Exercise Sheet 3

Probability Density Estimation

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Problem 3.1 Toy Data

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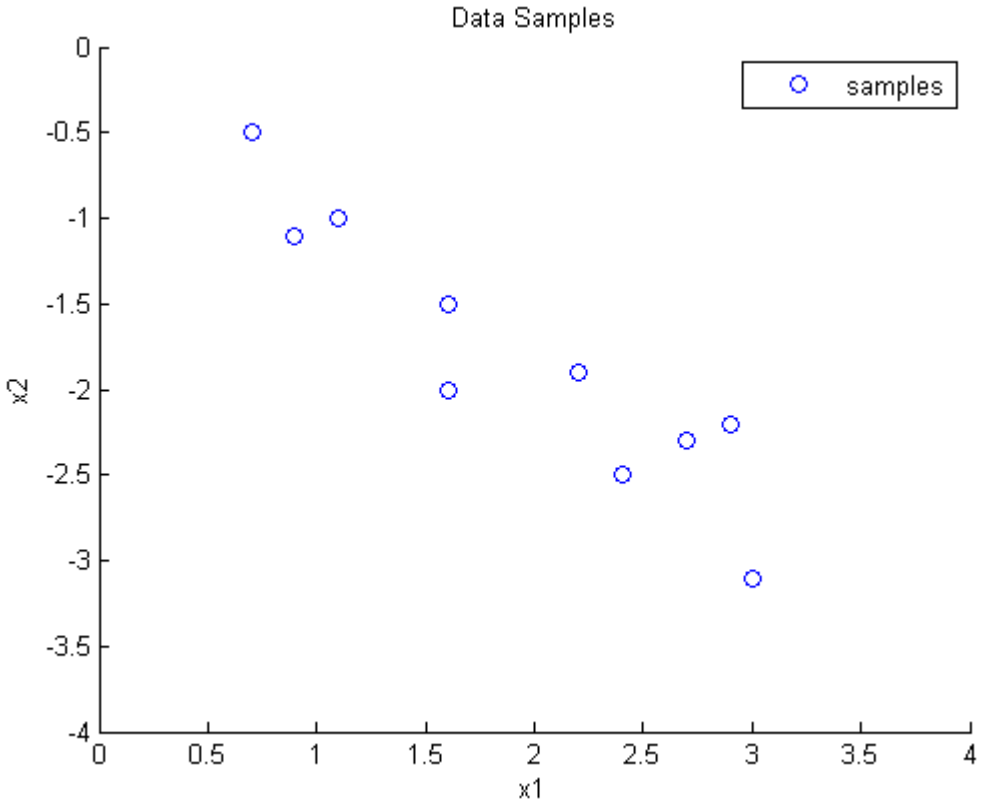
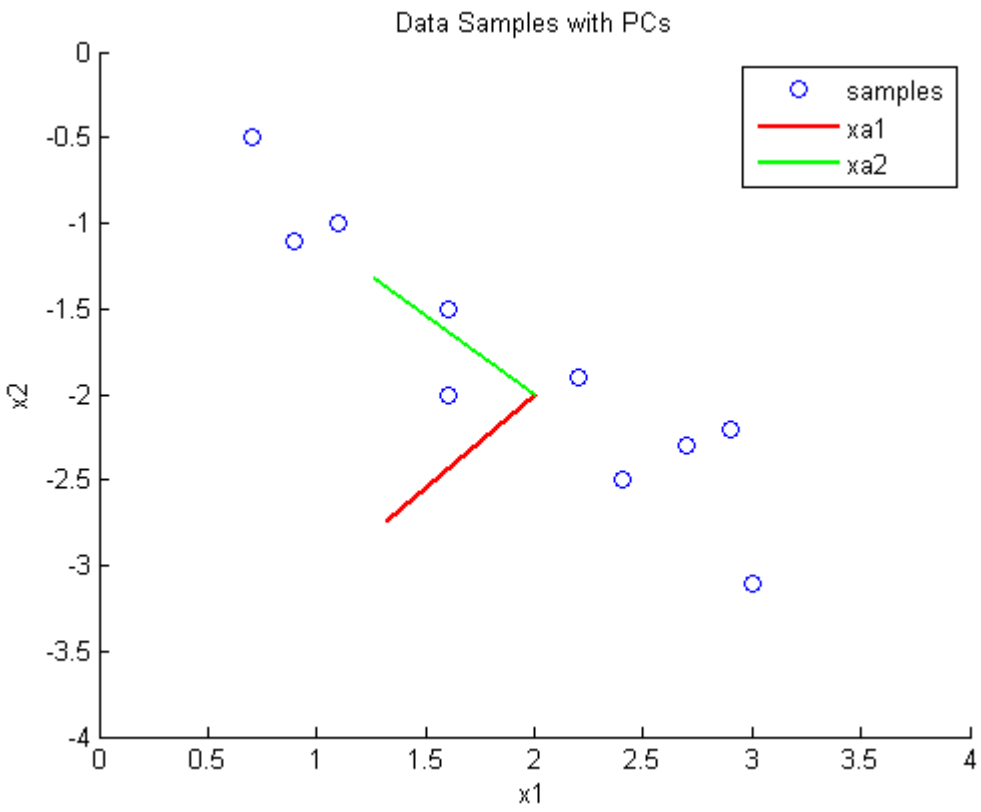
a) Scatter Plot:



