Exercise task:

1. In this section we first show the 10 natural images next we will show the sparse basis functions reached from the functions:

The raw image:

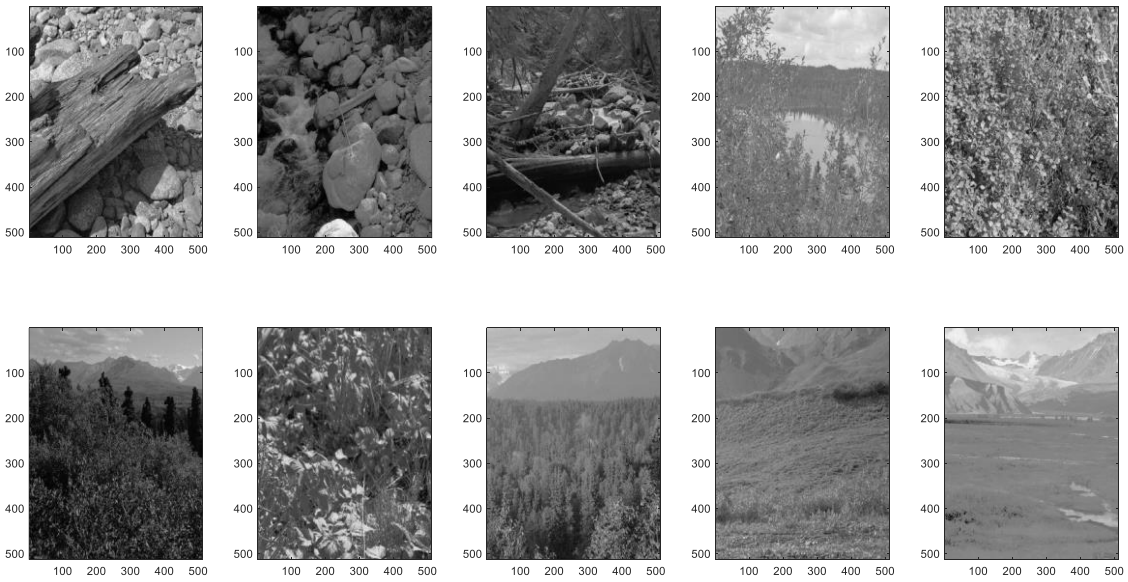
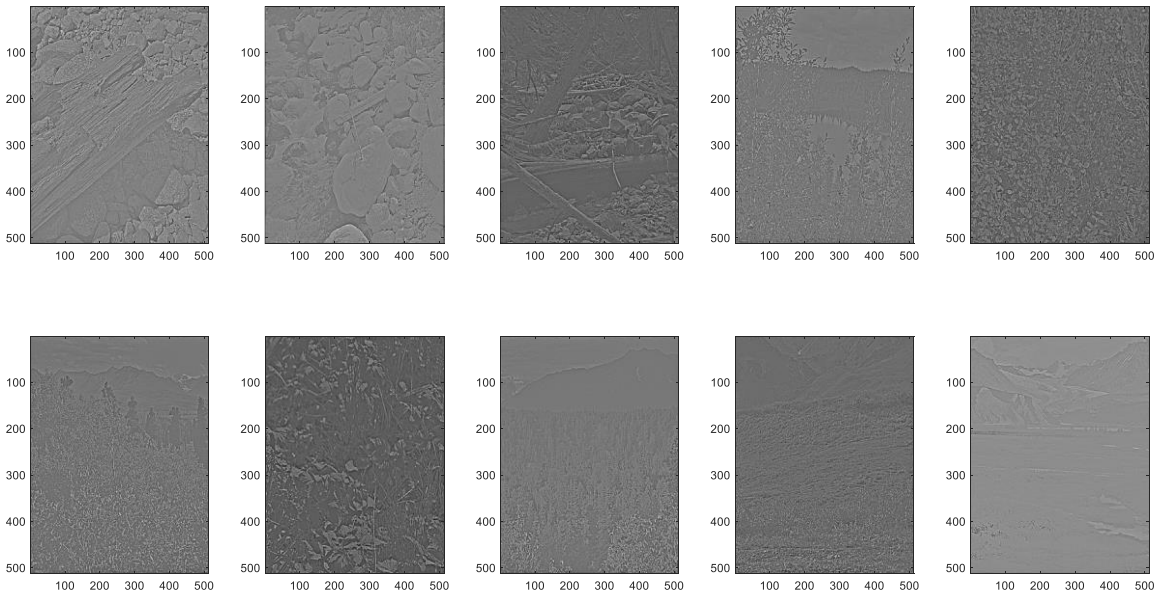
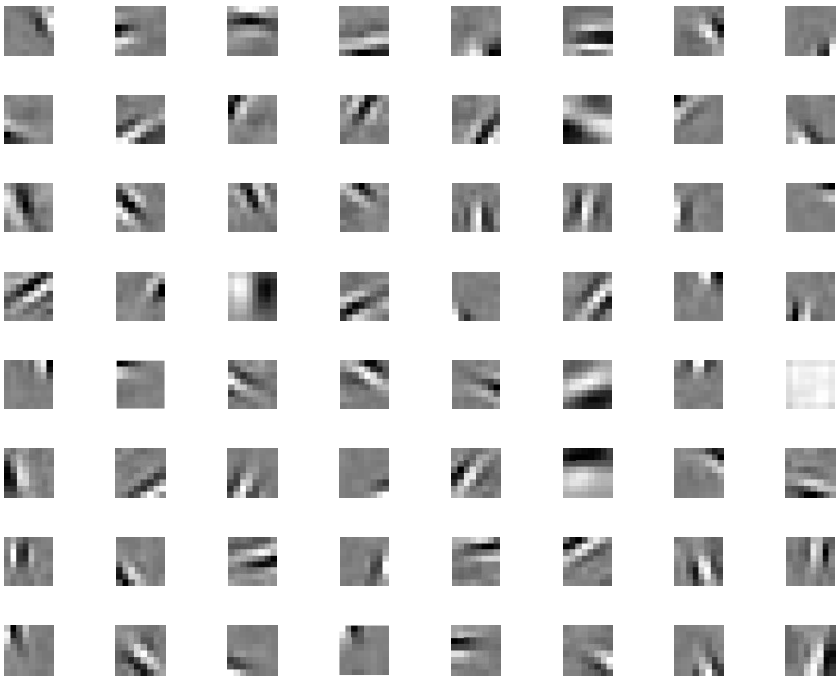
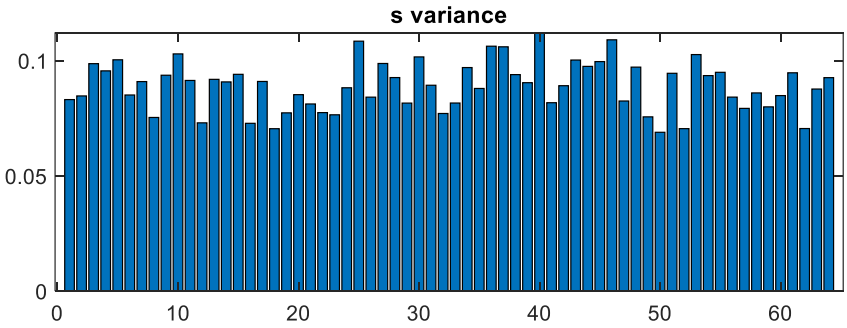


