Assignment 4

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April 16, 2013

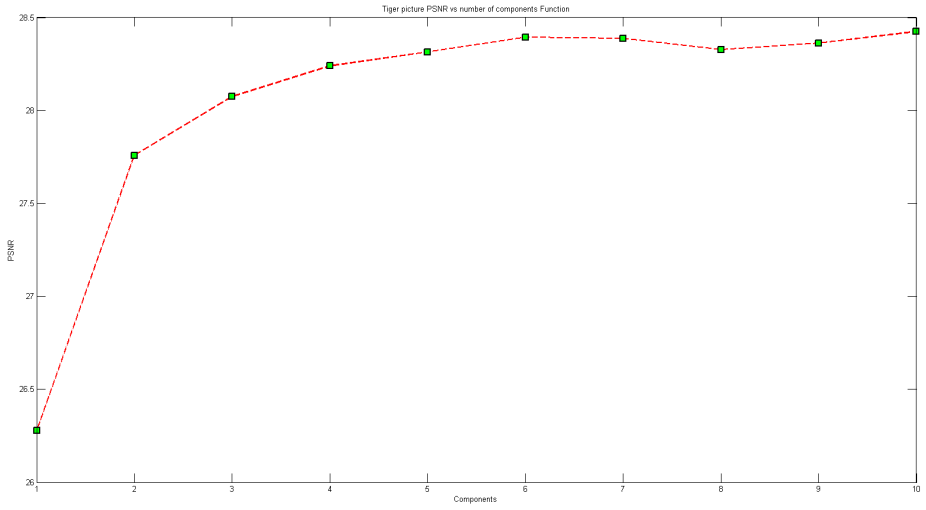
Part I

Number of components vs. denoising power

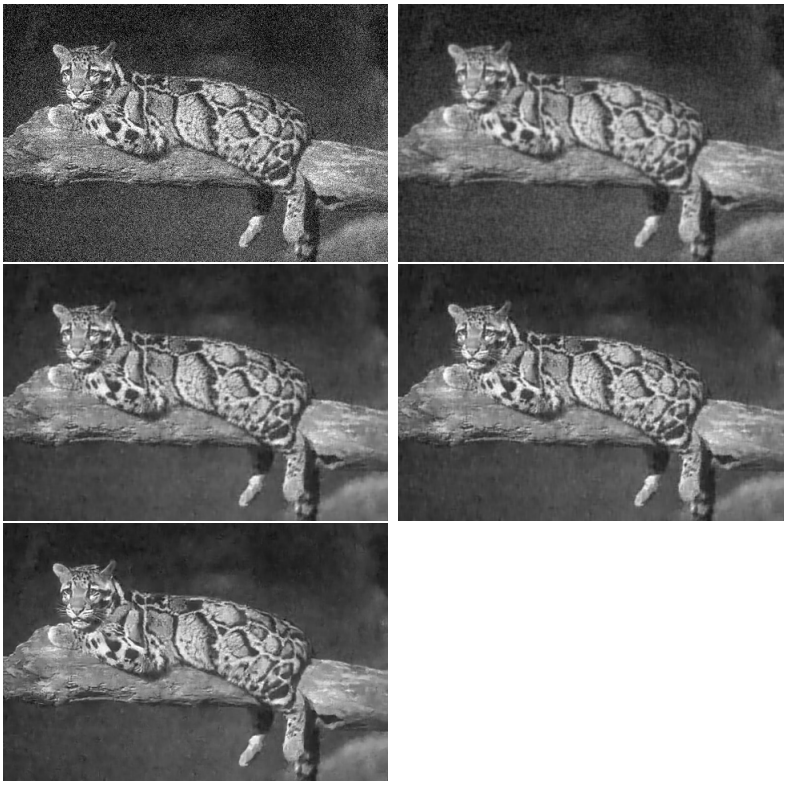
We checked how the denoising power of the mixture prior improves as a function of the number of components in the mixture. The denoising was done using MMSE estimation of patches and averaging of overlapping patches. The learning was done on 2000 patches [small number of patches to allow a short experiment]. The result are shown in the image below. We also compared the results to the results of denoising with MMSE using Daniel's prior [2,000,000 patches 200 components].

