

Report

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I didn't implement the second part (SMO) of this assignment. And I used cvx as my optimisation toolbox.

1. Rewrite Objective

Let $x' = [w_1, w_2, \dots, w_m, b, \epsilon_1, \epsilon_2, \dots, \epsilon_n]^T$

where m is the # input dimension and
 n is the # instances.

(1) $r^{(i)}(w^T x^{(i)} - b) \geq 1 - \epsilon_i$

$\Rightarrow -r^{(i)}(w^T x^{(i)} - b) - \epsilon_i \leq -1$

$G' \leftarrow \begin{bmatrix} -r^{(1)}x_1^{(1)}, -r^{(1)}x_2^{(1)}, \dots, -r^{(1)}x_m^{(1)}, r^{(1)}, -1, 0, 0, \dots, 0 \\ -r^{(2)}x_1^{(2)}, \dots, r^{(2)}, 0, -1, 0, \dots, 0 \\ \vdots \\ -r^{(n)}x_1^{(n)}, \dots, r^{(n)}, 0, 0, \dots, -1 \end{bmatrix} x' \leq \begin{bmatrix} -1 \\ -1 \\ \vdots \\ -1 \end{bmatrix}$

and $-\epsilon_i \leq 0$

$$\begin{matrix} & \overbrace{}^{m+n+1} \\ n \left\{ \begin{matrix} G' \\ 0, 0, -I_n \end{matrix} \right\} \cdot x' \leq \begin{matrix} \begin{bmatrix} -1 \\ \vdots \\ -1 \end{bmatrix} \\ \begin{bmatrix} 0 \\ \vdots \\ 0 \end{bmatrix} \end{matrix} \end{matrix}$$

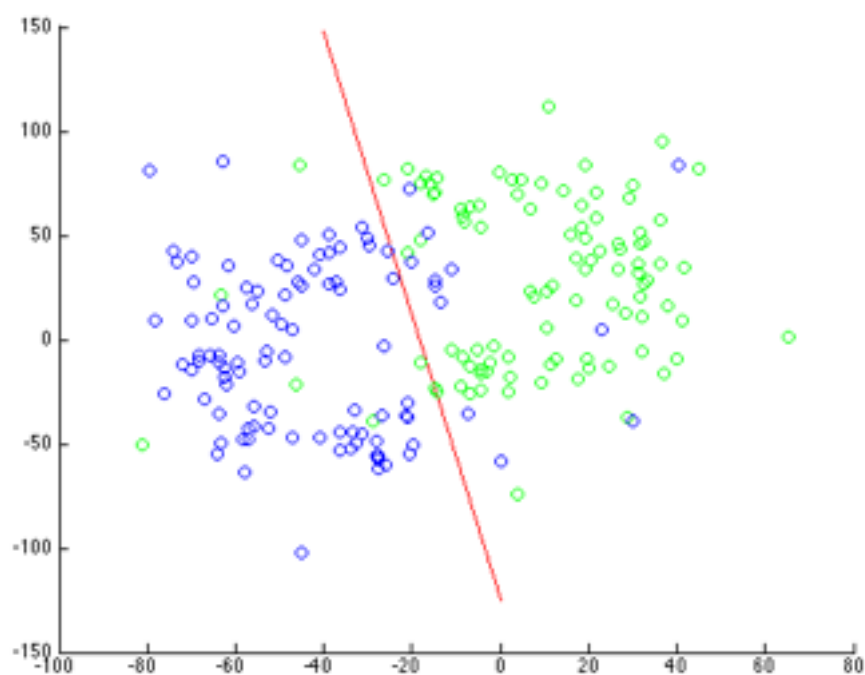
\uparrow G \uparrow h

$$\begin{aligned}
 (2) \quad & \|W\|_2^2 + C \sum_{i=1}^n \xi_i \\
 = & X'^T \begin{bmatrix} I_m & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & 0 \end{bmatrix} X' + \underbrace{[0, 0, \dots, 0]}_{m+1} \underbrace{[C, C, \dots, C]}_n X'
 \end{aligned}$$

\uparrow X^T \uparrow G \uparrow X \uparrow C^T

2. Decision boundary:

3. Error: $18/200 = 0.09$



4. Training time:

