# Advance Neuroscience HW 9


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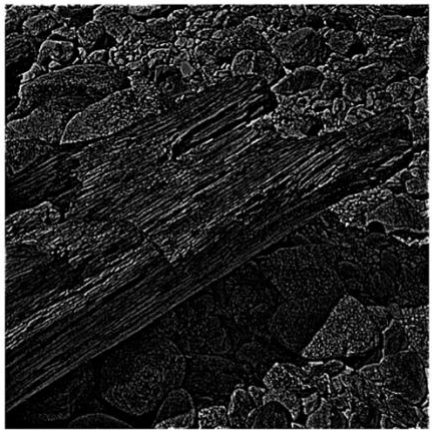
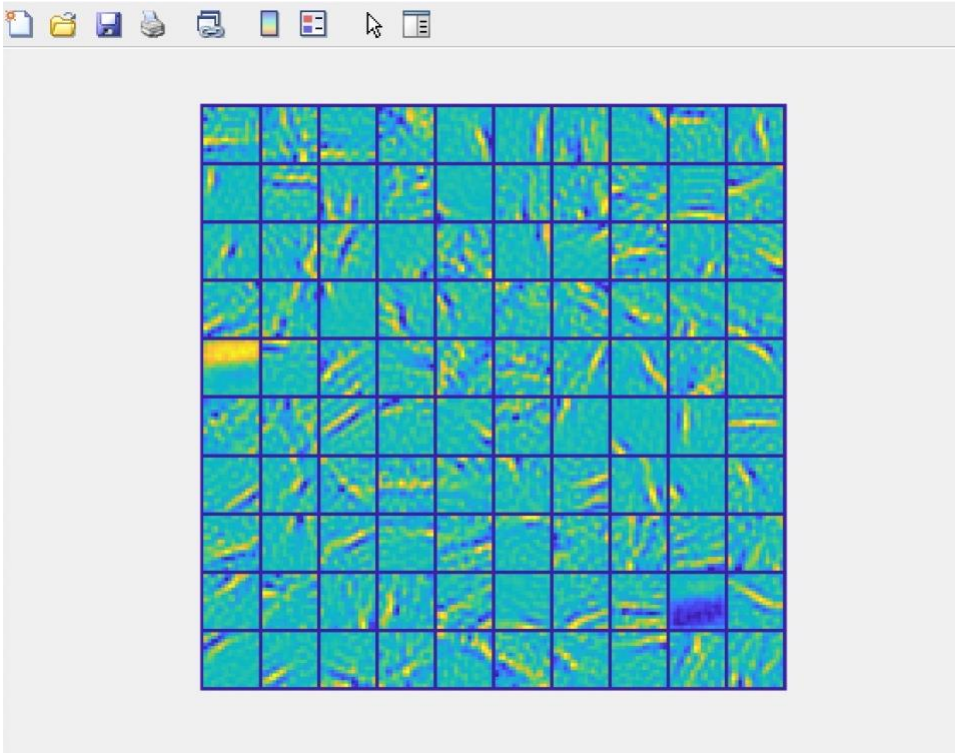
1. **Simulate sparse basis functions of the natural images:**

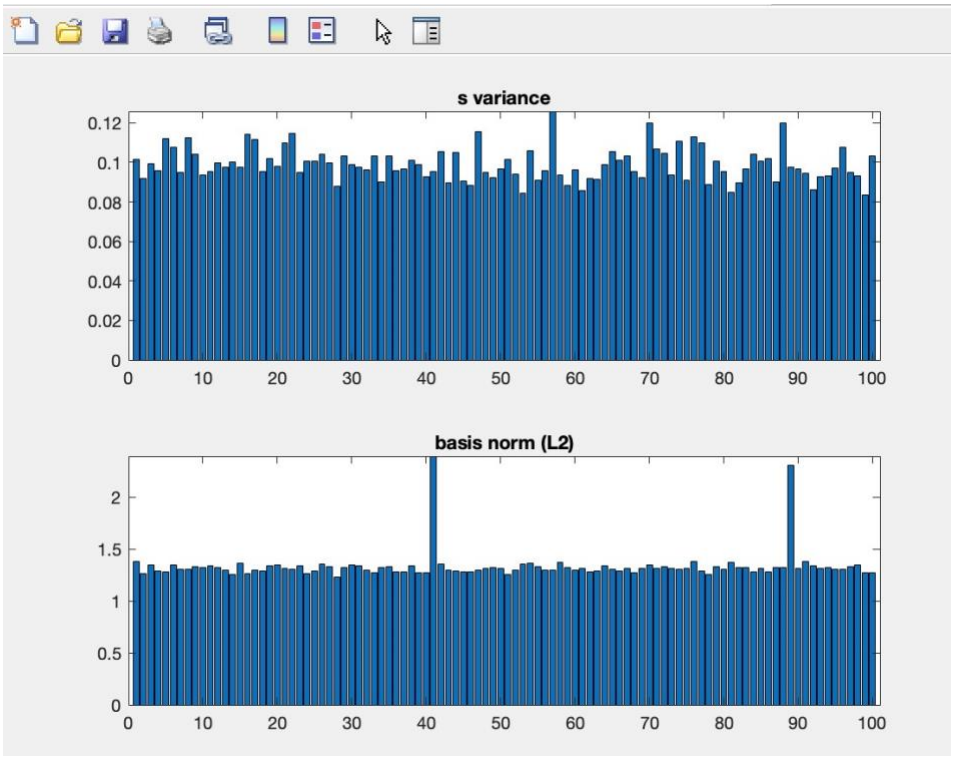
10 natural images :

