

## **Exercise Sheet 3**

# **Probability Density Estimation**

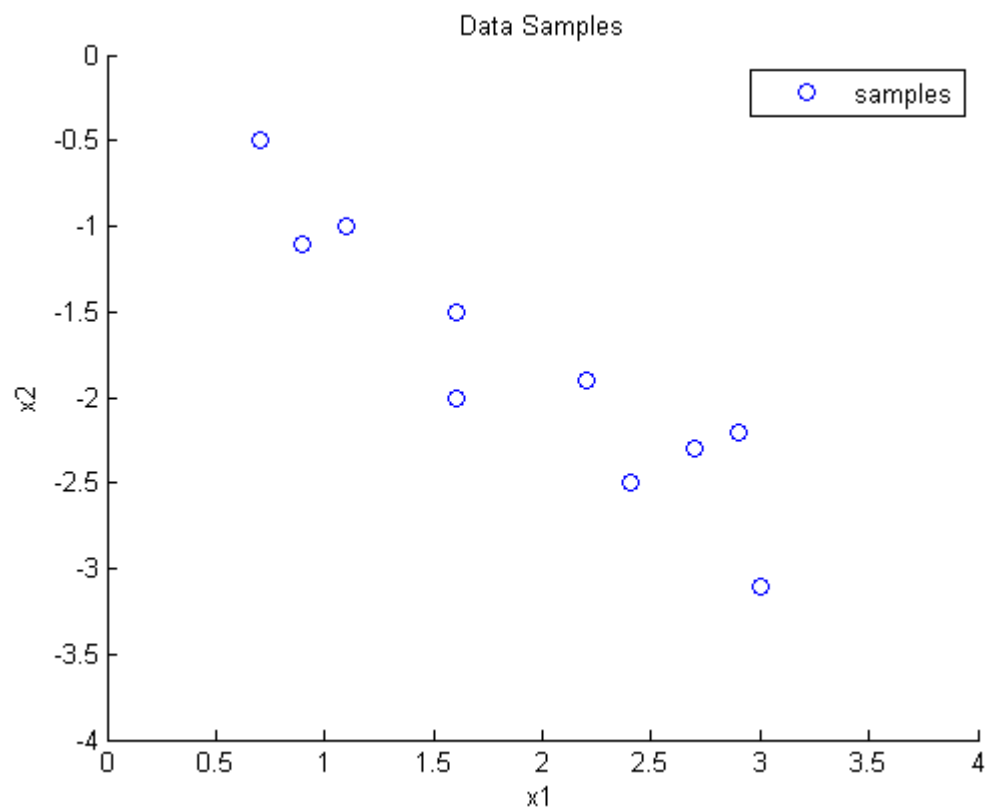
**Till Rohrmann - 343756**

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## **Problem 3.1 Toy Data**

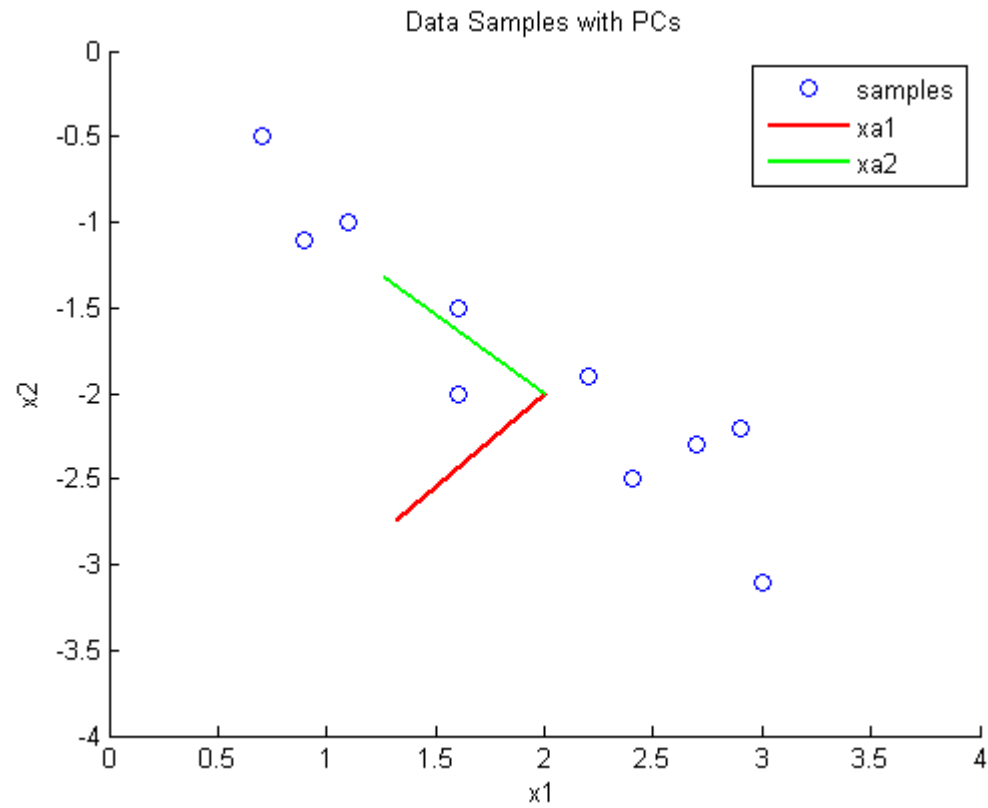
## Problem 3.1 Toy Data

a) Scatter Plot:



