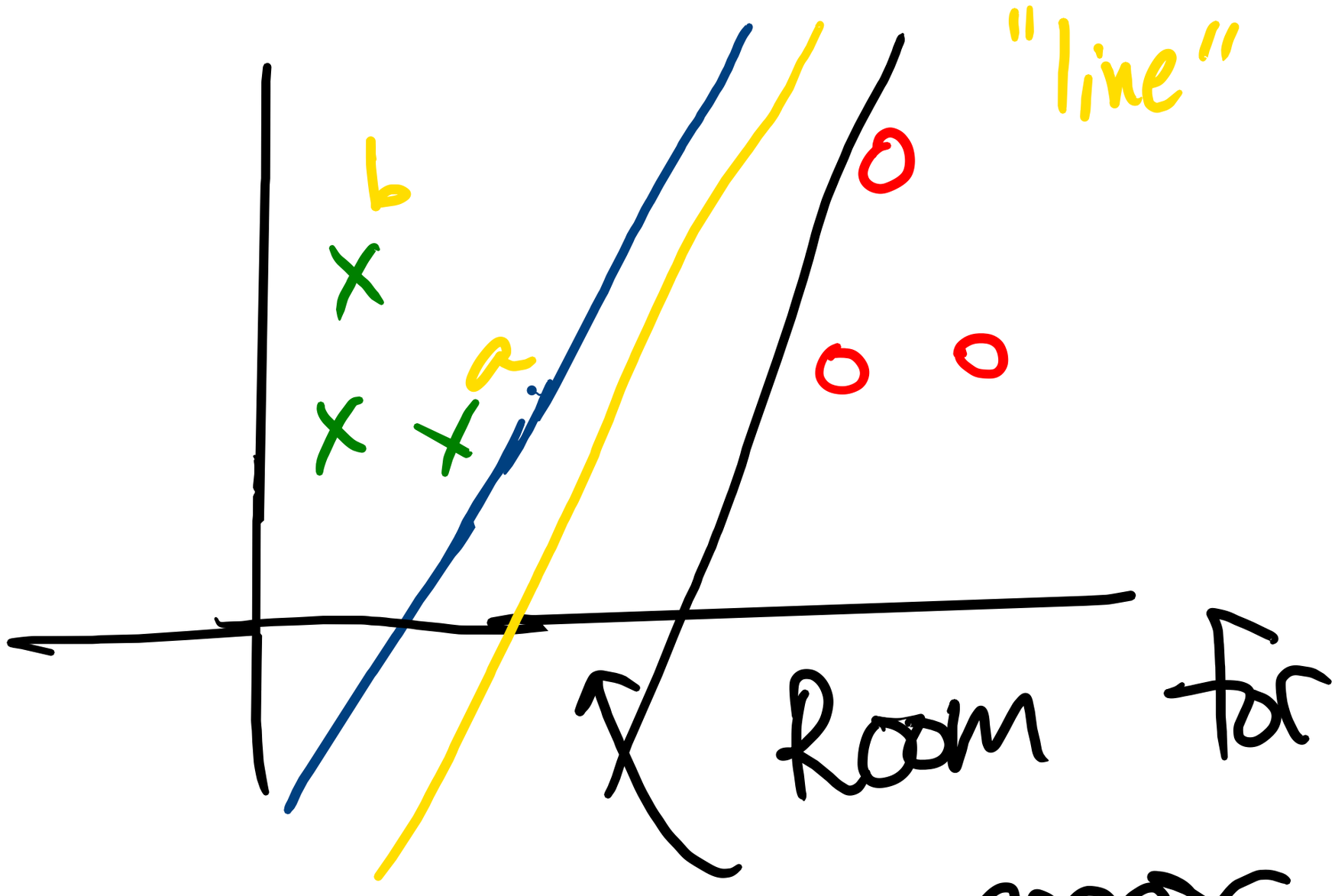
SVM

Support Vector Machine

