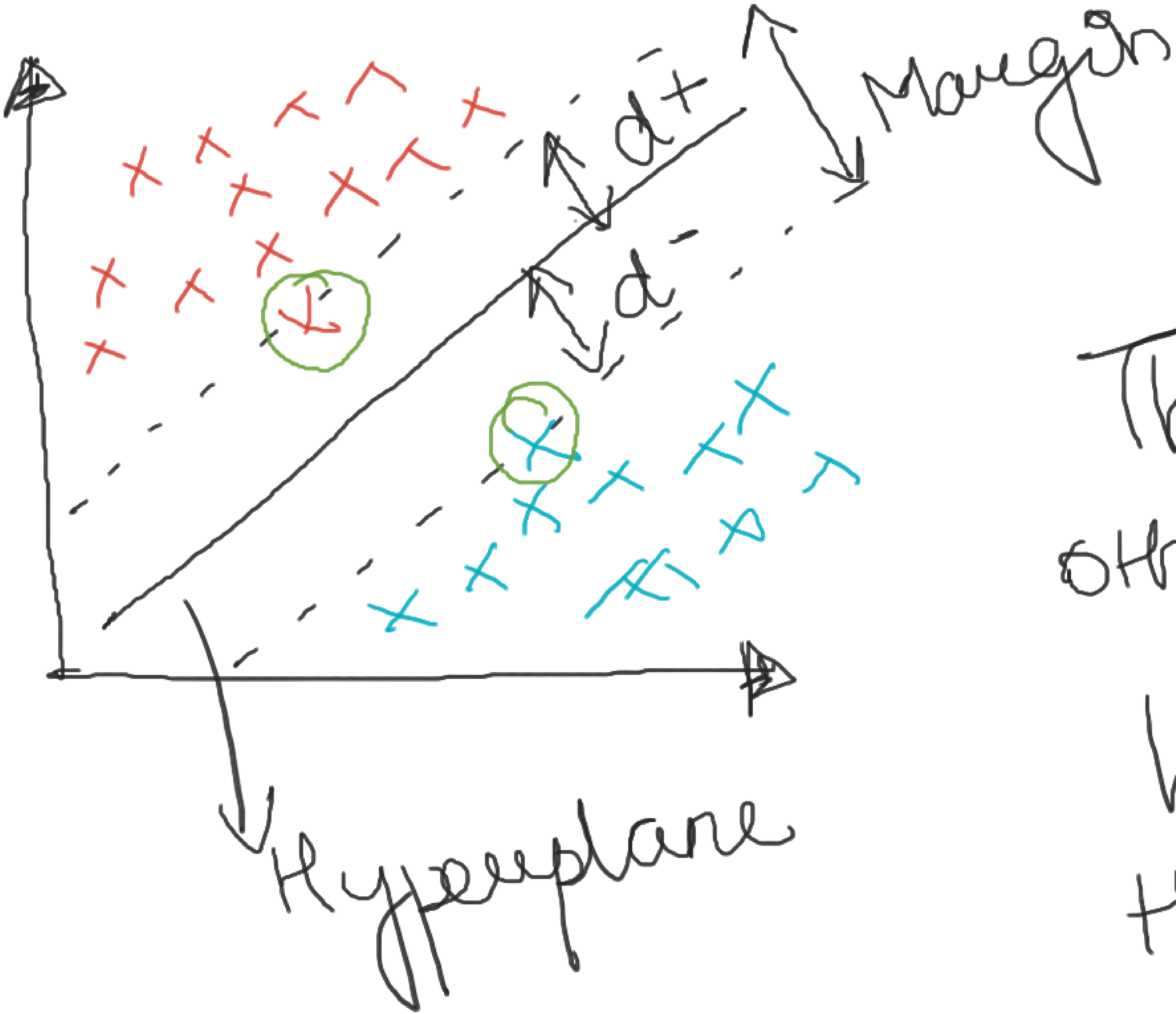