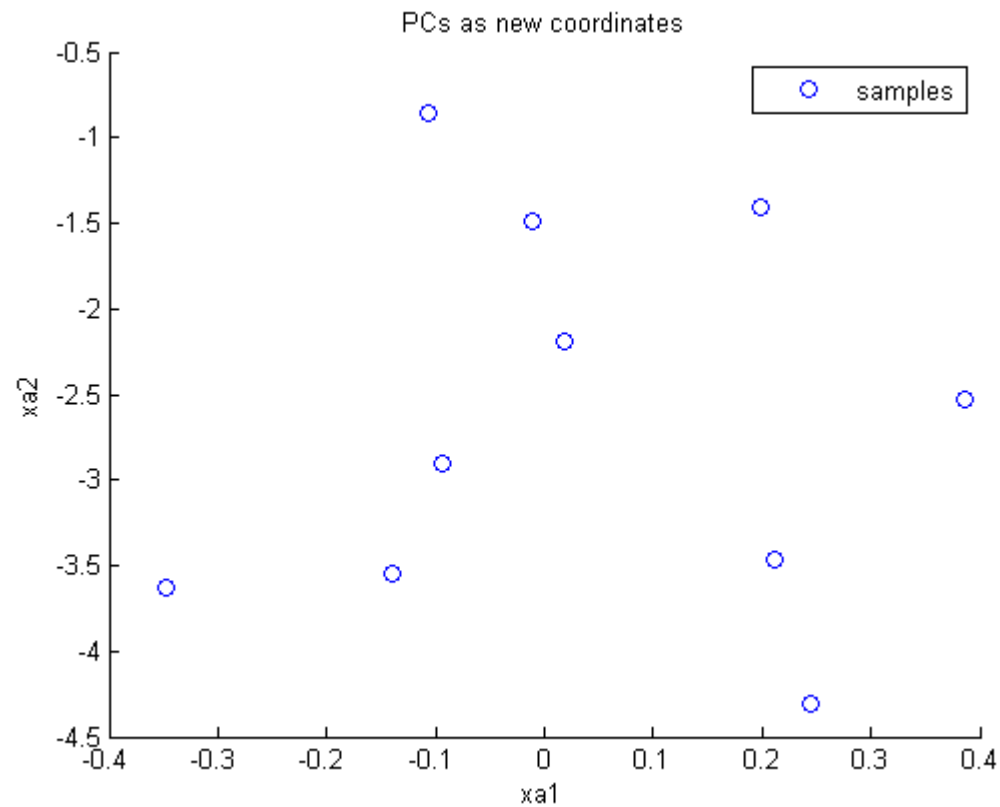
## Problem 3.1 Toy Data

### b) Scatter Plot with eigenvectors:



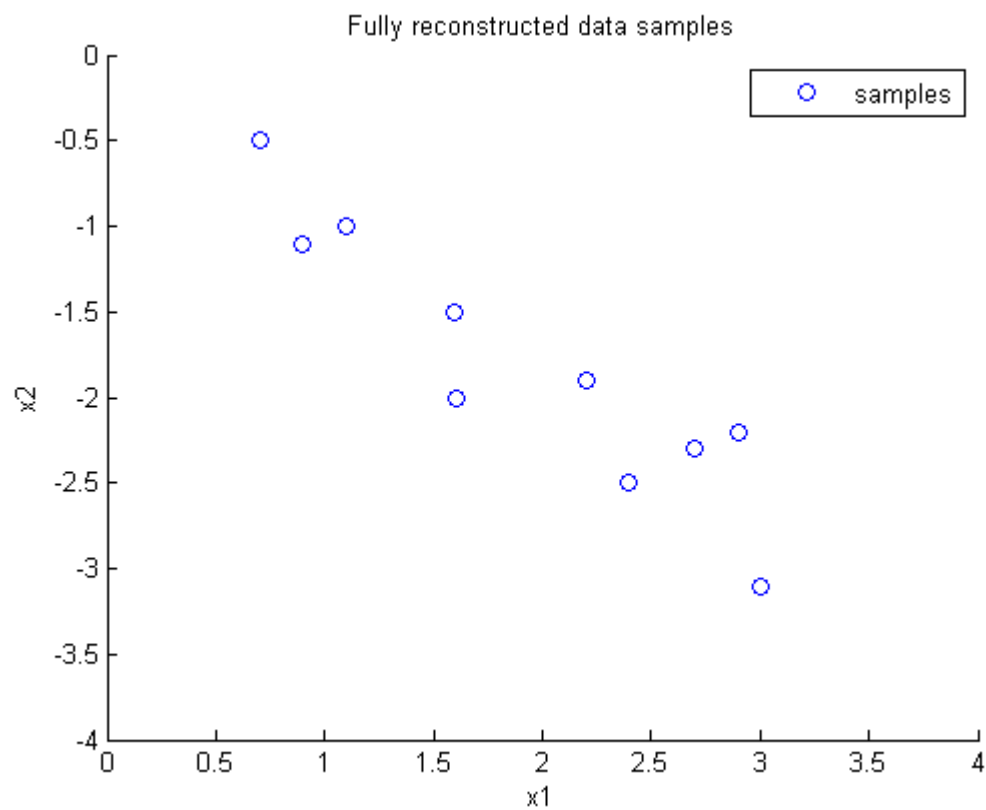
## Problem 3.1 Toy Data

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



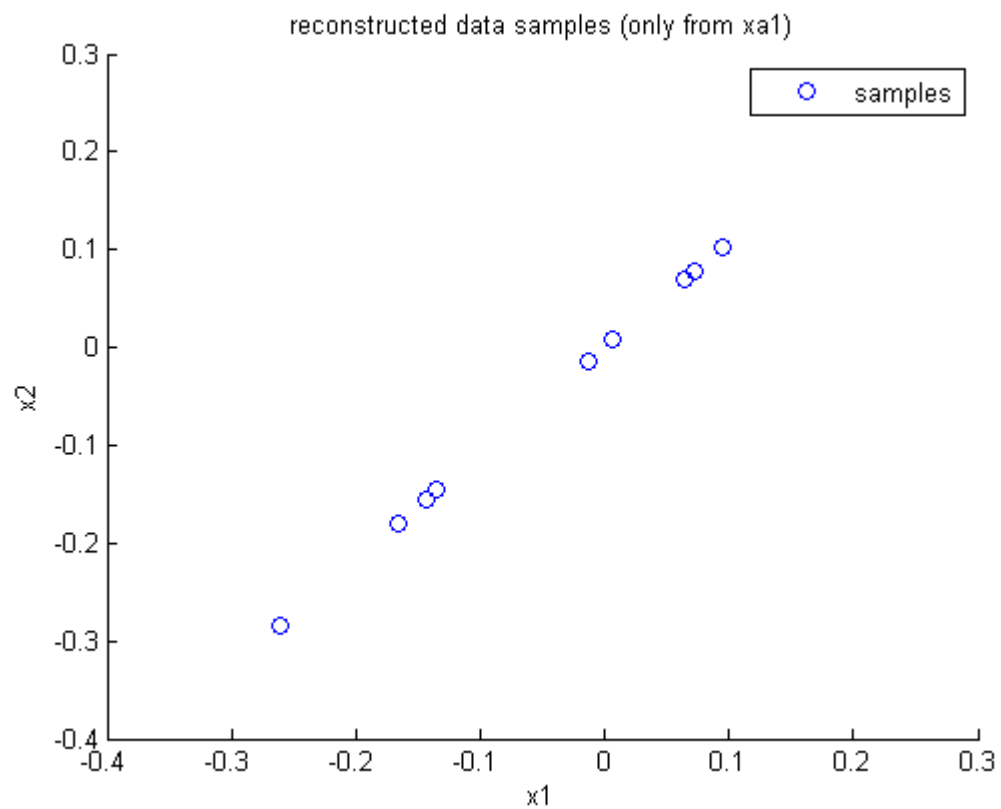
