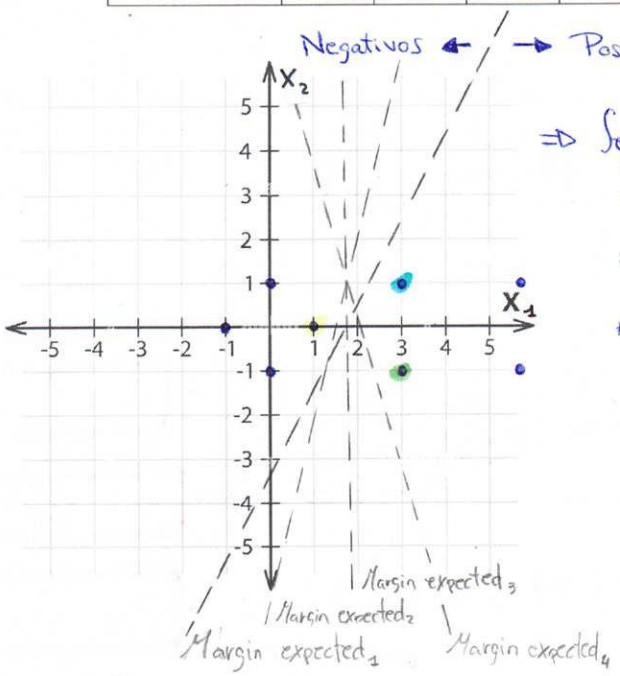
Ej1: Support Vector Machine (SVM) – Linear

Valores X	(-1, 0)	(0, 1)	(0, -1)	(1, 0)	(3, 1)	(3, -1)	(6, 1)	(6, -1)
Tipo	Neg.	Neg.	Neg.	Neg.	Pos.	Pos.	Pos.	Pos.
Valores Y	-1	-1	-1	-1	+1	+1	+1	+1



⇒ Según mi "Margins expected" mis "Support Vectors" son:

* $S_1 = (1, 0)$ ← Negativo = -1
* $S_2 = (3, 1)$ ← Positivo = +1
* $S_3 = (3, -1)$ ← Positivo = +1

$$S_1: \alpha_1 \cdot \tilde{S}_1 \cdot \tilde{S}_1 + \alpha_2 \cdot \tilde{S}_2 \cdot \tilde{S}_1 + \alpha_3 \cdot \tilde{S}_3 \cdot \tilde{S}_1 = -1$$

$$S_2: \alpha_1 \cdot \tilde{S}_1 \cdot \tilde{S}_2 + \alpha_2 \cdot \tilde{S}_2 \cdot \tilde{S}_2 + \alpha_3 \cdot \tilde{S}_3 \cdot \tilde{S}_2 = +1$$

$$S_3: \alpha_1 \cdot \tilde{S}_1 \cdot \tilde{S}_3 + \alpha_2 \cdot \tilde{S}_2 \cdot \tilde{S}_3 + \alpha_3 \cdot \tilde{S}_3 \cdot \tilde{S}_3 = +1$$

$$S_1: \alpha_1 \cdot (1,0,-1) \cdot (1,0,-1) + \alpha_2 \cdot (3,1,-1) \cdot (1,0,-1) + \alpha_3 \cdot (3,-1,-1) \cdot (1,0,-1) = -1$$

$$\alpha_1 \cdot [(1 \cdot 1) + (0 \cdot 0) + (-1 \cdot (-1))] + \alpha_2 \cdot [(3 \cdot 1) + (1 \cdot 0) + (-1 \cdot (-1))] + \alpha_3 \cdot [(3 \cdot 1) + (-1 \cdot 0) + (-1 \cdot (-1))] = -1$$

$$\Rightarrow 2\alpha_1 + 4\alpha_2 + 4\alpha_3 = -1$$

$$S_2: \alpha_1 \cdot (1,0,1) \cdot (3,1,1) + \alpha_2 \cdot (3,1,1) \cdot (3,1,1) + \alpha_3 \cdot (3,-1,1) \cdot (3,1,1) = +1$$