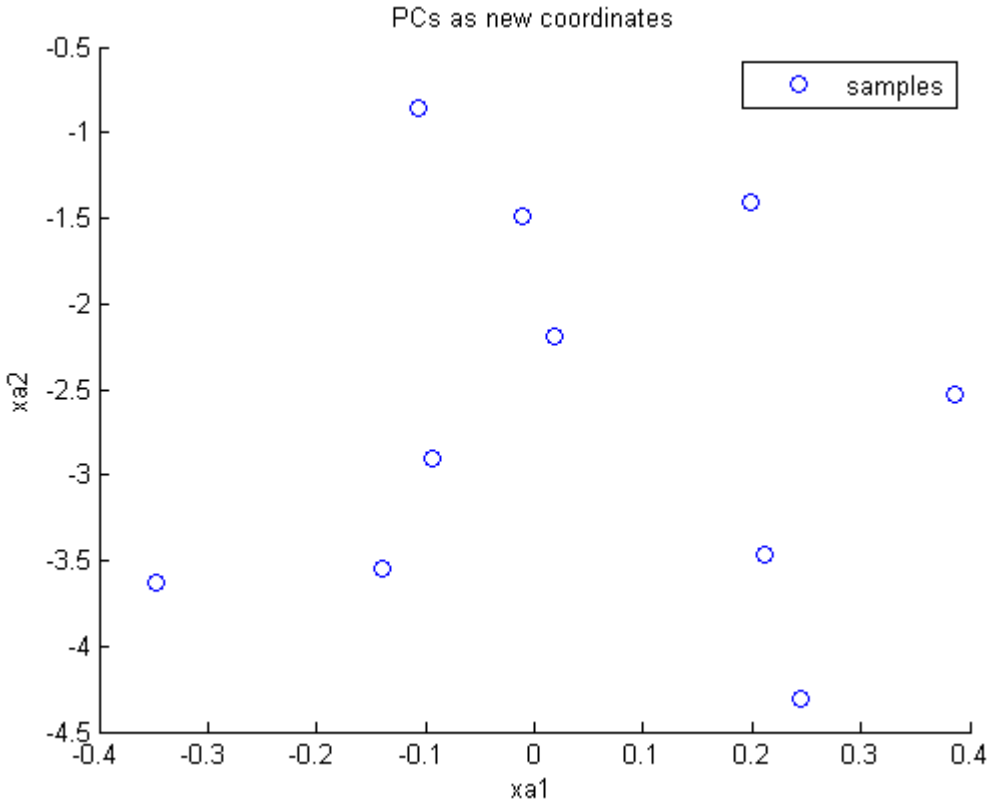
Problem 3.1 Toy Data

b) Scatter Plot with eigenvectors:



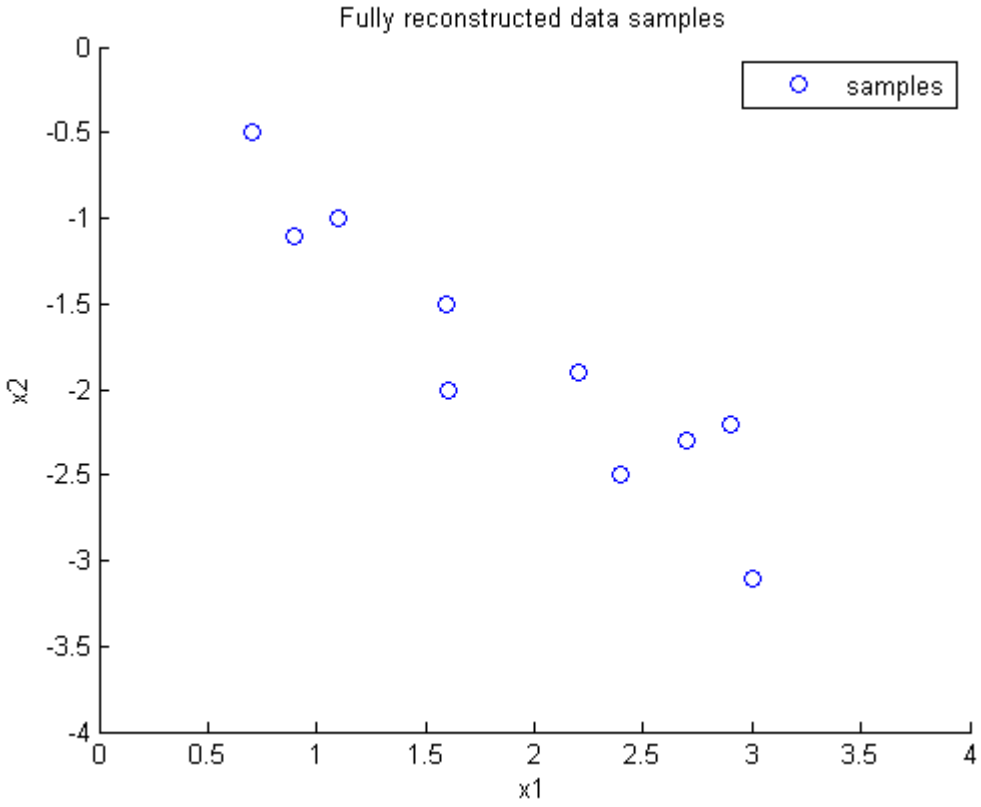
Problem 3.1 Toy Data

b) Scatter Plot of toy data with PCs as coordinates:



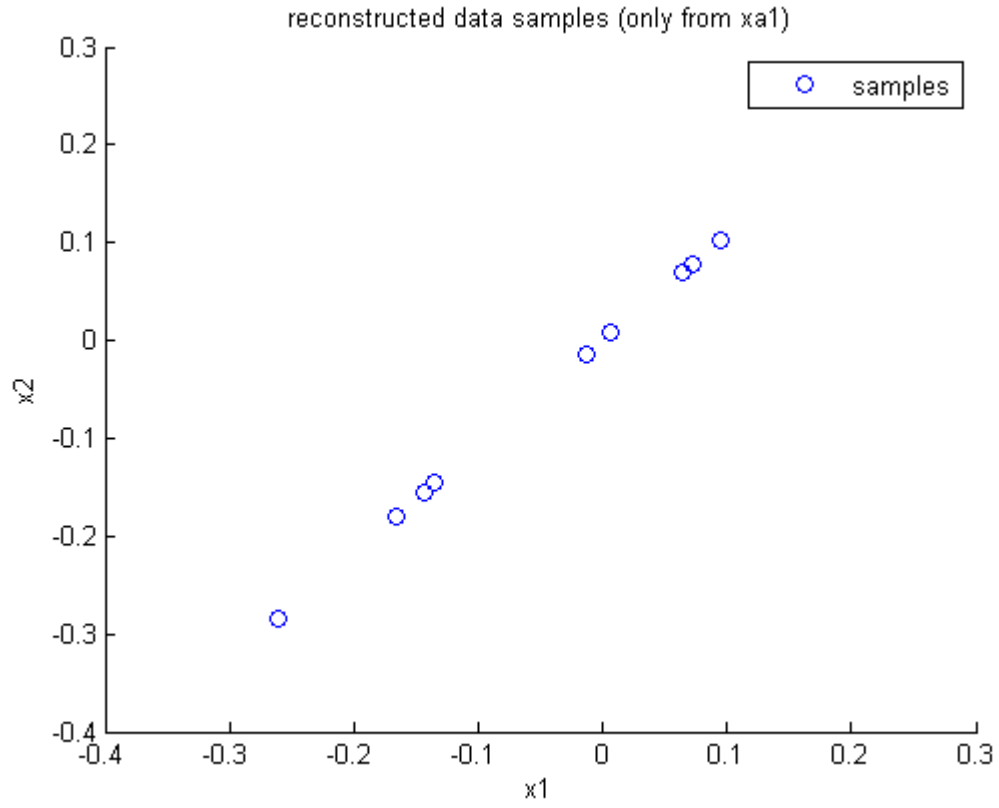
Problem 3.1 Toy Data

c) Fully reconstructed data:



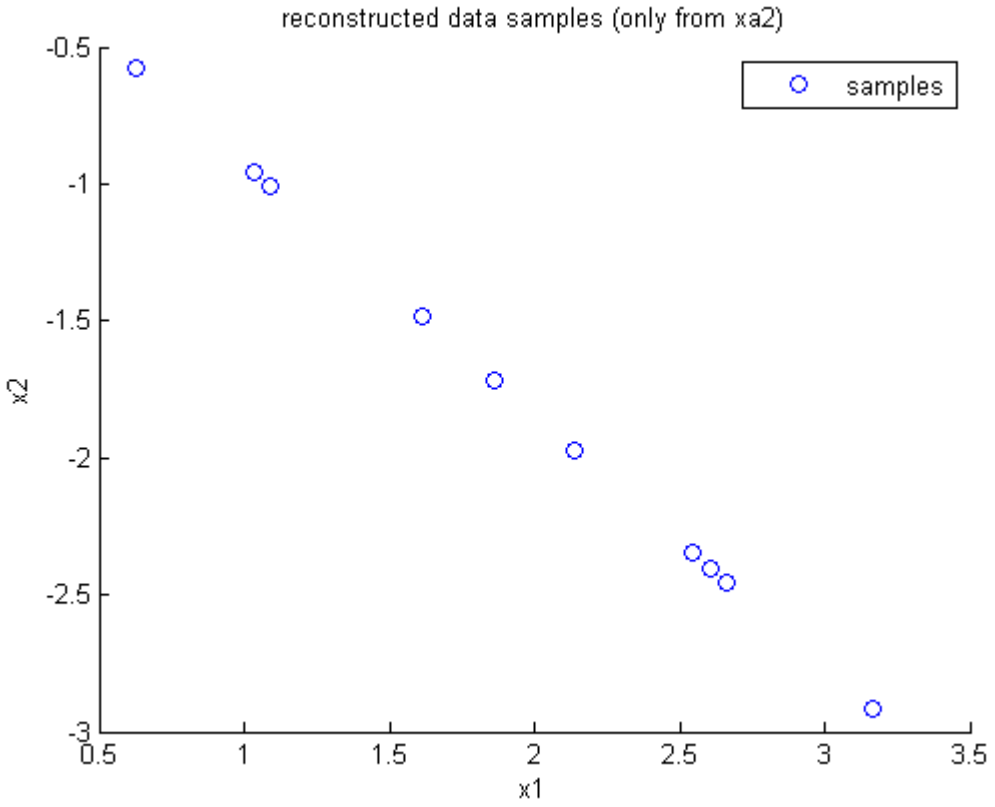
Problem 3.1 Toy Data

c) Reconstructed data (only using xa1):



