Problem Set 3*

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Problem 1

For α^* in the dual problem to be the same as u^* in the canonical form, we will have N=M. For the two inequalities to be the same, i.e. $0 \leq \alpha_i \leq C$ the same as $Au \leq a$. We let $A = \begin{bmatrix} -I \\ I \end{bmatrix}$ where I is the identity matrix of NxN. Let $\vec{0}$ be the column vector of size N where every entry in $\vec{0}$ is 0 and $\vec{C}$ be the column vector of same size where every entry is C. $a = \begin{bmatrix} \vec{0} \\ \vec{C} \end{bmatrix}$. $v = \begin{bmatrix} -1 & -1 & ... & -1 & -1 & -1 \end{bmatrix}$, a row vector of size 1xN. $B = \begin{bmatrix} y_1 & y_2 & y_3 & ... & y_N \end{bmatrix}$, $b = 0$. $L = 2N$. H will be the NxN matrix such that the $H(i,j) = y_i y_j < \phi(x_i), \phi(x_j) >$ for every i, j = 1...N.

Problem 2

Assume there exists some training point $k \in \{1...N\}$ such that $0 < \alpha_k^* < C$, then $C - \alpha_k^* > 0$, that is $\xi_k^* = 0$. We then have $y_k(< w^*, \phi(x_k) > +b^*) = 1 - \xi_k^* = 1$. y_k is either -1 or 1, so $y_k^2 = 1$. We multiply both sides with y_k, that is, $< w^*, \phi(x_k) > +b^* = y_k$. $b^* = y_k - \sum_{i=1}^{N} \alpha_i^* y_i < \phi(x_i), \phi(x_k) >$

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