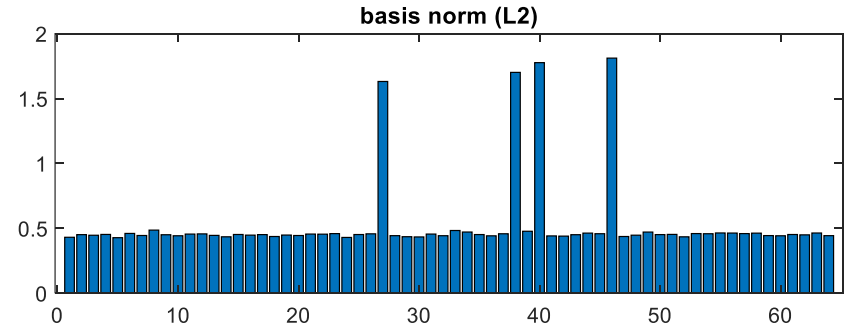
Image after whitening:



Here are the sparse basis functions. 8x8 images calculated after 3000 iterations.



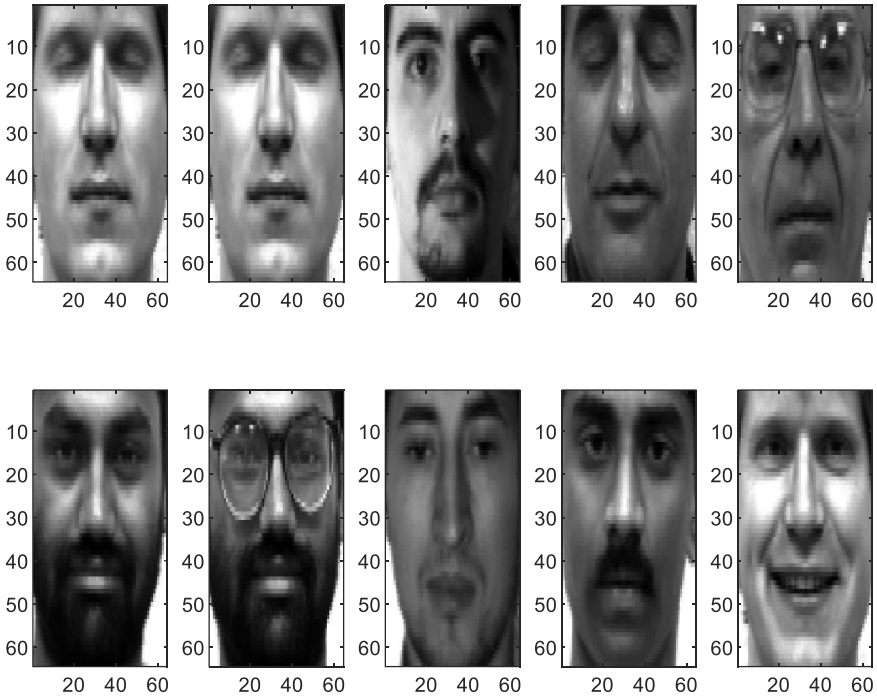




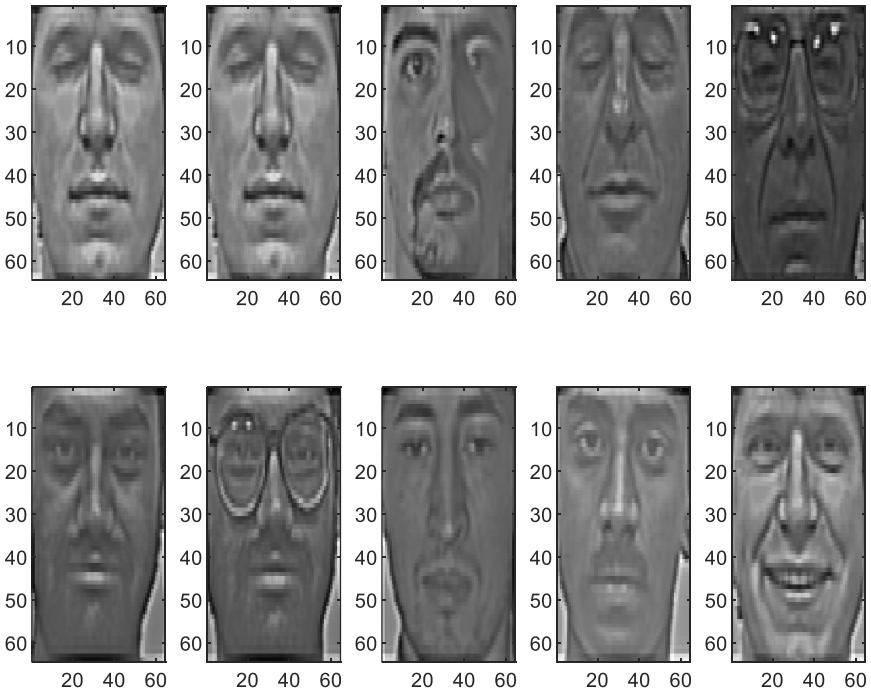
The images with the highest contrast have the large amounts of norm.

