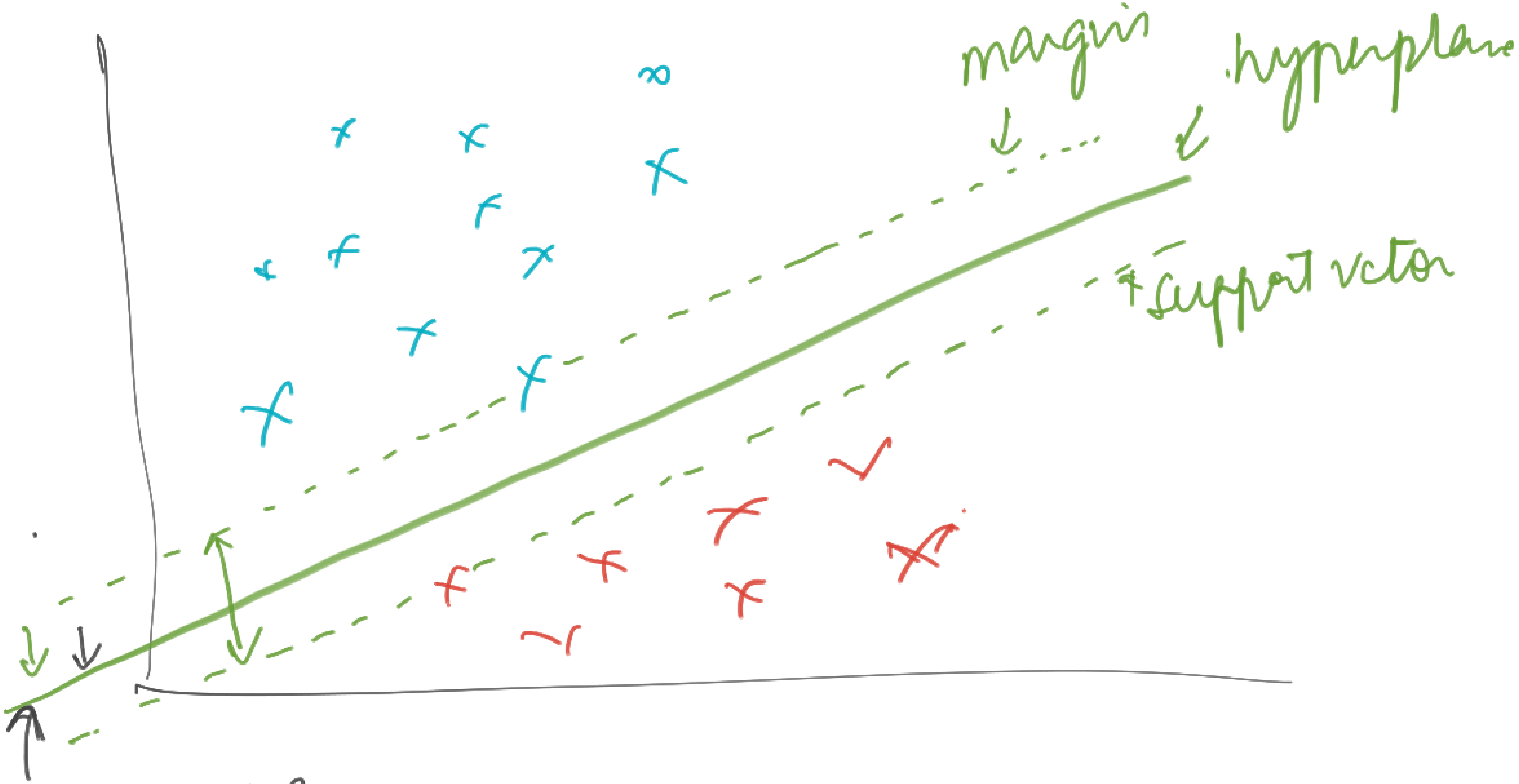
$\boxed{\text{SVM}}$ Support Vector Machine

