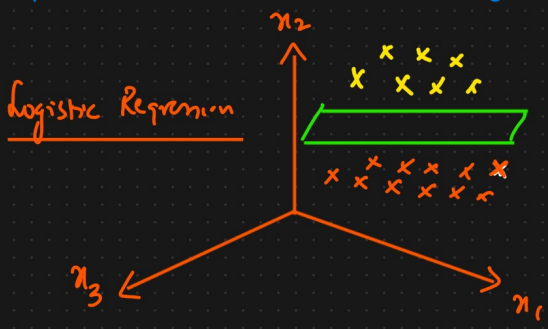
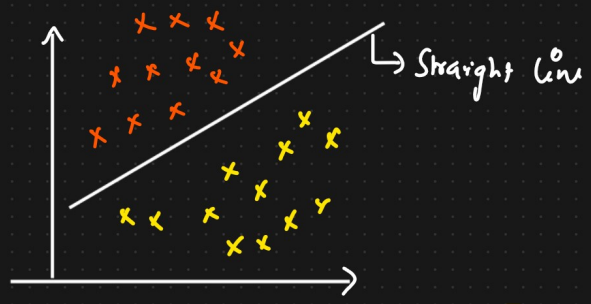
Support Vector Machines ML Algorithms.

helps us solve both classification and regression problem

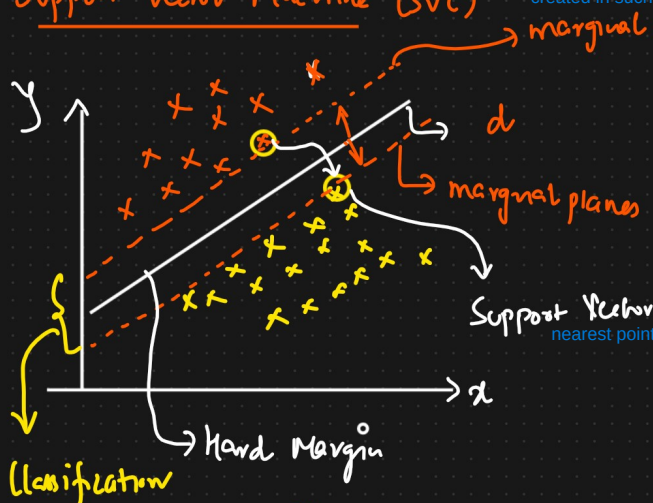
1. SVC (Support Vector Classifier)
2. SVR (Support Vector Regressor)





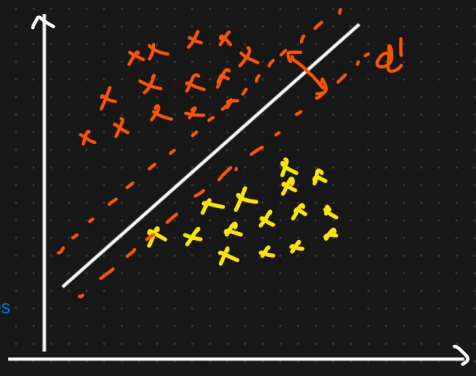
1. Support Vector Machine (SVC)

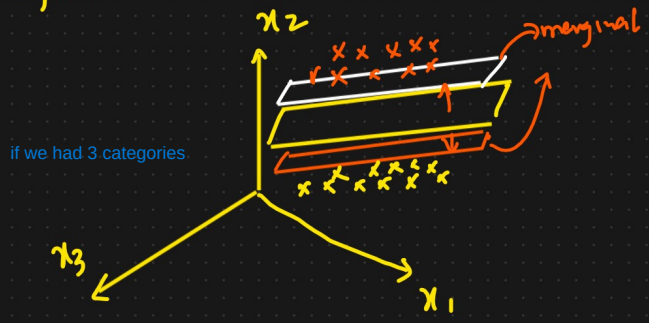
created in such a way, that distance between them is max.



