第4章 支持向量机

Exercise 4.1

已知正例点$x_1 = (1,2)^T$,$x_2 = (2,3)^T$,$x_3 = (3,3)^T$,负例点$x_4 = (2,1)^T$,$x_5 = (3,2)^T$,试求最大间隔分离超平面和分类决策函数，并在图上画出分离超平面、间隔边界及支持向量。

Exercise 4.2

假设你训练SVM后，得到一个线性决策边界，你认为该模型欠拟合，在下次迭代训练模型时，应该考虑：

A、增加训练数据

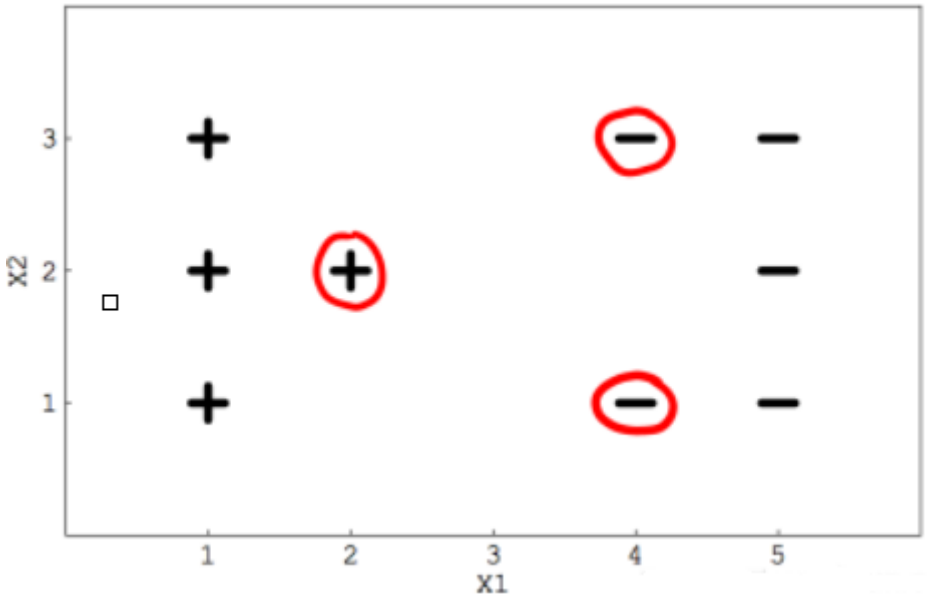
B、减少训练数据

C、计算更多变量

D、减少特征

Exercise 4.3

假定你用一个线性SVM分类器求解二类分类问题，如下图所示，这些用红色圆圈起来的点表示支持向量，据此回答问题1和2：



1.如果移除这些圈起来的数据，决策边界（即分离超平面）是否会发生改变？

A．Yes　B. No

2.如果将数据中除圈起来的三个点以外的其他数据全部移除，那么决策边界是否会改变？

A．True　B. False

Exercise 4.4

Consider two examples $(v, +1)$ and $(-v, -1)$ where $\mathbf{v} \in \mathbf{R}^2$. Which of the following hyperplane is the largest-margin separating one for the two examples?

A. $x_1 = 0$ B. $x_2 = 0$ C. $v_1 x_1 + v_2 x_2 = 0$ D. $v_2 x_1 + v_1 x_2 = 0$

Exercise 4.5

Consider three examples $(x1; +1)$, $(x2; +1)$, $(x3; -1)$, where $x_1 = (3, 0)$, $x_2 = (0, 4)$, $x_3 = (0; 0)$. In addition, consider a hyperplane $x_1 + x_2 = 1$. Which of the following is not true?

A. the hyperplane is a separating one for the three examples
B. the distance from the hyperplane to x_1 is 2
C. the distance from the hyperplane to x_3 is $\frac{1}{\sqrt{2}}$
D. the example that is closest to the hyperplane is x_3

Exercise 4.6

Consider two examples $(z_1; +1)$ and $(z_2; -1)$ with $z_1 = z$ and $z_2 = -z$. What is the Lagrange function $L(b; w; \lambda)$ of hard-margin SVM?
A $\frac{1}{2} w^T w + \lambda_1 (1 + w^T z + b) + \lambda_2 (1 + w^T z + b)$

B $\frac{1}{2} w^T w + \lambda_1 (1 - w^T z - b) + \lambda_2 (1 - w^T z + b)$

C $\frac{1}{2} w^T w + \lambda_1 (1 + w^T z + b) + \lambda_2 (1 + w^T z - b)$

D $\frac{1}{2} w^T w + \lambda_1 (1 - w^T z - b) + \lambda_2 (1 - w^T z - b)$

Exercise 4.7

For a single variable w, consider minimizing $\frac{1}{2} w^2$ subject to two linear constraints $w \geq 1$ and $w \leq 3$. We know that the Lagrange function $L(w, \alpha) = \frac{1}{2} w^2 + \lambda_1 (1 - w) + \lambda_2 (w - 3)$. Which of the following equations that contain λ are among the KKT conditions of the optimization problem?
A $\lambda_1 \geq 0$ and $\lambda_2 \geq 0$
B $w = \lambda_1 - \lambda_2$
C $\alpha_1 (1 - w) = 0$ and $\alpha_2 (w - 3) = 0$
D all of the above

Exercise 4.8

Consider two examples $(z_1; +1)$ and $(z_2; -1)$ with $z_1 = z$ and $z_2 = -z$. After solving the dual problem of hard-margin SVM, assume that the optimal λ_1 and λ_2 are both strictly positive. What is the optimal b?
A -1
B 0
C 1
D not certain with the descriptions above

Exercise 4.9

Consider applying dual hard-margin SVM on N = 5566 examples and getting 1126 SVs. Which of the following can be the number of examples that are on the fat boundary—that is, SV candidates?

A 0

B 1024

C 1234

D 9999