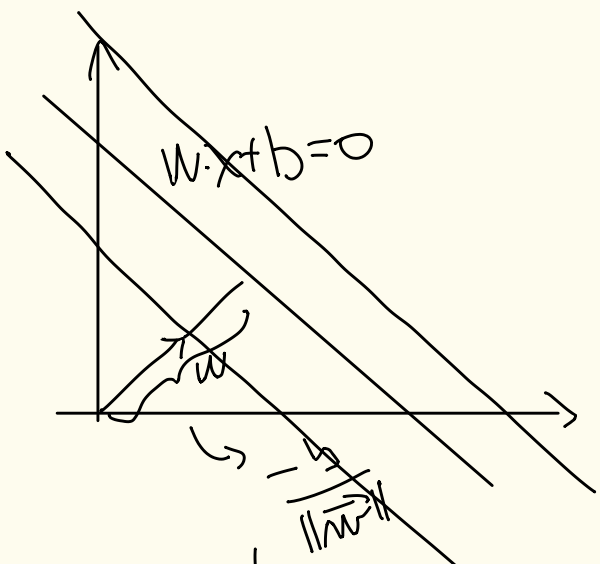
SVM



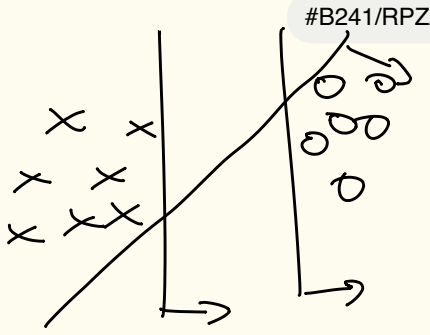
$\rightarrow w \cdot x + (b-1) = 0$

$\rightarrow w \cdot x + (b+1) = 0$

$y = ax + b$

$ax + by + c = 0$

$$\frac{-(b-1)}{\|w\|} - \frac{-(b+1)}{\|w\|} = \frac{2}{\|w\|}$$



$$\arg\max_{w,b} \frac{2}{\|w\|} \quad \cdots\cdots \quad \arg\min_{w,b} \frac{1}{2}\|w\|^2$$

s.t. $w \cdot x_i + b \geq 1$ pro $y_i = 1$ $\rightarrow$ $y_i (w x_i + b) \geq 1$

$w \cdot x_i + b \leq -1$ pro $y_i = -1$

$w \cdot x + b = 1 - \xi_i$

$$\arg\min_{w,b} \frac{1}{2}\|w\|^2 + C \sum \xi_i$$

s.t. $y_i (w \cdot x_i + b) \geq 1 - \xi_i$

$\xi_i \geq 0$

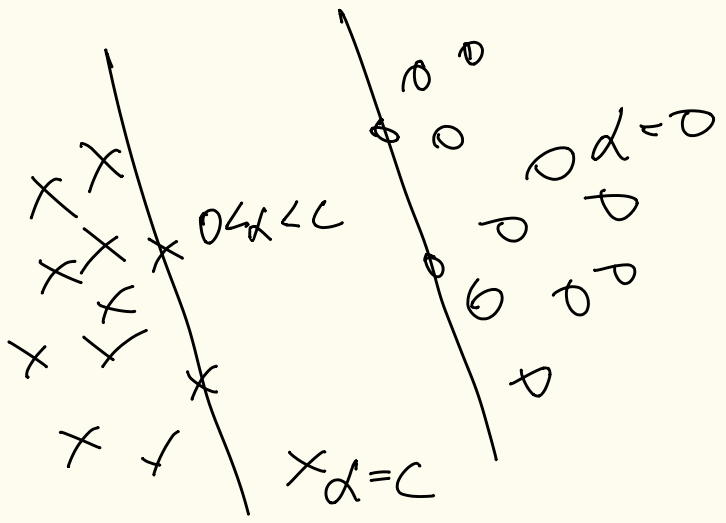
$$\alpha^* = \arg\max_{\alpha} \sum \alpha_i - \frac{1}{2} \sum_i \sum_j \alpha_i \alpha_j y_i y_j x_i \cdot x_j$$

s.t. $\sum_i \alpha_i y_i = 0$

$0 \leq \alpha_i \leq C$

$w = \sum \alpha_i y_i x_i$

$b =$



$$k(x_i, x_j) = \phi(x_i) \cdot \phi(x_j)$$

$$\phi(x) = (1, x_1, x_2, x_1^2, x_2^2, x_1 \cdot x_2)$$

$$\| \quad (x_1, x_2)$$

$$k(x, \bar{x}) = (1 + x \cdot \bar{x})^2$$

$$k(x, x') = e^{-(x - x')^2}$$

$$= e^{-x^2} \cdot e^{-x'^2} \cdot \underbrace{e^{2x \cdot x'}}_{\sum_{k=0}^{\infty} \frac{2^k x^k x'^k}{k!}}$$

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!}$$

$$\phi(x) = \left(e^{-x^2} \cdot \sqrt{\frac{2^0}{0!}} x^0, e^{-x^2} \sqrt{\frac{2^1}{1!}} x^1, \dots \right)$$

QPSolver (H, f, a, b, LB, UB) $\Rightarrow$ funzione $d \times y$

$$x^* = \underset{x}{\operatorname{argmin}} \; 0.5 \, x^T H x + f^T x \qquad f = (-1, -1, -1 \dots)$$

$$\text{s.t.} \quad a^T x = b \to 0$$

$$LB(i) \le x_i \le UB(i)$$

$\downarrow$ y $\quad$ $\downarrow 0$ $\quad$ $\downarrow C$