$$d_3 = \frac{|\vec{w}^T\vec{x}_3 + b|}{\|\vec{w}\|} = \frac{\left|(1,1)\binom{0}{0} - 1\right|}{\sqrt{(1^2+1^2)}} = \frac{\sqrt{2}}{2}$$

3，假设训练样本集为 $D = \{(\vec{x}_1, y_1) = ((0,0)^T, -1), (\vec{x}_2, y_2) = ((2,2)^T, -1), (\vec{x}_3, y_3) = ((2,0)^T, 1), (\vec{x}_4, y_4) = ((3,0)^T, 1)\}$,使用 QP 求解器时，$\vec{a}_n^T$(n=1,2,3,4)分别为多少？

解：$\vec{a}_1^T = (-1,0,0)$，$\vec{a}_2^T = (-1,-2,-2)$，$\vec{a}_3^T = (1,2,0)$，$\vec{a}_4^T = (1,3,0)$

4，假设训练样本集为：$D = \{(\vec{x}_1, y_1) = ((1,1)^T, 1), (\vec{x}_2, y_2) = ((2,2)^T, 1), (\vec{x}_3, y_3) = ((2,0)^T, 1), (\vec{x}_4, y_4) = ((0,0)^T, -1), (\vec{x}_5, y_5) = ((1,0)^T, -1), (\vec{x}_6, y_6) = ((0,1)^T, -1)\}$，请分别在$y_n(\vec{w}^T\vec{x}_n + b) \geq 1$和$y_n(\vec{w}^T\vec{x}_n + b) \geq 5$的条件下用 Primal SVM 方法来设计最优分类面$g(\vec{x})$，判断两种情况下的分类面是否一致，指出哪些是候选的支撑向量，并回答如何确认哪些是支撑向量。

解：（1）对于条件$y_n(\vec{w}^T\vec{x}_n + b) \geq 1$，可列出如下的式子

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

$$s.t. \begin{cases} w_1 + w_2 + b \geq 1 \\ 2w_1 + 2w_2 + b \geq 1 \\ 2w_1 + b \geq 1 \\ -b \geq 1 \\ -w_1 - b \geq 1 \\ -w_2 - b \geq 1 \end{cases} \Longrightarrow \begin{cases} w_1 \geq 2 \\ w_2 \geq 2 \\ b \leq -3 \end{cases}$$

当且仅当$w_1 = 2, w_2 = 2, b = -3$，