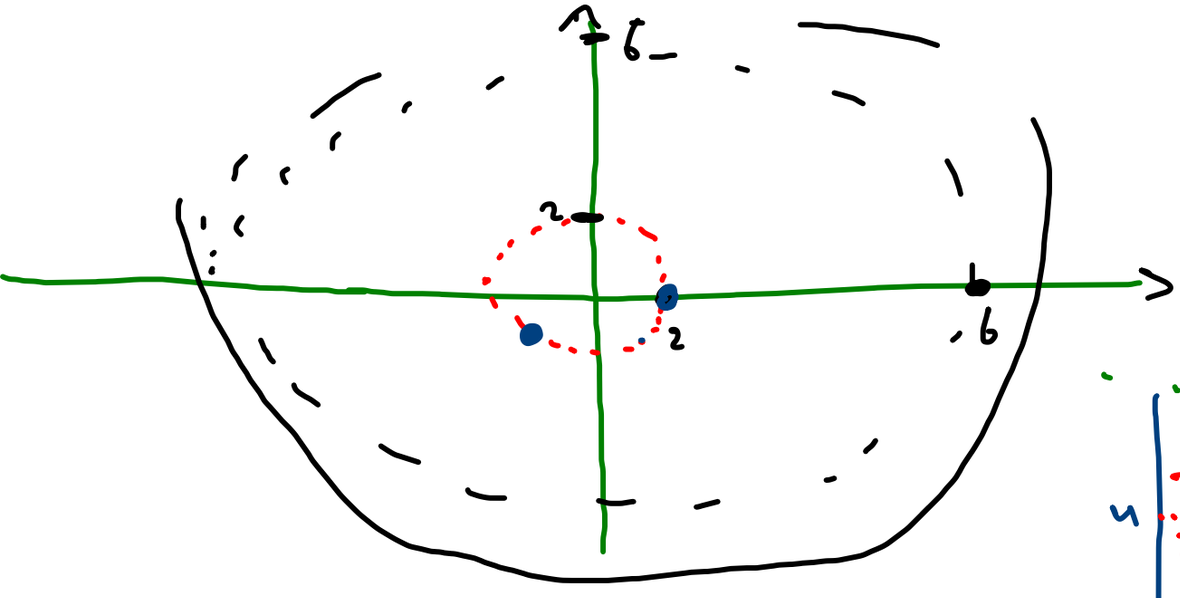
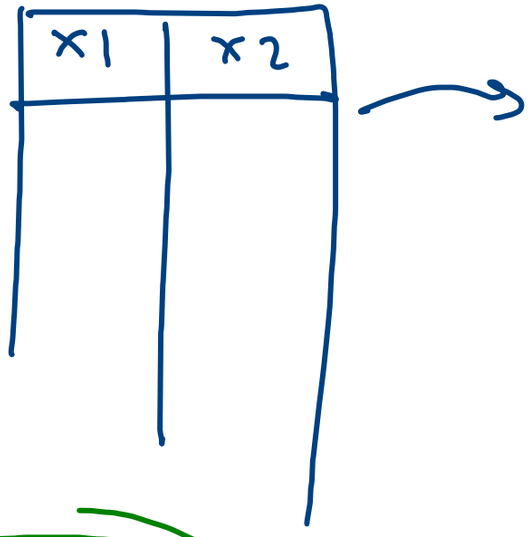
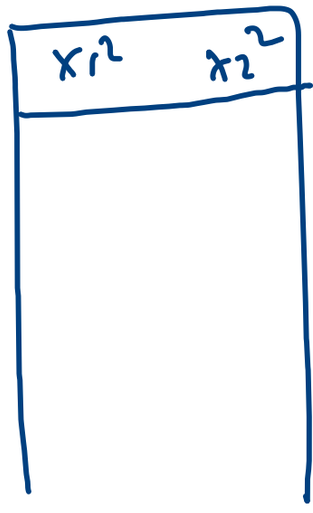
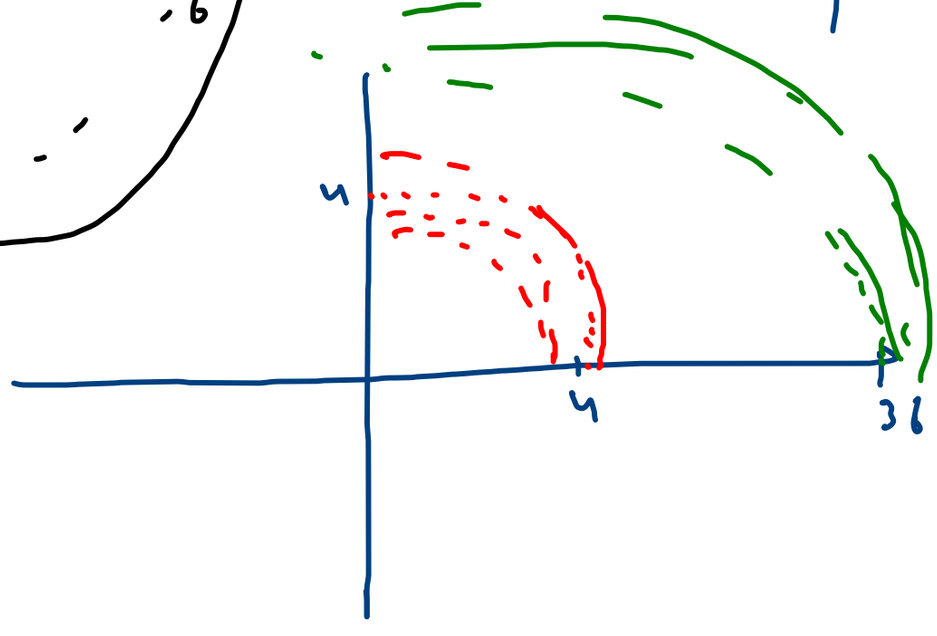






