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

<table>
<thead>
<tr>
<th>dim 1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>dim 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

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?