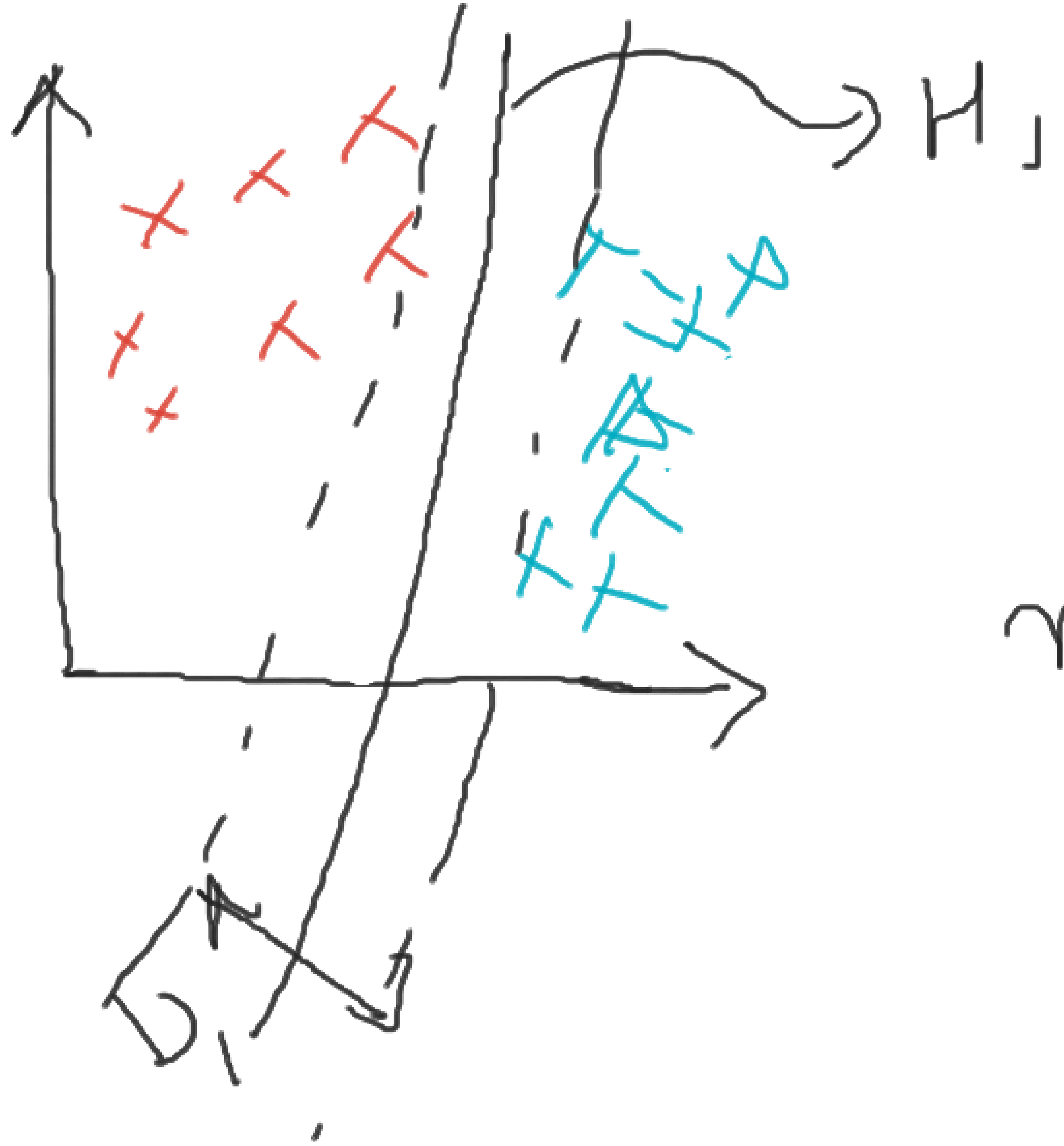
Support vector Machine