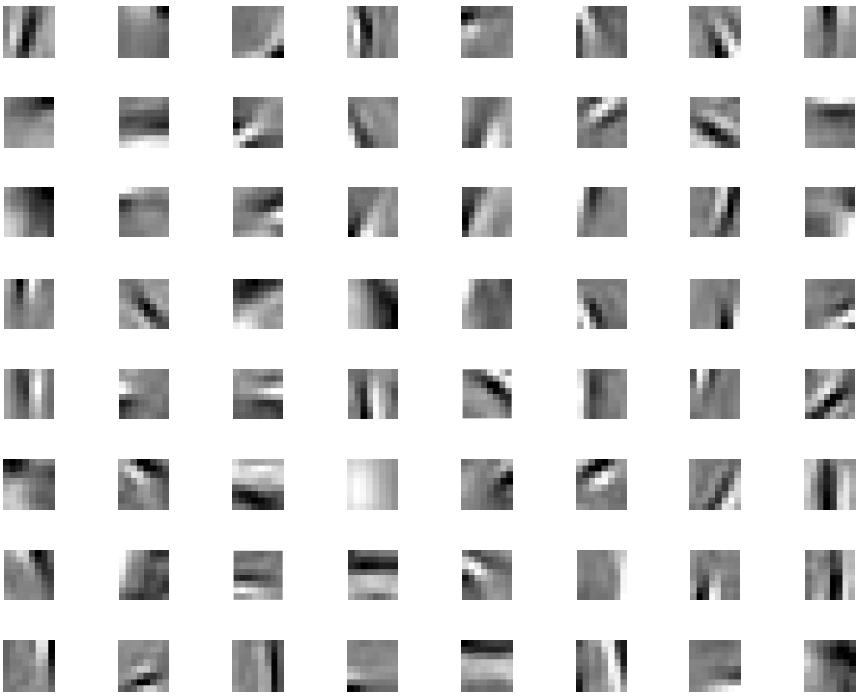
2. In this section we try to repeat the previous procedure for different images there are three other datasets that are going to be investigated in the following images:
    a. The Yale dataset:

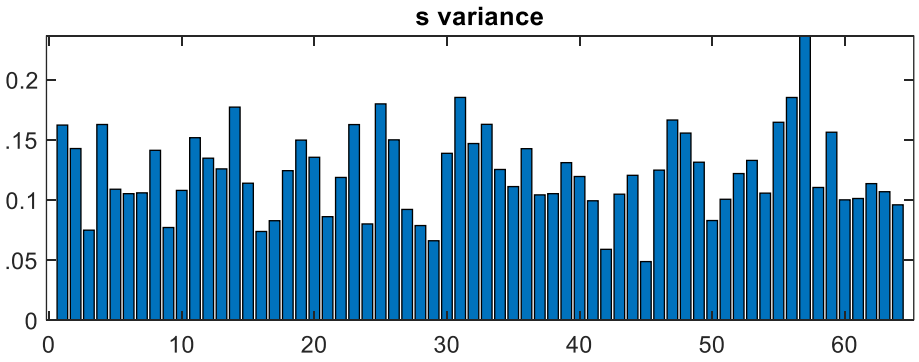
10 random images:

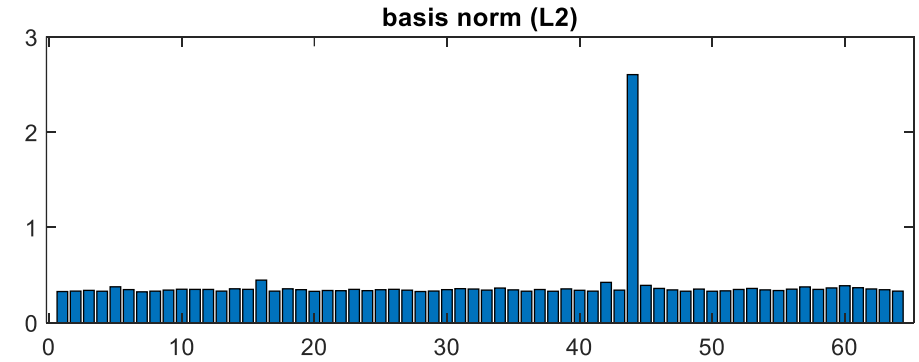


After whitening:





