$$\min_{w \in \mathbb{R}^{d+1}} F(w) := \|w\|^2 + \frac{C}{n} \sum_{i=1}^{n} l_h(y_i, f(x_i))$$

$y = (y_1, y_2 \cdots y_n)^T \in \mathbb{R}^n$

$$l_h(y,t) = \begin{cases} 0, & yt > 1+h \\ \frac{(1+h-yt)^2}{4h}, & \|1-yt\| \le h \\ 1-yt, & yt < 1-h \end{cases}$$

$X \in \mathbb{R}^{n \times d+1}$ $\quad X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$ $\quad x_1 \to [\quad]_{1 \times d+1}$

$w^T X$ $\quad w = \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix}_{n \times 1}$

$$F(w) = \|w\|^2 + \frac{C}{n}, \quad yt > 1+h$$

$$= \|w\|^2 + \frac{C}{n}\left(\frac{(1+h-\langle y, w^T X\rangle)^2}{4h}\right), \quad \|1-yt\| \le h.$$

$$= \|w\|^2 + \frac{C}{n}\left(1 - \langle y, w^T X \rangle\right), \quad yt < 1-h.$$

where $\|w\|^2 = \langle w, w \rangle$

$t_i = w^T x_i$

$1 - \sum y_i \cdot w^T x_i$

$y^T = [\quad]_{n \times 1}$

$y^T w^T X$

$\frac{d(w^T X)}{dw}$

$\|w\| = \sqrt{\langle w, w \rangle}$

$\frac{d w^T}{dw} X$

$\langle w, w \rangle$

$\left(\frac{dw}{dw_1}, \ldots, \frac{dw}{dw_n}\right) \cdot X \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}_{n \times 1}$

$\|w\|^2 = (w_1^2, w_2^2, \ldots, w_n^2)$

$\frac{d\|w\|^2}{dw} = \frac{d\|w\|^2}{dw_1}, \ldots, \frac{d\|w\|^2}{dw_n}$

$= 2w_1, 2w_2, \ldots, 2w_n$

$$\nabla F(w) = 2\vec{w}$$

$$= 2\vec{w} + \frac{C}{n}\left(\frac{2(1+h-\langle y, w^T X\rangle)}{4h} \cdot \left\langle y, \overrightarrow{\frac{d(w^T)}{dw} X} \right\rangle\right)$$

$$= 2\vec{w} + \frac{C}{n}\left(\left\langle y, \overrightarrow{\frac{d(w^T)}{dw}} X \right\rangle\right)$$

2.1.2.