### 4.1

根据所给数据,对偶问题是

$$\begin{split} L(\alpha) &= min\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}\alpha_{i}\alpha_{j}y_{i}y_{j}(x_{i}\cdot x_{j}) - \sum_{i=1}^{N}\alpha_{i} \\ &= \frac{1}{2}(5\alpha_{1}^{2} + 13\alpha_{2}^{2} + 18\alpha_{3}^{2} + 5\alpha_{4}^{2} + 13\alpha_{5}^{2} \\ &+ 16\alpha_{1}\alpha_{2} + 18\alpha_{1}\alpha_{3} - 8\alpha_{1}\alpha_{4} - 14\alpha_{1}\alpha_{5} + 30\alpha_{2}\alpha_{3} - 14\alpha_{2}\alpha_{4} - 24\alpha_{2}\alpha_{5} - 18\alpha_{3}\alpha_{4} - 30\alpha_{3}\alpha_{5} + 16\alpha_{4}\alpha_{5} \\ &- \alpha_{1} - \alpha_{2} - \alpha_{3} - \alpha_{4} - \alpha_{5}) \\ &s.t. \quad \alpha_{1} + \alpha_{2} + \alpha_{3} - \alpha_{4} - \alpha_{5} = 0 \end{split}$$

由

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abla L(lpha)}{
abla lpha_1} &= 0 \ rac{
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abla lpha_2} &= 0 \ rac{
abla L(lpha)}{
abla lpha_3} &= 0 \ rac{
abla L(lpha)}{
abla lpha_4} &= 0 \ rac{
abla L(lpha)}{
abla lpha_5} &= 0 \end{aligned}$$

且

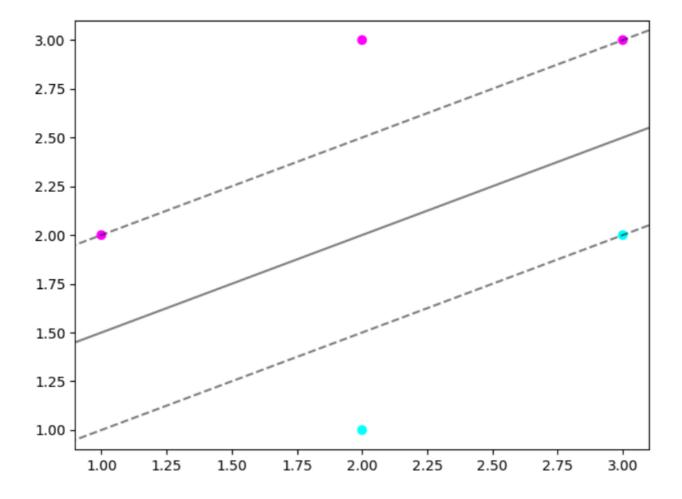
$$w^* = \sum_i lpha_i^* y_i x_i, b^* = y_j - \sum_{i=1}^N lpha_i^* y_i (x_i \cdot x_j)$$

求解得

$$w^* = [-1, 2], b^* = -2$$

所以超平面为 $-x_1 + 2x_2 - 2 = 0$ , 分类决策函数为 $f(x) = sign(-x_1 + 2x_2 - 2)$ 

图为



# 4.2

A,C

## 4.3

1.No

2.False

## 4.4

C.D

## 4.5

A,C,D

4.6

В

4.7

D

4.8

В

4.9

A,B