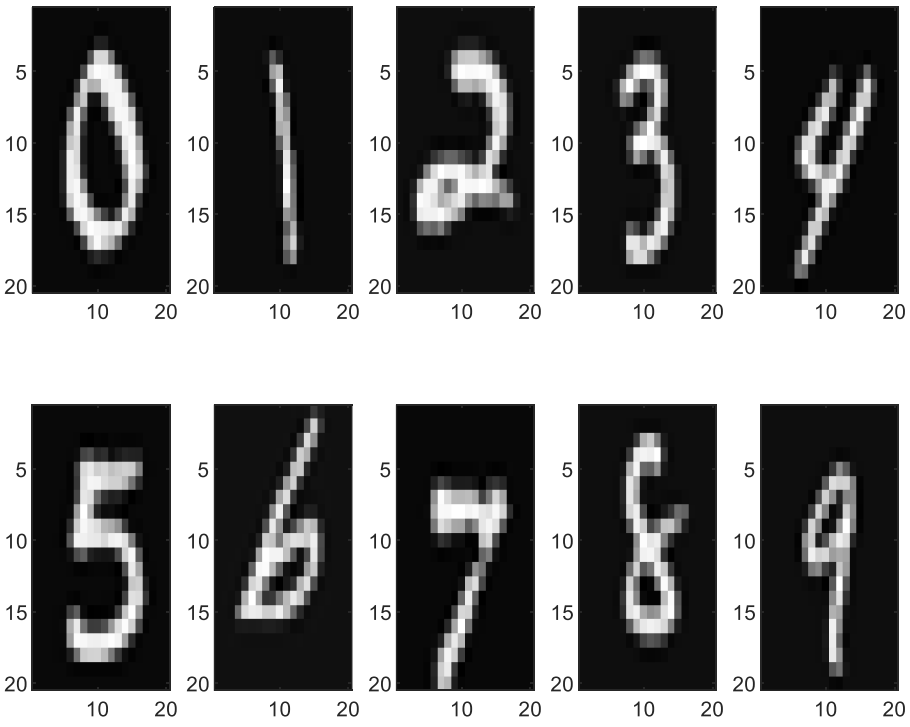




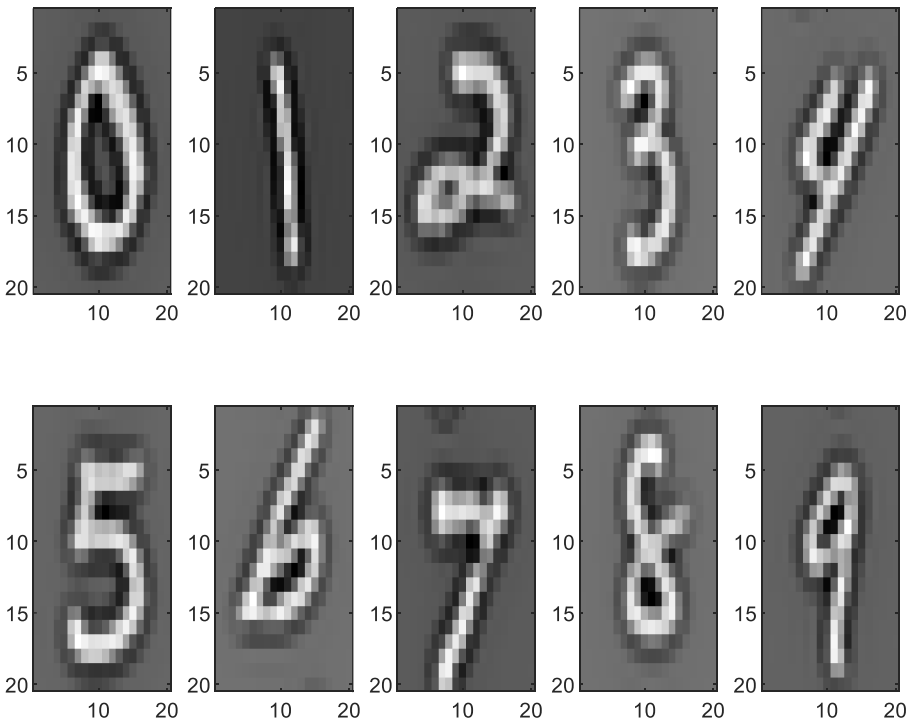
The above figures are the result of 1750 iterations of the sparsenet code.

b. The MNIST dataset:

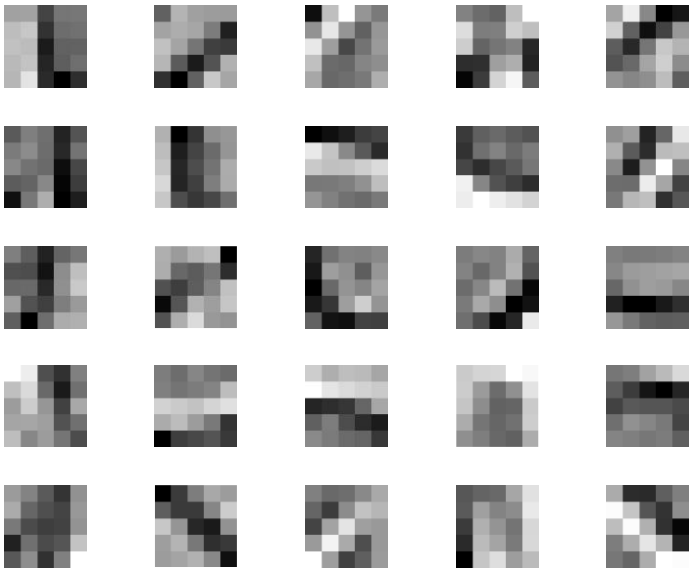
10 random images:



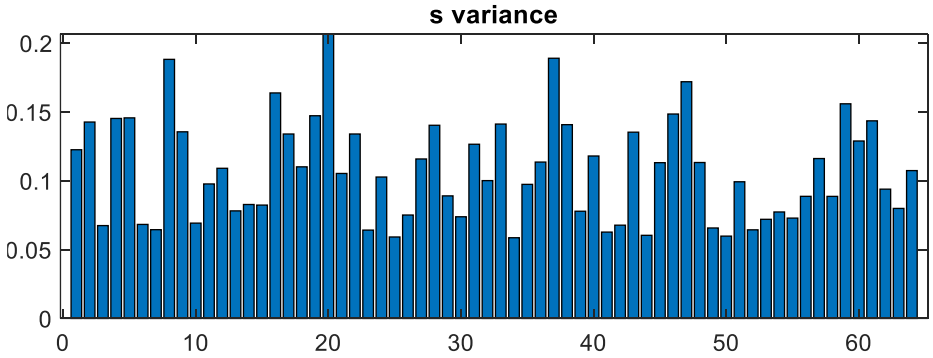
After whitening:

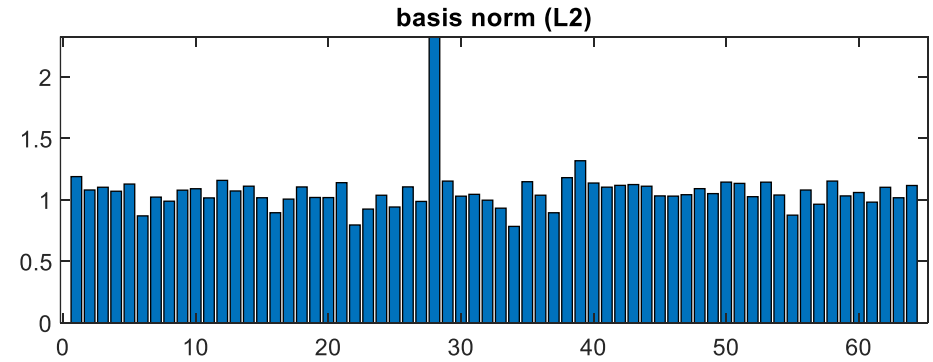


The data images are 20x20 so at first we try to find 5x5 sparse basis functions and then find the functions as previous parts.