1) Classification SVC

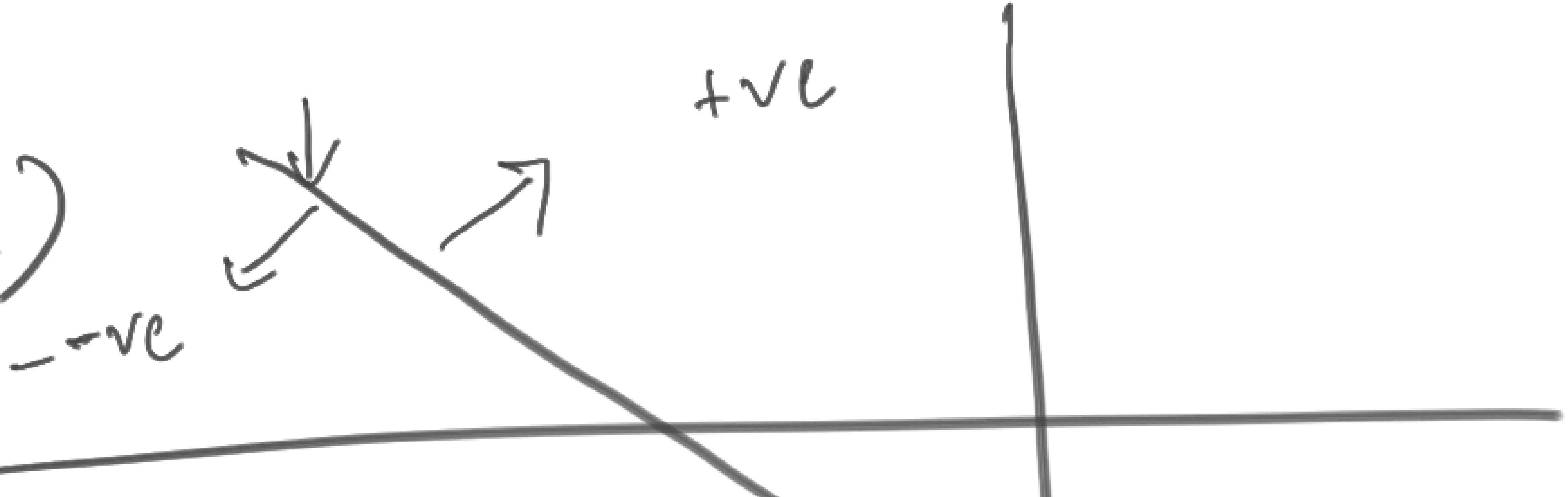
2) Regression SVR



$y = mx + C$

$3x + 2y + 4 = 0$

$(-4, -2) \quad (2, 2)$



$3x + 2y + 4 = 0$

$<$

$3(-4) + 2(-2) + 4$

$= -12 \cancel{-4} + 4$

$= -12$

$-12 < 0$

$3(2) + 2(2) + 4$

$= 6 + 4 + 4$

$= 14 > 0$

$(-4, +4)$

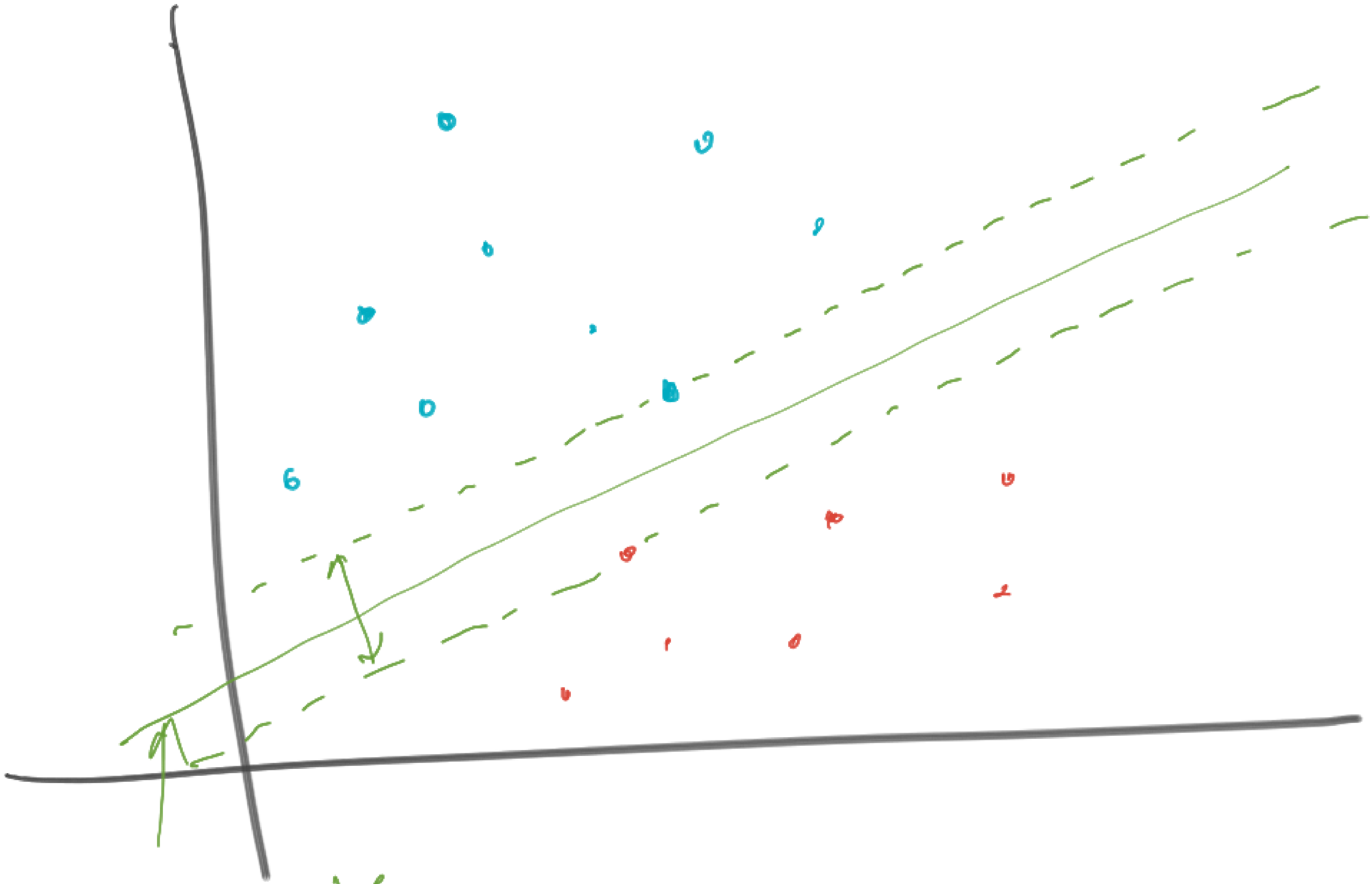
$3(-4) + 2(4) + 4$

$= \cancel{-12} + 8 + 4 = 0$

If pt lies on lies > on line

— 11 — above > +ve region