## Problem 3.1 Toy Data

c) Fully reconstructed data:



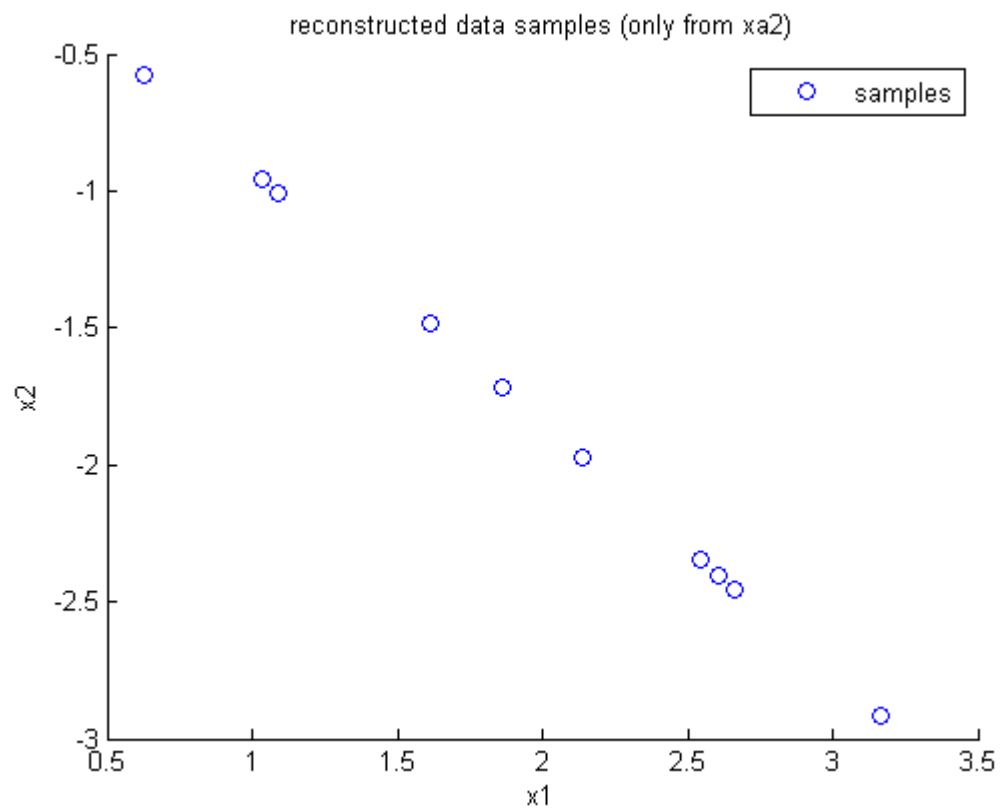
## Problem 3.1 Toy Data

### c) Reconstructed data (only using $x_{a1}$ ):



## Problem 3.1 Toy Data

c) Reconstructed data (only using  $x_2$ ):