Problem 3.1 Toy Data

c) Reconstructed data (only using xa2):



Problem 3.2 PCA: Image Data

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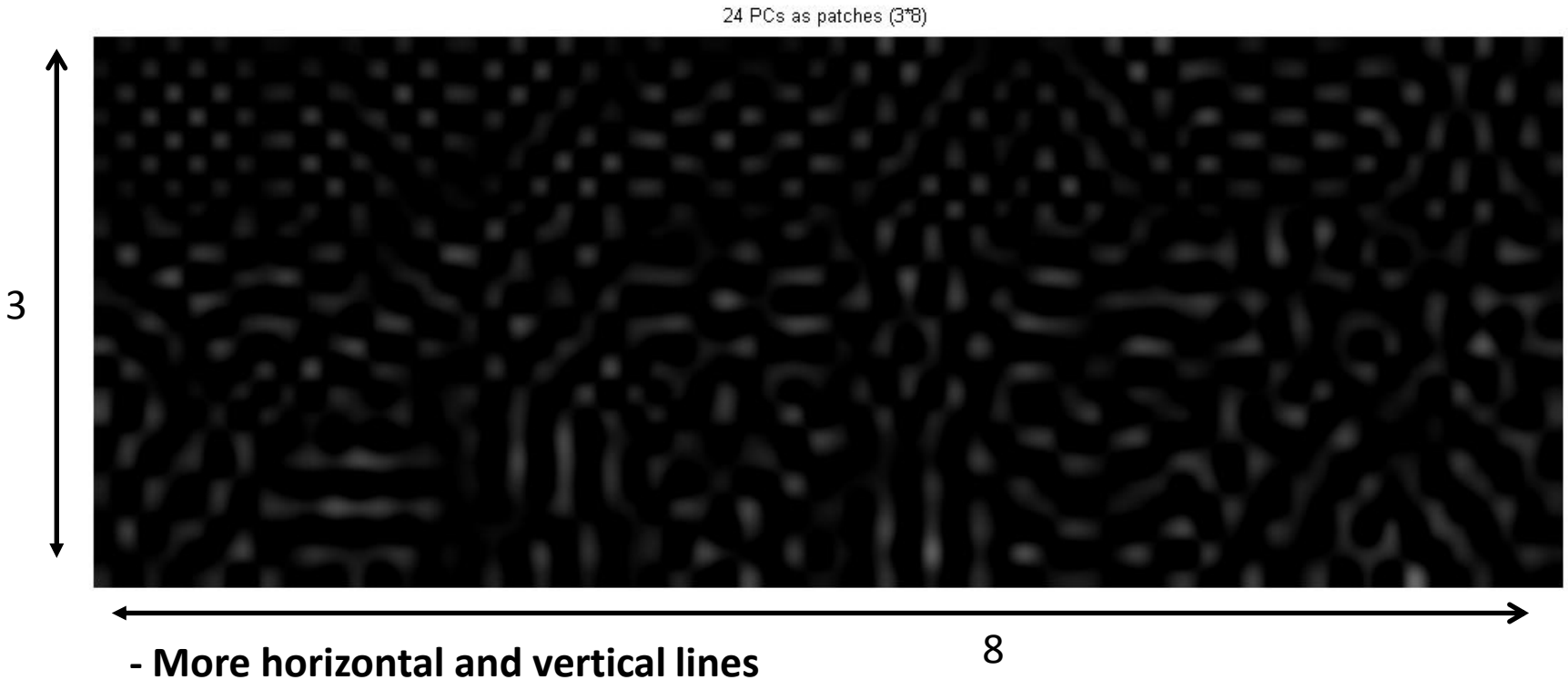
b) PCs of used image patches (shown as 8*8 image patch)