below > -ve region



$y = mx + c$

$$-3(x)+2(y)-5=0$$

$(-4,4)$

$-3(-4)+2(4)-5$

$=12+8-5$

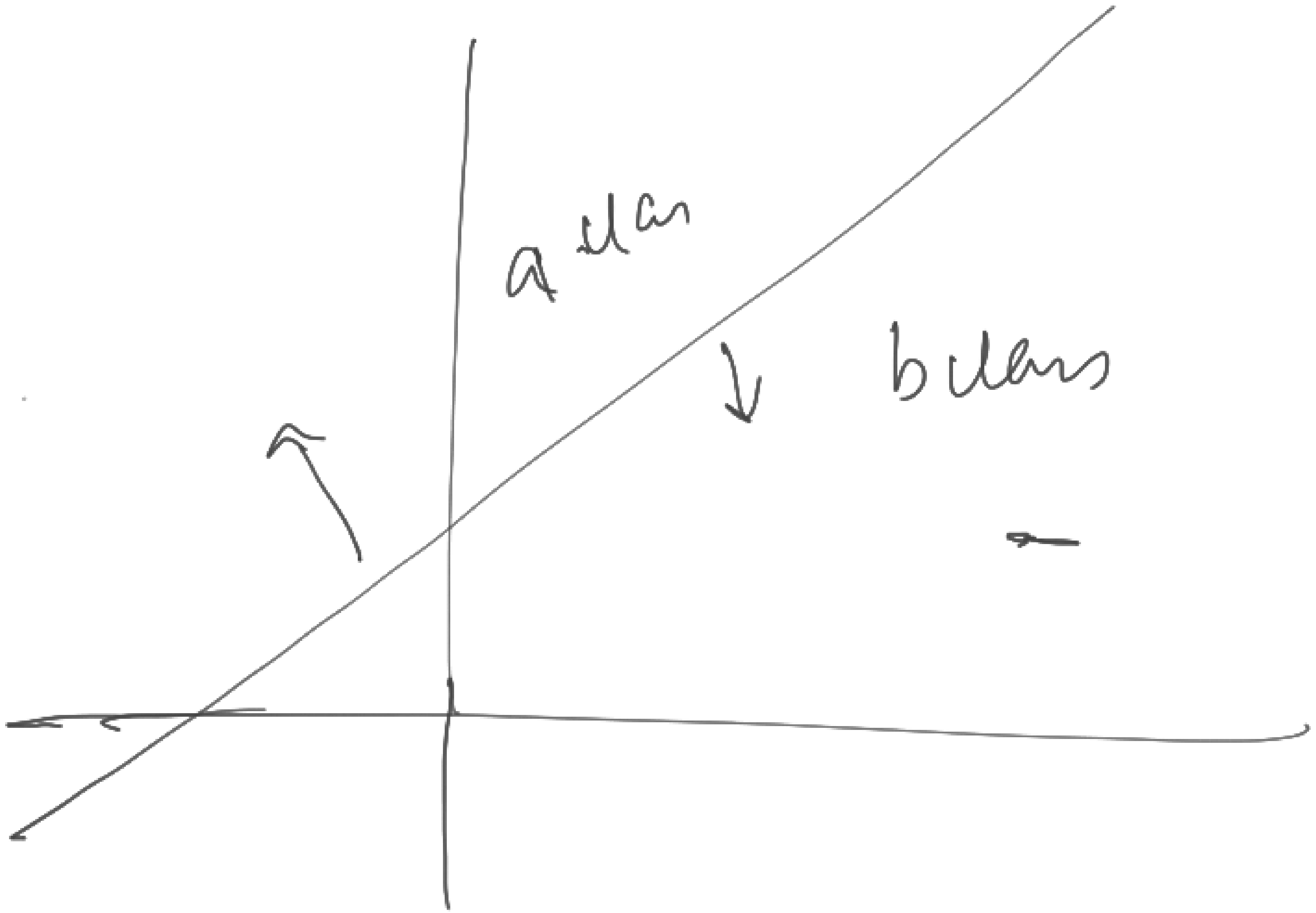
$=15>0$

$(2,-2)$

$-3(2)+2(-2)-5$

$=-6-4-5$

$=-15<0$



$$\boxed{y = mx + c}$$

5 5 7 7

$$= m_1 x_1 + m_2 x_2 + m_3 x_3 + \dots m_n x_n + c$$

$$= [m]_{1\times n} [x]_{1\times n} + c$$

1 2 3

$$= w^T_{n\times 1} \, x_{1\times n} + c$$

$$\boxed{y = w^T x + b}$$

x_1	x_2	x_3

$$y = m_1x_1 + m_2x_2 + m_3x_3 + c$$

$$\underbrace{\begin{bmatrix} m_1 & m_2 & m_3 \end{bmatrix}}_{w,\ 1\times 3} \underbrace{\begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}}_{1\times 3} + C$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix}_{3\times 1} \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}_{1\times 3}$$

$$= \begin{bmatrix} m_1x_1 & m_2x_2 & m_3x_3 \\ & & \\ & & \end{bmatrix}_{3\times 3} + C$$