1 Tiger image

1.1 Graph:



1.2 Noisy/1/5/10/200 components denoising results [according to order]:

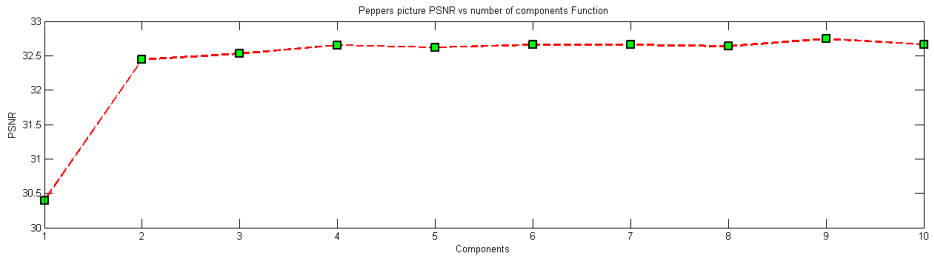


1.3 Comparison to Daniel's prior [no EPLL]

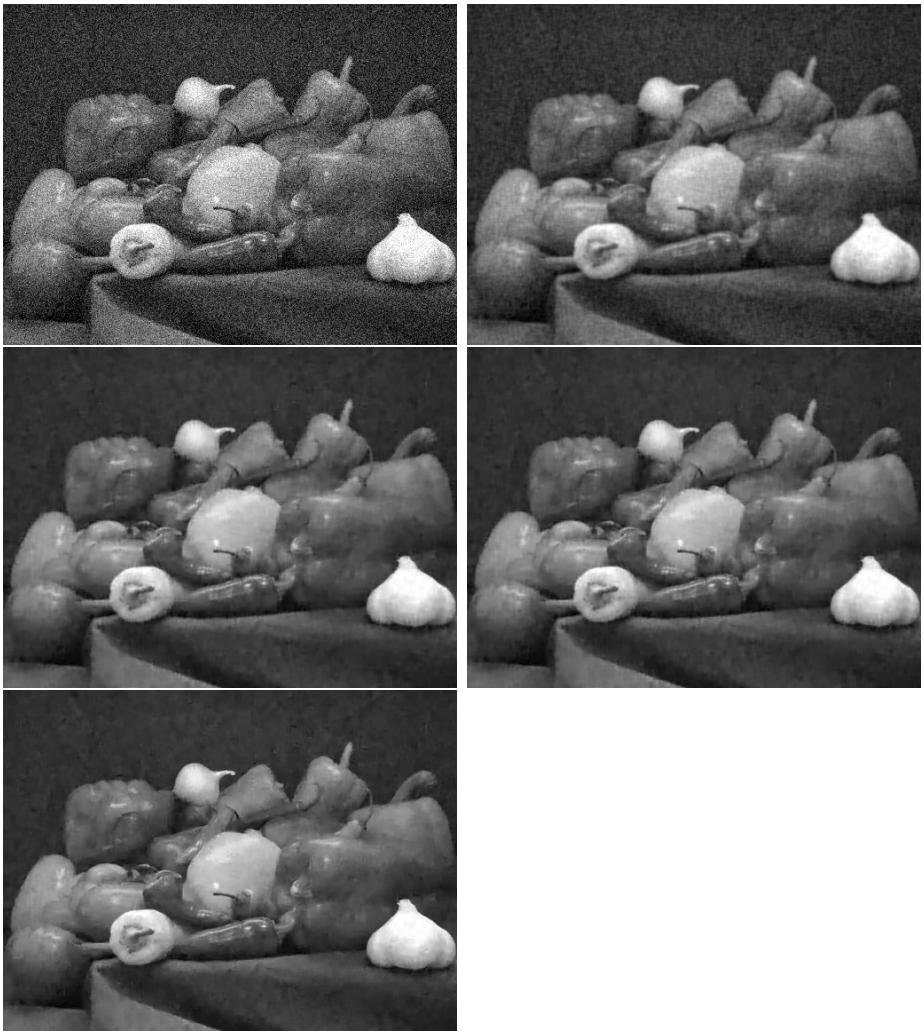
The initial PSNR of the noisy image: **20.17**
Results when using Daniel's prior [200 components and 2 million patches]: **29.00**
Our results: **28.42** using 10 components and 2000 patches

2 Peppers image

2.1 Graph:



2.2 Noisy/1/5/10/200 components denoising results [according to order]:



2.3 Comparison to Daniel's prior [no EPLL]:

The initial PSNR of the noisy image: **20.18**
Results when using Daniel's prior [200 components and 2 million patches]: **33.01**
Our results: **32.74** using 10 components and 2000 patches.