<u>Category:</u> Nature

<u>Shown PCs</u>: 24



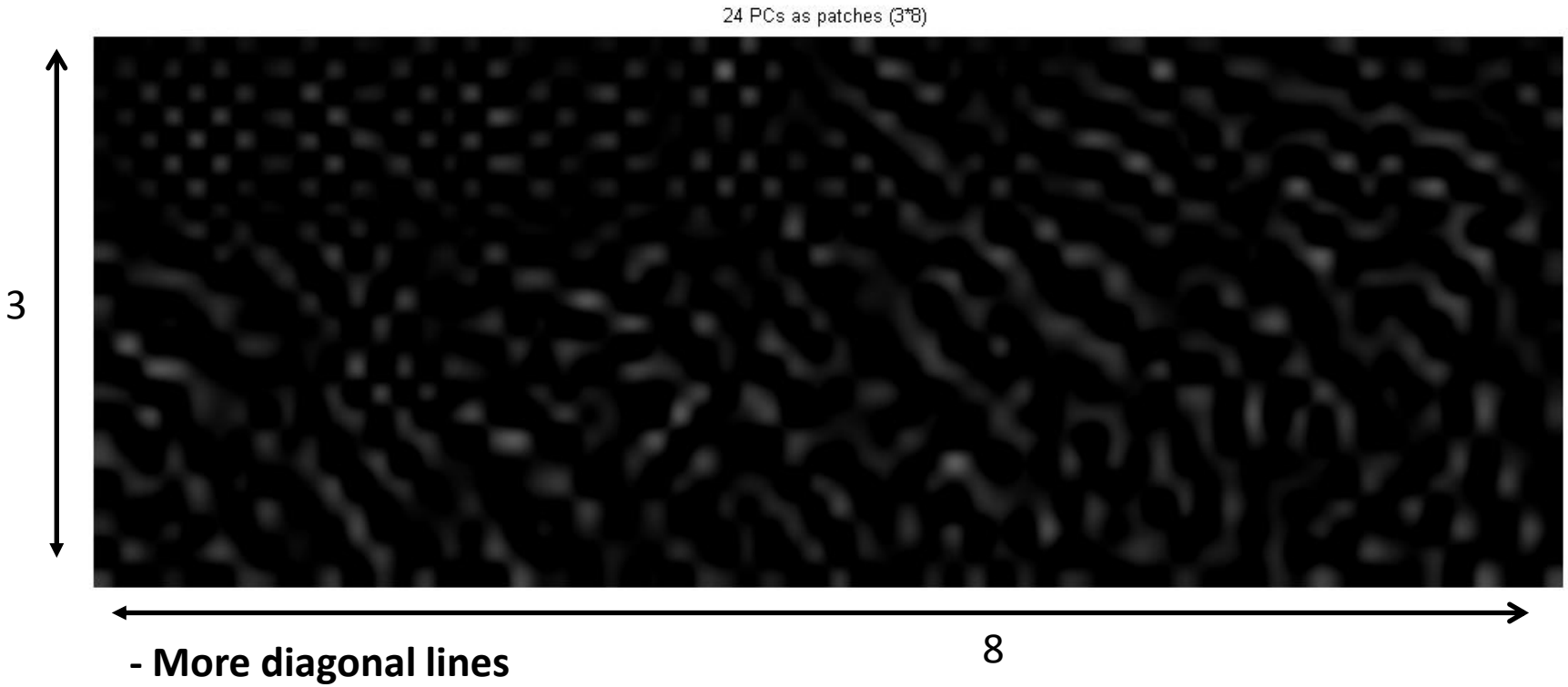
- More horizontal and vertical lines
- More homogenous structure

Problem 3.2 PCA: Image Data

b) PCs of used image patches (shown as 8*8 image patch)

<u>Category:</u> Buildings

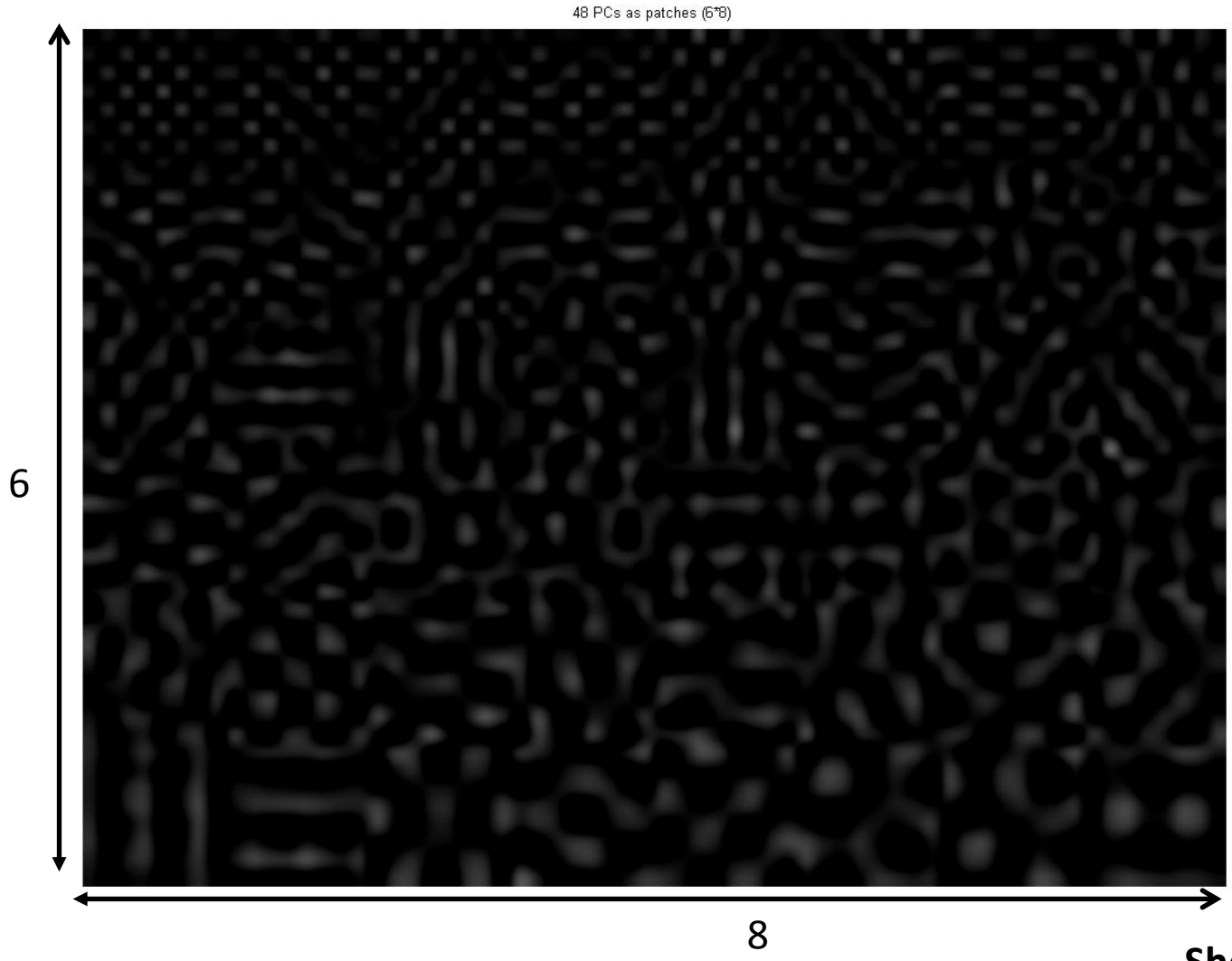
<u>Shown PCs</u>: 24



- **More diagonal lines**
- **More inhomogenous structure**

Problem 3.2 PCA: Image Data

b) PCs of used image patches (shown as 8*8 image patch)