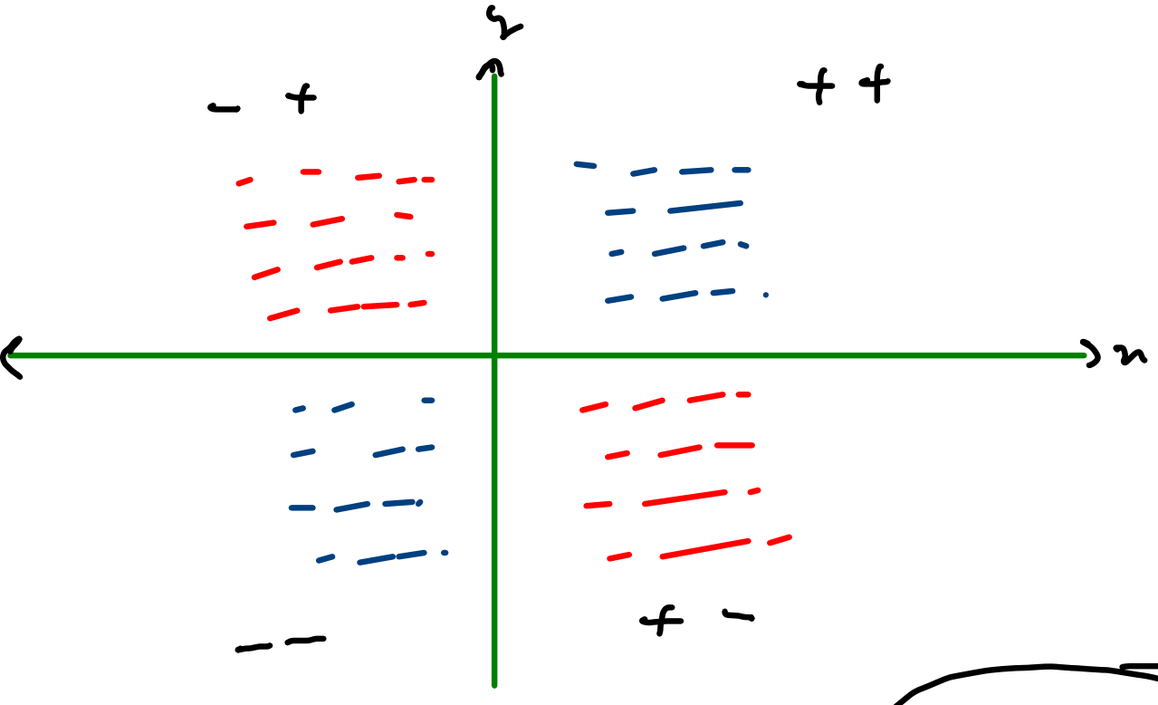


$(-2)^2 = 4$

$2^2 = 4$

$6^2 = 36$

$-6^2 = 36$

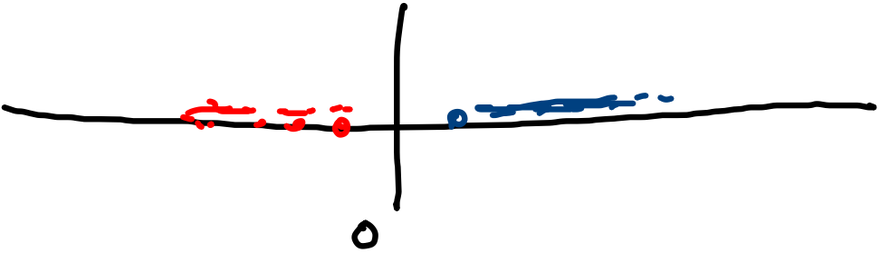


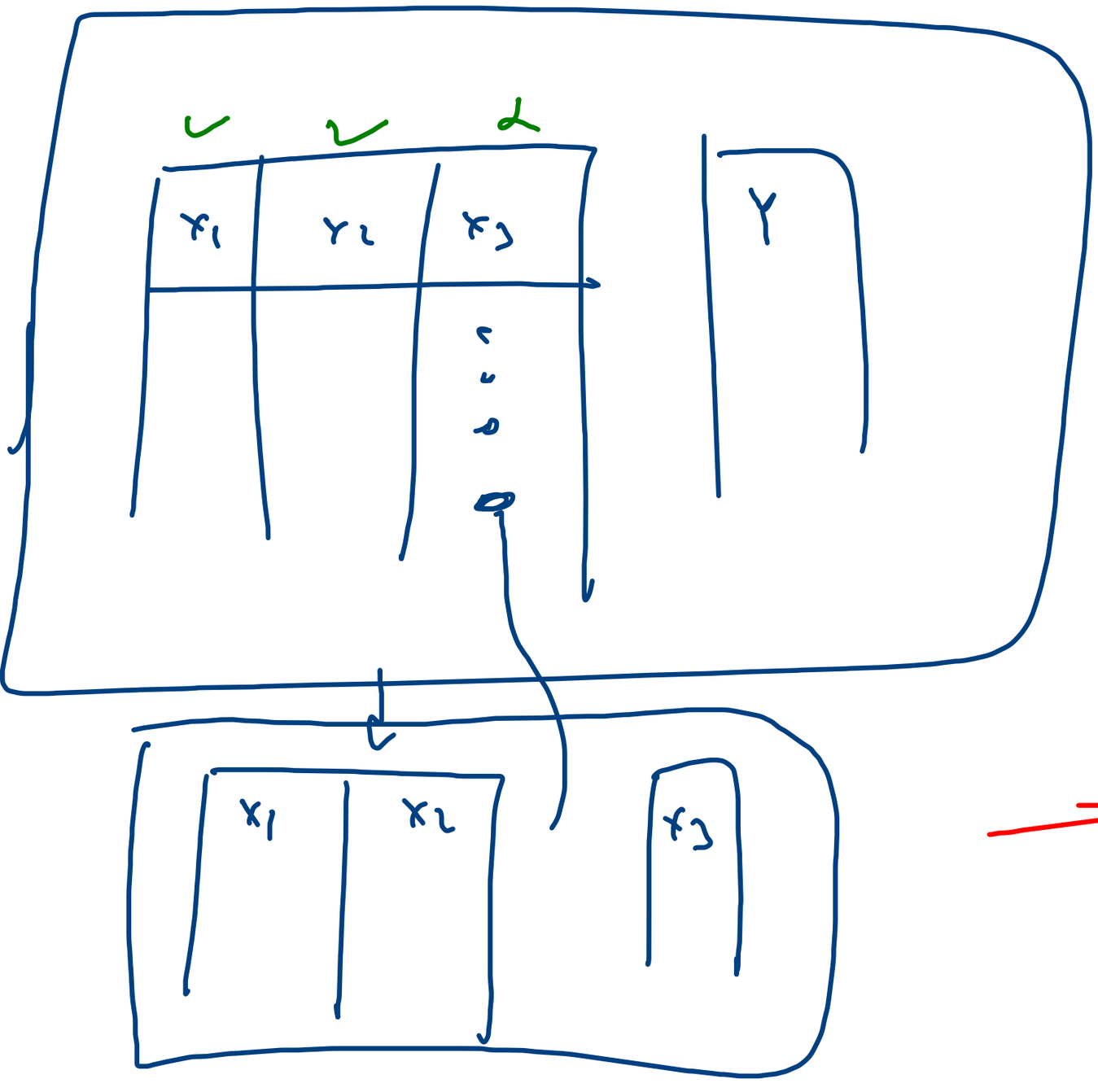
x_1	x_2	Y
+	+	0
-	-	
+	-	1
-	+	

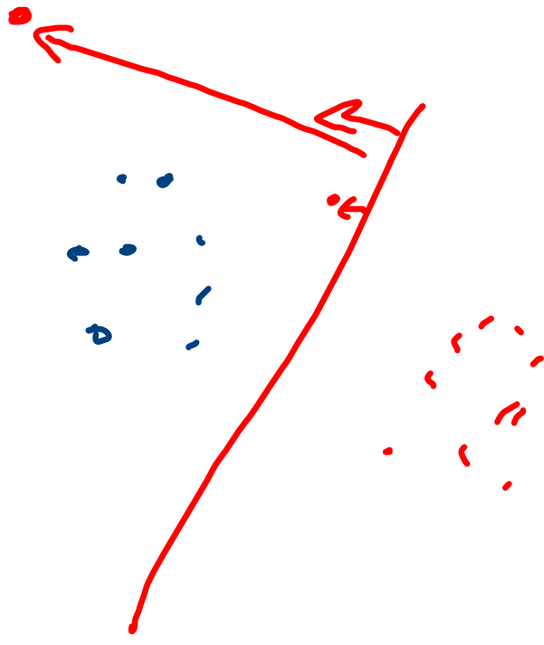
