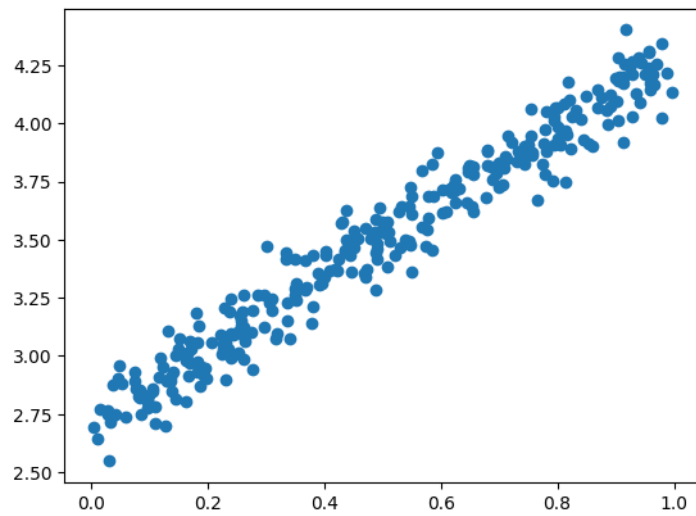


Assignment-2

Dive into digital Image processing

Aman Verma

Q1. A)



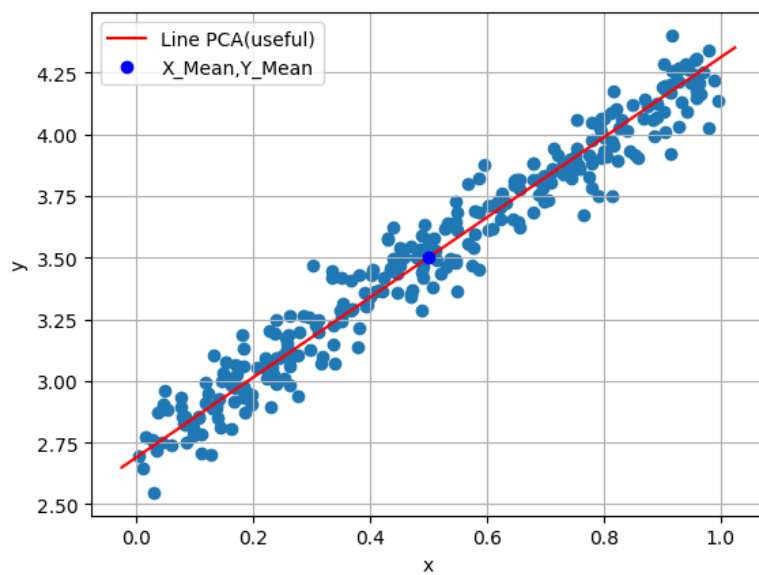
0.4999641865601916

3.500428385621437

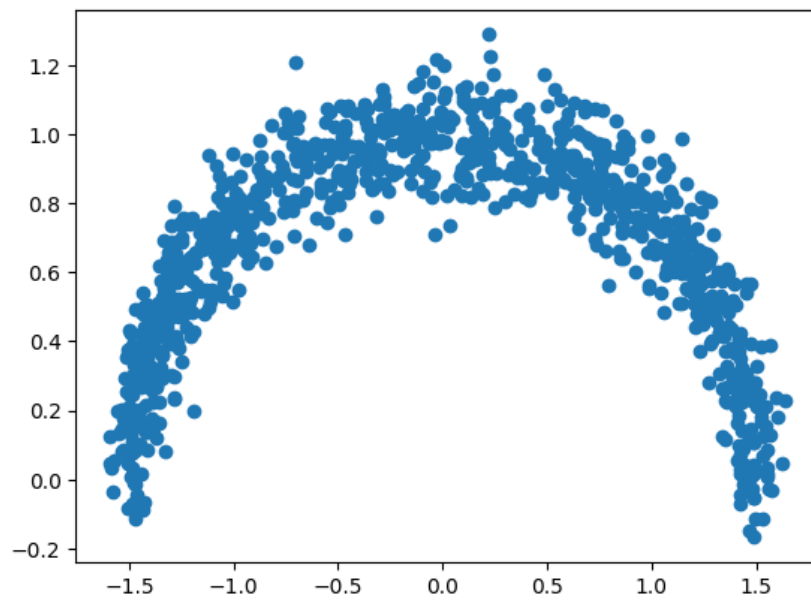
Covariance matrix (2, 2)

Eigen vectors (2, 2)

Eigen values (2,)



Q1)B)



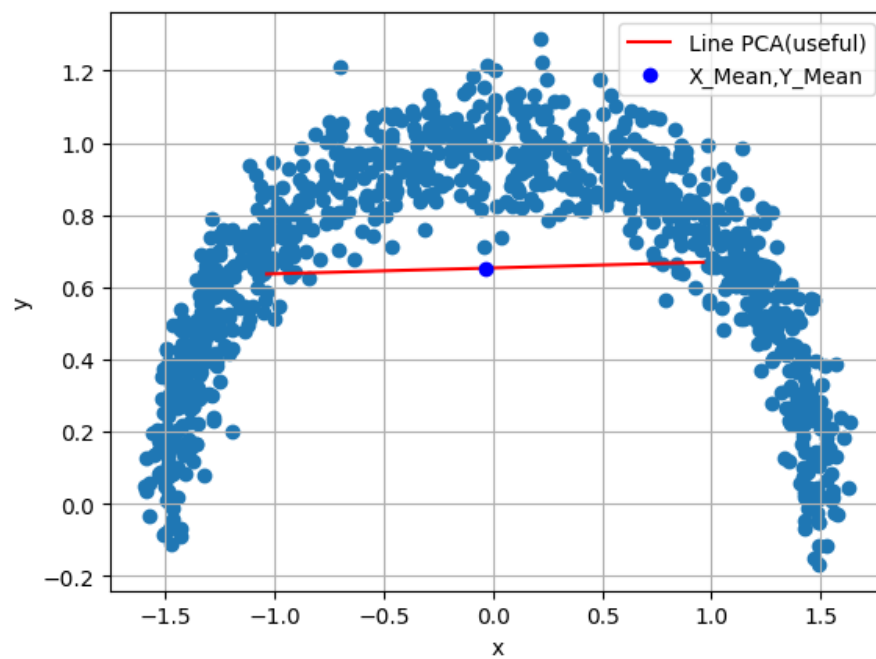
-0.036711629094701624

0.6526887060173189

Covariance matrix (2, 2)