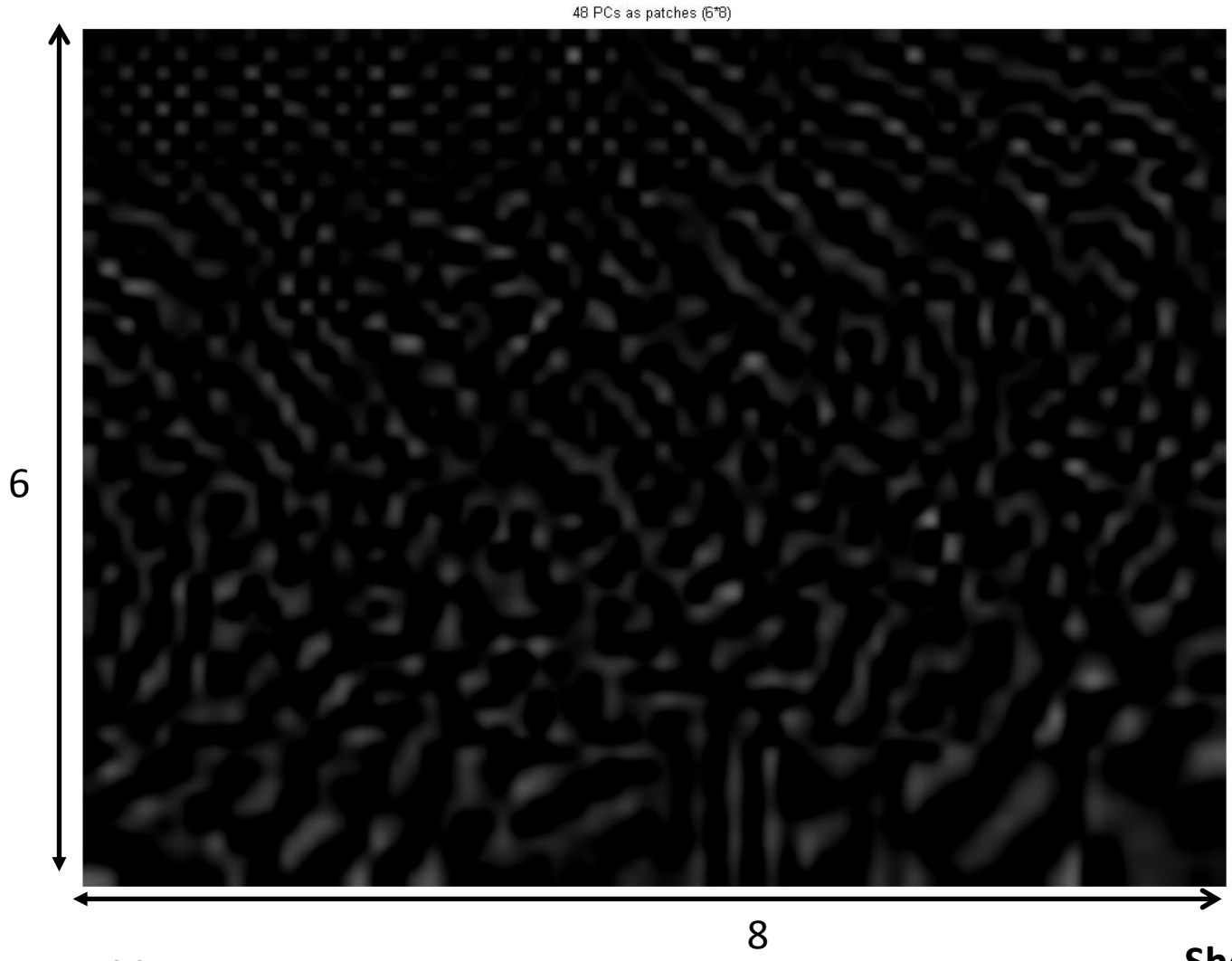


<u>Category:</u> Nature

<u>Shown PCs</u>: 48

Problem 3.2 PCA: Image Data

b) PCs of used image patches (shown as 8*8 image patch)