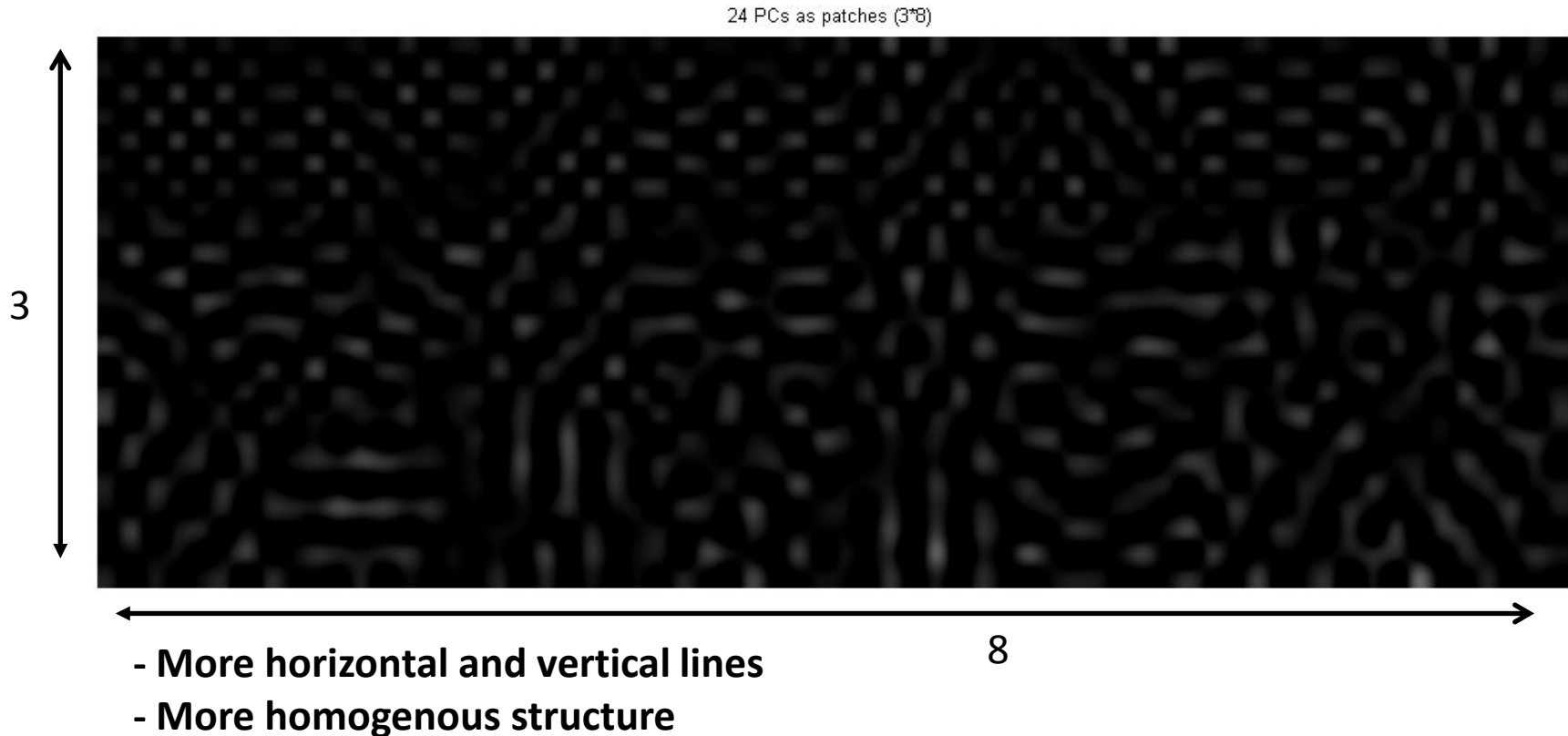
## **Problem 3.2 PCA: Image Data**

## Problem 3.2 PCA: Image Data

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

Category: Nature

Shown PCs: 24

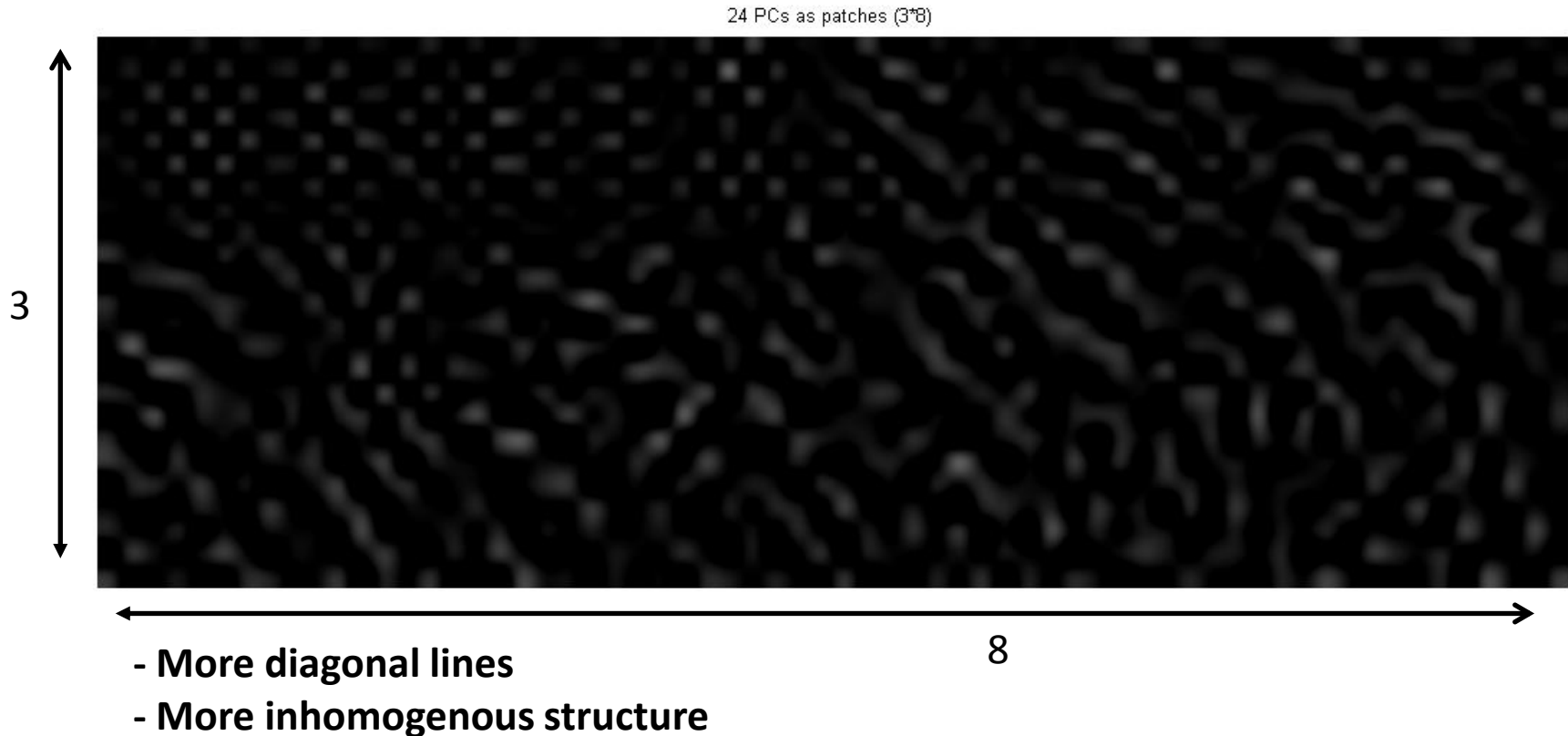