They pass thru margin
O → support vectors

There are other possibilities but we choose this because



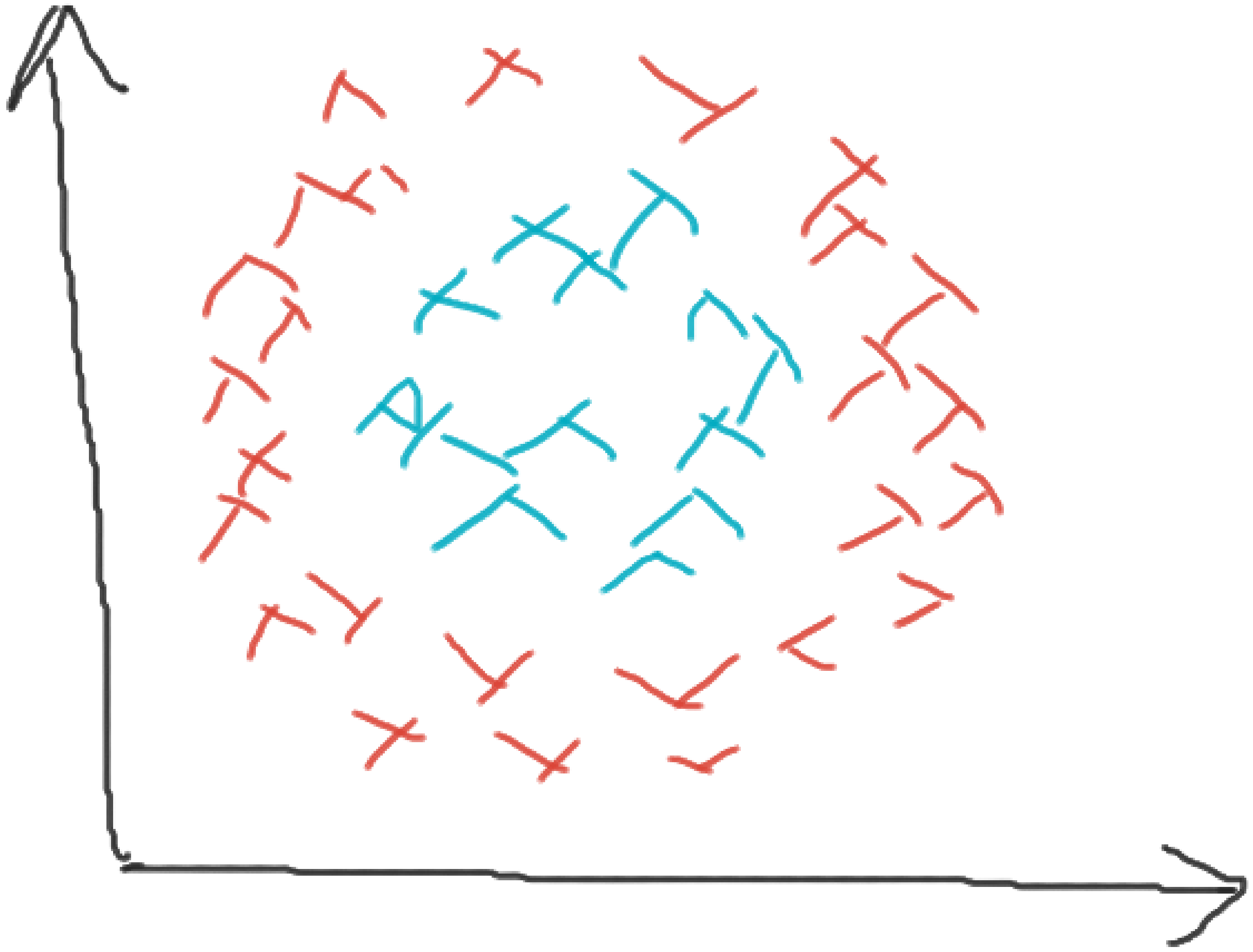
Our main aim is to maximise D → marginal distance

Note: The hyperplane with max margin is best hyperplane.

