CS215 ASSIGNMENT 2

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Question 5

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1 Introduction

The Code for this question is in Q5.m file which is in code folder

We have also included "mnist.mat" file in code folder so that everytime when Q5.m executes it can take the input from the mnist.mat file

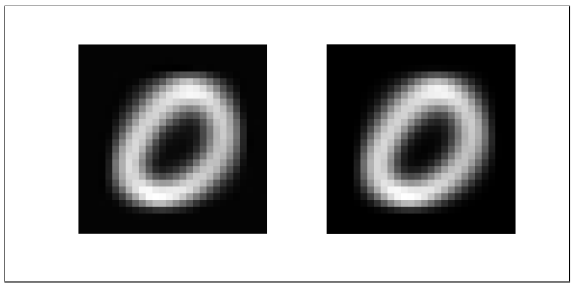
In the results folder we are also submitting the 10 generated images while executing the code

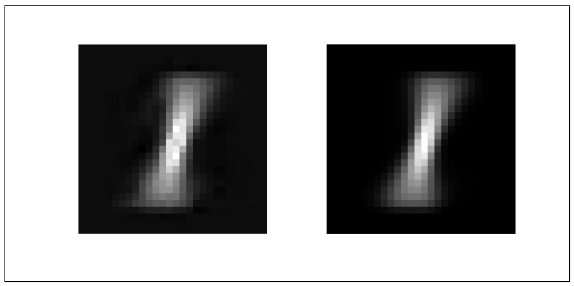
2 Part a

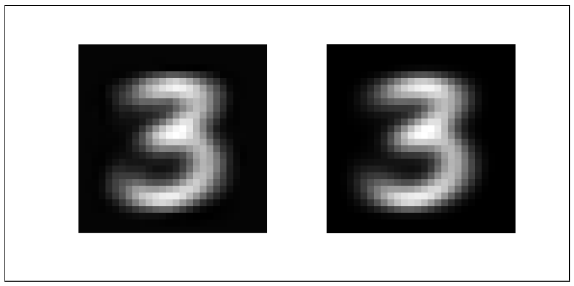
For this part we wrote a function named **'computing_84_coord'** in Q5.m file which takes for which digit we have to compute and allcovariance variable (which contains covariance matrices of all digits) as inputs and returns the 84 eigen vectors and their eigen values as output

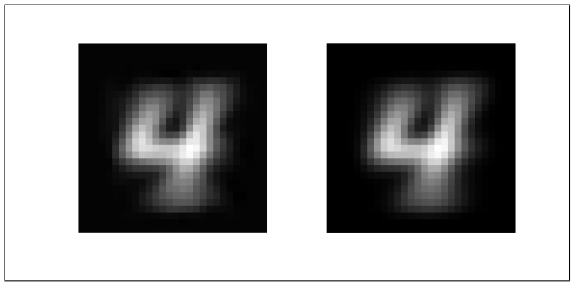
3 Part b

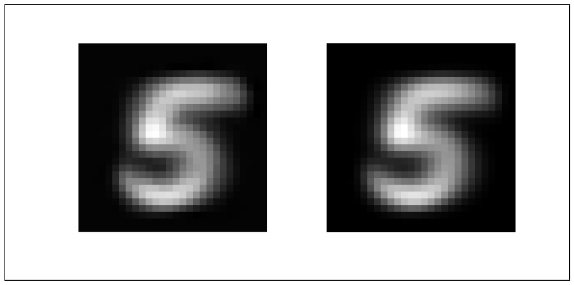
Here for each digit from 0 to 9 by using their 84 coordinates we have reconstructed the each digit, the left image of each figure is generated image using 84 eigen vectors and the right image is the mean image of that digit

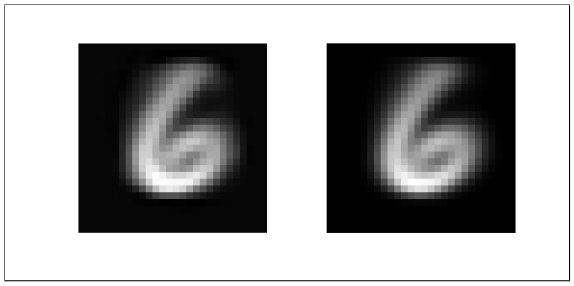


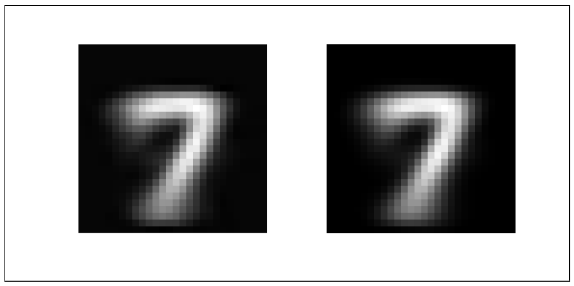


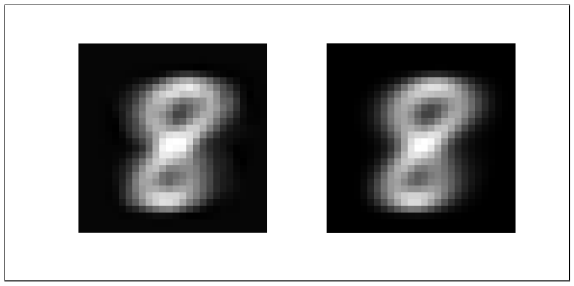


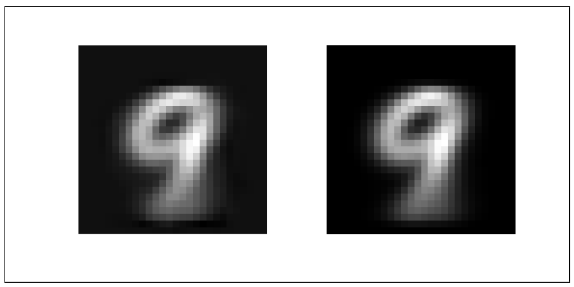












In the next page we are attaching proof of what we assumed while calculating the coefficients for finding the newly generated vector by linear combination of 84 eigen vectors.

In this question we are using the 84 eigen vectors out of 784 to generate the image for each digit from 0 to 9.

Let A be the original vector and let A_1 be the generated vector.

$$A_1 = c_1 v_1 + c_2 v_2 + c_3 v_3 + \cdots + c_{84} v_{84}$$

where $c_1, c_2, \cdots, c_{84}$ are constants and $v_1, v_2, v_3 \cdots, v_{84}$ are eigen vectors.

we have to select these constants such that $\|A - A_1\|_2$ should be minimum.

$\|A - A_1\|_2$ will be minimum when those coefficients are obtained by $A \cdot V_i$ for C_i

Because

$$A = C_1V_1 + C_2V_2 + \cdots + C_{784}V_{784}$$

For A_1 we are using first 84 eigen vectors. and all eigen vectors are orthogonal.
So $C_i = A^TV_i$

$$\boxed{C = A^TV}$$

C = coeff matrix (consists of coeff as columns)

A = original matrix

V = eigen vector matrix.

$$C_{1\times84} \quad A^T_{1\times784} \quad V_{784\times84}$$

84-columns of C contains 84 coe-fficients.