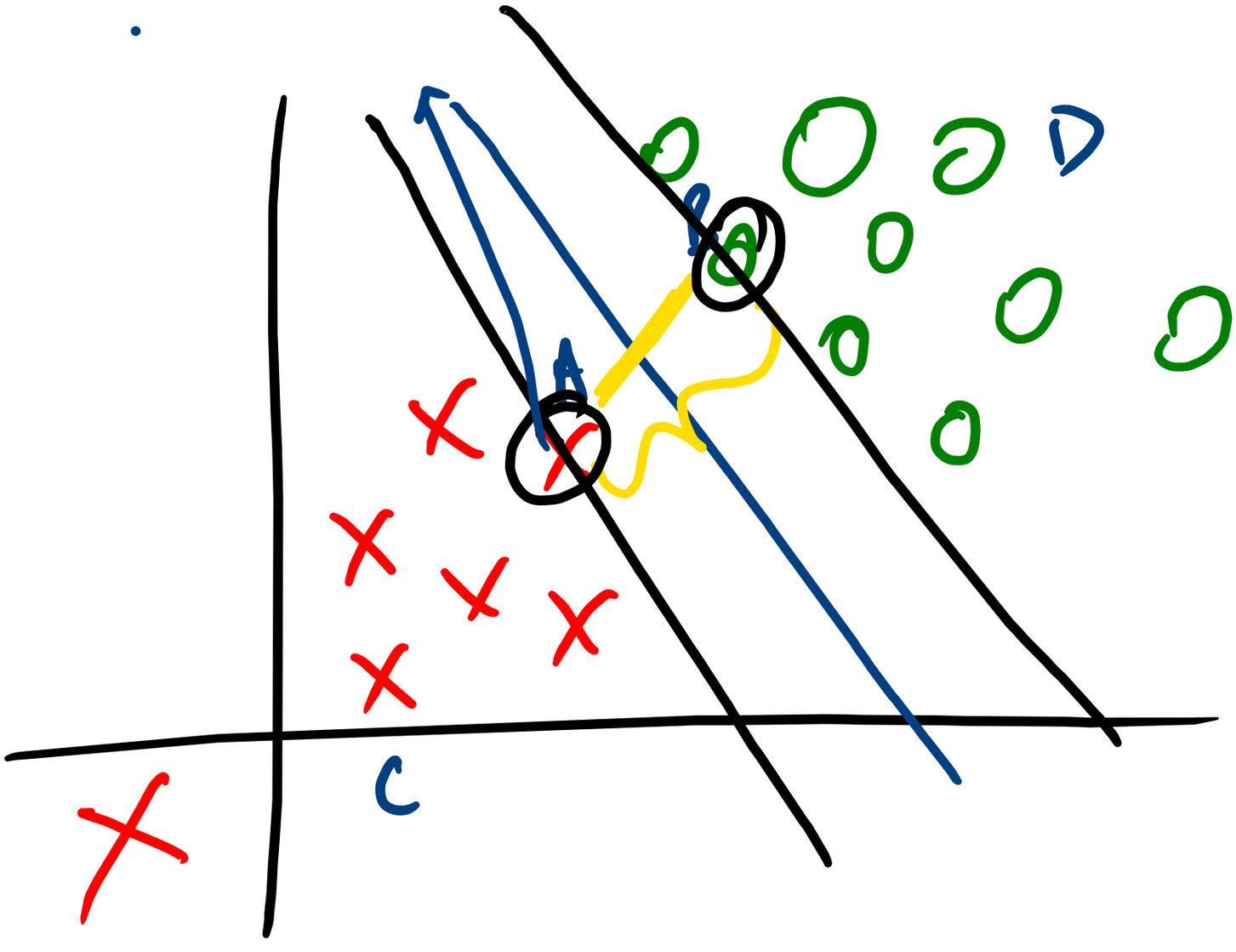
X

labels

"decision boundary"