Eigen vectors (2, 2)

Eigen values (2,)

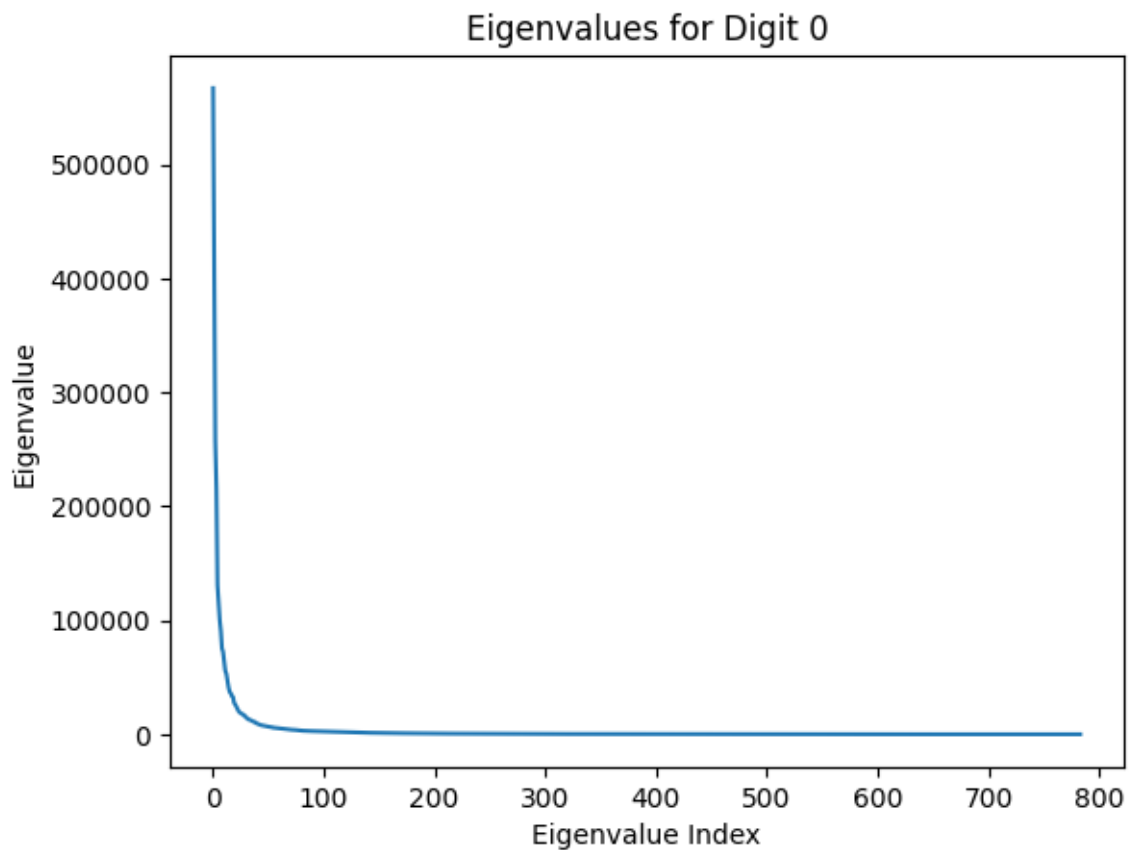


C) In part A the data turns out to be more linearly related that can be clear form the scatter plot as well but in Part B it is not linearly related and we get a line which is parallel to x axis indicating that they have no linear correlation with each other which is clear from the semicircular like pattern of the scatter plot indicating absolutely no linear correlation .

Q2)

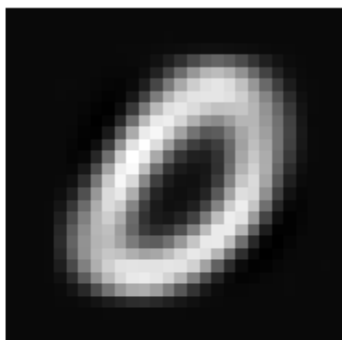
Principal Eigenvalue:

(567256.8569284894+0j)