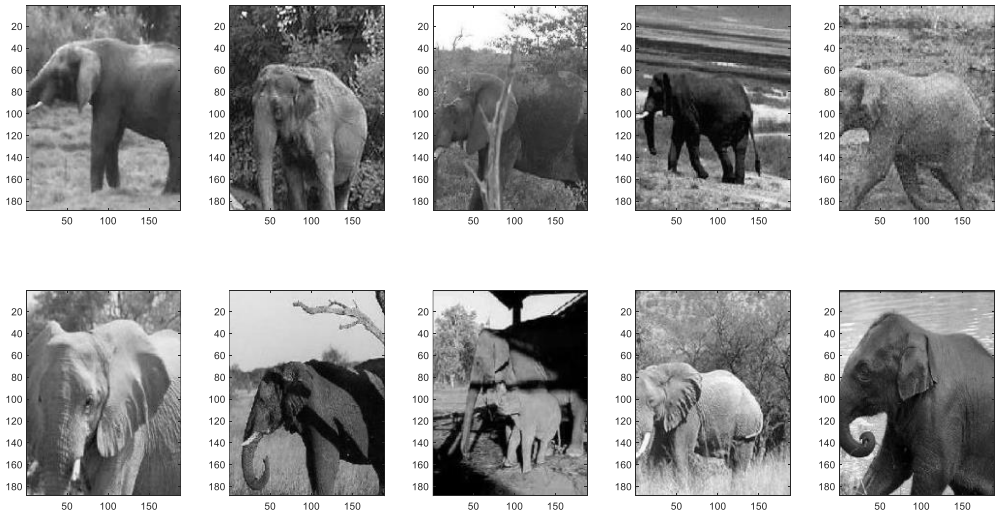
The regular 8x8 one:



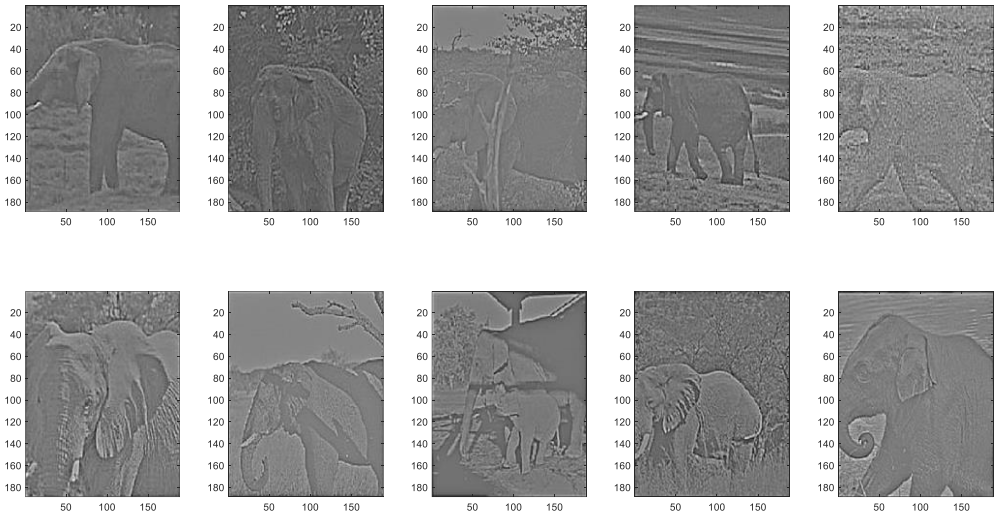


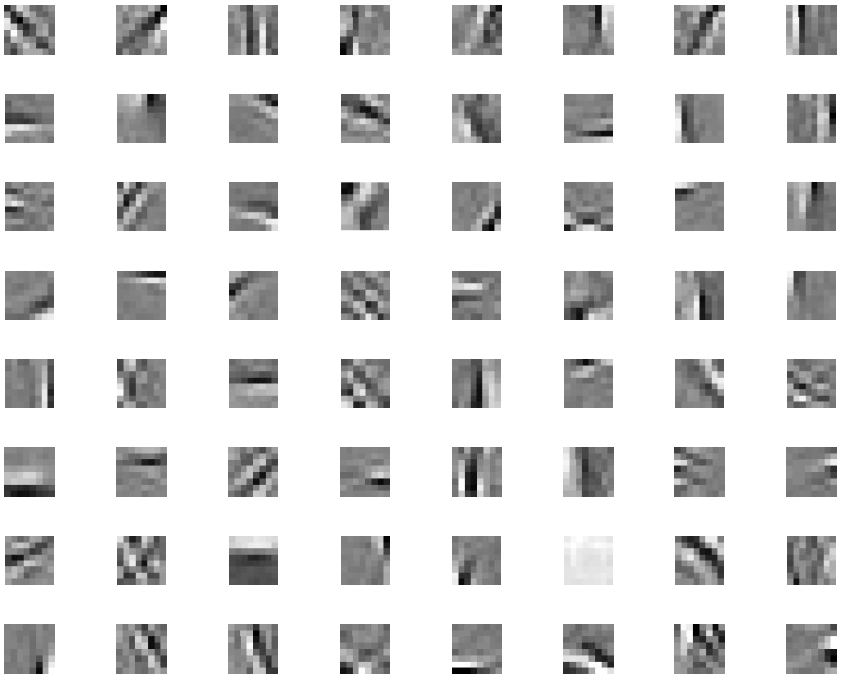
c. The Caltech101 dataset:

