


线性划分回顾，将乘到 $w \cdot x + b$ 左边将1、2等式归一

## Linear Classifier

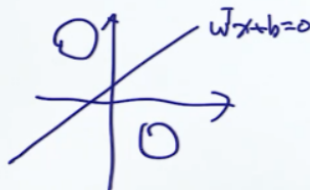


贪心科技  
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$D = \{(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)\} \quad y_i \in \{-1, 1\} \quad i=1, 2, \dots, n$   
 $\theta = \{w, b\} \quad \underline{w \cdot x + b = 0} \leftarrow \text{Decision Boundary}$

①  $w \cdot x_i + b \geq 0$  时  $y_i = 1$   
 ②  $w \cdot x_i + b < 0$  时  $y_i = -1$

$\Rightarrow (w \cdot x_i + b) \cdot y_i \geq 0$



回顾

123三条线中2号线的性质最好，有最大的安全区域，最鲁棒

## Consider These Cases

Max-Margin Method

对于 perturbation, 它不够 Robust.

保持 Robust.

Robust to the perturbation

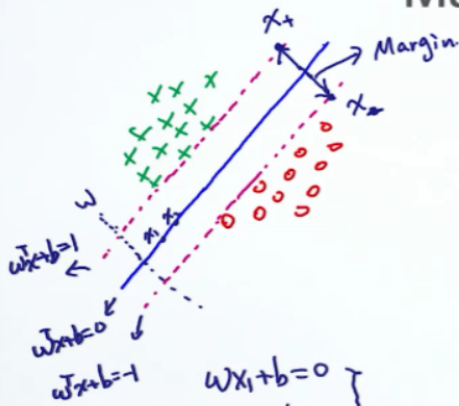


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推导目标函数的过程，左边证明为什么 $w$ 向量垂直于直线，中间推导两条直线公式，右边选出margin的最大值

scaling parameter

## Maximize the Margin



$$\left. \begin{aligned} w x_1 + b &= 0 \\ w x_2 + b &= 0 \end{aligned} \right\} \Rightarrow w(x_1 - x_2) = 0 \\ w \perp (x_1 - x_2)$$

$$\left. \begin{aligned} w^T x_+ + b &= 1 \\ w^T x_- + b &= -1 \end{aligned} \right\} \Rightarrow x_+ = x_- + \lambda w$$

$$\text{margin} = |x_+ - x_-|$$

$$w^T \cdot (x_- + \lambda w) + b = 1$$

$$w^T x_- + \lambda w^T w + b = 1$$

$$\lambda w^T w = 2$$

$$\boxed{\lambda = \frac{2}{w^T w}}$$

$$\begin{aligned} \text{margin} &= |\lambda w| \\ &= \lambda \|w\| \\ &= \frac{2}{w^T w} \|w\| \\ &= \frac{2}{\|w\|} \end{aligned}$$

Maximize  $\boxed{\frac{2}{\|w\|}}$