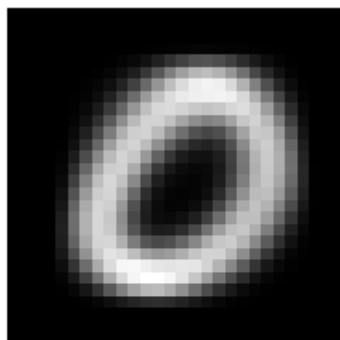


Principal Mode of Variation for Digit 0

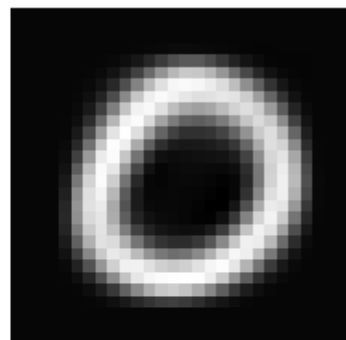
Reconstructed Image-1



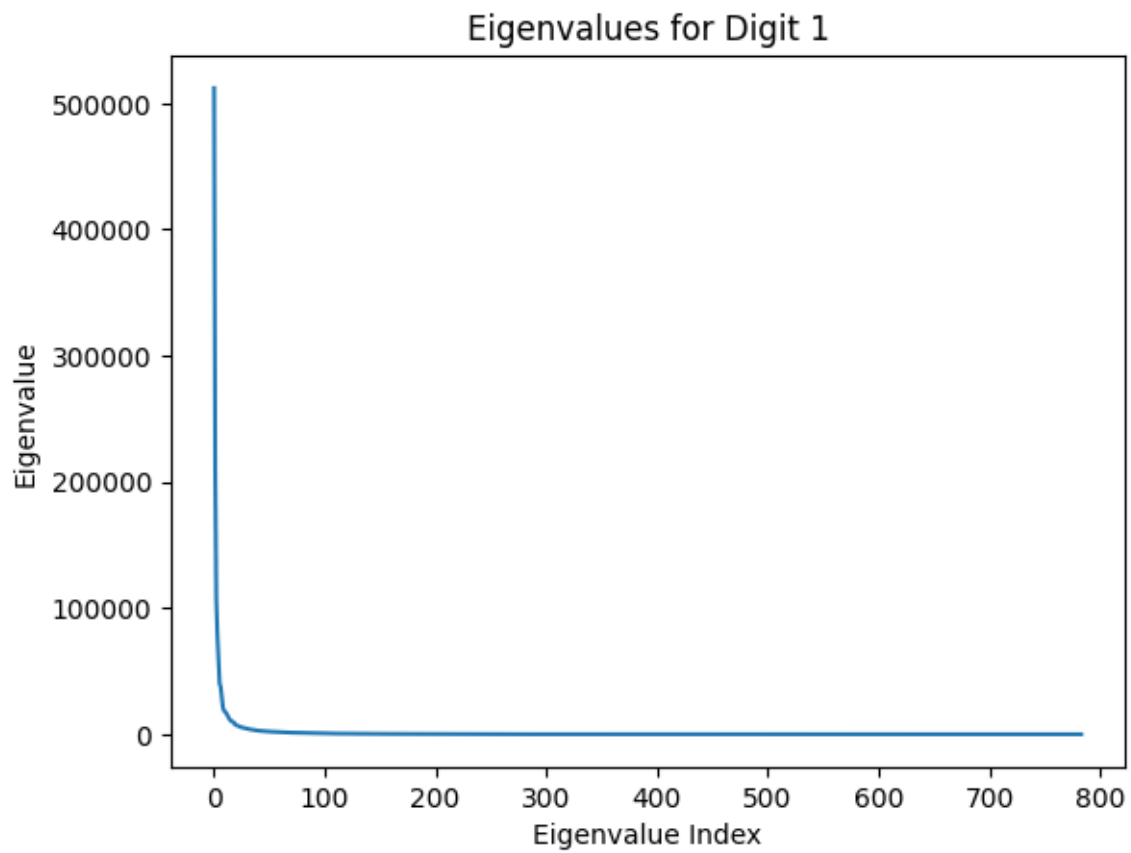
Mean Image



Reconstructed Image-2

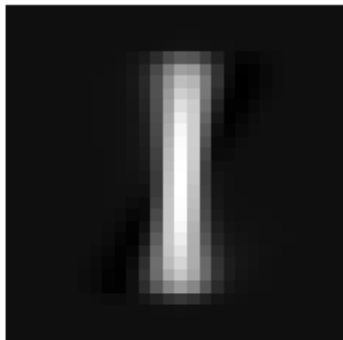


Principal Eigenvalue:
(512065.47723822645+0j)

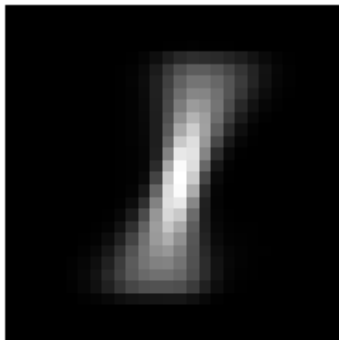


Principal Mode of Variation for Digit 1

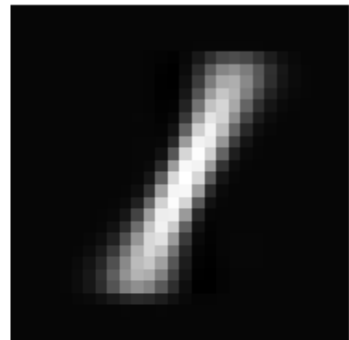
Reconstructed Image-1



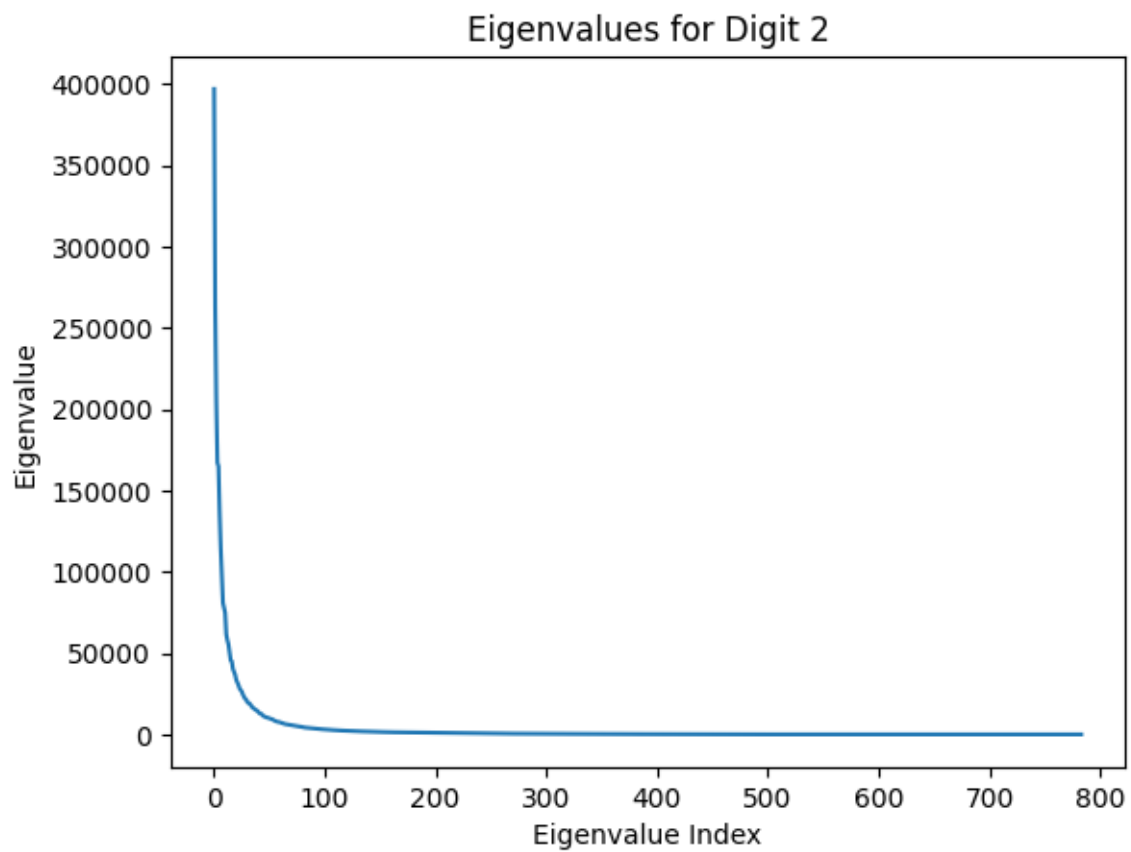
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(396935.13677015004+0j)

