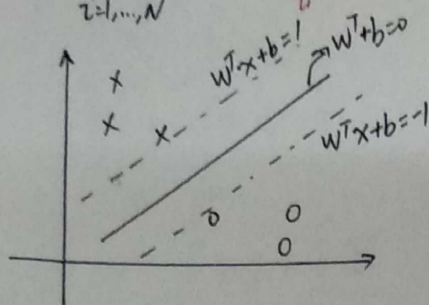


Soft-Margin SVM

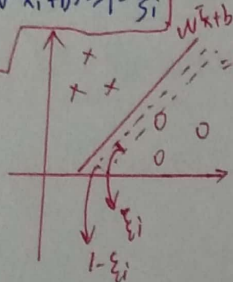
$$\text{Data} = \{(x_i, y_i)\}_{i=1}^N, x_i \in \mathbb{R}^p, y_i \in \{+1, -1\}$$

$$\begin{cases} \min_{w, b} \frac{1}{2} w^T w + \max\{0, 1 - y_i(w^T x_i + b)\} \\ \text{s.t. } y_i(w^T x_i + b) \geq 1 - \xi_i \end{cases}$$



$$\xi_i \lambda \xi_i = 1 - y_i(w^T x_i + b), \xi_i \geq 0$$

$$\begin{cases} \min_{w, b} \frac{1}{2} w^T w + C \sum_{i=1}^N \xi_i \\ \text{s.t. } y_i(w^T x_i + b) \geq 1 - \xi_i \\ \xi_i \geq 0 \end{cases}$$



Support Vector Machine 支持向量机

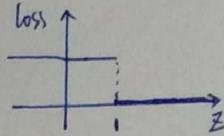
Soft: 允许一点点错误

$$\begin{aligned} &\min_{w, b} \frac{1}{2} w^T w + \text{loss} \\ &\text{loss} = \sum_{i=1}^N I[y_i(w^T x_i + b) < 1] \end{aligned}$$

不连续

$$\text{令 } z = y(w^T x + b)$$

$$\text{loss}_{0/1} = \begin{cases} 1, & z < 1 \\ 0, & \text{otherwise} \end{cases}$$



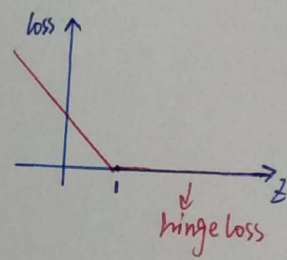
② loss: 距离 → hinge loss

$$\begin{cases} \text{如果 } y_i(w^T x_i + b) \geq 1, \text{ loss} = 0 \\ \text{如果 } y_i(w^T x_i + b) < 1, \text{ loss} = 1 - y_i(w^T x_i + b) \end{cases}$$

$$\text{loss} = \max\{0, 1 - y_i(w^T x_i + b)\}$$

z

$$\text{loss}_{\max} = \max\{0, 1 - z\}$$



$$\begin{aligned} &1 - z > 0 \quad (z < 1) \\ &1 - z \leq 0 \quad z \geq 1 \end{aligned}$$