Zoom in:



You can see the Basis function as a result here:



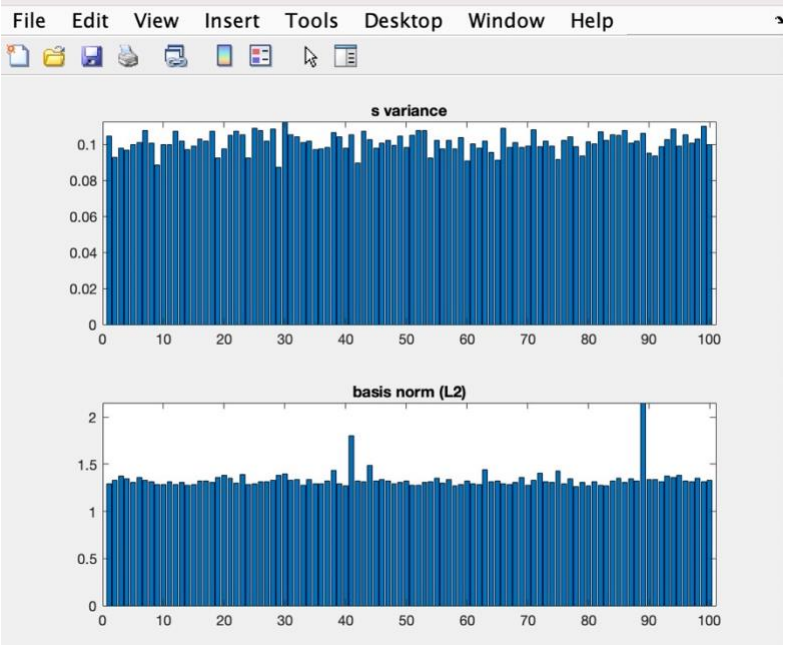


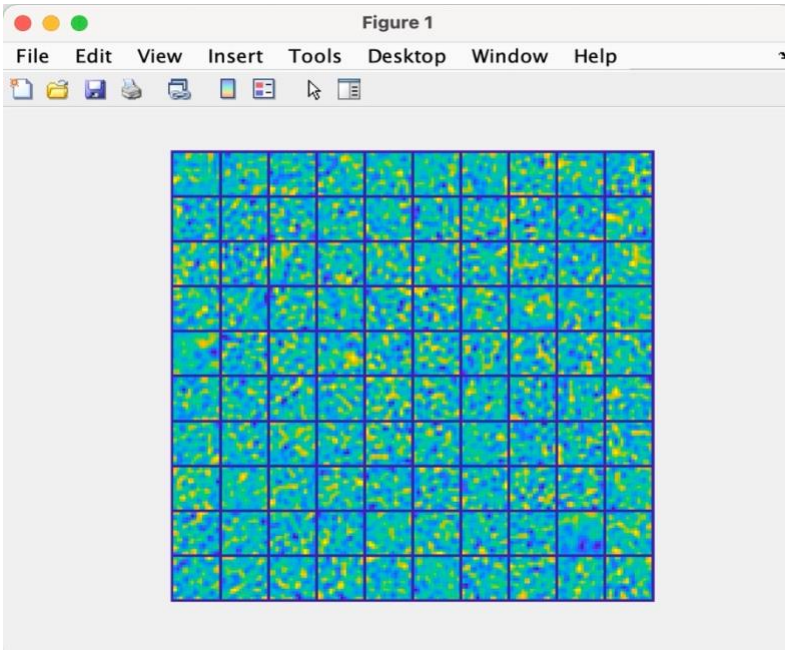
2. **Study the effect of different datasets**:

For Yale and MNIST dataset we have these result(for 100 basis functions) :

First: Yale dataset:

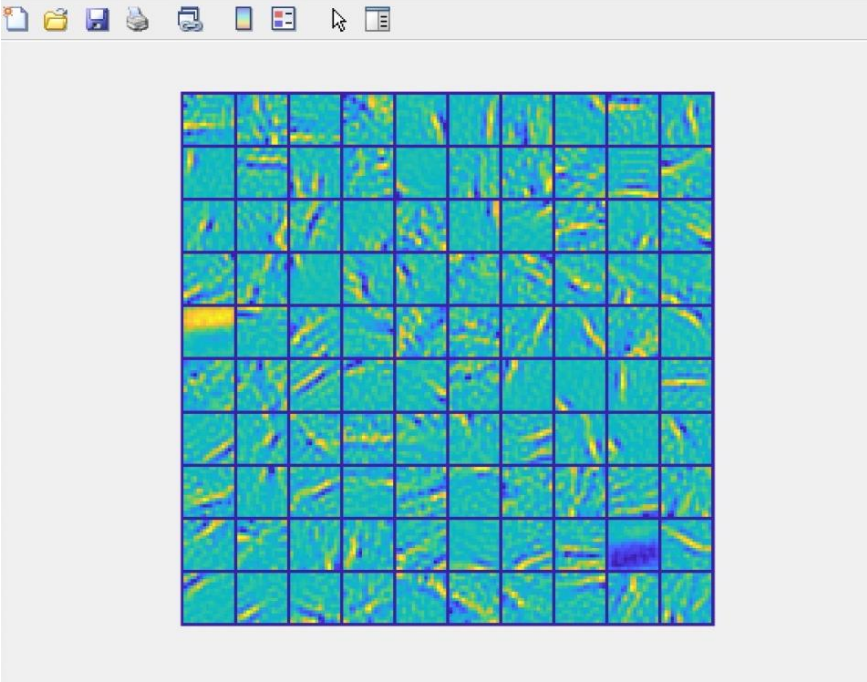
First of all we show the result for 16*16 image paches



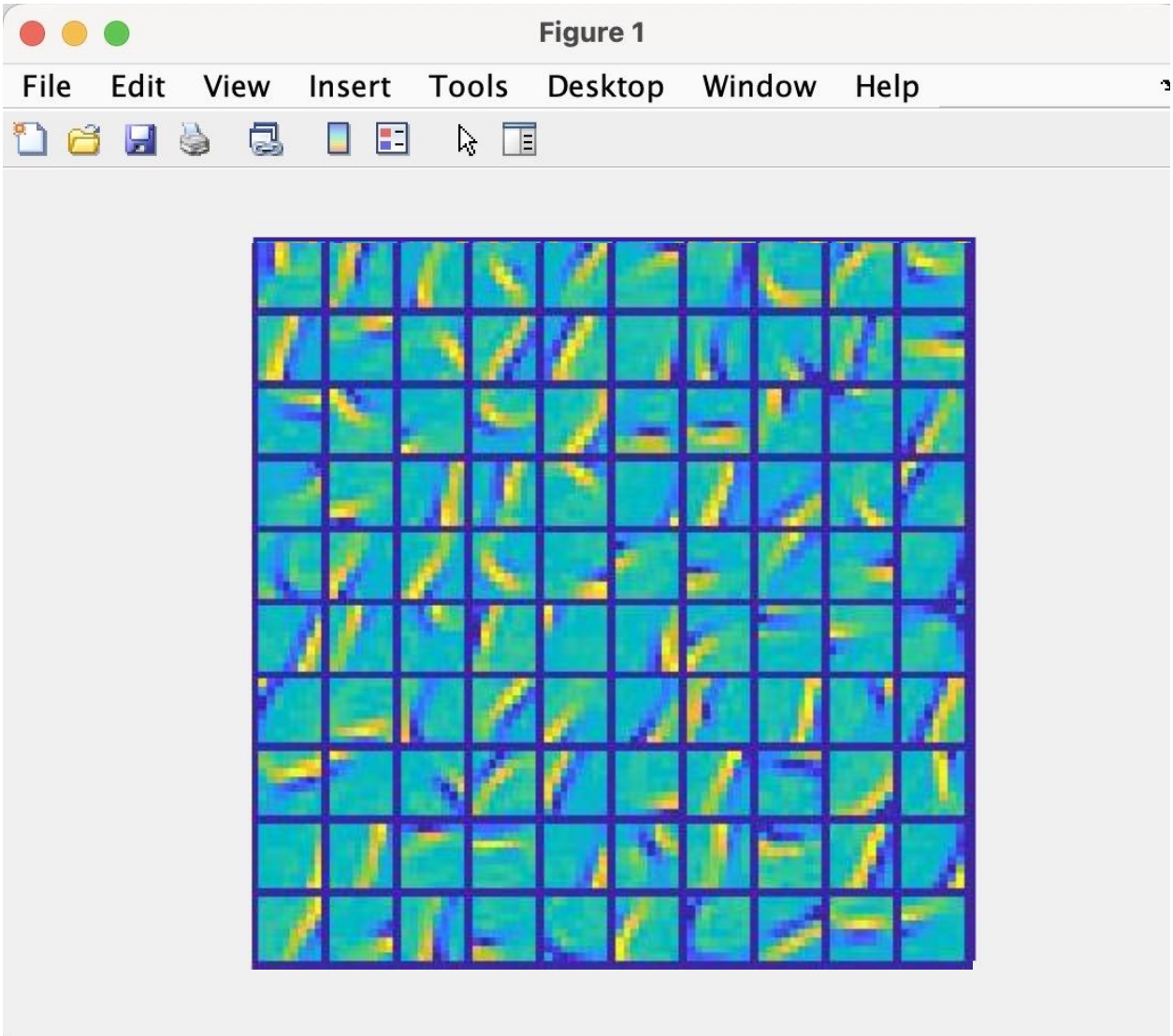
then we show the result for 8*8 image paches