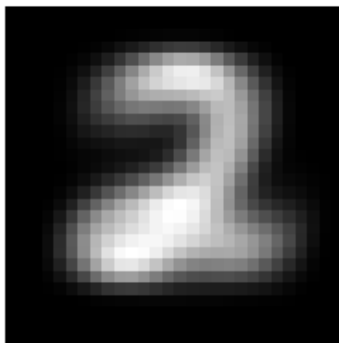


Principal Mode of Variation for Digit 2

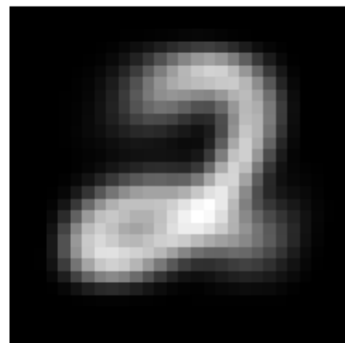
Reconstructed Image-1



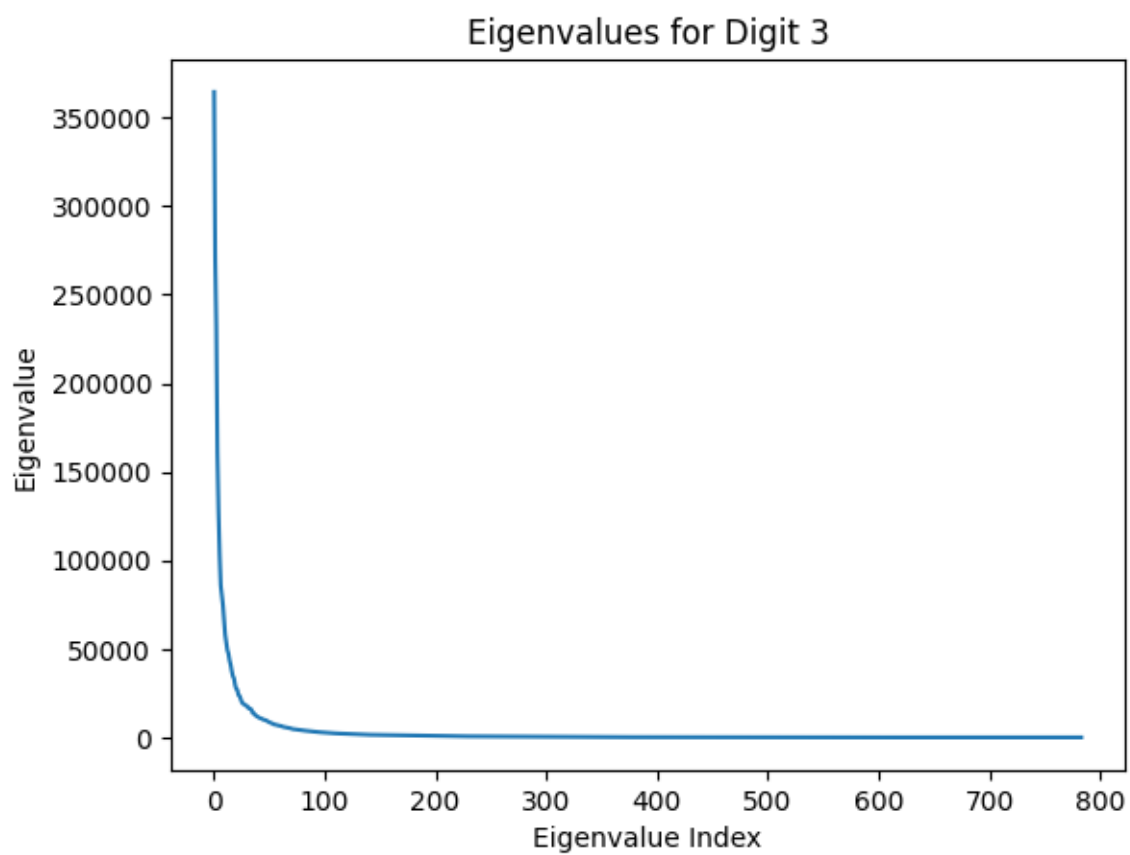
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(364484.34619636484+0j)