$$\boxed{w^T x + C}$$

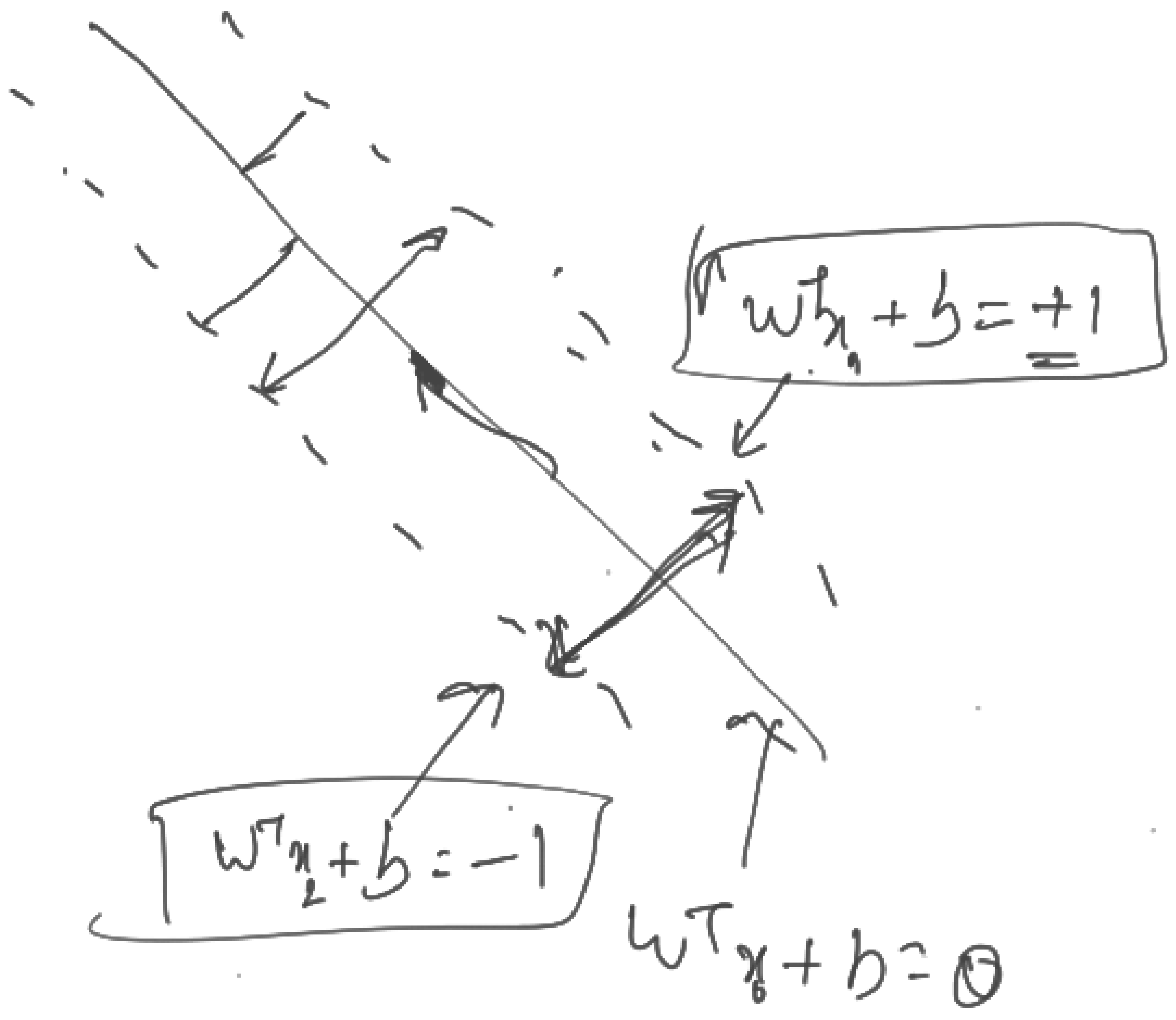
$\boxed{y} = w^T x + b$

$0 > +ve$

$0 < -ve$

$$w^T x_1 + \cancel{b} = +1$$
$$w^T x_2 + \cancel{b} = -1$$

$$w^T (x_1 - x_2) = 2$$



$\underline{\underline{w^T}} (x_1 - x_2) = 2$

vector magnitude, dirⁿ

$$\frac{w^T (mag, dir)}{||w^T|| \; mag} \Rightarrow dir^n$$

$$\boxed{\frac{w^T (x_1 - x_2)}{||w^T||} = \frac{2}{||w||}}$$

Maximize

+ve = 1

-ve : -1

✓ $y_i = +1$

$= -1$

$\boxed{w^T x + b \geq 1}$ +ve