And we have:



seccond: MNIST dataset:

like previous part, we show the result for 100 Baisis function(8*8)



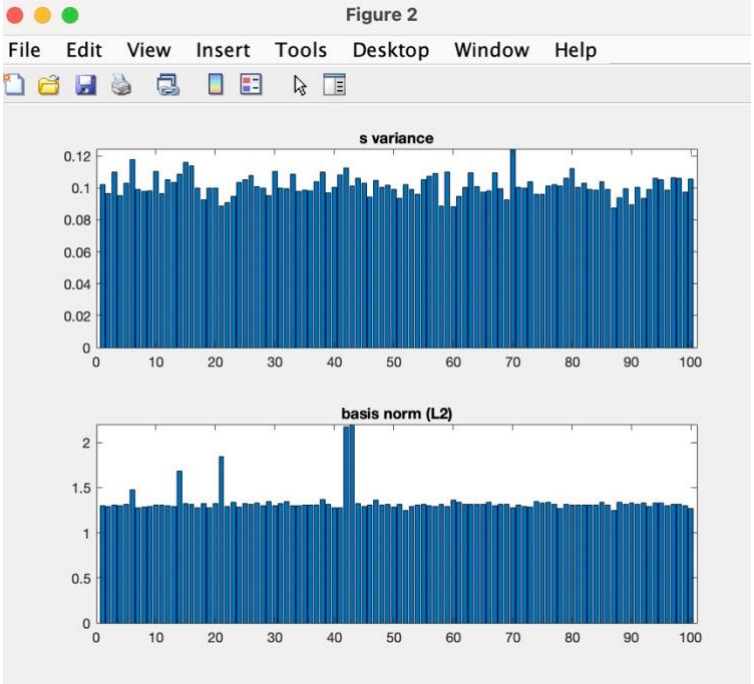
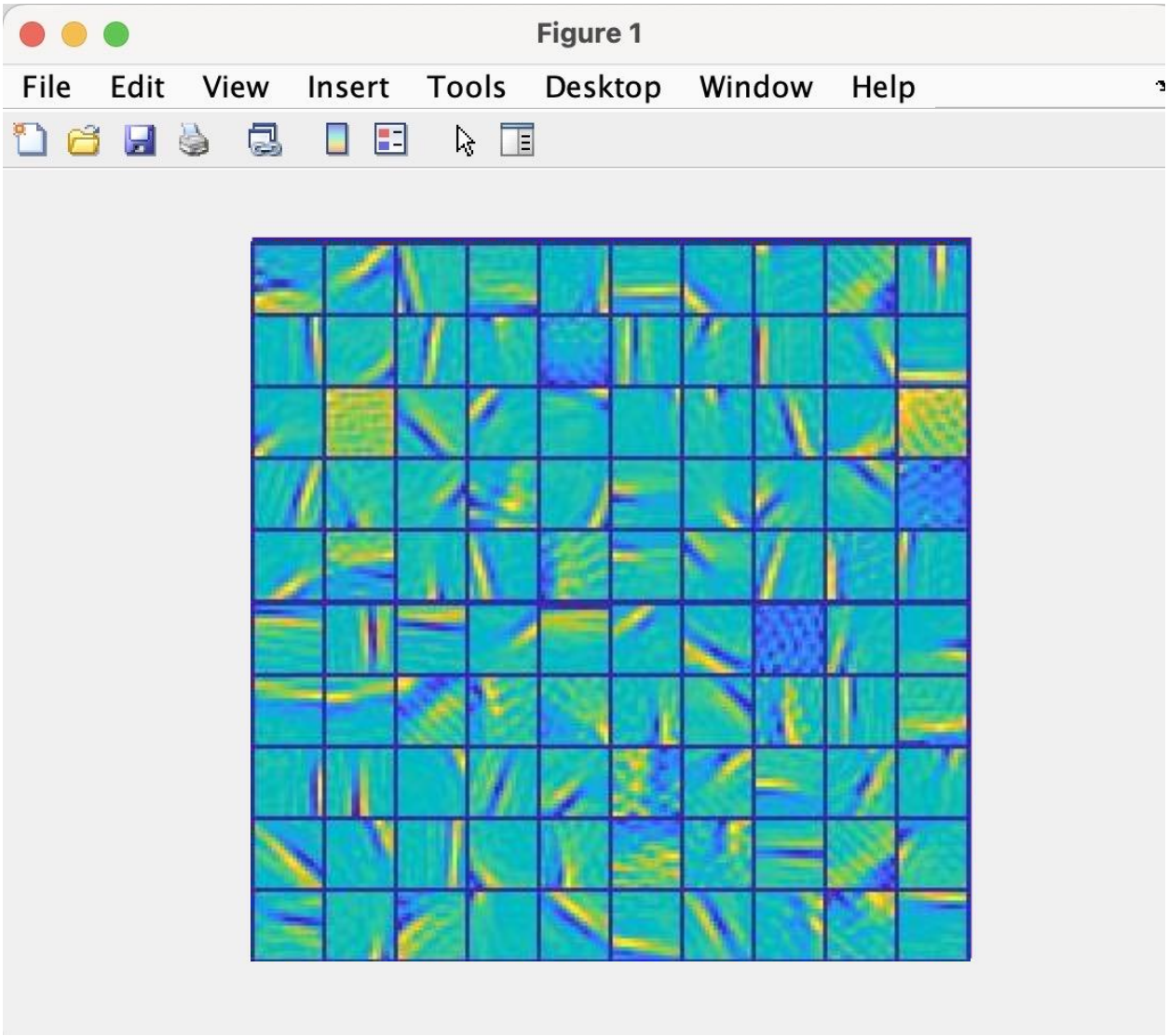


Figure 2
File Edit View Insert Tools Desktop Window Help
s variance
0.12
0.1
0.08
0.06
0.04
0.02
0
0 10 20 30 40 50 60 70 80 90 100
basis norm (L2)
2
1.5
1
0.5
0
0 10 20 30 40 50 60 70 80 90 100

Third: Show the basis functions for a different natural image dataset like Caltech101: (8*8)