## Problem 3.2 PCA: Image Data

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

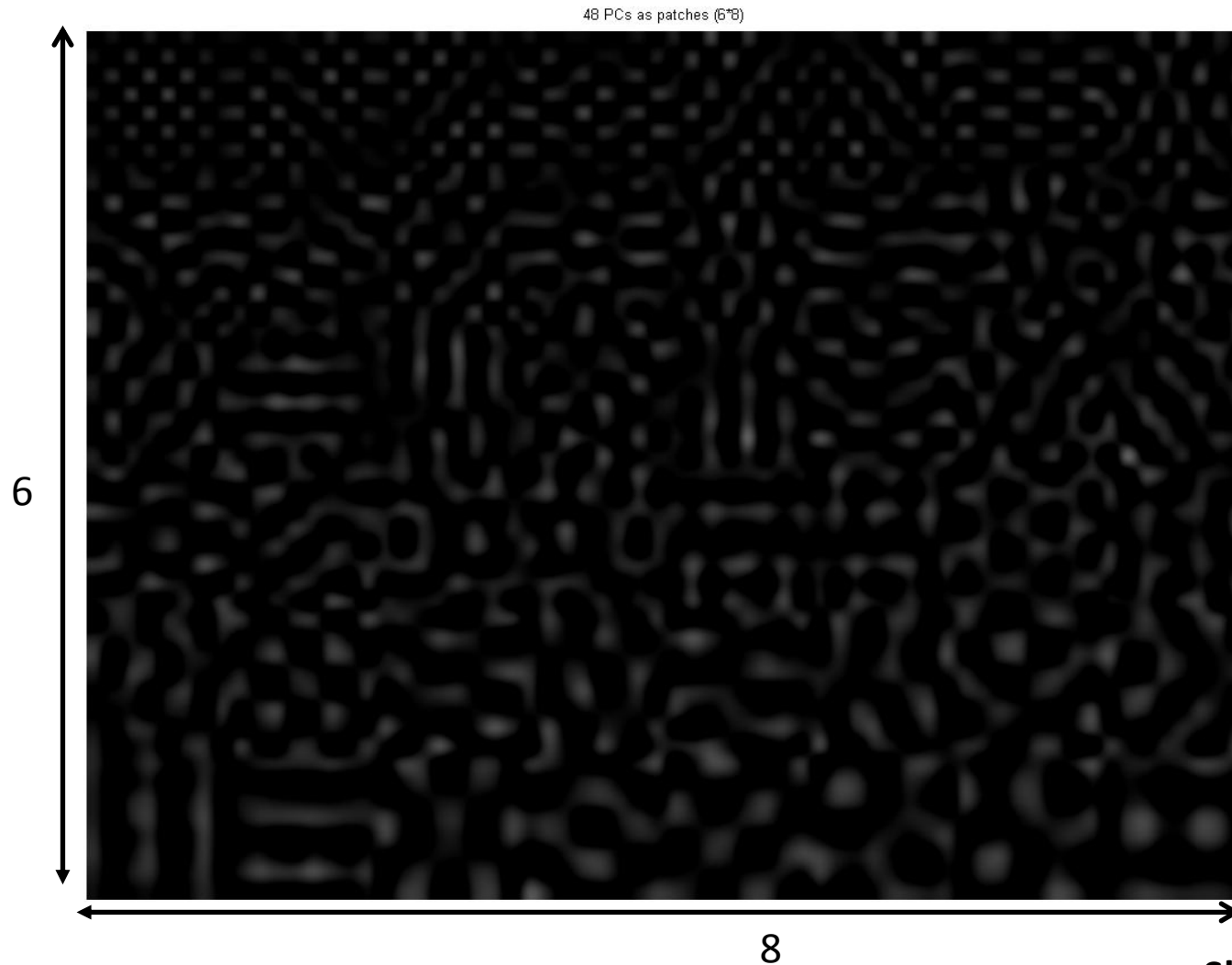
Category: Buildings

Shown PCs: 24



## Problem 3.2 PCA: Image Data

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

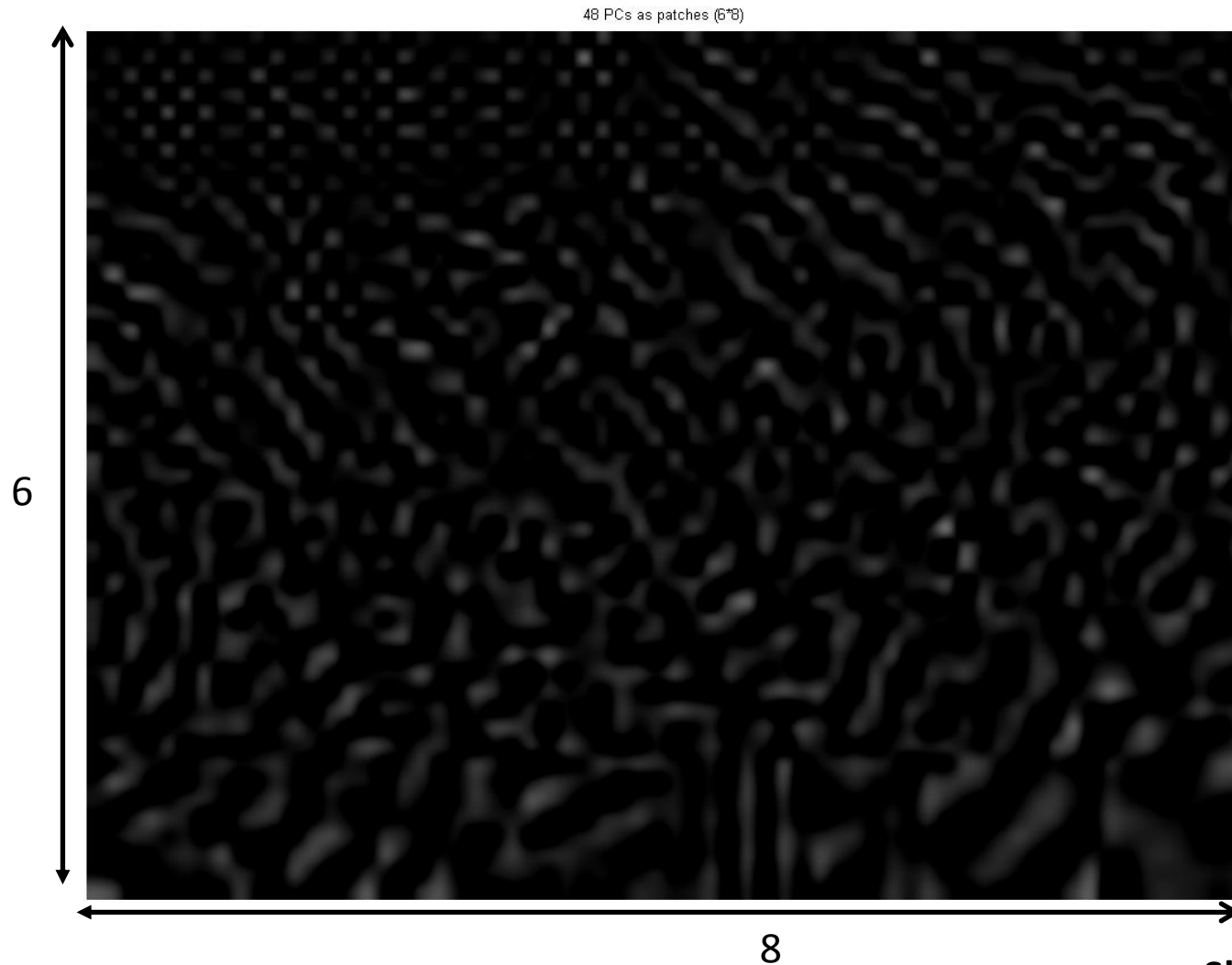


