

# Homework04

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## Problem01

(1). No, if we want to separate the data set, we have to curve the linear classifier or raise the dimension to determine that the data set can be separated.

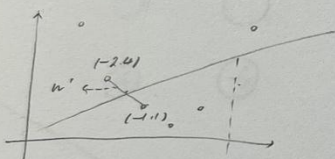
(3). Yes, there are many available lines to split the data set.

(4).

$$\begin{aligned}
 (4) \quad K(x, x') &= (x, x^2) \cdot (x', x'^2) \\
 &= x x' + x^2 x'^2 \\
 &= x x' + (x \cdot x')^2
 \end{aligned}$$

(5).

(5).



To minimize margin,  $(-\frac{3}{2}, \frac{5}{2})$  have to pass.

$$w' = \frac{3}{-1} = -3 \quad \therefore \text{Hyperplane slope} = \frac{1}{3}$$

$$w_1 x_1 + w_2 x_2 + c = 0 \quad \Rightarrow \quad y = \frac{1}{3}x + 3$$

$$y = \frac{1}{3}x + b \quad (-\frac{3}{2}, \frac{5}{2})$$

$$\frac{5}{2} = -\frac{1}{2} + b$$

$$b = 3$$

$$\therefore y = \frac{1}{3}x + 3$$

$$\therefore w_1 = -\frac{1}{3} \quad w_2 = 1 \quad c = 3$$

$$\text{Margin} = \frac{2}{\sqrt{(-1+2)^2 + (1-4)^2}} = \frac{2\sqrt{10}}{10}$$

(8).

$$\begin{aligned}
 (8). \quad L(d) &= \sum d_i - \frac{1}{5} \sum \sum d_i d_j \eta_i \eta_j K(u_i, u_j) \\
 &= d_1 + d_2 + -\frac{1}{5} (d_1^2 (u_1 \cdot u_1) + 2d_1 d_2 (+)(-) (u_1 \cdot u_2) + d_2^2 (u_2 \cdot u_2)) \\
 &= d_1 + d_2 - \frac{1}{5} d_1^2 (u_1 \cdot u_1) + d_1 d_2 (u_1 \cdot u_2) - \frac{1}{5} d_2^2 (u_2 \cdot u_2) \quad [u_1 = (-2, 4) \quad u_2 = (-1, 1)] \\
 &= d_1 + d_2 - 10d_1^2 + d_1 d_2 \cdot 6 - d_2^2 \quad (d_1 = d_2) \\
 &= \underline{2d - 5d^2} \rightarrow \\
 +1 &= \sum d_i \eta_i K(u_i, u_i) + b \\
 1 &= \frac{1}{5} (1+1) (-2, 4) \cdot (-2, 4) + \frac{1}{5} (-1) (-1, 1) \cdot (-2, 4) + b \\
 b &= \underline{-\frac{9}{5}} \rightarrow
 \end{aligned}$$

(9). No, the location of the point is out of Margin and classified correctly.