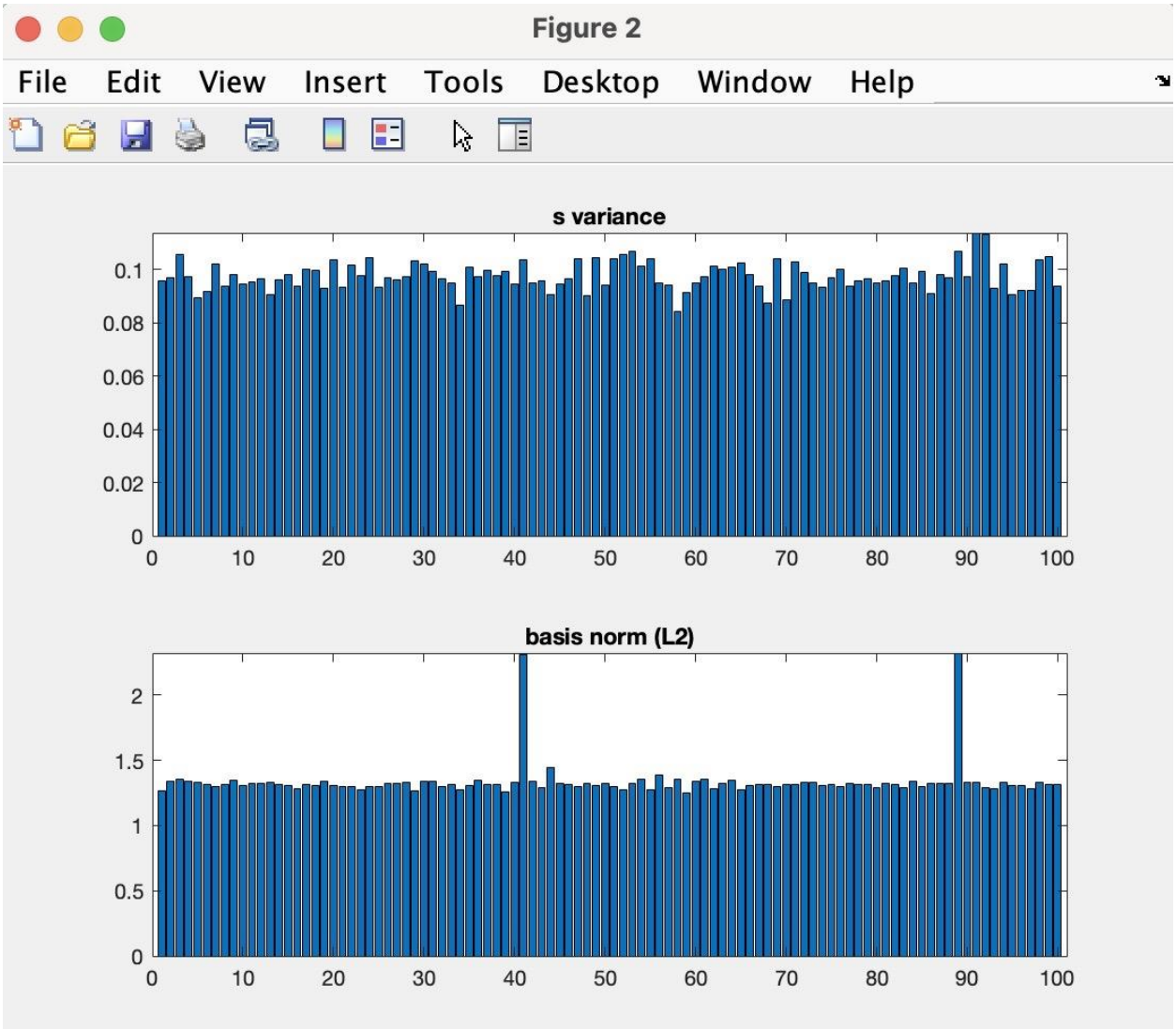


Figure 2
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s variance
0.1
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0 10 20 30 40 50 60 70 80 90 100
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1.5
1
0.5
0
0 10 20 30 40 50 60 70 80 90 100

Discussing the "sparsity" of basis functions across different datasets, specifically the Yale, MNIST, and Caltech110 datasets. The term "sparsity" often refers to how much non-zero data there is in the basis function or how spread out the features are in the feature space.