3 Thoughts

Maybe for denoising we don't not need too many components? it looks like we can get very good results with just a few components.

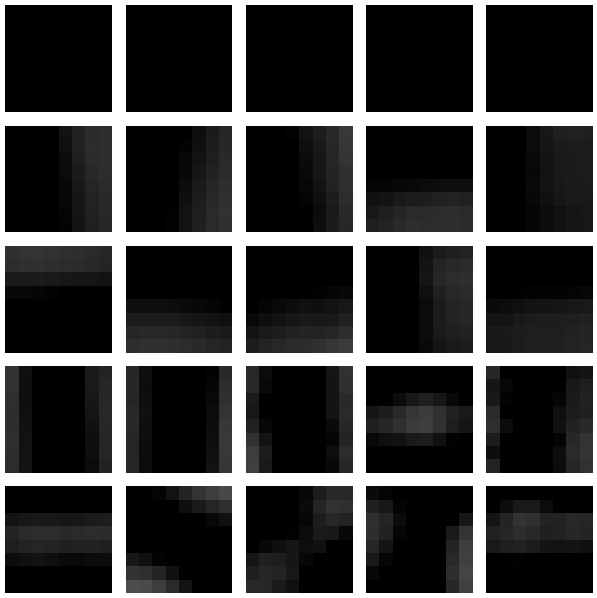
Part II
Visualizing the learnt mixture model

We would like to see what kind of components are learnt. In order to visualize this we wrote a function that constructs a table of singular vectors of the covariance matrices of each component. Each column in the following table represent a component in the mixture according to descending order of the mixture weights. In each column we can see the first 5 most important singular vectors. Note that this singular vectors show us dependencies that were learnt between the pixels.

4 one components mixture

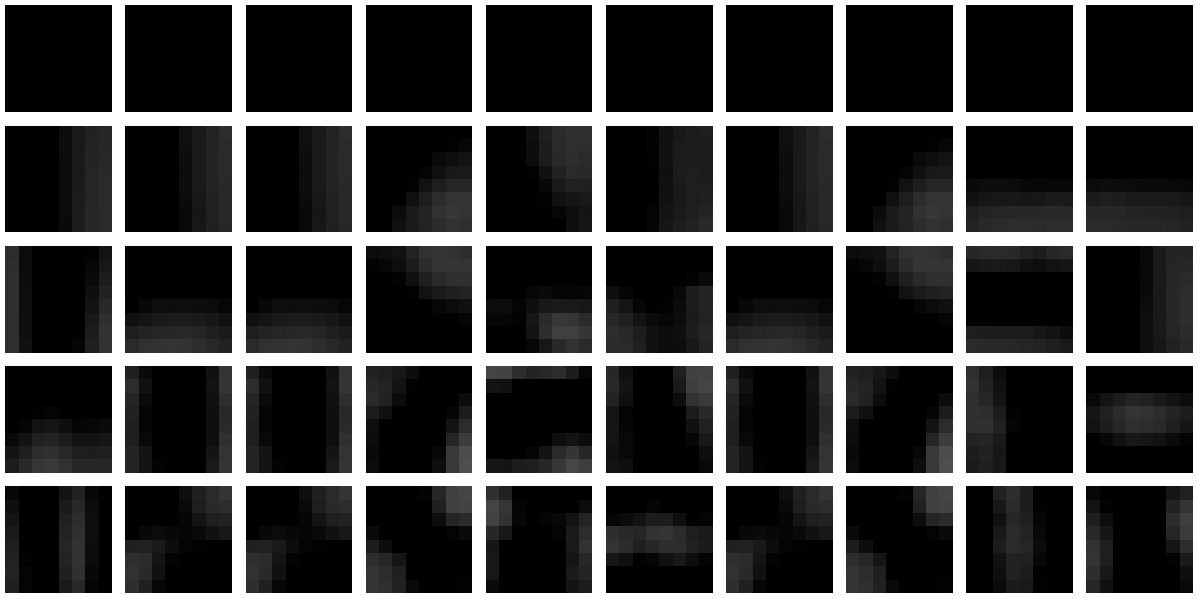
We can see that the strongest singular vector is constant, and the other singular vectors show vertical and horizontal textures.

5 5 components mixture



Again, we see that the strongest singular vectors are all constant. In addition we can see that some diagonal textures appear.

6 10 components mixture



We can see that richer textures were learnt, but one can also see that the 2,3 and 7th components look the same - probably due to poor convergence of the EM algorithm.

7 Thoughts