+ve

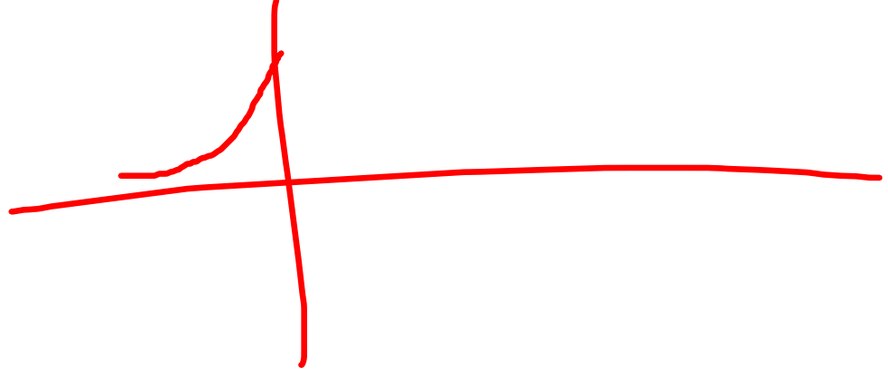
-ve

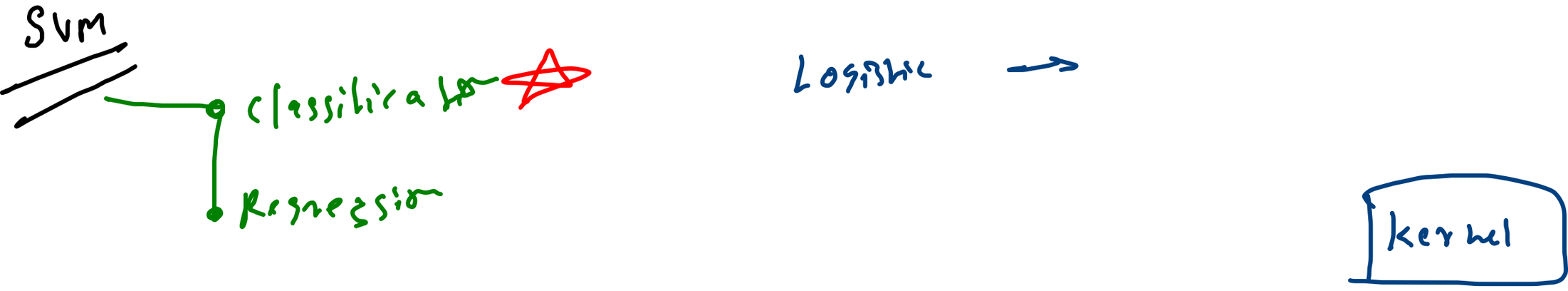
$n_1 \times n_2$





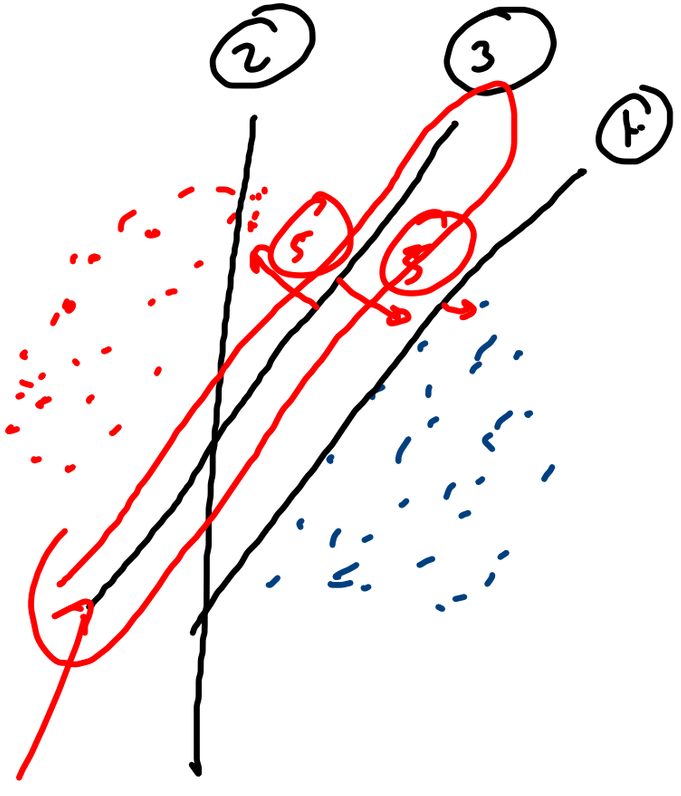





SVM
classification
Regression
Logistic
kernel

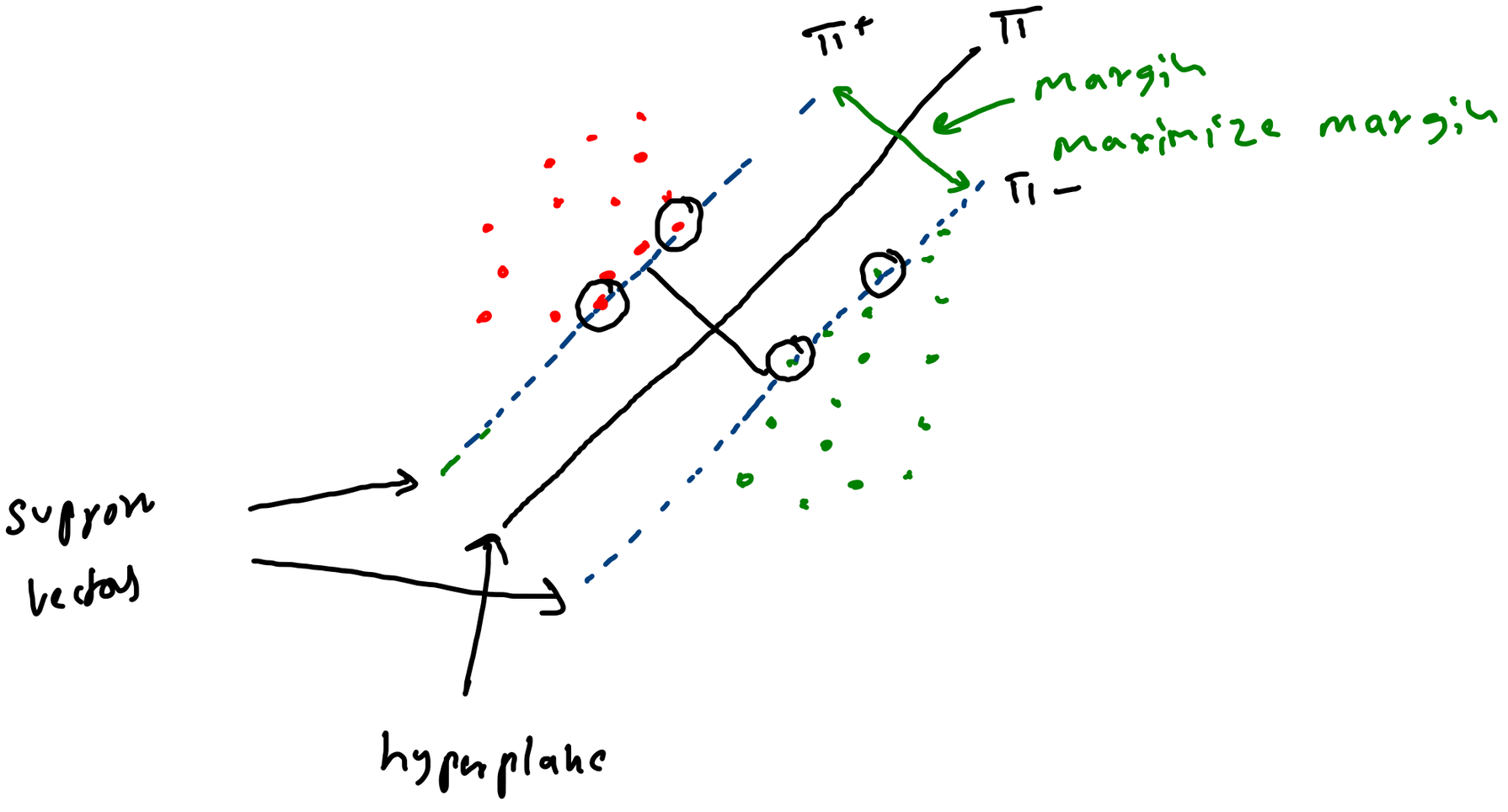