Robust

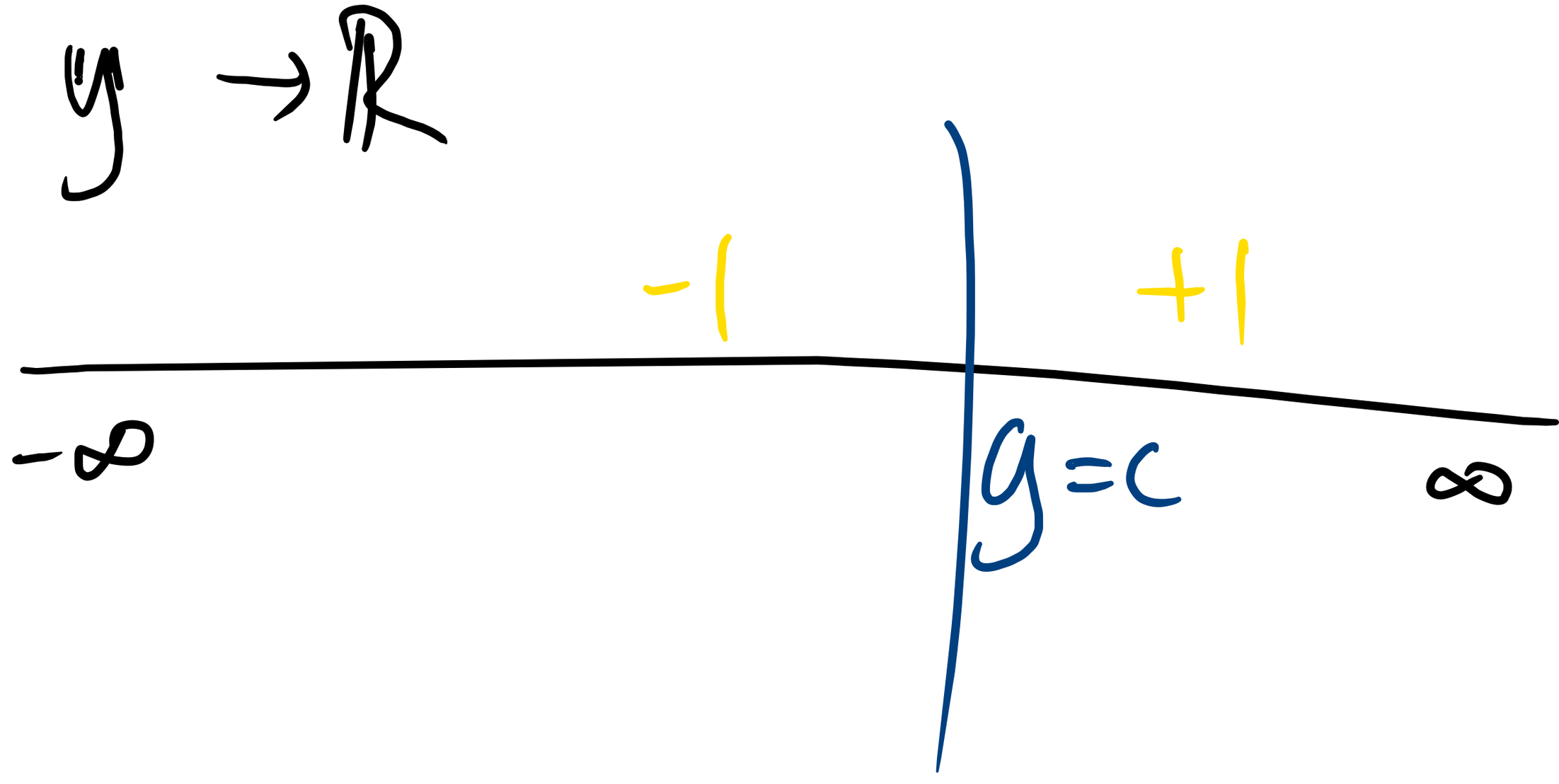


$y_i = +1$

$ax+by \geq c$

$ax+by \leq c$

$y_i = -1$


$y \to \mathbb{R}$
-1
$+1$
$-\infty$
$g = c$
∞

28

28

29

A

4

5

B

Oct