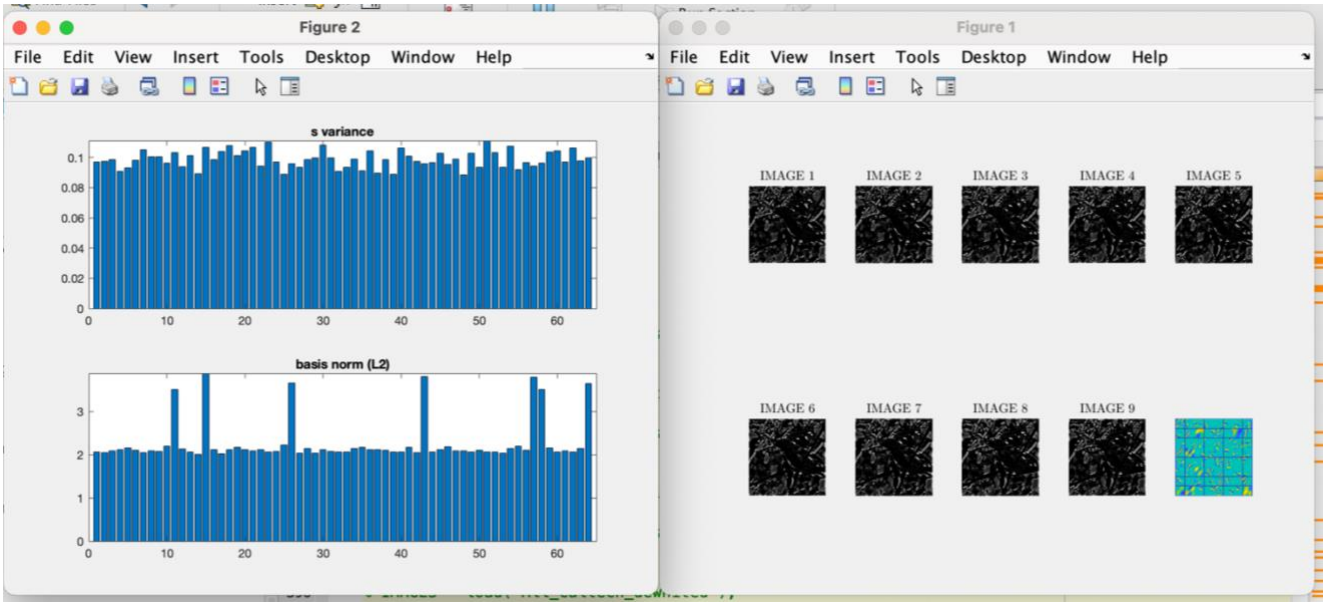
Here's a breakdown of the points discussed:

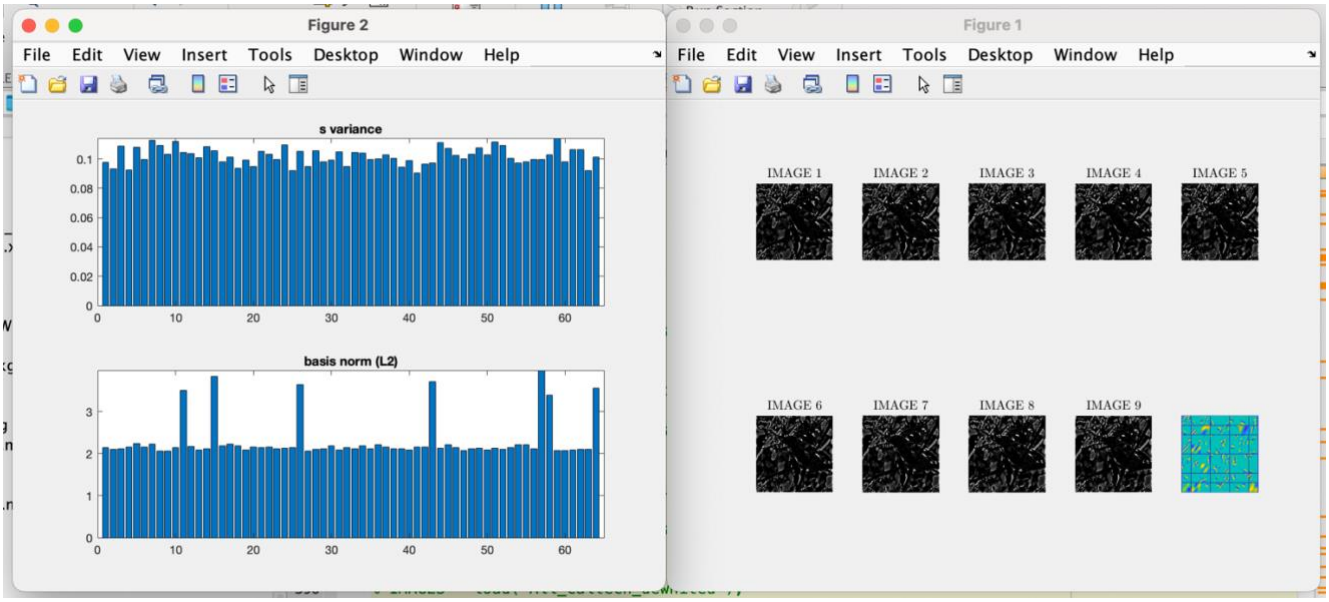
1. Basis Functions: These are the underlying components that the dataset can be reduced to. When you apply techniques like PCA (Principal Component Analysis) or ICA (Independent Component Analysis), the 'directions' or vectors that are discovered are your basis functions. They effectively capture the structure in your data.

