrstuvw**xv**z**

Result: There exists mistakes for f,g,y totally 3 mistakes.

Q&A:

1. Which of the above classifiers worked the best in this experiment?

The second, third and fourth classifier works the same in the experiment.

2. In constraining the covariance, what is the trade off between the accuracy of the data model and the accuracy of the estimates?

In the case of this experiment, the constraint will lower the accuracy of this data model, but it turns out we received a better result, which means a better accuracy of the estimates. But one should be aware that once the constrain goes beyond a threshold, the accuracy of the estimate will also be reduced.