$$\begin{cases} W \cdot X^+ + b = +1 \\ W \cdot X^- + b = -1 \end{cases}$$

(1)

$$W \cdot (X^+ - X^-) = 2$$

(2)

$$X^+ = X^- + \lambda W \;\Rightarrow\; \lambda = \frac{2}{W \cdot W}$$

(3)

$$d = \left| X^+ - X^- \right| = |\lambda W| = \frac{2}{W \cdot W} \|W\| = \frac{2}{\|W\|}$$

(4)

$$\begin{cases} W \cdot X_i + b \geqslant 1 & \text{if } y_i = 1 \\ W \cdot X_i + b \leqslant -1 & \text{if } y_i = -1 \end{cases}$$

(5)

$$y_i(W \cdot x + b) \geqslant 1 \;,\; i = 1, 2, \ldots, N$$

(6)

$$f(W) = \frac{\|W^2\|}{2}$$

(7)

$$\begin{cases} \min\limits_{W} \frac{\|W^2\|}{2} \\ s.t.\; y_i(W \cdot X + b) \geqslant 1 \end{cases}$$

(8)

$$L_P = \frac{1}{2} \|W\|^2 - \sum_{i=1}^{N} \lambda_i (y_i(W \cdot X + b) - 1)$$

(9)

$$\frac{\partial L_P}{\partial W} = 0 \Rightarrow W = \sum_{i=1}^{N} \lambda_i y_i X_i$$

(10)

$$\frac{\partial L_P}{\partial b} = 0 \Rightarrow \sum_{i=1}^{N} \lambda_i y_i = 0$$

(11)

$$L_D = \sum_{i=1}^{N} \lambda_i - \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \lambda_i \lambda_j y_i y_j X_i X_j$$

(12)