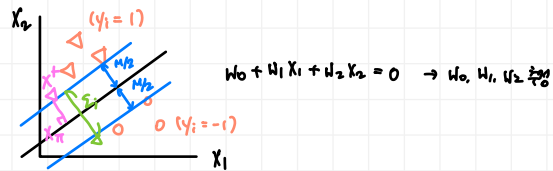# #1. SVM의 수학적 모델링

초평면 : $f(x) = w_0 + w_1 x_1 + w_2 x_2 + \cdots + w_p x_p$

(p 차원에서 형성되는 초평면)

각 클래스의 서포트 벡터를 지나는 직선의 방정식

(1) $w_0 + w_1 x_1 + w_2 x_2 = M/2$

(2) $w_0 + w_1 x_1 + w_2 x_2 = -M/2$

(1) 보다 위에 있는 경우 : $w_0 + w_1 x_1 + w_2 x_2 \geq M/2$

(2) 보다 아래에 있는 경우 $w_0 + w_1 x_1 + w_2 x_2 \leq -M/2$

△ : For Data i $(y_i = +1)$, $w_0 + w_1 x_1 + w_2 x_2 \geq +M/2$

○ : For Data i $(y_i = -1)$, $w_0 + w_1 x_1 + w_2 x_2 \leq -M/2$

$y_i (w_0 + w_1 x_{i1} + w_2 x_{i2}) \geq M/2$

$y_i (w \cdot x_i + w_0) \geq M/2$

△ For Data i, $y_i (w \cdot x_i + w_0) \geq M/2 - \xi_i$

·목적함수

$w_0 + w_1 x_1 + w_2 x_2 = \dfrac{M}{2}$

$\dfrac{2}{M} w_0 + \dfrac{2}{M} w_1 x_1 + \dfrac{2}{M} w_2 x_2 = 1$

$w_0 + w_1 x_1 + w_2 x_2 = 1$

$w_0 + w \cdot x = 1$

$w_0 + w \cdot x = 1 \quad \leftarrow x^+$

$w_0 + w \cdot x = 0 \quad \leftarrow x_\pi \qquad \rightarrow \quad w \cdot (x^+ - x_\pi) = 1$

$w_0 + w \cdot x = -1$

직선 $w_0 + w_1 x_1 + w_2 x_2 = 0$ 의 법선벡터는 $w = \langle w_1, w_2 \rangle$ 이다.

w와 $(x^+ - x_\pi)$는 평행 vector.

$w(x^+ - x_\pi) = 1$

$\|w\| \cdot \| x^+ - x_\pi \| \cdot \cos 0° = 1$

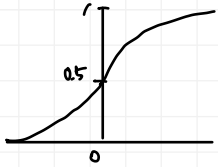$\| x^+ - x_\pi \| = \dfrac{1}{\|w\|}$

$\therefore M = \dfrac{2}{\|w\|}$

$\text{Max } M = \text{Max } \dfrac{2}{\|w\|} = \text{Min } \dfrac{\|w\|}{2} = \text{Min } \dfrac{\|w\|^2}{2}$

$$\boxed{\text{Min } \dfrac{\|w\|^2}{2} + C \sum_i \xi_i}$$

$\downarrow$

$w = \sum_i \alpha_i y_i x_i$

#2. sigmoid 함수의 공식, 정의역, 치역

$$S(x) = \frac{1}{1+e^{-x}} = \frac{e^x}{e^x + 1}$$

$$x \in R$$
$$y \in (0,1)$$

#3 F1-score 계산

	Real	
	T	F
Pred T	TP 200	FP 400
F	300 FN	100 TN

$$\text{Precision} = \frac{200}{200 + 400} = \frac{2}{6} = \frac{1}{3}$$

$$\text{Recall} = \frac{200}{200 + 300} = \frac{2}{5}$$

$$F_1 = \frac{2}{3 + \frac{5}{2}} = \frac{2}{\frac{11}{2}} = \frac{4}{11}$$