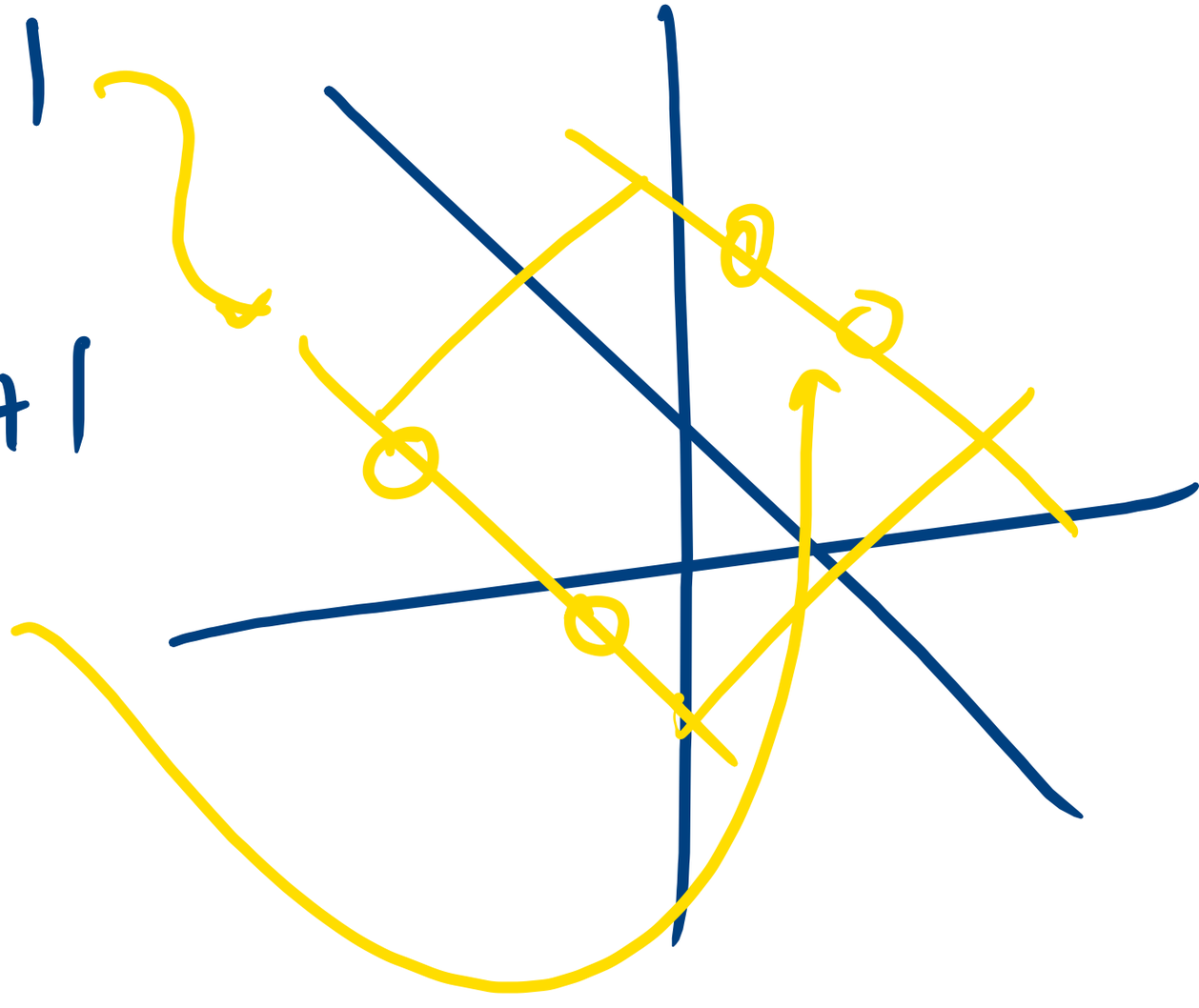
10

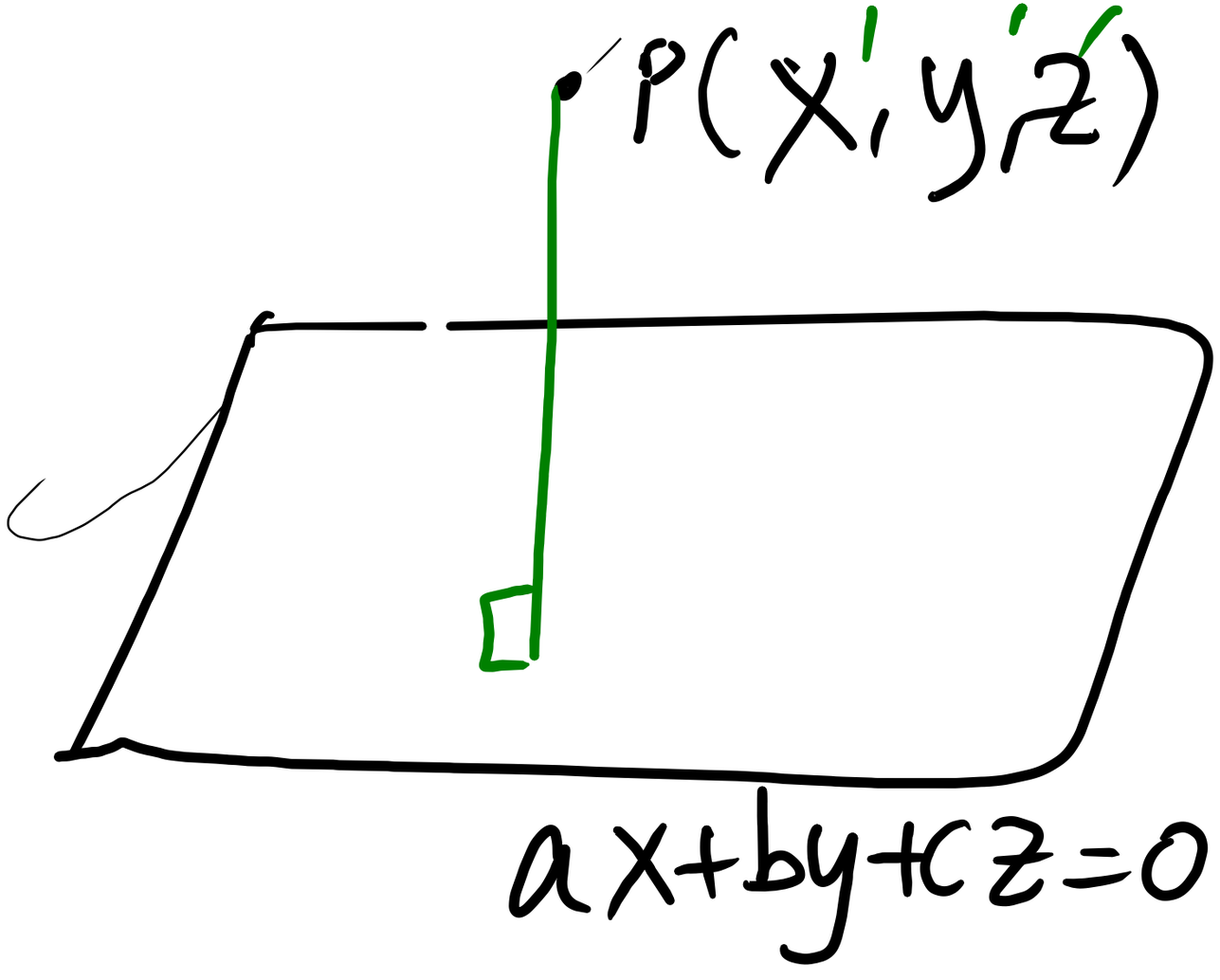
11

Nov

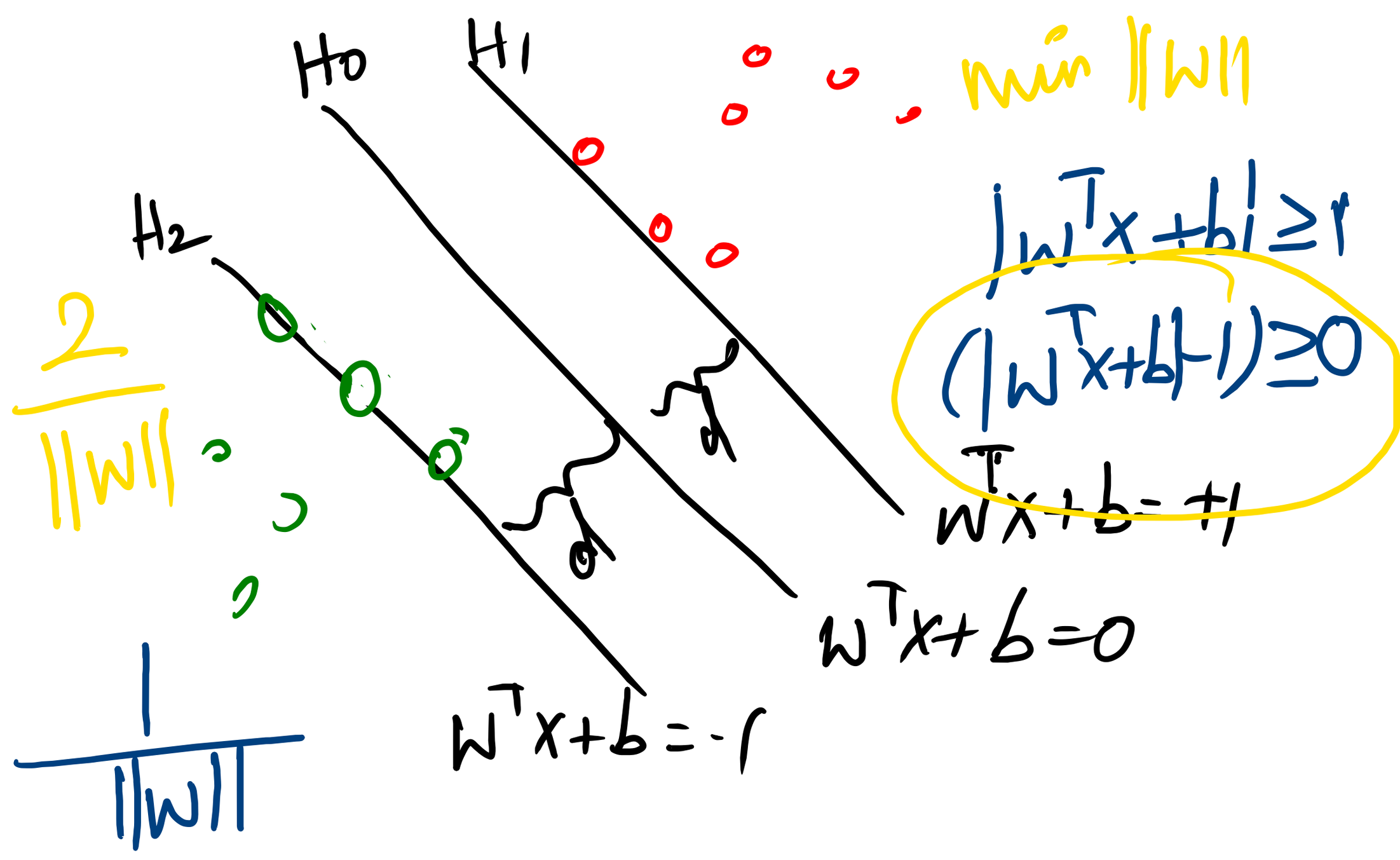
$$w^T x + b = -1$$

$$w^T x + b = +1$$





$$\frac{|ax'+by'+cz'|}{\sqrt{a^2+b^2+c^2}}$$


