4.1

根据所给数据，对偶问题是

$$
\begin{gathered}
L(\alpha)=\min_{\alpha}\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}\alpha_i\alpha_jy_iy_j(x_i\cdot x_j)-\sum_{i=1}^{N}\alpha_i \\
=\frac{1}{2}(5\alpha_1^2+13\alpha_2^2+18\alpha_3^2+5\alpha_4^2+13\alpha_5^2 \\
+16\alpha_1\alpha_2+18\alpha_1\alpha_3-8\alpha_1\alpha_4-14\alpha_1\alpha_5+30\alpha_2\alpha_3-14\alpha_2\alpha_4-24\alpha_2\alpha_5-18\alpha_3\alpha_4-30\alpha_3\alpha_5+16\alpha_4\alpha_5 \\
-\alpha_1-\alpha_2-\alpha_3-\alpha_4-\alpha 5) \\
s.t. \quad \alpha_1+\alpha_2+\alpha_3-\alpha_4-\alpha_5=0
\end{gathered}
$$

由

$$
\begin{gathered}
\frac{\nabla L(\alpha)}{\nabla\alpha_1}=0 \\
\frac{\nabla L(\alpha)}{\nabla\alpha_2}=0 \\
\frac{\nabla L(\alpha)}{\nabla\alpha_3}=0 \\
\frac{\nabla L(\alpha)}{\nabla\alpha_4}=0 \\
\frac{\nabla L(\alpha)}{\nabla\alpha_5}=0
\end{gathered}
$$

且

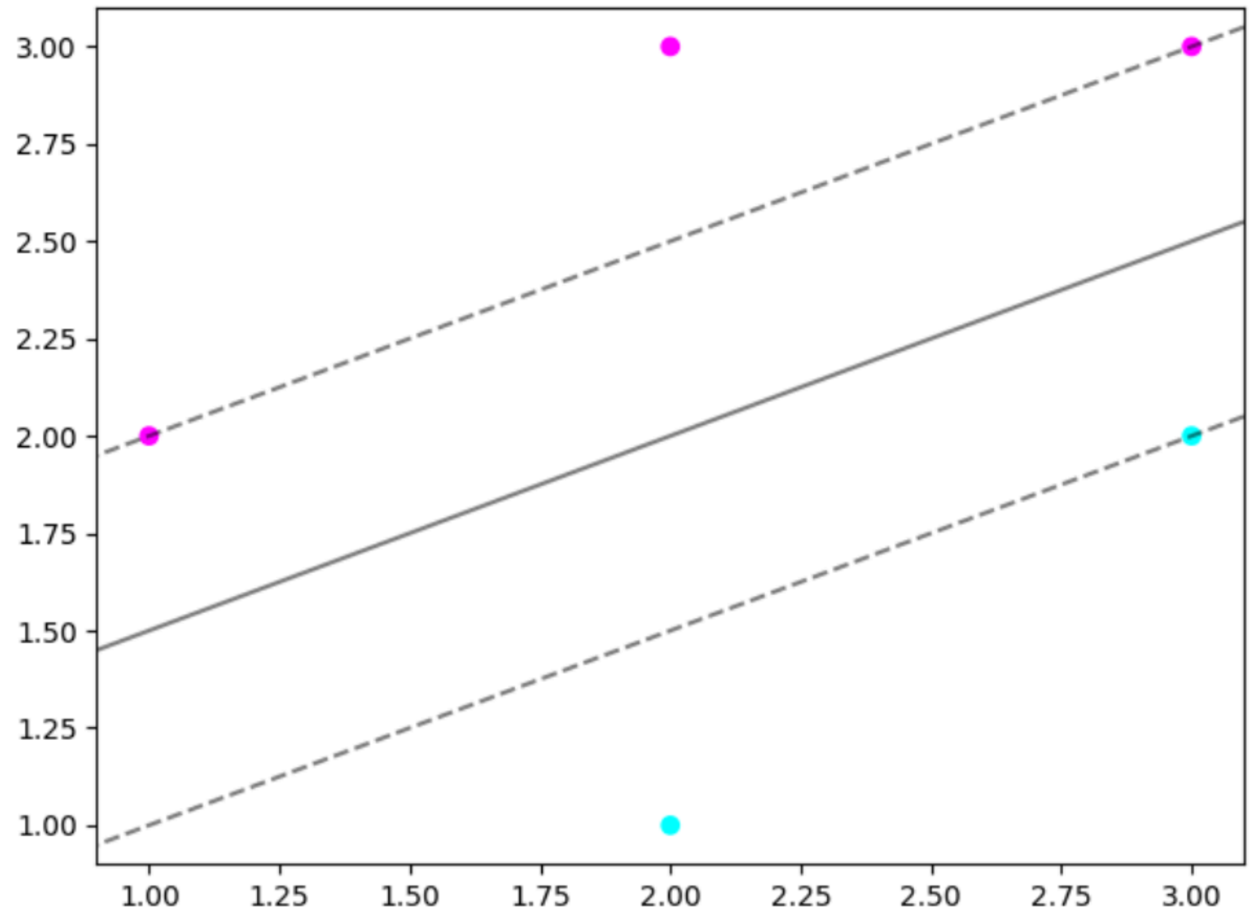
$$
w^*=\sum_i\alpha_i^*y_ix_i, b^*=y_j-\sum_{i=1}^{N}\alpha_i^*y_i(x_i\cdot x_j)
$$

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

B

4.7

D

4.8

B

4.9

A,B