+ve

$w^T x + b \leq -1$ -ve

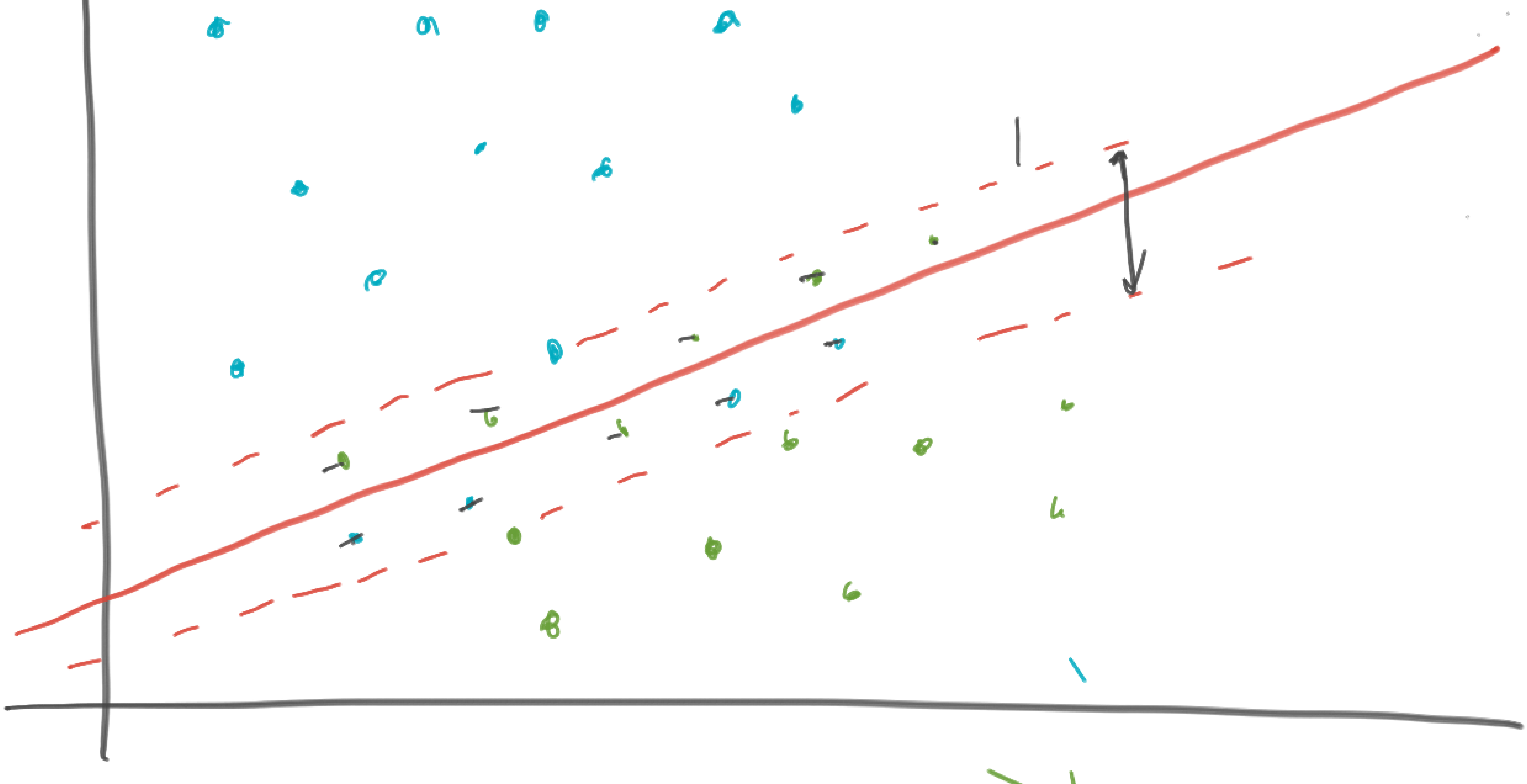
for all correct pt $y_i * (w^T x_i + b) \geq 1$

$$\max_{(w,b)} = \boxed{\frac{2}{\|w^T\|}} \qquad \frac{w^T(x_1 - x_2)}{\|w^T\|} = \boxed{\frac{2}{\|w^T\|}}$$

$$\min_{(w,b)} = \frac{\|w^T\|}{2}$$

$$\text{Obj fun}^n : \min_{(w,b)} \frac{\|w^T\|}{2} + \underbrace{c_i \sum_{i=1}^{n} \xi_i}_{10}$$

✓ hard / soft margin



Desmos tool link :
https://www.desmos.com/calculator/paczfstnvy