H0
H1
H2
min ||w||
$|w^T x + b| \geq 1$
$(|w^T x + b| - 1) \geq 0$
$w^T x + b = +1$
$w^T x + b = 0$
$w^T x + b = -1$
$\frac{2}{\|w\|}$
$\frac{1}{\|w\|}$

$\|w\|^2$

$$|y_i(w^T x_i + b)| \geq 1$$

$$L^{(w,b)} = \frac{1}{2}\|w\|^2 - \sum_i a_i y_i (w^T x_i + b) + \sum_i a_i$$

- Dot product formulation.

↳ Similarity

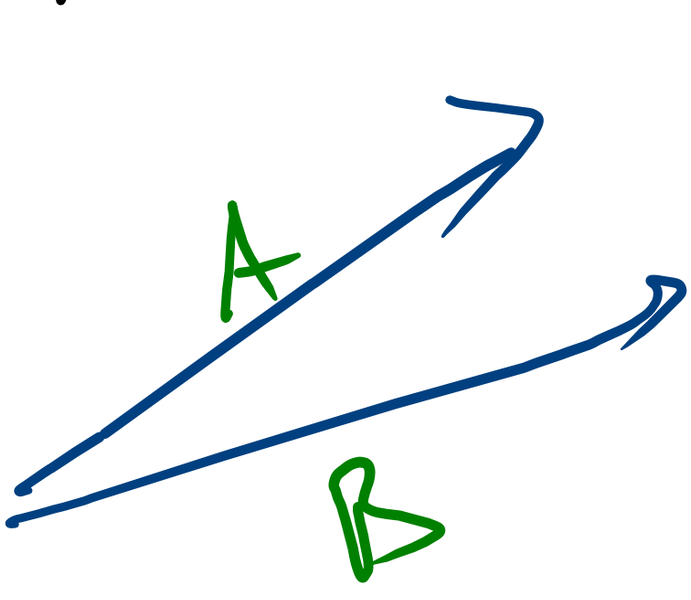
$a \cdot b = \|a\| \|b\| \cos\theta(a,b)$

