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Machine Learning and Data Mining

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Exercise Sheet 3

Presentation of Solutions to the Exercise Sheet on the 15.05.2014

Aufgabe 3-1 PCA

a) Please describe what a PCA aims for and under what circumstances it is most helpful.

b) Which possibly negativ consequences might arise when applying PCA to a dataset of unknown structure?

Aufgabe 3-2 PCA

Consider the $\mathbf{X} \in \mathbb{R}^{M \times N}$ matrix containing six data points $\mathbf{x}_i \in \mathbb{R}^2$. Note that in contrast to the conventional representation, the patterns are held in columns here.

dim 1	1	2	3	5	6	7
dim 2	0	0	0	6	6	6

Conduct a PCA on the given data. Please state the eigenvectors, eigenvalues, covariance matrix and visualize the data before and after the PCA.

Aufgabe 3-3 Eigenfaces

The term *eigenfaces* describes the eigenvectors of a normalized covariance matrix.

a) Find the eigenfaces of the number dataset from the `numberMatrix.RTable`.

b) How many principal components are required to reconstruct the dataset? Are the eigenfaces sufficient for this purpose? Are all patterns reconstructable with equal quality?