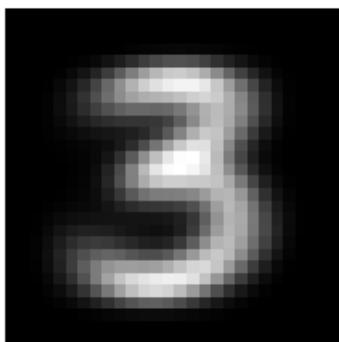


Principal Mode of Variation for Digit 3

Reconstructed Image-1



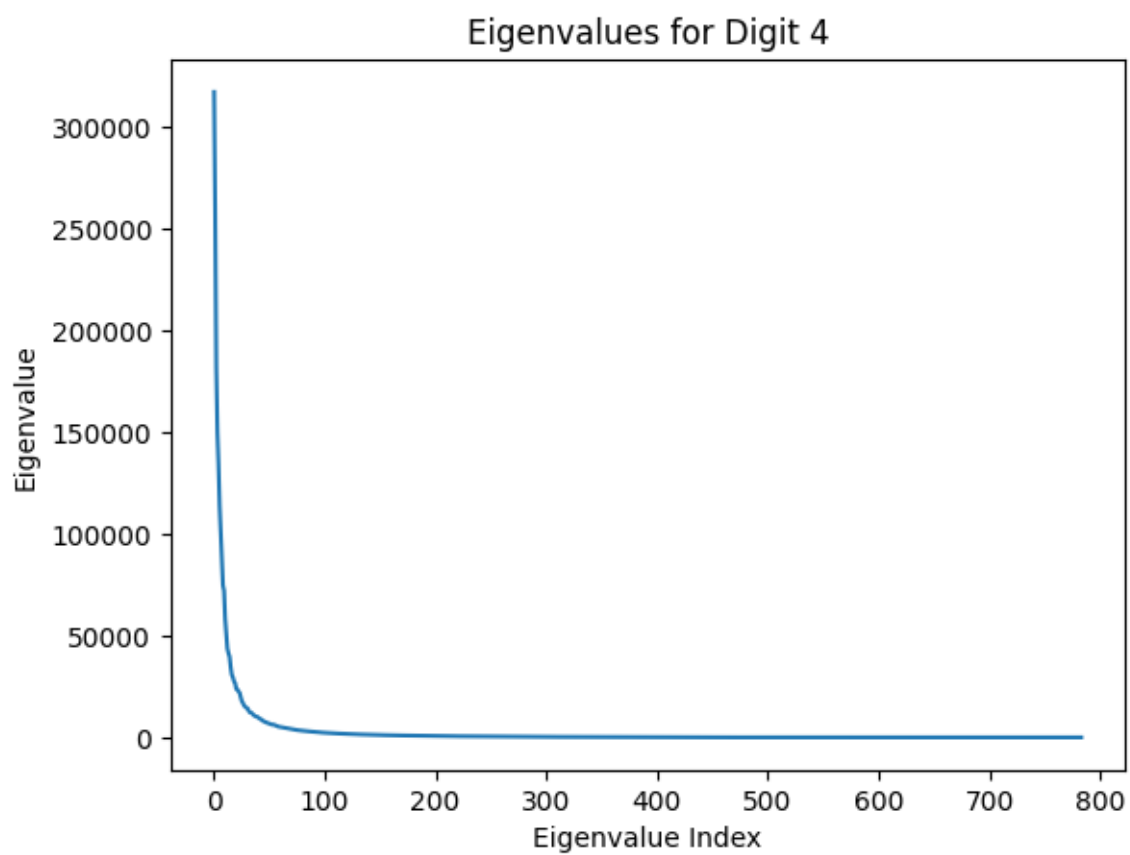
Mean Image



Reconstructed Image-2

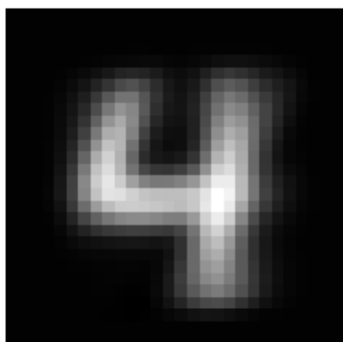


Principal Eigenvalue:
(317196.916131112+0j)

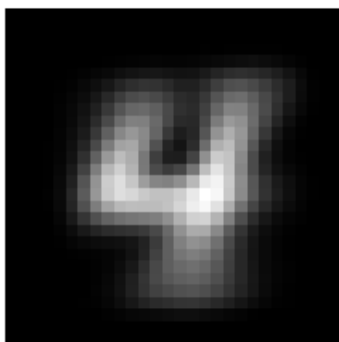


Principal Mode of Variation for Digit 4

Reconstructed Image-1



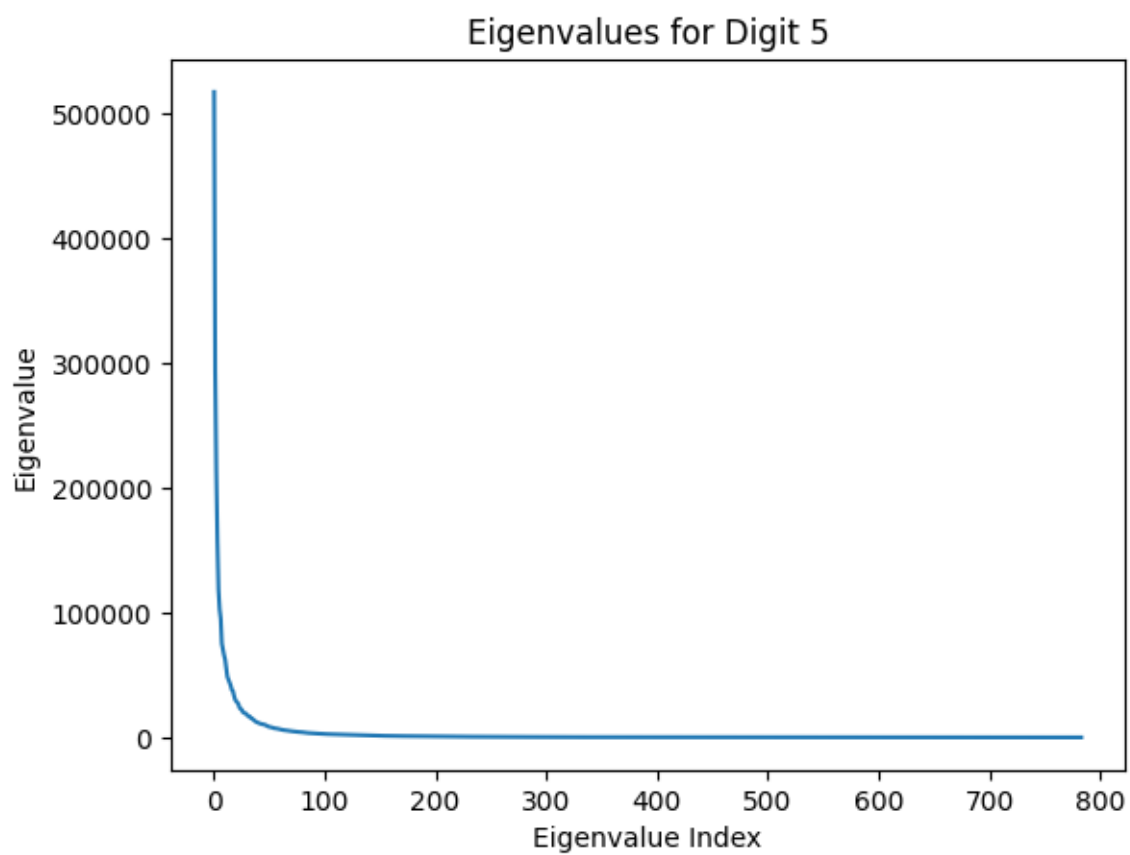
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(517504.59547298774+0j)