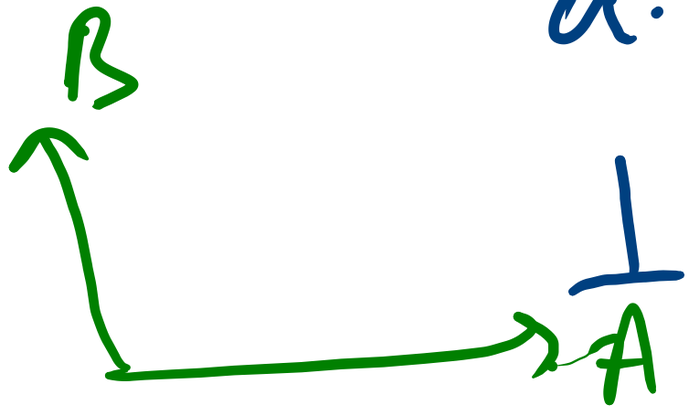
$a^T b$

$a \cdot a = \|a\|^2$

proj. of a on b

$a \cdot b = 0$





$f(a,b) = a \text{ DOT } b$

- $f(a,b) = f(b,a)$
- $f(a,a) \geq 0$
- $f(ca,b) = c \cdot f(a,b)$

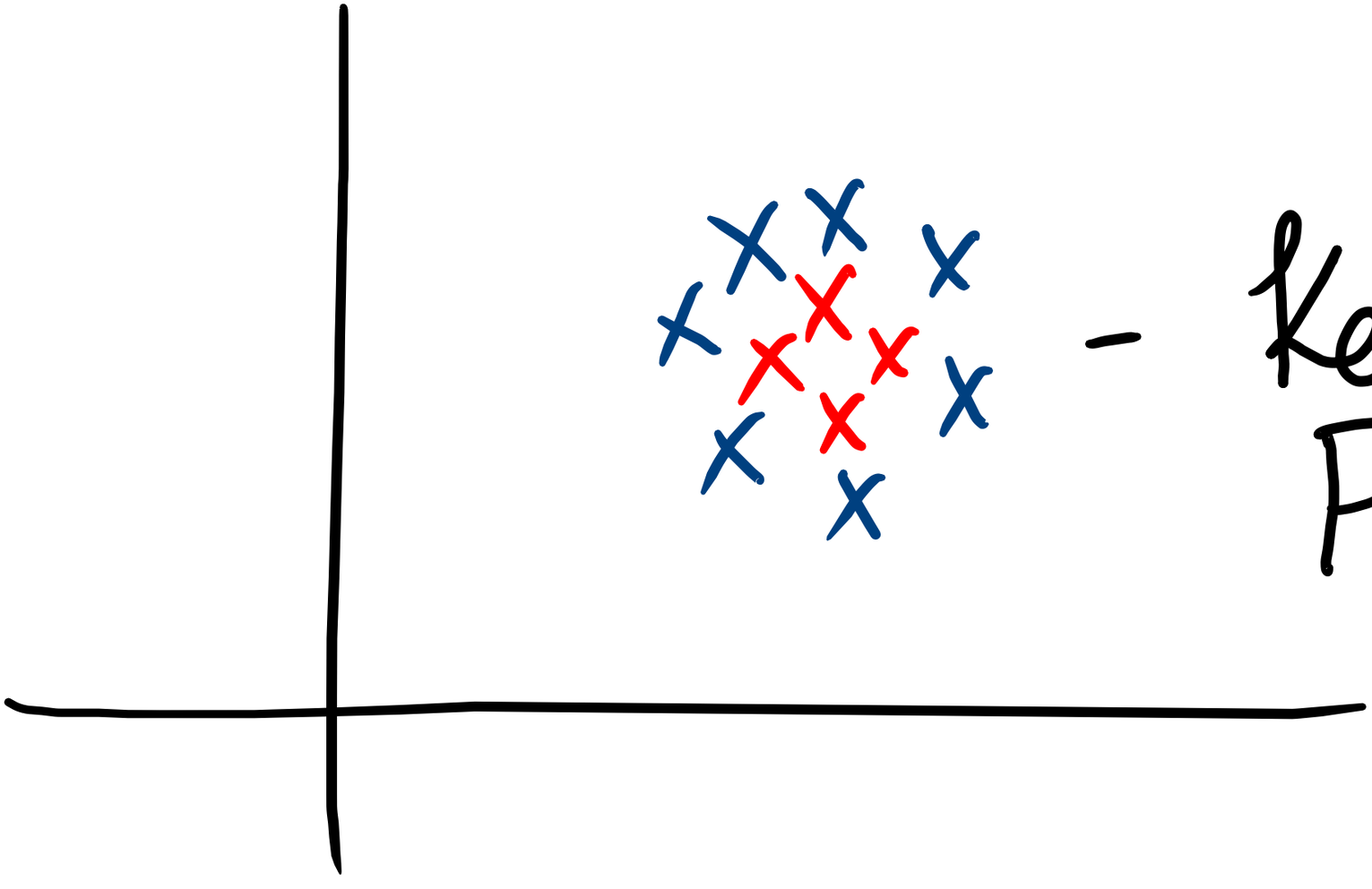
- Margin
- Formulation
- S.V
- Separator
- Similarity