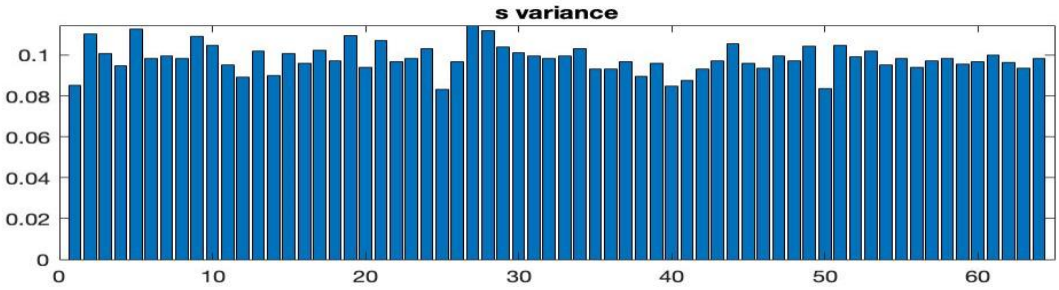
2. Sparsity: In this context, it means the amount of non-zero components in the basis functions. A more sparse basis function would have more zeroes and fewer non-zero elements.

3. Comparison of Different Datasets: The passage discusses three datasets - Yale, MNIST, and Caltech110. It compares the basis functions of these datasets and comments on the difference in sparsity.
    - Caltech110: It seems to have more natural images. Natural images tend to have greater intensity hence their basis functions are more spread out or sparse.
    - Yale and MNIST: These datasets are less natural compared to Caltech110, hence have less sparse basis functions

3. **Study the dynamics of the sparse coefficients**:




s variance
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0.06
0.04
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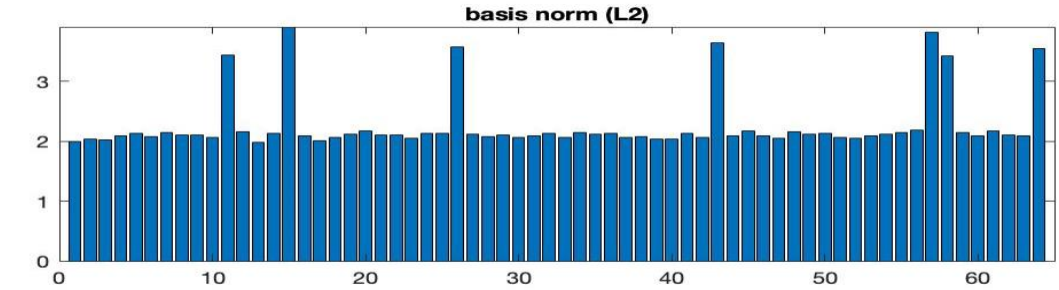
basis norm (L2)
3
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0
10
20
30
40
50
60

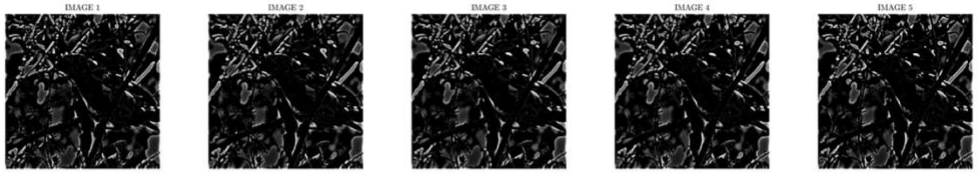
IMAGE 1
IMAGE 2
IMAGE 3
IMAGE 4
IMAGE 5


IMAGE 6
IMAGE 7
IMAGE 8
IMAGE 9

1. Calculation of Sparse Coefficients: Each frame in the series is divided into patches of the same size as the basis functions matrix. Sparse coefficients are then calculated for each of these patches. The coefficients are likely obtained using a sparse coding algorithm, which finds a set of sparse coefficients that, when multiplied with the basis functions, will recreate the original data (frame patch) as closely as possible.
2. Plotting Coefficients Value vs Frame (Time) & Window Number: A plot is then created where the x-axis represents the frame number (which is equivalent to time in the context of a video) and the window number (specific patch of the frame), and the y-axis

**For this part please run the last part in my code (HW9.m) it shows a movie like gif and you can clearly see the coefficients. I cannot put video in this PDF.**