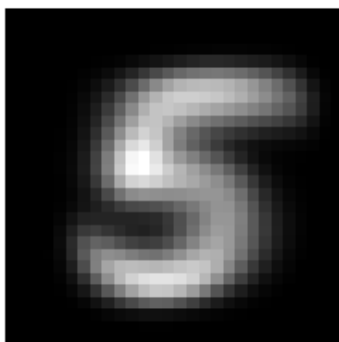


Principal Mode of Variation for Digit 5

Reconstructed Image-1



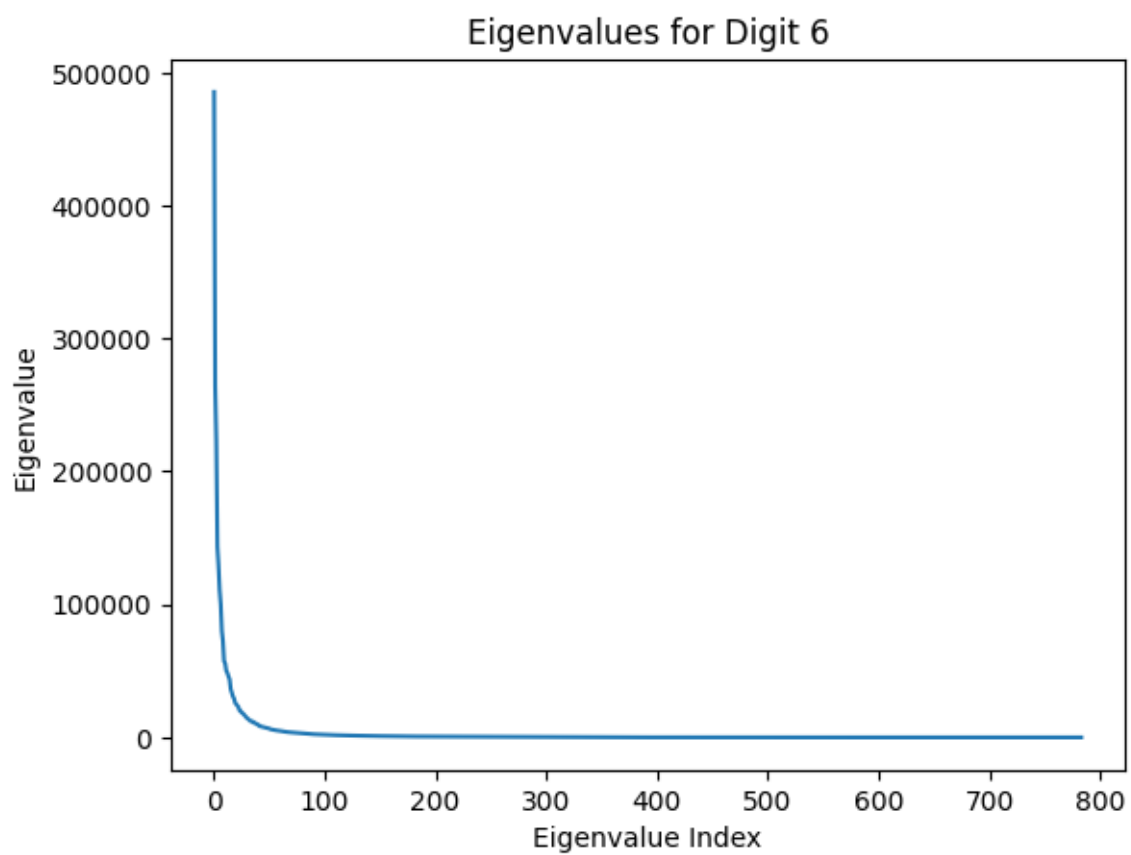
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(485467.88951001863+0j)

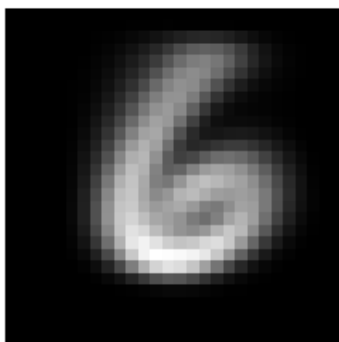


Principal Mode of Variation for Digit 6

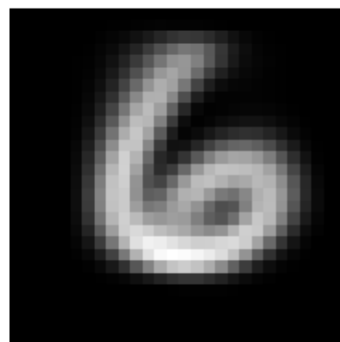
Reconstructed Image-1



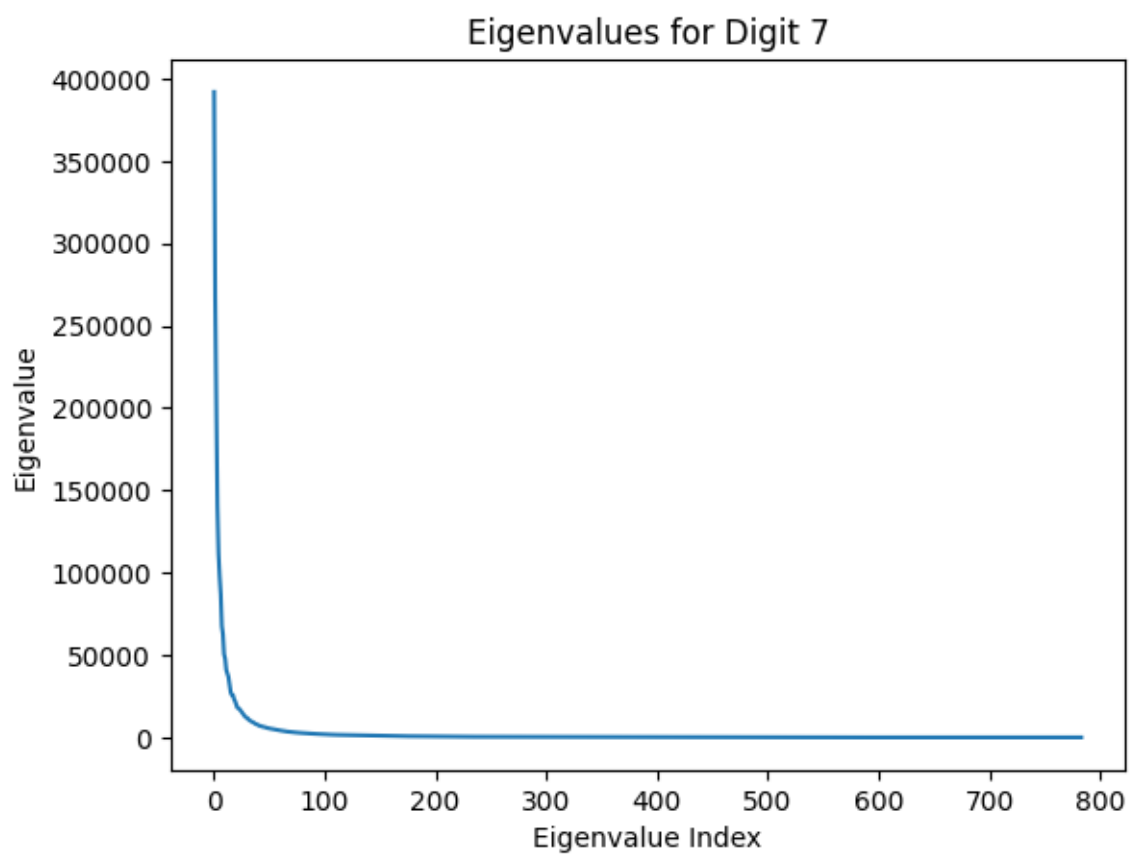
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(391915.45671628264+0j)