<u>Category:</u> Buildings

<u>Shown PCs</u>: 48

Problem 3.3 Kernel PCA: Toy Data

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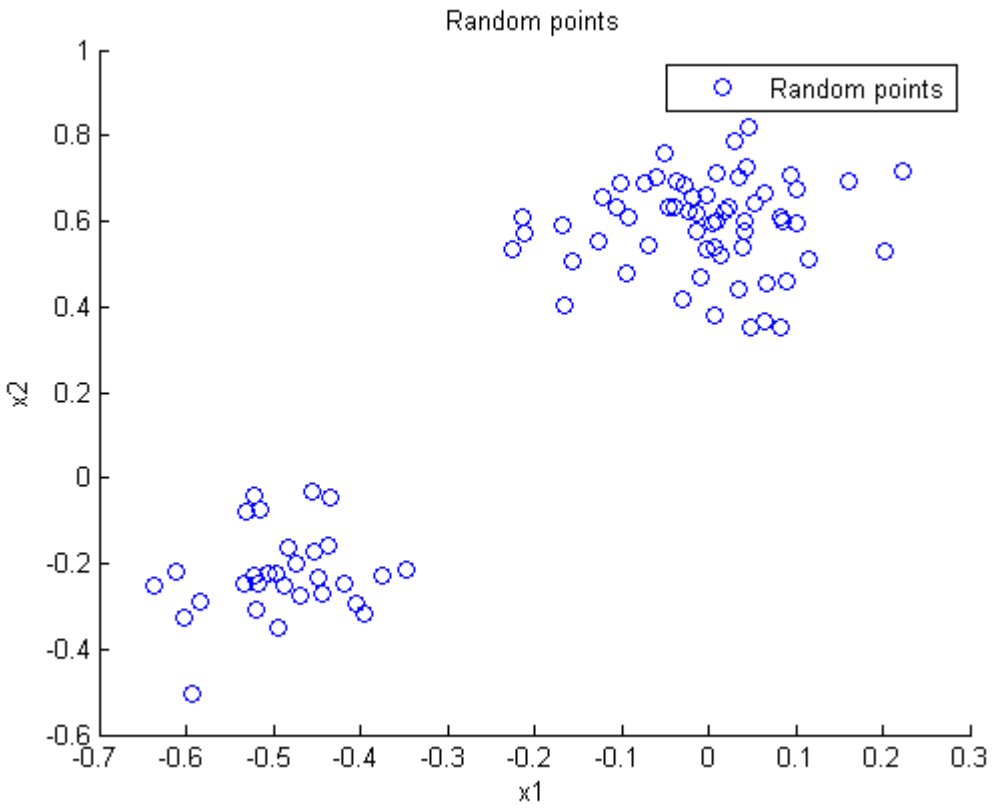
a) Toy data:



Used distributions:

N([-0.5,-0.2],0.1)

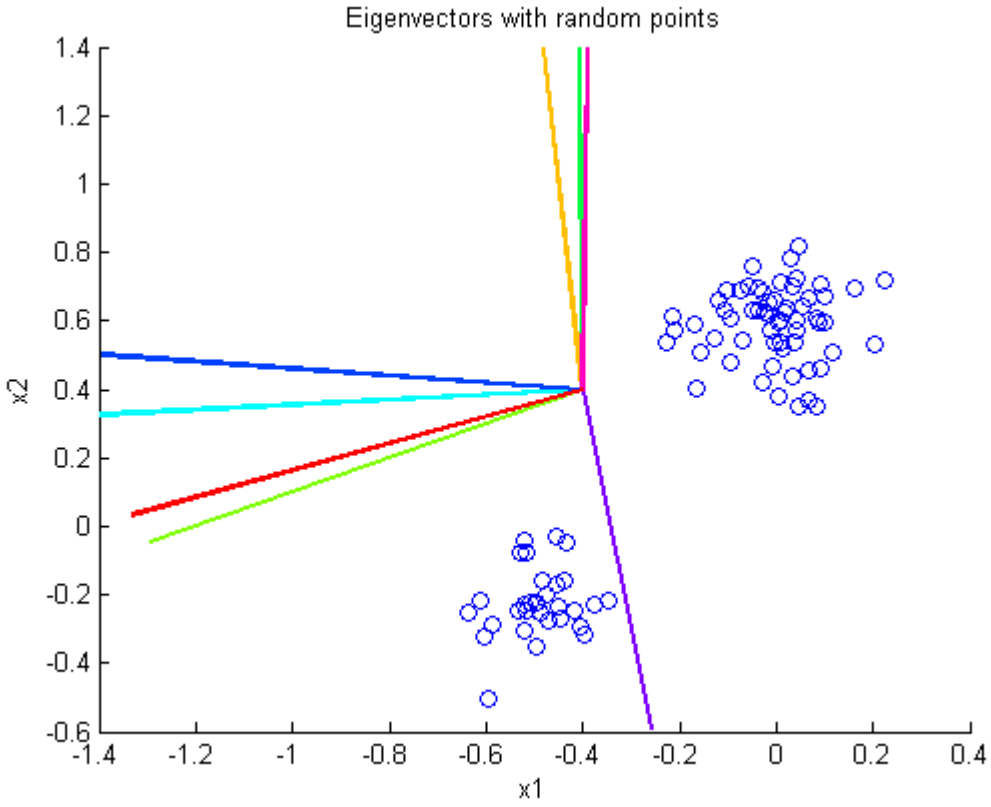
N([0,0.6],0.1)

N([0.5,0],0.1)

Problem 3.3 Kernel PCA: Toy Data

b) Kernel PCA with RBF Kernel:

- Colored Lines are eigenvectors

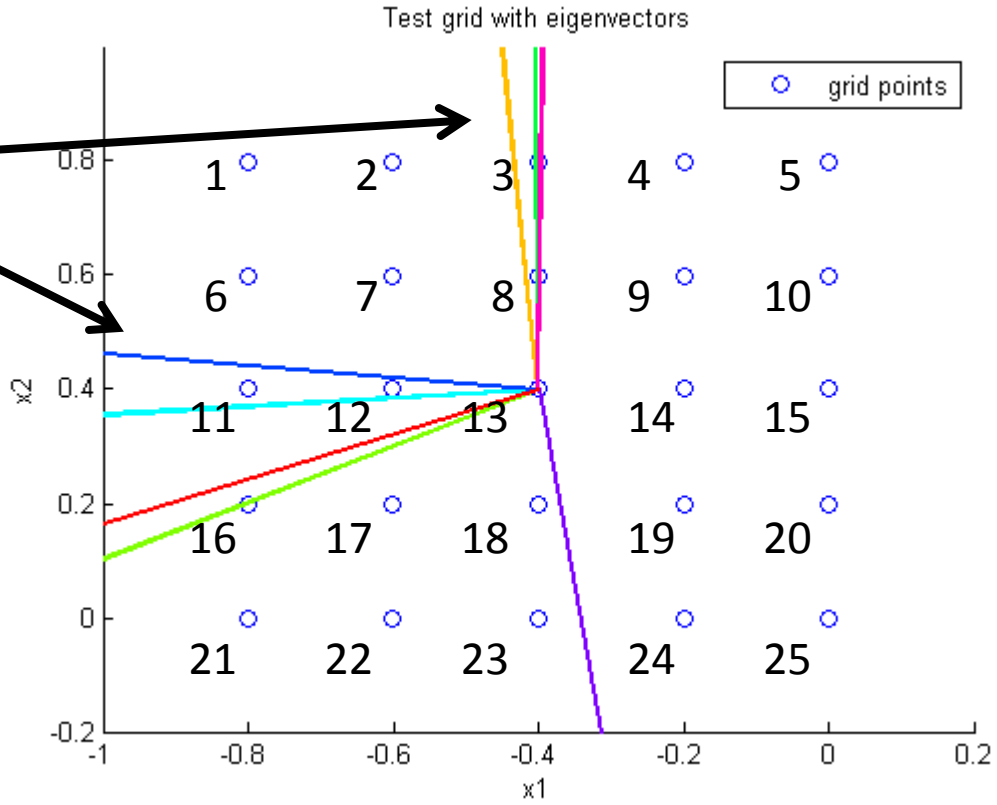


Problem 3.3 Kernel PCA: Toy Data

c) Used Test Grid with eigenvectors:

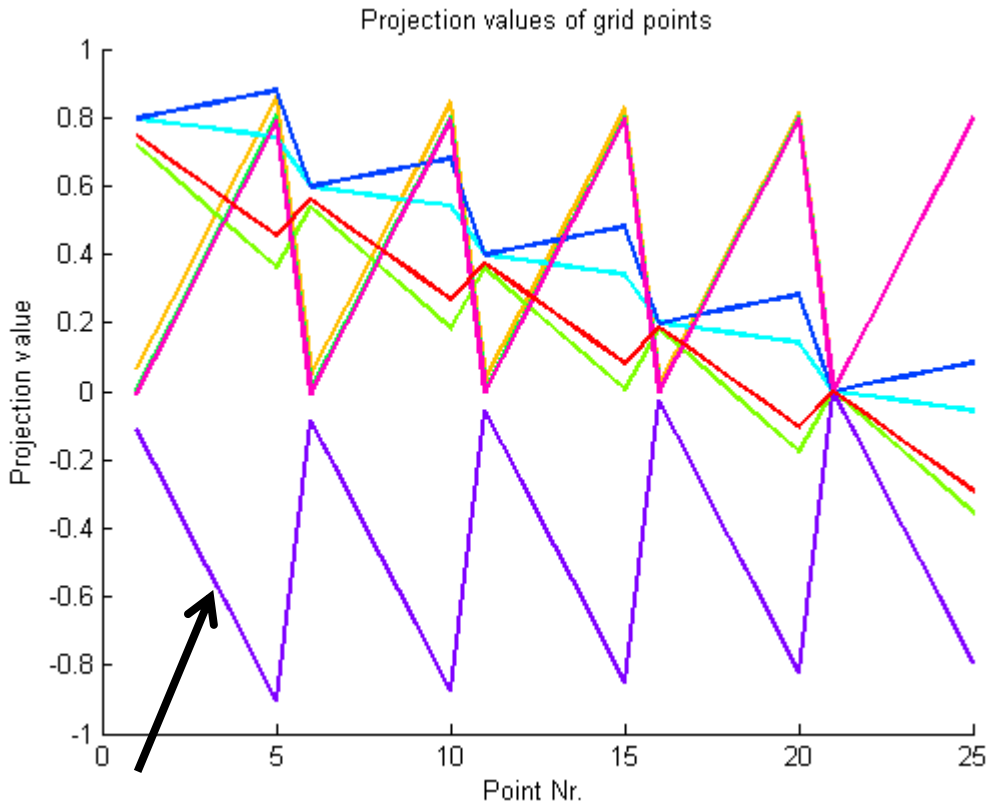
- Every point has a number

-two groups of eigenvectors



Problem 3.3 Kernel PCA: Toy Data

c) Projections of the eigenvectors:



One Outlier

- Projections values show a common behavior (2 groups)

- variances of projection values are all high enough to distinguish projection values

- sometimes one or two outliers occur which show an uncommon Behaviour (here: the purple one)

<u>-> The RBF Kernel is just an estimation for the scalar products! Outliers can occur!</u>