**Homework for SVM**

**Paper sheet homework**

**3.1** (Haykin’s book, pp.357, 6.5) Now let us revisit Exclusive OR (XOR) problem. Let the kernel function to be , where  and . Please give the kernel matrix for the four logic input samples for this problem, and write down the corresponding objective function of the dual problem.

**3.2** (Haykin’s book, pp.348, 6.6) The inner-product kernel  is evaluated over a training sample set of size , yielding the -by-matrix



where . The matrix  is positive in that all of its elements have positive values. Using the similarity transformation



where  is a diagonal matrix of eigenvalues and is a matrix made up of the corresponding eigenvectors, formulate an expression for the inner-product kernel  in terms of the eigenvalues and eigenvectors of the matrix . What conclusions can you draw from this representation?

**3.3** Throughout the chapter we discussed the use of a support vector machine for binary classification. Discuss how a support vector machine can be used to solve an -ary pattern classification problem, where .

**Computer exercises**

**3.4** (Hykin’s book, pp.349, 6.9) The inner-product kernel for a polynomial learning machine used to solve the XOR problem is defined by



What is the minimum value of power for which the XOR problem is solved? Assume that  is a positive integer. What is the result of using a value for  larger than the minimum?

**3.5 (selective)** Fisheriris data can be read by the following matlab command and its meaning can be found from the internet:

**load fisheriris**

At first, use one-against-all strategy to decompose the 3-ary classification problem into binary classification problems. Then use a SVM to solve each binary classification problems and combine all the binary classifiers to solve the problem. What is the generalization performance of the classifiers you designed?