



Principal Component Analysis (PCA)

Exercise 26 You have acquired the following sample set:

$$w = \left\{ \begin{pmatrix} -1 \\ -2 \end{pmatrix}, \begin{pmatrix} 1 \\ 3 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \end{pmatrix}, \begin{pmatrix} 2 \\ 0.5 \end{pmatrix} \right\}.$$

Perform PCA (principal component analysis) on w and draw a graph containing the samples, principal components and the projected samples.

Exercise 27 Programming Task: Implement the principal component analysis. For this purpose, download the file `pca_data.mat`.

The patterns are 2D-data points (thus, the x - and y -coordinates of the points are given). The matlab array contains one data point per column. The class variables indicate whether a point belongs to class 0 or 1.

The PCA itself requires only the data points, not the class information. With the class information, we can, however, build a simple classifier that assigns an unknown point to the nearest class center.

- Write a program that applies PCA to the data points given in the data file and reduce the dimensionality from two dimensions to one dimension.
- Visualize the patterns, the results of the PCA (mean value, scaled eigenvectors) and the transformed features.
- Now use the class information given for the points to develop a rudimentary classifier on basis of the above PCA and the class information to classify the new data points

$$w_1 = \left\{ \begin{pmatrix} 0.4 \\ 0.6 \end{pmatrix}, \begin{pmatrix} -0.2 \\ -0.6 \end{pmatrix} \right\}.$$