Intuition

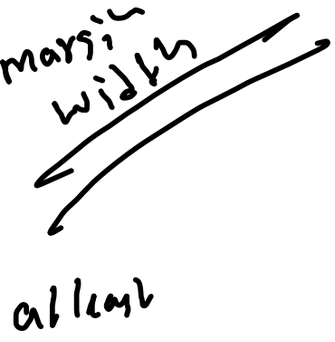
SVM

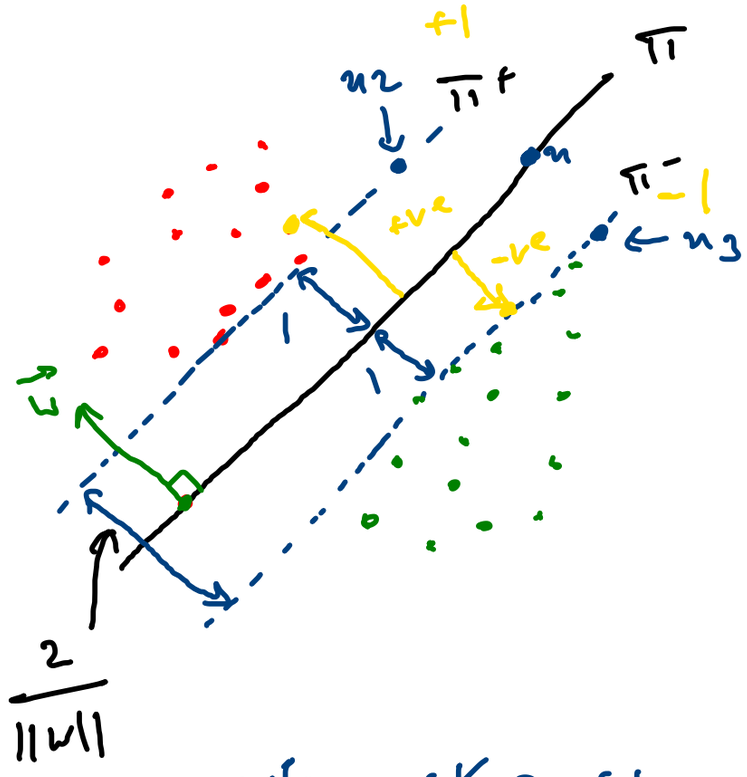


SVM finds this

Team's







$$\text{distance} = \frac{w^T x + b}{\|w\|}$$

★

π	$w^T x + b = 0$
π_+	$w^T x_2 + b = +1$
π_-	$w^T x_3 + b = -1$