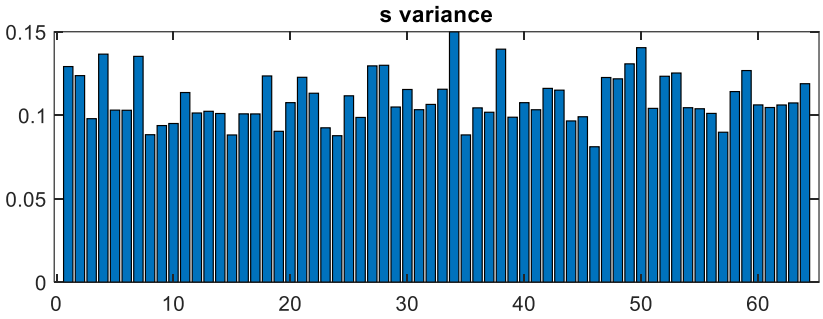
10 random images:

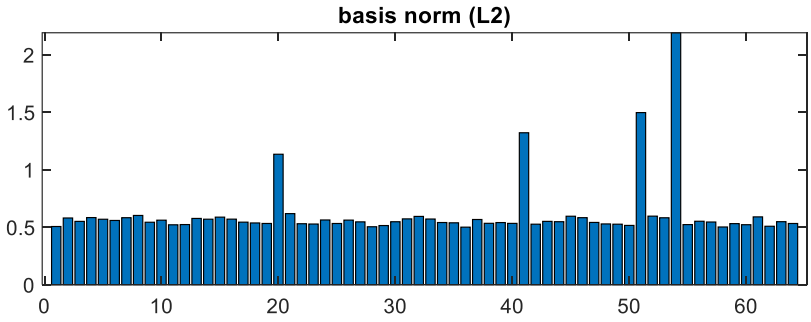


After whitening:

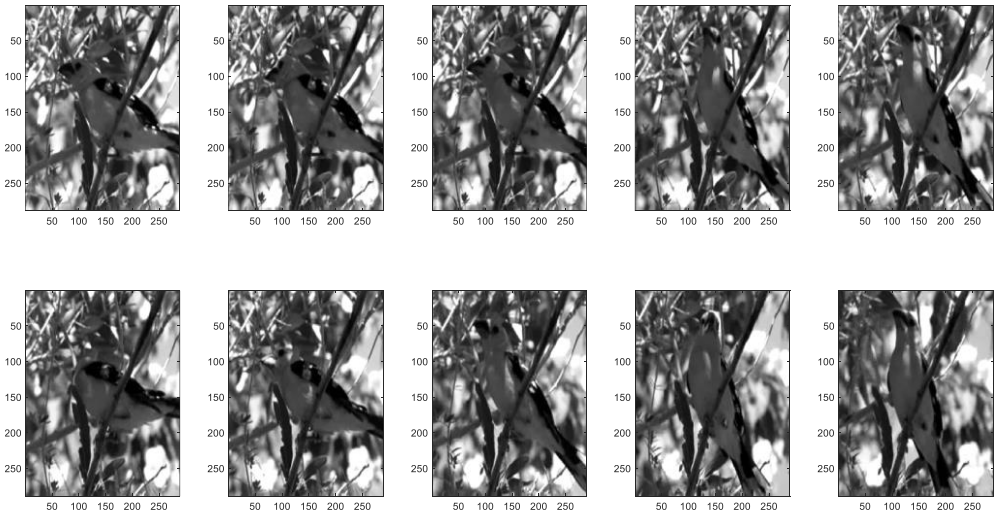






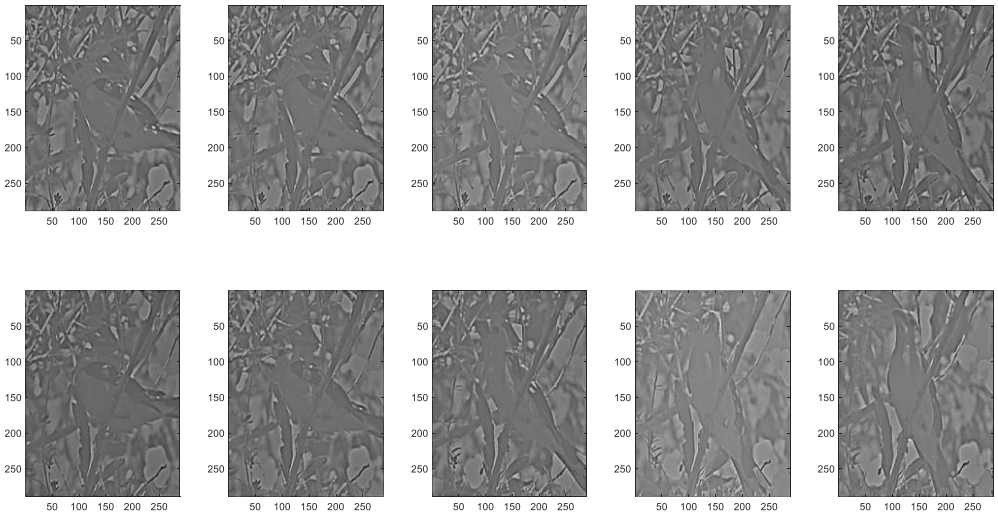


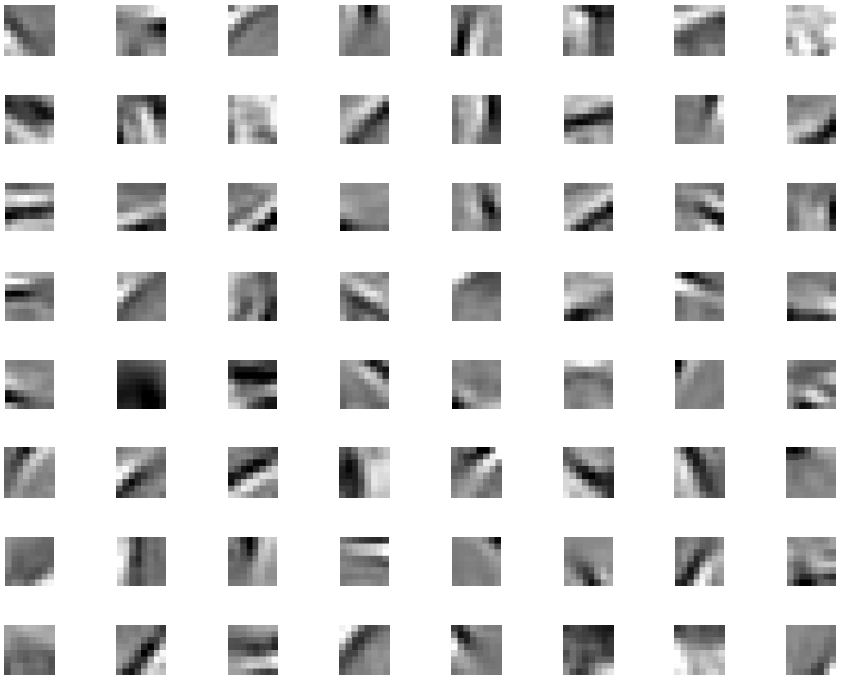
3. In this section we are trying to investigate sparse function on a video:
   At first we show the video frames in different times:

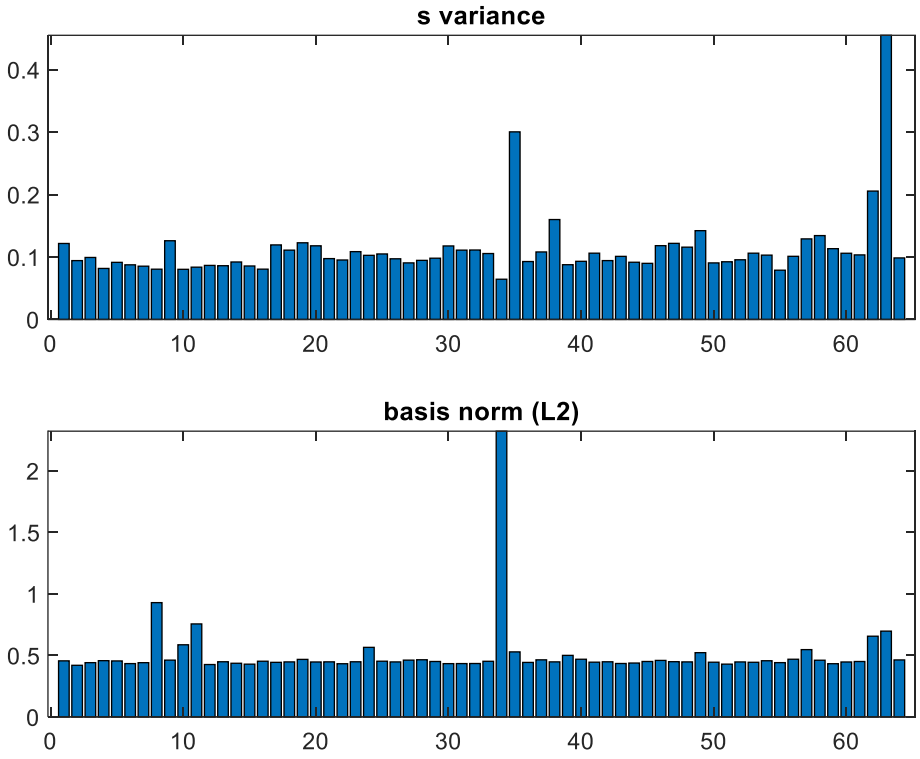


Now we try to find the sparse basis functions for each 10 frames

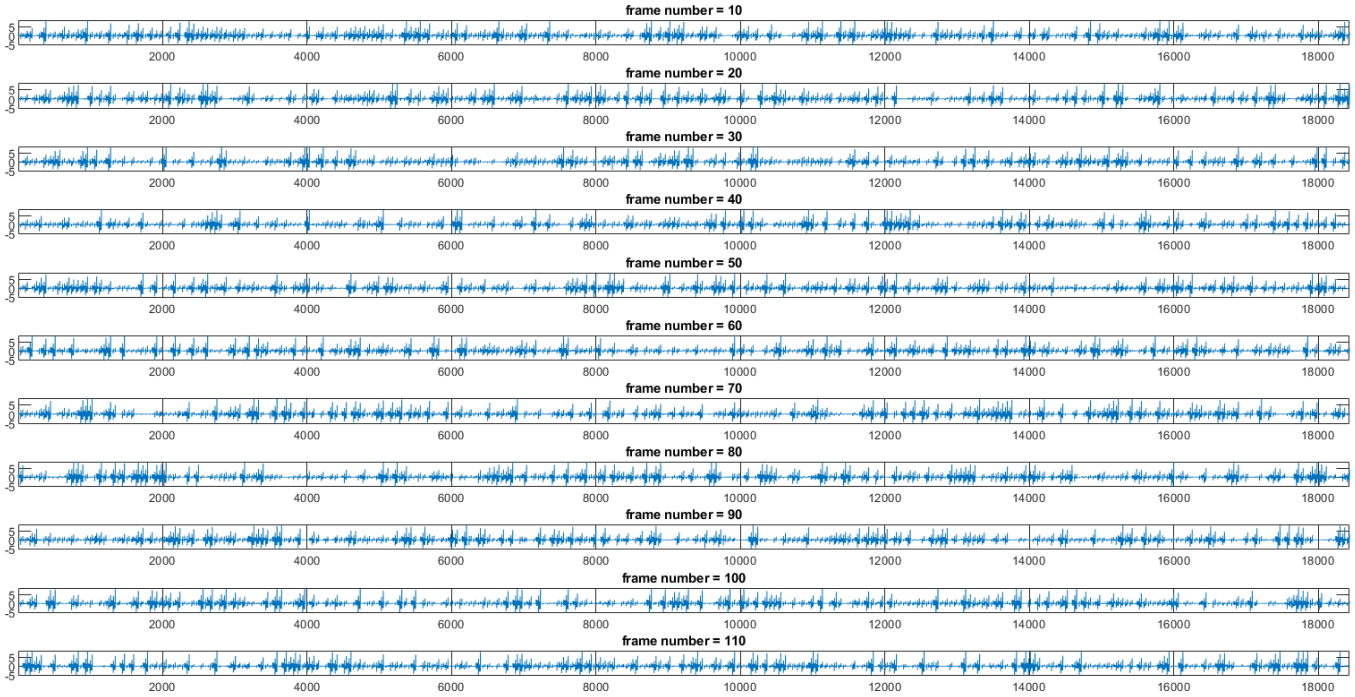
Advanced Topics in Neuroscience *problem set # 9 (Visual Model)*
Instructor: Dr. Ali Ghazizadeh *Name: Sana Aminnaji*
Student ID: 98104722

