PRML Homework Assignment III

(Due on Monday, June 8, 2020.)

Please submit to our TA–Siwen Liu before 5:30 pm.

For every 5 minutes beyond the deadline, 5 points will be deducted from your score.

Problem 2: Support Vector Machine (50 points)

DHS p276-Problem 33 (p225-33 in the translated book).
(Hint for (b): You may use the original feature space rather than the augmented feature space.)

Part II (Optional, Extra Credits)

Support Vector Machine (SVM) (30 points)

In this problem, we will write a program to implement the SVM algorithm. Let us start with a toy example (which can be found at SVM_matlab_Prof_olga_Veksler.pdf) and then work on more complicated cases. The toy example (credit goes to Prof. Olga Veksler, University of Western Ontario) provides detailed implementation of SVM using Matlab. It is noted that this example works in the original feature space, rather than the augmented one.

(a) (5 points) Try the toy example, and plot the separating hyperplane $g(\mathbf{x}) = \mathbf{w}^t\mathbf{x} + \mathbf{w_0}$ and the support vectors.

(b) (10 points) Train a SVM classifier with TrainSet1.txt*, and plot the separating hyperplane and the support vectors.

(c) (15 points) Design a quadratic kernel and train a SVM classifier with TrainSet2.txt. Plot the separating boundary and support vectors in the original feature space.

* You can download TrainSet1.txt and TrainSet2.txt from the shared folder of the QQ group. The format of the training data is as follows:

$$\mathbf{X} = \begin{pmatrix} x_{11} & x_{12} & z_1 \\ x_{21} & x_{22} & z_2 \\ & \cdots & \\ x_{n1} & x_{n2} & z_n \end{pmatrix},$$

where $z_i \in \{1, -1\}$ denotes the class label, and $\mathbf{x}_i = [x_{i1}, x_{i2}]^t$ denotes the training samples.

Submission Guidelines for Part II

1. Create a zip file, YourID_HW3.zip, which includes your source code and a short report that clearly illustrates the required results. The report has to be in the format of pdf or doc. In addition, please verify that all the files can be successfully extracted from the zip file before submission.