机器学习理论作业3

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正：$x_1=(1,2)^T$，$x_2=(2,3)^T$，$x_3=(3,3)^T$

负：$x_4=(2,1)^T$，$x_5=(3,2)^T$

$$\min_{w,b} \frac{1}{2}\|w\|^2$$

s.t.

$w_1+2w_2+b\geq 1$ ①

$2w_1+3w_2+b\geq 1$ ②

$3w_1+3w_2+b\geq 1$ ③

$2w_1+w_2+b\leq -1$ ④ $\Leftrightarrow$ $-2w_1-w_2-b\geq 1$ ⑥

$3w_1+2w_2+b\leq -1$ ⑤ $\Leftrightarrow$ $-3w_1-2w_2-b\geq 1$ ⑦

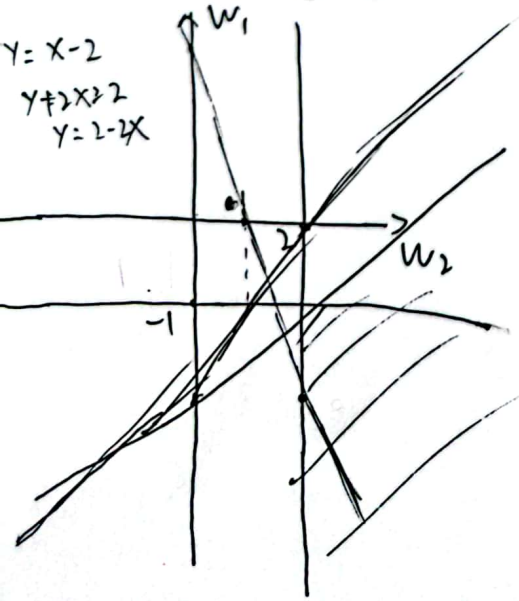
①⑦ $-2w_1\geq 2 \Leftrightarrow 2w_1\leq -2$ $w_1\leq -1$

②⑥ $2w_2\geq 2 \Leftrightarrow w_2\geq 1$

⑦③ $w_2\geq 2$

⑥① $-w_1+w_2\geq 2 \Rightarrow w_1-w_2\leq -2$

⑥③ $w_1+2w_2\geq 2$



$\therefore \min_{w,b} \frac{1}{2}\|w\|^2$ 时 $w_1=-1$ $w_2=2$

代入①⑤

① $-1+4+b\geq 1 \Rightarrow b\geq -2$

⑤ $-3+4+b\leq -1 \Rightarrow b\leq -2$ $\Rightarrow b=-2$

分离超平面 $-x_1+2x_2-2=0$

分类决策函数 $f(x)=\text{sign}(-x_1+2x_2-2)$

$-x_1+2x_2-2=1$ x_1 ✓ ~~x_2~~ x_3 ✓

$-x_1+2x_2-2=-1$ ~~x_4~~ x_5 ✓

∴ x_1, x_3, x_5 是支持向量