HW-6.1

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1   Problem 6.1

Use the attached function to reconstruct the example of lesson 6.1. In particular, you must:

1. 1) Construct a train dataset and represent them. Your representation may be rotated 90° with respect to the one of the slides.

2. 2) Construct a function to directly map the data into a 10 dimension Hilbert space using the Volterra expansion.

3. 3) Compute the weights of the MMSE solution, and represent the boundary as indicated in the slides.

Provide a document that summarizes the theory and a graph of the result. Comment your results.

2   Solution

I used function given in the problem 6.1 to make data sets. I used Volterra expansion for getting Training dataset. The Volterra expansion for 10 dimension is given by,

$$1, x_1, x_2, x_1^2, x_2^2, x_1 x_2, x_1^2 x_2, x_1 x_2^2, x_1^3, x_2^3 \tag{1}$$

We can use Minimum Mean Square Error(MMSE) to find the solution given by,

$$w = (XX^T)^{-1} Xy \tag{2}$$

The solution for the w using a=1.5 is

$$\begin{bmatrix} -0.1812 & 0.2381 & -0.4616 & 0.0387 & 0.0251 & -0.0340 & 0.1894 & -0.0875 & -0.1097 & 0.1028 \end{bmatrix}$$

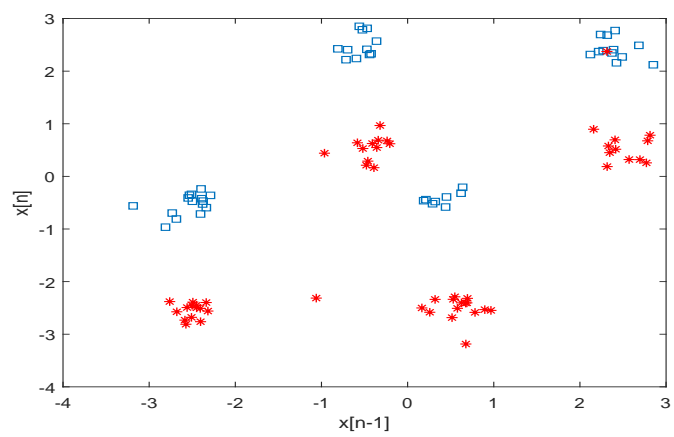we are able to create boundary to classify the data given in figure.
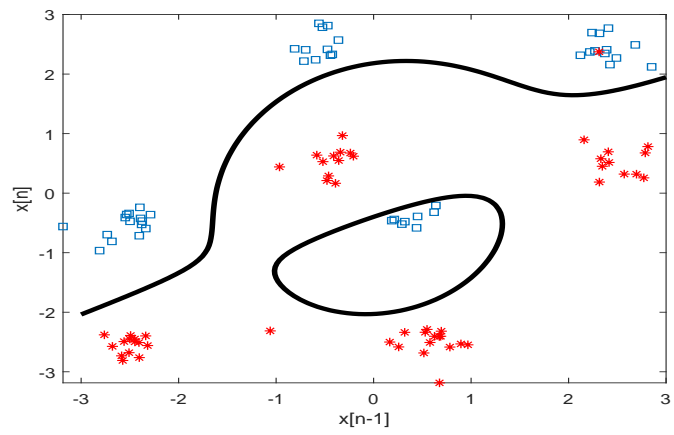
Figure 1: Training Data

Figure 2: Classification using MMSE and Voltera expansion

we need more dimension in Volterra expansion in order to use as kernel function which is lengthy but worth it.