Category: Nature

Shown PCs: 48

## Problem 3.2 PCA: Image Data

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



Category: Buildings

Shown PCs: 48

## **Problem 3.3 Kernel PCA: Toy Data**

## Problem 3.3 Kernel PCA: Toy Data

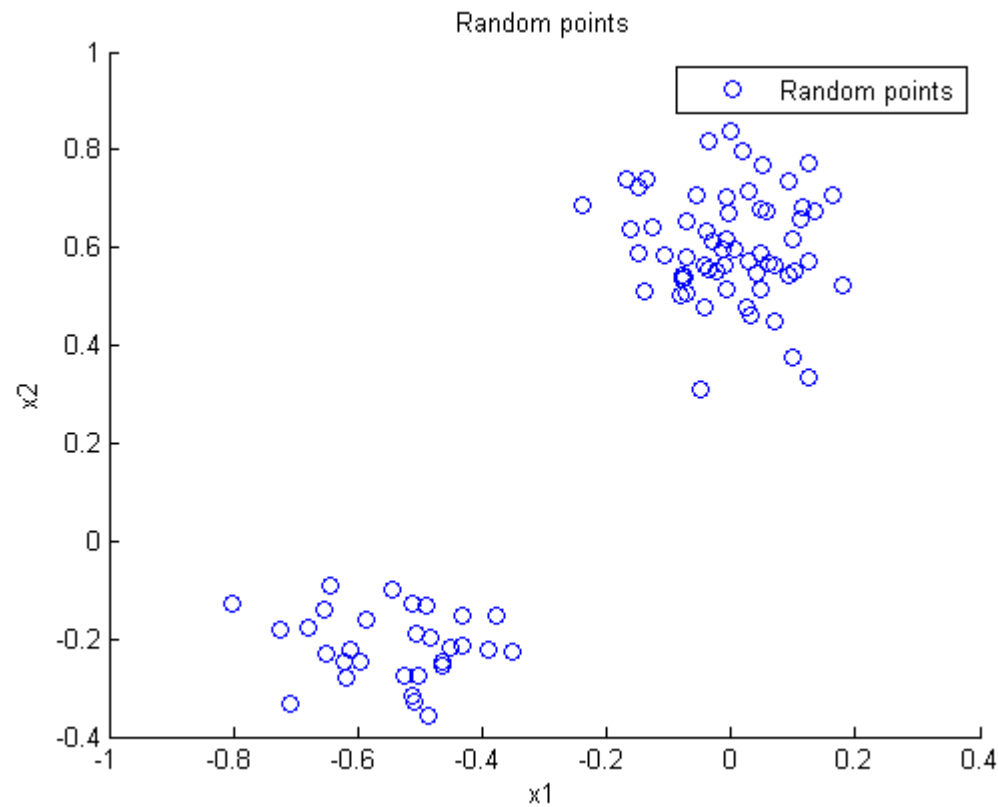
