EE E6887 Statistical Pattern Recognition

Homework #6

Due Date: Nov. 16th 2005 Wed.

Please complete all problems.

P.1 (Dual Problem of SVM)

In the lecture note (slide 14-6), we have formulated the unconstrained Lagrangean as follows

\[ L_p = \frac{1}{2} \|w\|^2 - \sum_{i=1}^{l} \alpha_i (y_i (w^T x_i + b) - 1) \]

subject to \( \alpha_i \geq 0 \). This is called the primal form.

Take the derivatives of the above with respect to \( w \) and \( b \). By making the derivatives vanish, show that you can derive the following “dual form”

\[ L_D = \sum_{i=1}^{l} \alpha_i - \frac{1}{2} \sum_{i=1}^{l} \sum_{j=1}^{l} \alpha_i \alpha_j y_i y_j x_i \cdot x_j \]

P.2 (SVM)

Problem 34 of Chap 5.

Note you need to find the Lagrange multipliers \( \alpha_i \), point out which samples are support vectors, derive the discriminant function, and derive the equation of classification hyperplane in the higher-dimensional space. Though it is not mandatory, you are encouraged to plot the decision hyperplane and the hyperplanes crossing the support vectors in the original space \((x_1, x_2)\).