The previous examples were linearly separable

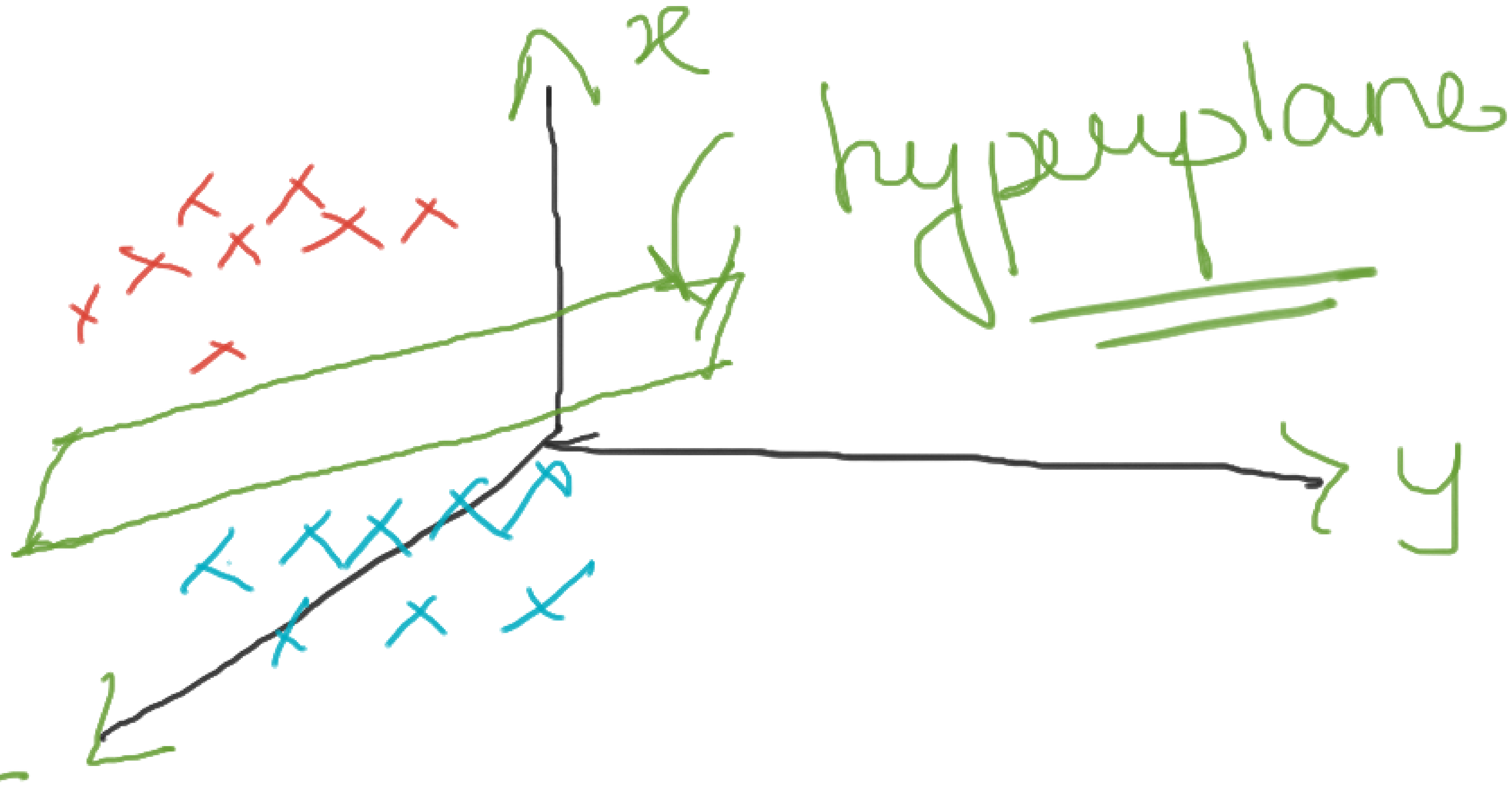
But there may be non-linear separable

E.g

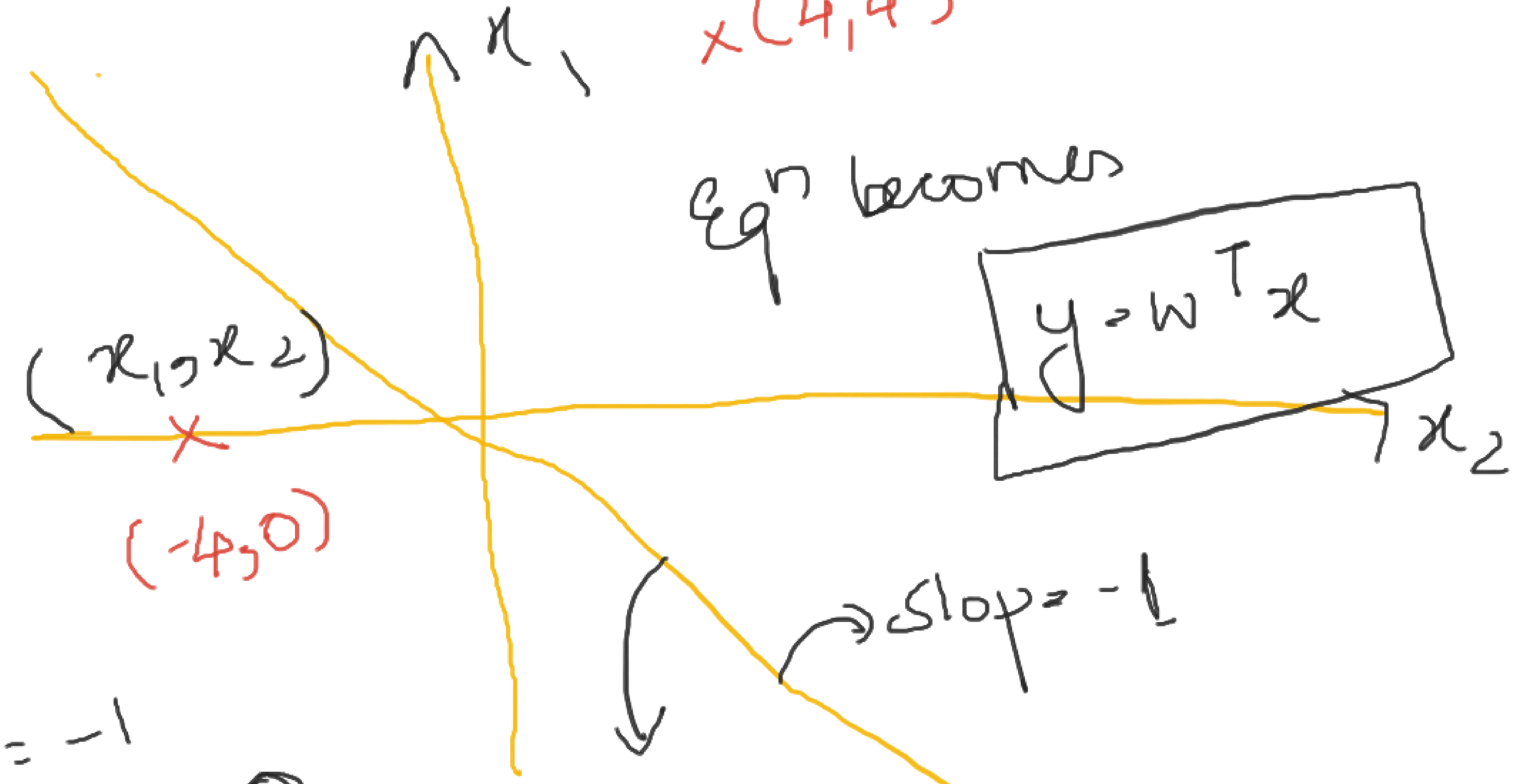


To solve non linear separable data, we use SVM Kernels.

↳ convert 2D → 3D



SVM maths intuition



$m = -1$

c or $b = 0$

$w^T x + b = 0$

$$
\begin{array}{cc}
w & \\
= \begin{bmatrix} -1 \\ 0 \end{bmatrix} & \begin{bmatrix} -4 & 0 \end{bmatrix} \\
1 \times 2 & 2 \times 1
\end{array}
$$

$= 4 \rightarrow +ve$ value

Any point in red below line, it will always be +ve ✓

For above point

$$y = w^T x$$

$$= \begin{bmatrix} -1 \\ 0 \end{bmatrix} \begin{bmatrix} 4 & 4 \end{bmatrix}$$

$$= -4 \Rightarrow -ve$$

Always -ve above line

$+ve \rightarrow +1$

$-ve \rightarrow -1$

→ For simplification

x_1
x_2
b
$w^T x + b = -1$
$w^T x + b = 0$
$w^T x + b = +1$

$$w^T x_1 + b = -1$$

$$w^T x_2 + b = +1$$

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

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

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

maximize this

Update w^*, b^* such that

we maximize $\frac{2}{\|w\|}$

such that $\begin{cases} +1, & w^T x + b \geq 1 \\ -1, & w^T x + b \leq -1 \end{cases}$

$y_i * w^T x_i + b_i \geq 1 \rightarrow$ okay

$$(w^*, b^*) = \min \frac{\|w\|}{2} + C\sum_{i=1}^{n} \xi_i$$

→ value of error

How many errors my model can consider

SVM optimization fn

→ Regularization