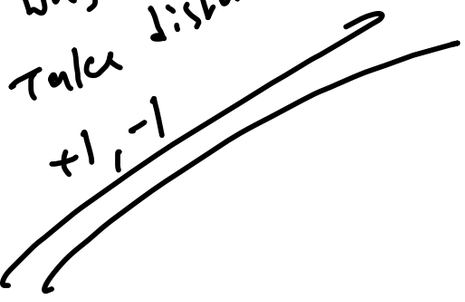
$\pi_+ - \pi_-$

$$w^T x_2 + b = +1$$
$$- \quad w^T x_3 + b = -1$$
$$w^T (x_2 - x_3) = 2$$

$$x_2 - x_3 = \frac{2}{w}$$

$$\text{margin distance} = \frac{2}{\|w\|}$$

Why take distance $+1, -1$



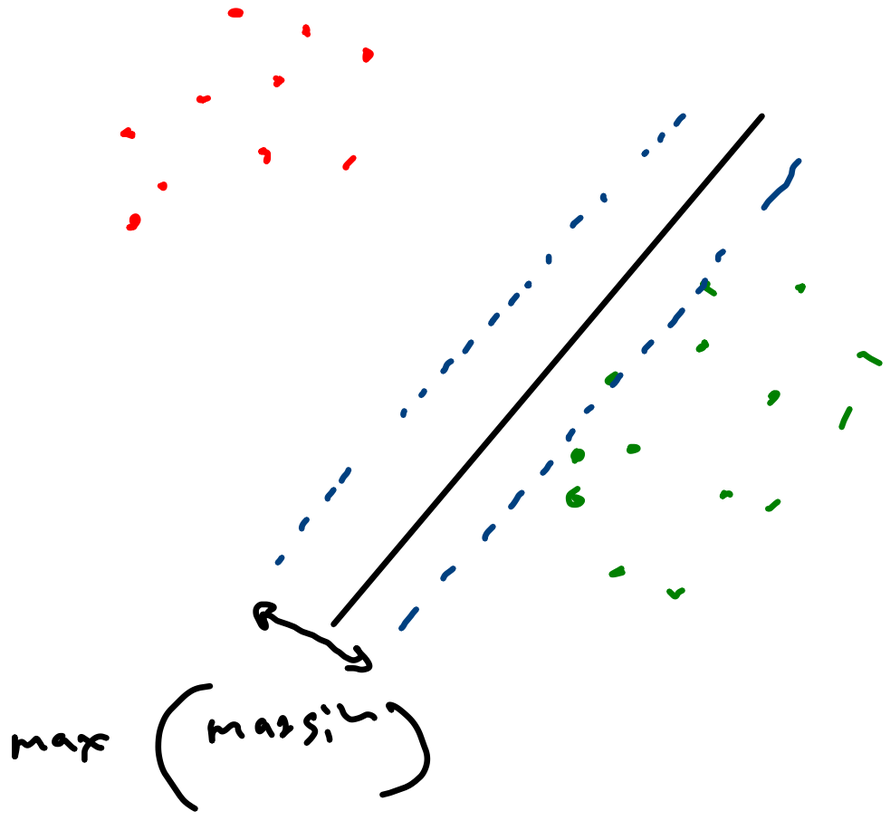
$$w^T x + b = k$$

$$\frac{w^T x}{k} + \frac{b}{k} = 1$$

$$\hat{w}^T x + b' = 1$$

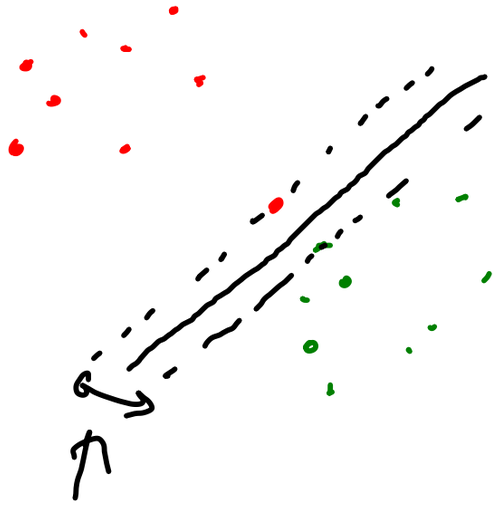
π	$w^T x + b = 0$
$\pi +$	$w^T x_2 + b = +1$
$\pi -$	$w^T x_3 + b = -1$