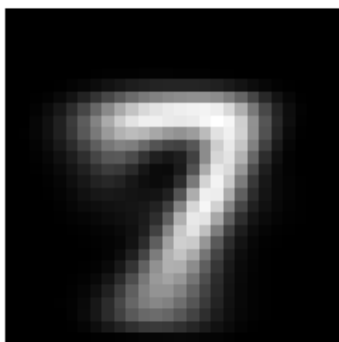


Principal Mode of Variation for Digit 7

Reconstructed Image-1



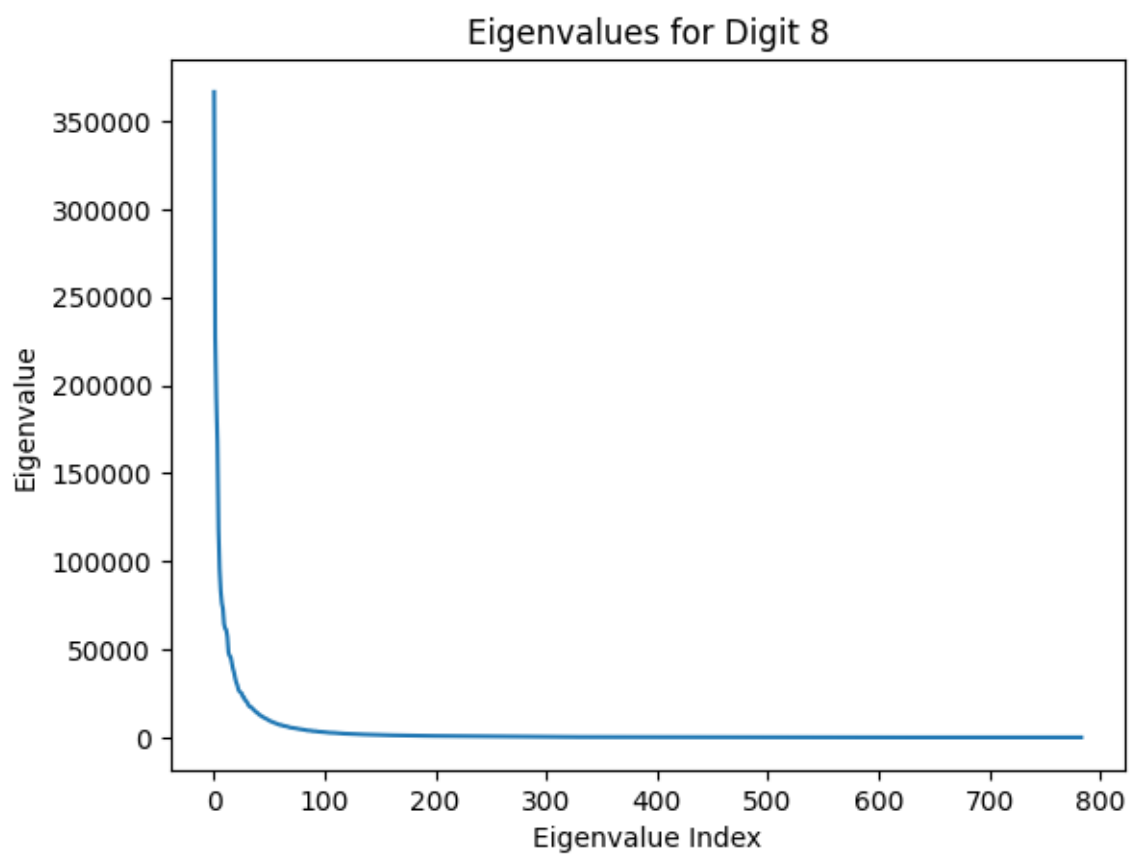
Mean Image



Reconstructed Image-2



Principal Eigenvalue:
(366390.884762311+0j)