Used distributions:

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

$N([0, 0.6], 0.1)$

$N([0.5, 0], 0.1)$

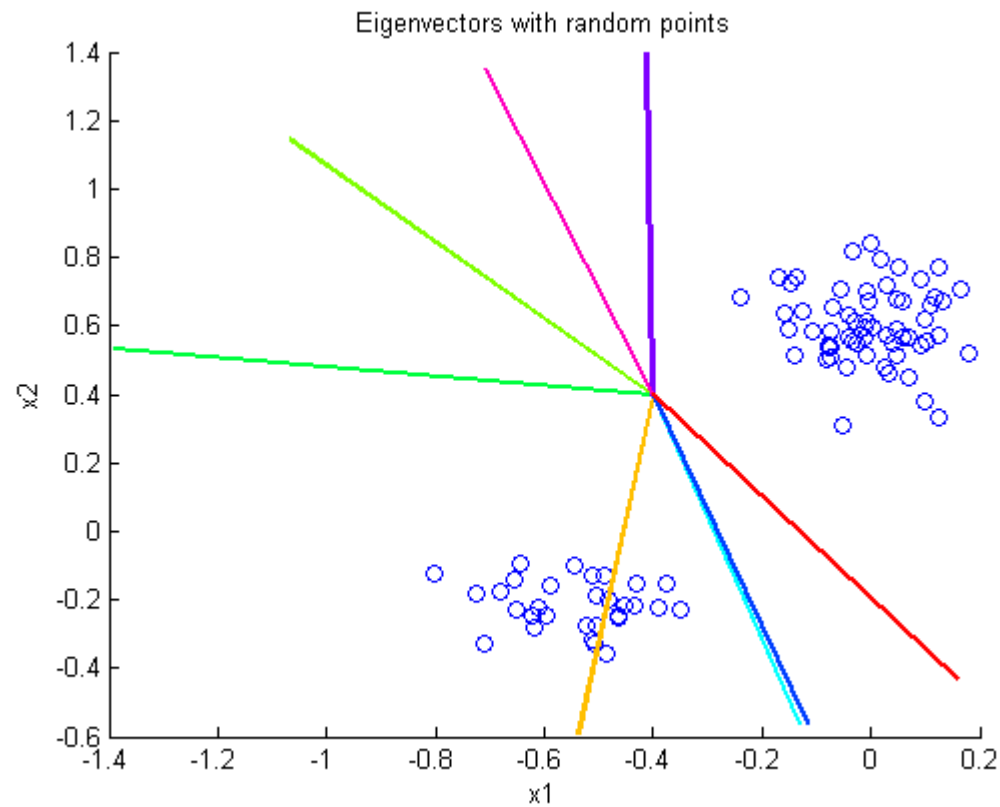
a) Toy data:



## Problem 3.3 Kernel PCA: Toy Data

b) Kernel PCA with RBF Kernel:

- Colored Lines are eigenvectors

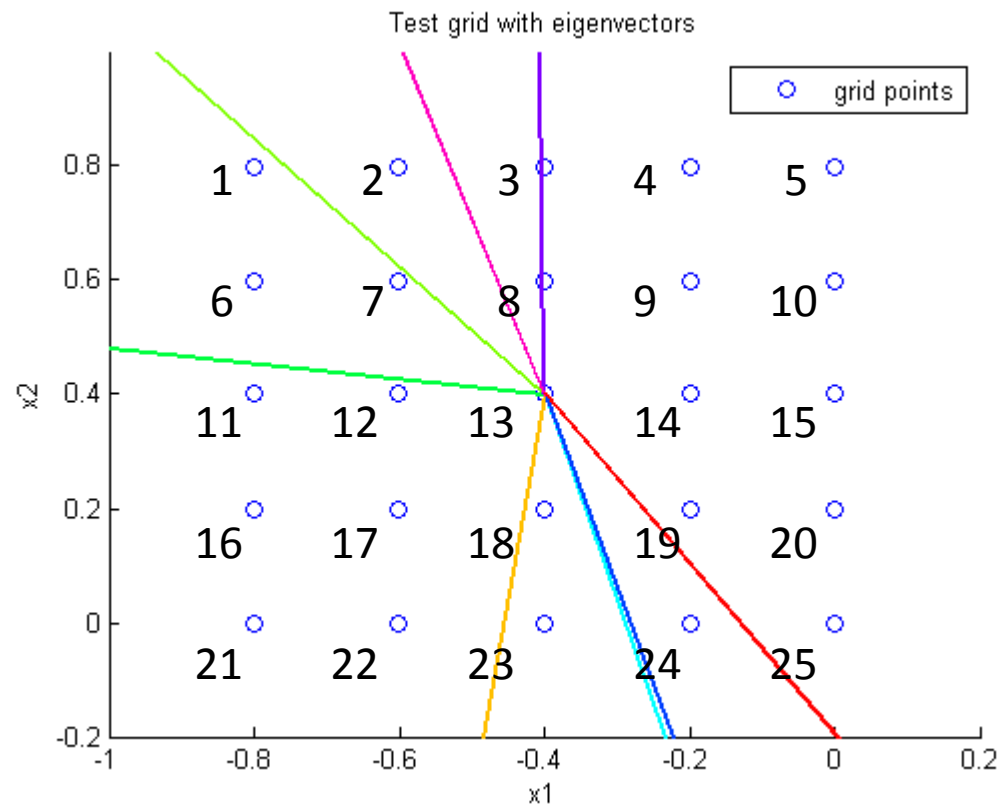




## Problem 3.3 Kernel PCA: Toy Data

c) Used Test Grid with eigenvectors:

- Every point has a number

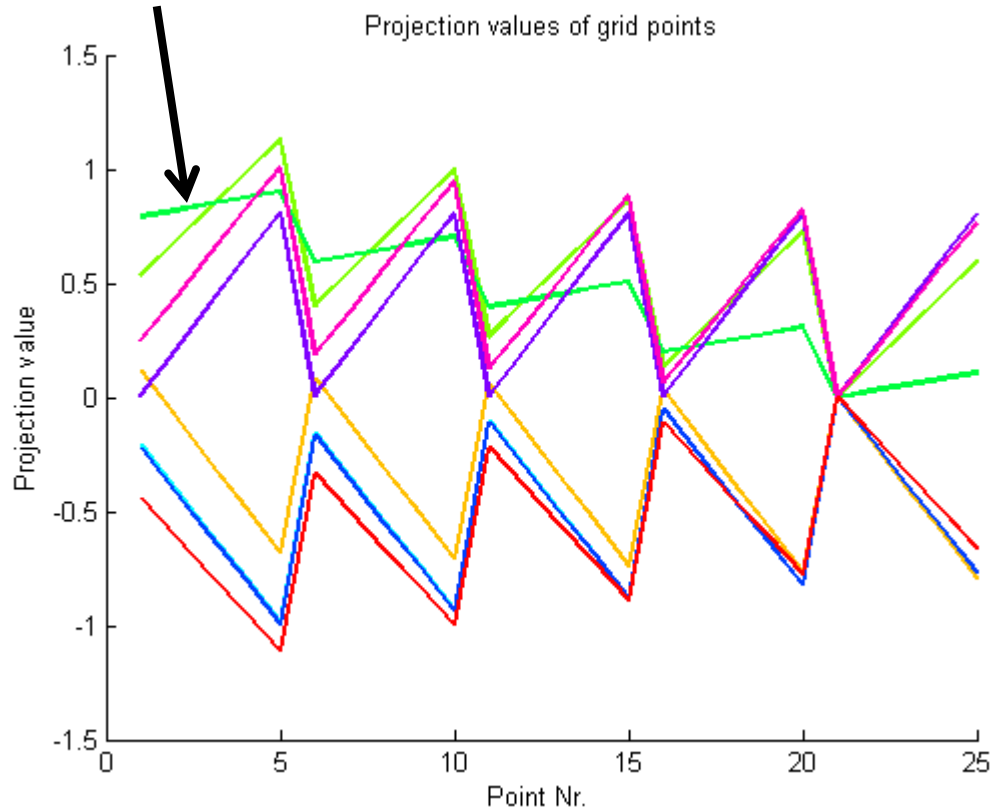


## Problem 3.3 Kernel PCA: Toy Data

c) Projections of the eigenvectors:

- Projections values show a common behavior

One Outlier



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

- sometimes one or two outliers occur which show an uncommon behaviour

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