$$\alpha_1 \cdot [(1 \cdot 3) + (0 \cdot 1) + (1 \cdot 1)] + \alpha_2 \cdot [(3 \cdot 3) + (1 \cdot 1) + (1 \cdot 1)] + \alpha_3 \cdot [(3 \cdot 3) + (-1 \cdot 1) + (1 \cdot 1)] = +1$$

$$\Rightarrow 4\alpha_1 + 11\alpha_2 + 9\alpha_3 = +1$$

$$S_3: \alpha_1 \cdot (1,0,1) \cdot (3,-1,1) + \alpha_2 \cdot (3,1,1) \cdot (3,-1,1) + \alpha_3 \cdot (3,-1,1) \cdot (3,-1,1) = +1$$

$$\alpha_1 \cdot [(1 \cdot 3) + (0 \cdot (-1)) + (1 \cdot 1)] + \alpha_2 \cdot [(3 \cdot 3) + (1 \cdot (-1)) + (1 \cdot 1)] + \alpha_3 \cdot [(3 \cdot 3) + (-1 \cdot (-1)) + (1 \cdot 1)] = +1$$

$$\Rightarrow 4\alpha_1 + 9\alpha_2 + 11\alpha_3 = +1$$

- Sistema de 3 ecuaciones y 3 incógnitas:

$$\begin{cases} 2\alpha_1 + 4\alpha_2 + 4\alpha_3 = -1 \rightarrow (1) \\ 4\alpha_1 + 11\alpha_2 + 9\alpha_3 = +1 \rightarrow (2) \\ 4\alpha_1 + 9\alpha_2 + 11\alpha_3 = +1 \rightarrow (3) \end{cases}$$

(2) y −(3): $4\alpha_1 + 11\alpha_2 + 9\alpha_3 = +1$

$-4\alpha_1 - 9\alpha_2 - 11\alpha_3 = -1$

$+2\alpha_2 - 2\alpha_3 = 0 \rightarrow \boxed{\alpha_2 = \alpha_3}$

−2·(1) y (2): $-4\alpha_1 - 8\alpha_2 - 8\alpha_3 = 2$

$4\alpha_1 + 11\alpha_2 + 9\alpha_3 = 1$

$3\alpha_2 + \alpha_3 = 3 \rightarrow$

$4\alpha_2 = 3 \rightarrow \boxed{\alpha_2 = 3/4 = 0{,}75}$

$4\alpha_3 = 3 \rightarrow \boxed{\alpha_3 = 3/4 = 0{,}75}$

(1): $2\alpha_1 + 4\alpha_2 + 4\alpha_3 = -1 \rightarrow 2\alpha_1 + 4\cdot(3/4) + 4\cdot(3/4) = -1 \rightarrow \boxed{\alpha_1 = -7/2 = -3.5}$

$$\tilde{\omega} = \sum_{i=1}^{n} \alpha_i \cdot \tilde{s}_i = \left(\alpha_1 \cdot \tilde{s}_1\right) + \left(\alpha_2 \cdot \tilde{s}_2\right) + \left(\alpha_3 \cdot \tilde{s}_3\right) =$$

$$= -3.5 \cdot (1,0,1) + 0{,}75 \cdot (3,1,1) + 0{,}75 \cdot (3,-1,1) =$$

$$= \left((-3{,}5\cdot 1) + (0{,}75\cdot 3) + (0{,}75\cdot 3),\ (-3{,}5\cdot 0) + (0{,}75\cdot 1) + (0{,}75\cdot(-1)),\ (-3{,}5\cdot 1) + (0{,}75\cdot 1) + (0{,}75\cdot 1)\right)$$

$$= (1, 0, -2)$$

w_1 w_2 b

- Predice si un vector (x_1, x_2) pertenece a un grupo u a otro.

$y = +b + \omega x \longrightarrow \boxed{y = -2 + 1x_1 + 0x_2}$

Recta del hiperplano en SVM lineal: $w_1x_1 + w_2x_2 + b = 0$

↳ $1x_1 + 0x_2 + (-2) = 0 \rightarrow x_1 - 2 = 0 \rightarrow \boxed{x_1 = 2}$

Conclusión: La recta del hiperplano es una línea vertical en $x_1 = 2$