- Kernel
- Transform
- Dimension

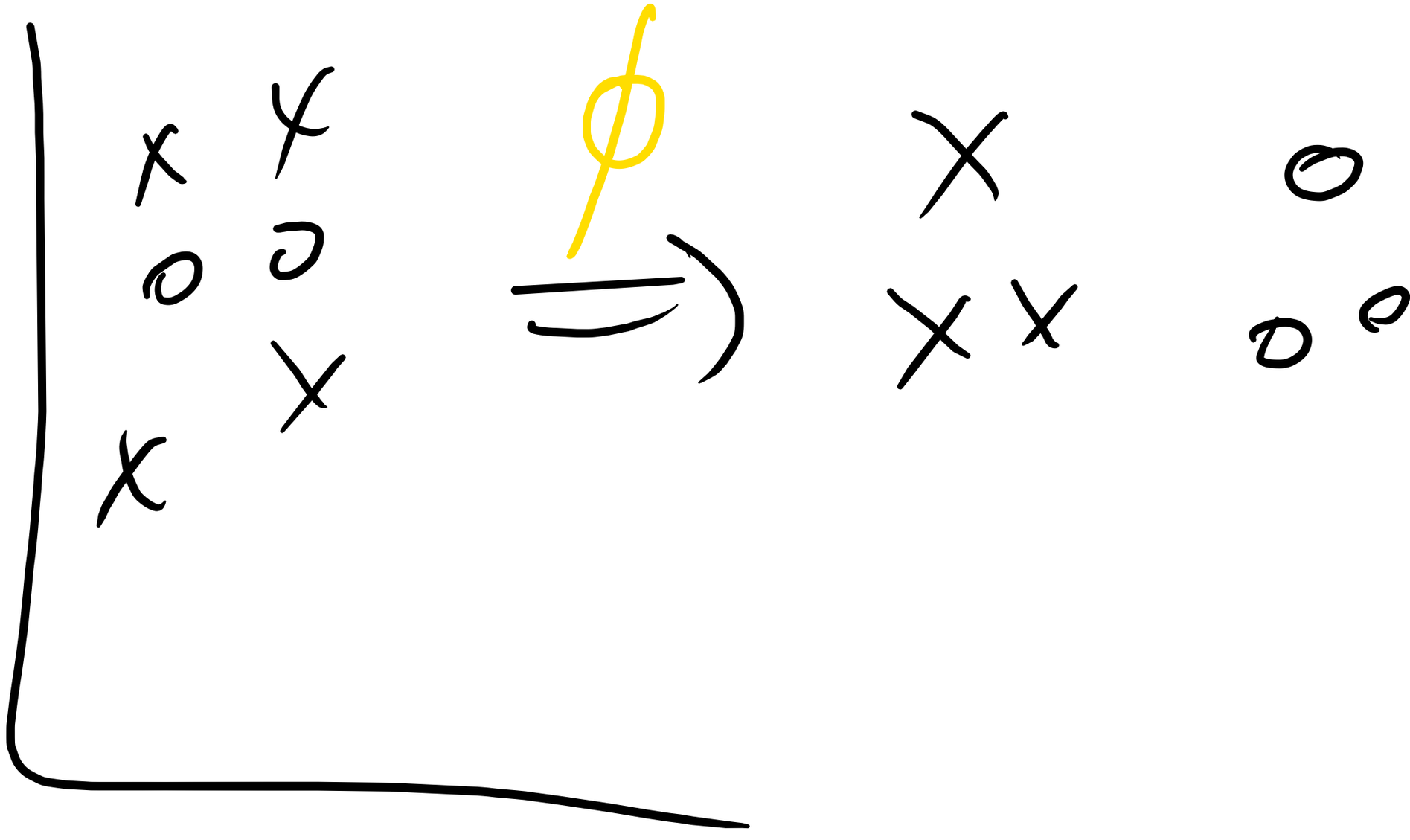
Are the points

linearly Separable?

NOT ALWAYS



- Kernel Functions



$\ldots \phi(a) \cdot \phi(b) \ldots$

1. Keep a & b ready ✓
2. Keep $\phi(a)$ 100 dim ?
3. Keep $\phi(b)$?
4. Compute $\phi(a) \cdot \phi(b)$ $O(m^2)$

$K(a,b)$ ↓ $\langle \phi(a), \phi(b) \rangle$

5

$k(a, b)$

Kernel Trick

5 x 5 x size