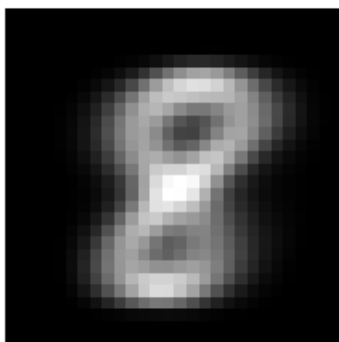


Principal Mode of Variation for Digit 8

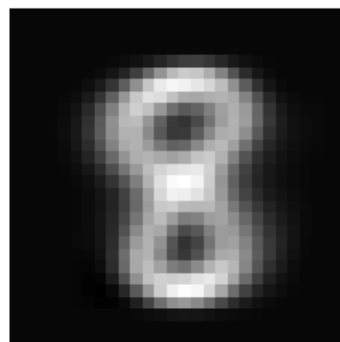
Reconstructed Image-1



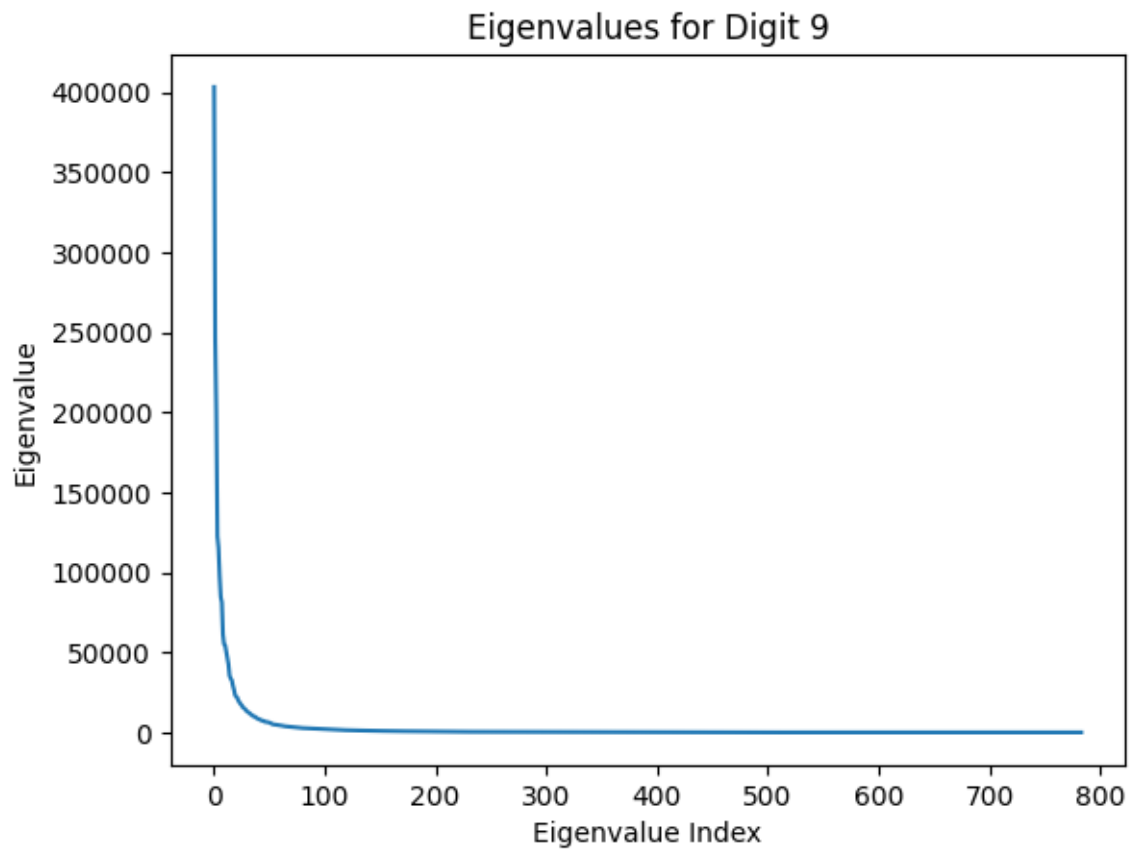
Mean Image



Reconstructed Image-2

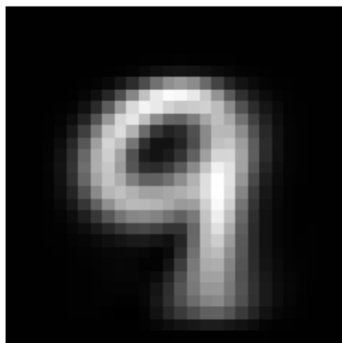


Principal Eigenvalue:
(403359.8429987726+0j)

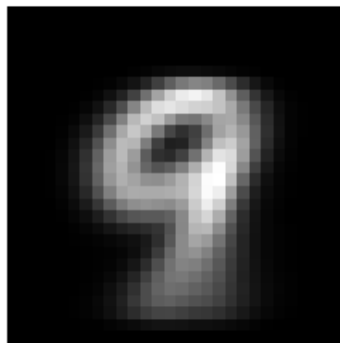


Principal Mode of Variation for Digit 9

Reconstructed Image-1



Mean Image



Reconstructed Image-2



Above I have given all the graphs of the eigenvalues corresponding to each digit and the three image corresponding to what is mentioned in the question. Next thing which I noticed is that

In the graphs only the lower index eigenvalues are useful that is the eigenvalues which have high magnitude only they appear in the graph. This should occur because of the PCA as it say only the principle component is of our matter of interest and changing them effects us significantly and this can be seen in the graph and the images only the higher eigenvalues are our matter of interest.

For each digit the found below 50-100 in somecases below 20 which is far less in comparison to the 784 eigenvalues which appear here. Again the reason is the principle components the there are only less number of eigenvectors with a particular eigenvalue which point in the direction of highest change.

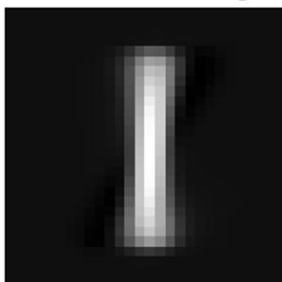
I have shown the 3 images side by side for all the digits.

For each digit, show the 3 images side by side:

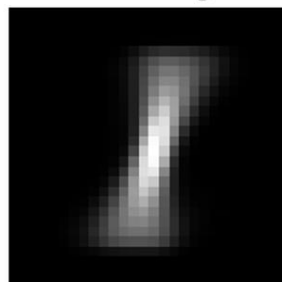
- a) $\mu - \sqrt{\lambda_1}v_1$
- b) μ
- c) $\mu + \sqrt{\lambda_1}v_1$

Principal Mode of Variation for Digit 1

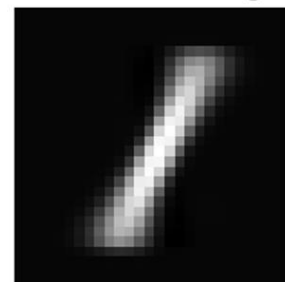
Reconstructed Image-1



Mean Image



Reconstructed Image-2



As I go towards mean starting from a I notice people write one in more slanted manner and when I go from b to c I notice the same thing and length of 1 also increases and becomes thinner the way people write it.