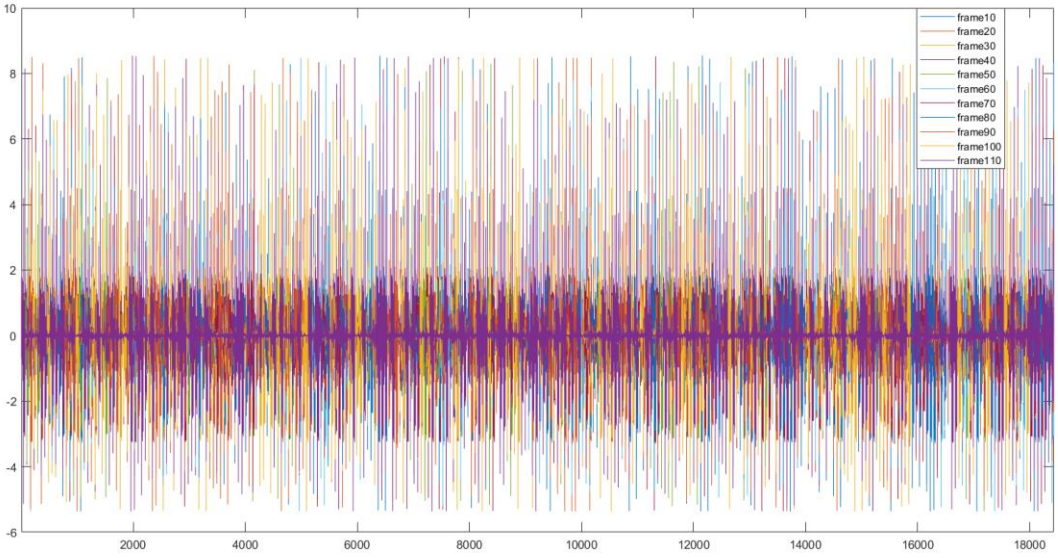


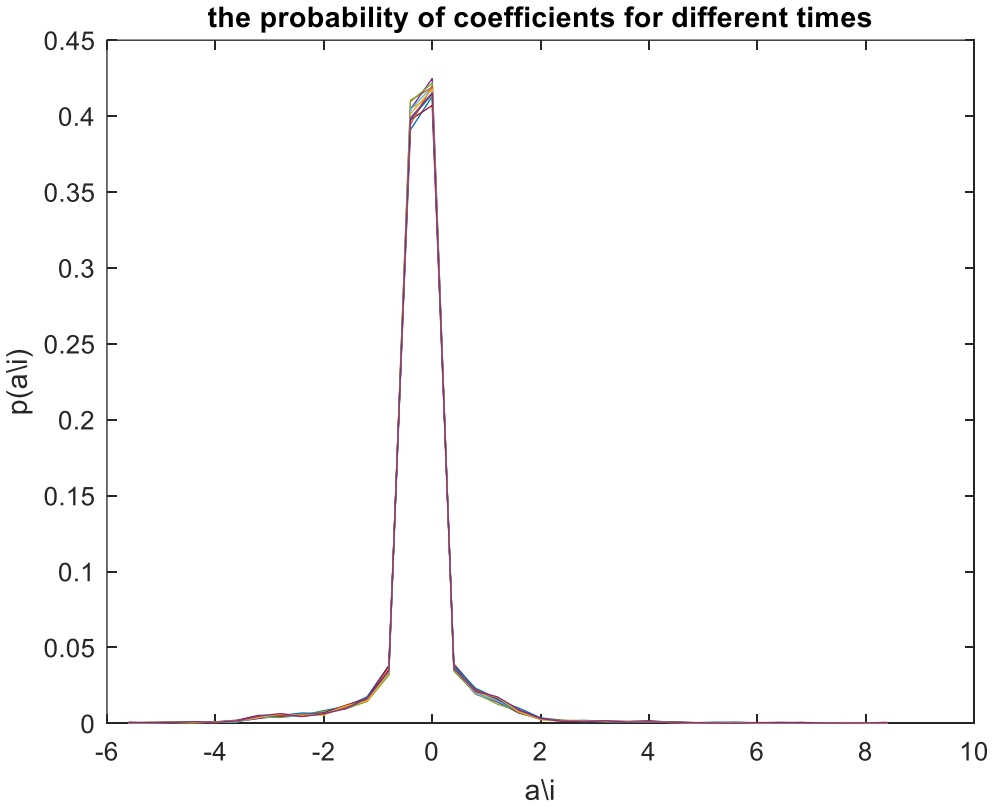




As you can see the sparse coefficients changes through time because of the change in the background frame of the video. (the neurons as well as the basis functions act sparse so by changing the image the coefficients will change in order to code the exact details that are expected).


frame number = 10
frame number = 20
frame number = 30
frame number = 40
frame number = 50
frame number = 60
frame number = 70
frame number = 80
frame number = 90
frame number = 100
frame number = 110
5
0
-5
2000
4000
6000
8000
10000
12000
14000
16000
18000


frame10
frame20
frame30
frame40
frame50
frame60
frame70
frame80
frame90
frame100
frame110
10
8
6
4
2
0
-2
-4
-6
2000
4000
6000
8000
10000
12000
14000
16000
18000



As you can see in the plot for each frame most of the coefficients are zero and that is the energy efficiency of the sparse model.