Kernel PCA Examples

Polynomial kernel w/ degree d

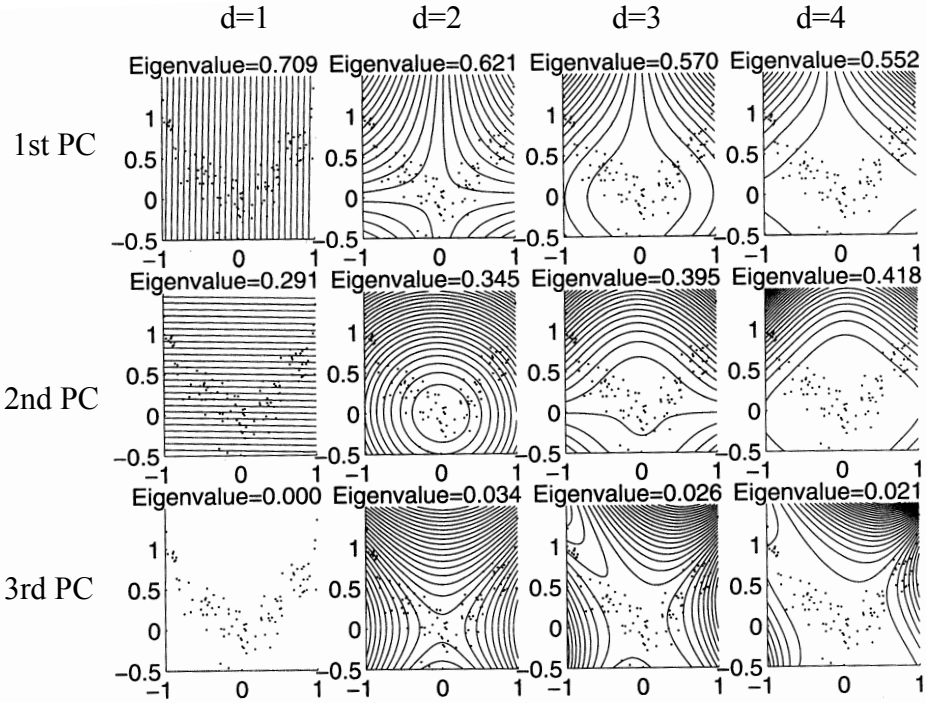
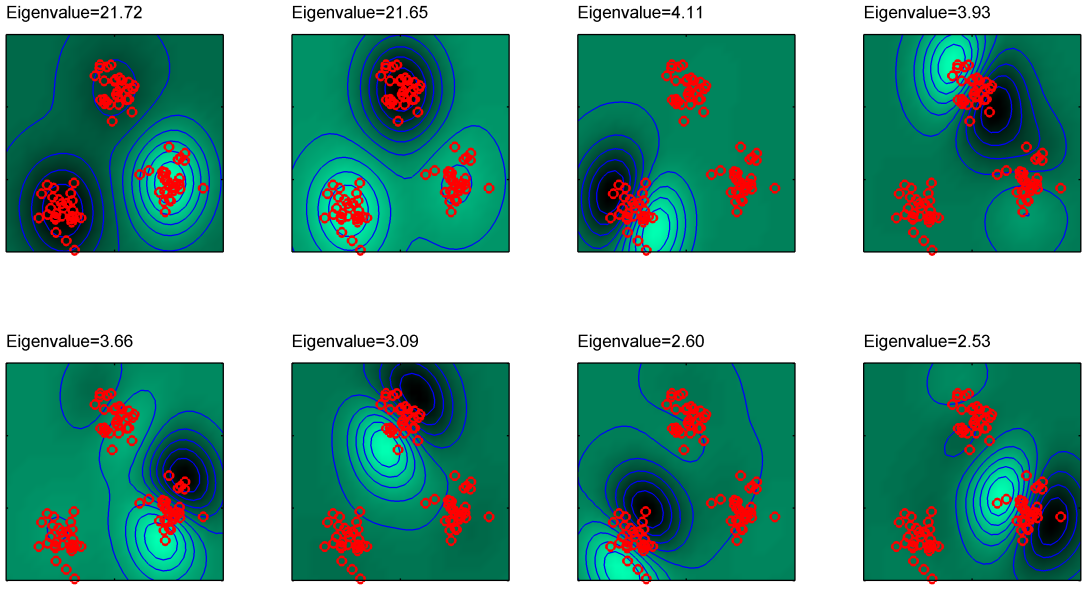


Figure 14.3 Two-dimensional toy example, with data generated as follows: x-values have uniform distribution in $[-1, 1]$, y-values are generated from $y_i = x_i^2 + v$, where v is normal noise with standard deviation 0.2. From left to right, the polynomial degree in the kernel (14.21) increases from 1 to 4; from top to bottom, the first 3 eigenvectors are shown, in order of decreasing eigenvalue size (eigenvalues are normalized to sum to 1). The figures contain lines of constant principal component value (contour lines); in the linear case ($d = 1$), these are orthogonal to the eigenvectors. We did not draw the eigenvectors, as in the general case, they belong to a higher-dimensional feature space. Note, finally, that for $d = 1$, there are only 2 nonzero eigenvectors, this number being equal to the dimension of the input space.

Contours are the lines along which the projection onto the PC is constant.

(Figure 14.3 from "Learning with Kernels", Scholkopf and Smola)

Gaussian kernel



The first 8 PCs. The first 2 PCs separate the 3 clusters, while the next 3 PCs split the cluster into halves. The remaining PCs spit the clusters into halves along directions orthogonal to the previous splits.

(Figure 12.17 from "Pattern Recognition and Machine Learning", Bishop)