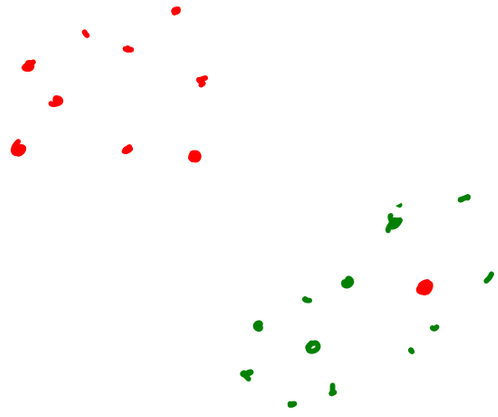
Why maximize margin



Hard margin

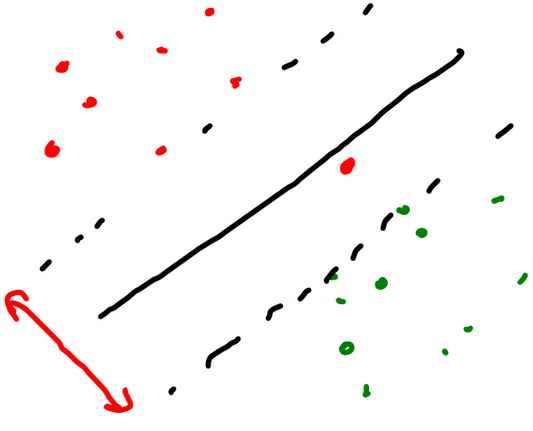
- margin maximize
- error = 0





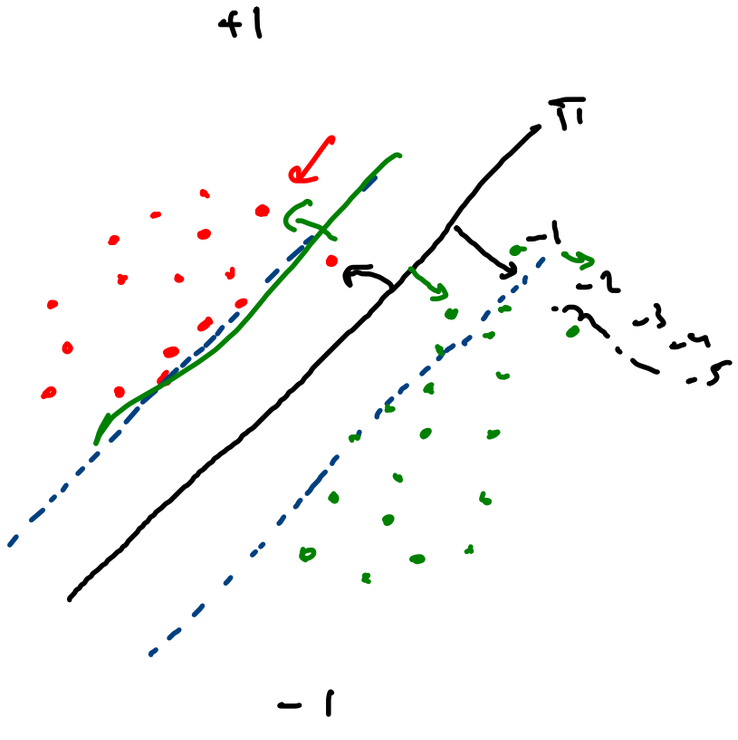
Soft margin

Trade off margin error



error

Intuition



$-1\left(w_n + b\right) \geq +1$

$y_i = +1$

$w_n + b \geq 1$ correct

$w_n + b < 1$ wrong

$y_i = -1$

$w_n + b \leq -1$ correct

$w_n + b > -1$ wrong

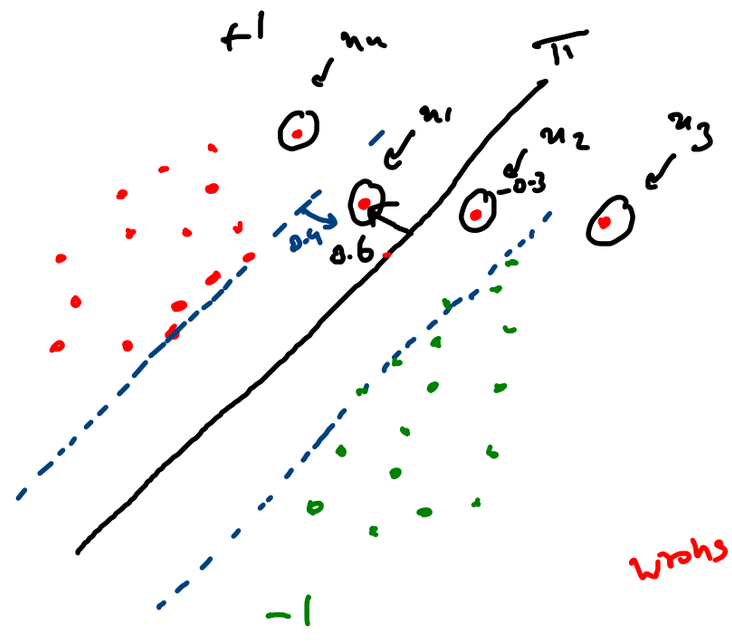
Generalize

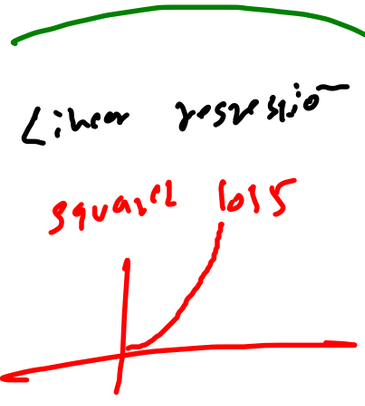
$y_i\left(w_n + b\right) \geq 1$ correct

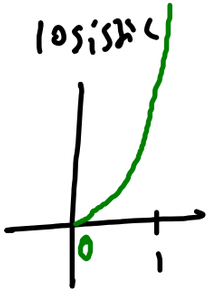
$y_i\left(w_n + b\right) < 1$ wrong

Error

$y_i(wx+b) < 1$







Wrong

x_1 $y_i(wx+b)$

$1 \times 0.6 = 0.6$

$= 1 - 0.4$ error

x_2 $y_i(wx+b)$

$1(-0.3) = -0.3$

$= 1 - (1.3)$ Bigger

x_3 $y_i(wx+b)$

$1 \times (-1.7) = -1.7$

$= 1 - (2.7)$ error

Correct

x_4 $y_i(wx+b)$

$1 \times 1.7 = 1.7$

$1 - (-0.7)$ -ve

$$\text{error} = \begin{cases} 0 \\ z \end{cases}$$

$$y_i (wx + b) \geq 1$$

$$y_i (wx + b) = 1 - (z)$$

$$\frac{1}{m} \sum_{i=1}^{m} z_i$$

$$z = 1 - y_i (wx + b)$$

maximize width

minimize error

$$\text{cost function} = \max\left(\frac{2}{\|w\|}\right) + \min\left(\frac{1}{m}\sum_{i=1}^{m} \xi_i\right)$$

$$= \min\left(\|w\|\right) + C \min\left(\frac{1}{m}\sum_{i=1}^{m} \xi_i\short\right)$$

if $C = 0 \rightarrow$ underfitting

$C = \infty \rightarrow$ overfitting

short maximize

$$\min \left[\left(\|w\| \right) + C \left(\frac{1}{m} \sum_{i=1}^{m} \xi_i \right) \right]$$

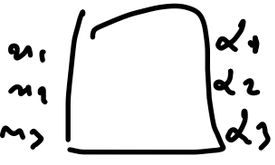
$$f(x_q) = w^T x_q + b$$

Primal

$$\max \left[0,\ 1 - y_i (w x + b) \right]$$

Consider

Lagrange

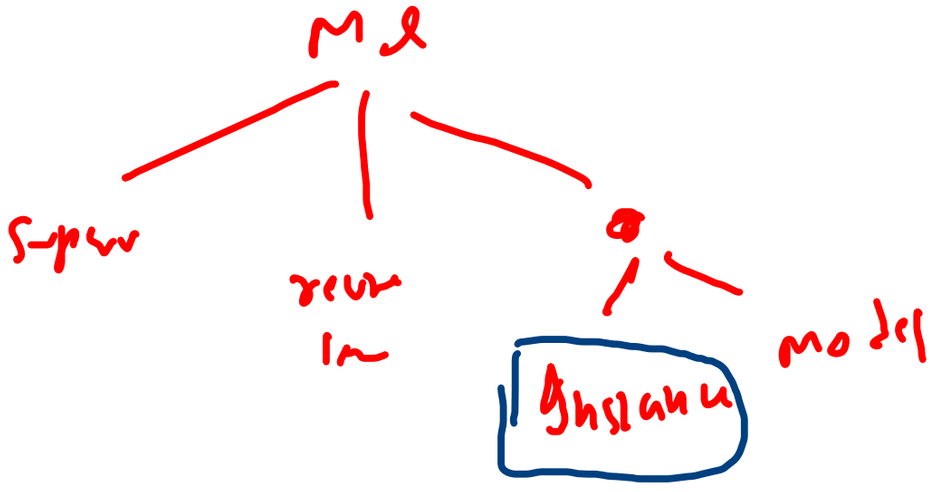


Dual form →

$$\min \left[+ \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \alpha_i \alpha_j y_i y_j \boxed{x_i^T x_j} - \sum_{i=1}^{m} \alpha_i \right]$$

$$k(a, b) = a^T . b$$

$$f(x_q) = \sum_{i=1}^{m} \alpha_i y_i k(x_i, x_q) + b$$


ML
Supervised
Reinforcement
Unsupervised
Model