$d > d'$

so we select 'd' s best fit line

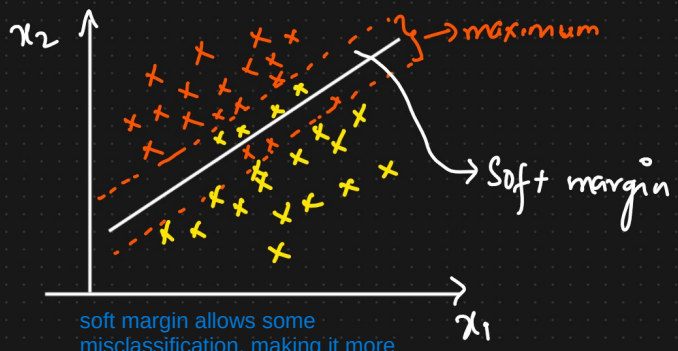




if we had 3 categories

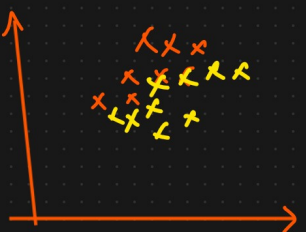
Soft Margin And Hard Margin In SVM

refer video subtitles



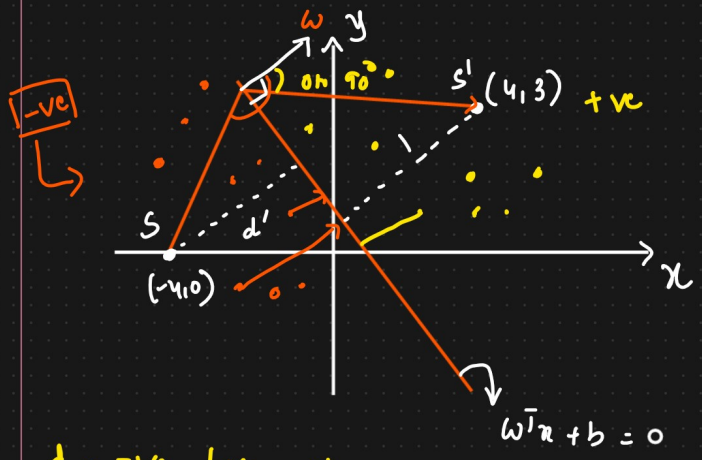
soft margin allows some misclassification, making it more flexible for non-linearly separable data. In reality, there will always be some misclassification

if real world scenario, we will have overlapping



hard margin requires a strict separation with no misclassifications, suitable for linearly separable data.

⑧ Support Vector Machines (SVC) Maths Intuition



$ax + by + c = 0$

$\Downarrow$

$w_1 x_1 + w_2 x_2 + b = 0$

$\boxed{w^T x + b = 0}$

$\Downarrow$

$b = 0$

$\boxed{w^T x = 0}$

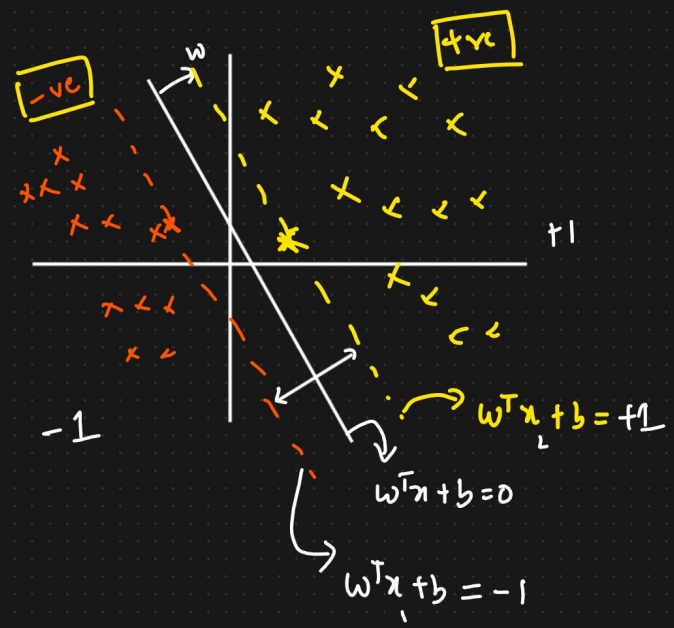
w = vector which is 90 degree to this particular line

To calculate distance of s, s' from line, we find distance between vector W and S, W and S'.

And if angle between them > 90, then distance between S to hyperplane = -ve. if < 90, its positive

d = -ve below plane

d = +ve above plane



$w^T x_1 + b = 1$

$w^T x_2 + b = -1$

(-) (-) (+)

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

Unit vector {Magnitude of the vector is 1}

Cost function

Maximize $\frac{2}{||w||}$ w, b $\Rightarrow$ Distance between marginal plane

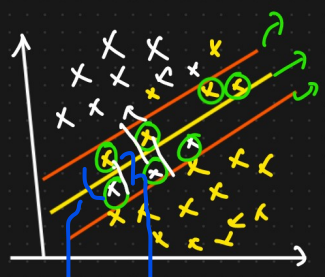
Constraint such that $y_i \begin{cases} +1 & w^T x + b \geq 1 \\ -1 & w^T x + b \leq -1 \end{cases}$ ← correctly classified points

For all correct (predicted) points ← predicted points

Constraint $\longrightarrow$ $\boxed{y_i * (w^T x + b) \geq 1}$

$C_i = 6$ ✓

Maximize $\frac{2}{||w||}$ w, b $\Rightarrow$ (or) $\boxed{\text{Min}_{(w,b)} \frac{||w||}{2}}$



Cost function of SVM (SVC)

$\text{Min}_{w,b} \frac{||w||}{2} + \boxed{C_i \sum_{i=1}^{n} \zeta_i} \Rightarrow$ Hinge loss

C_i ← hyperparameter

ζ_i (spelled as 'zeita')

$\Downarrow$

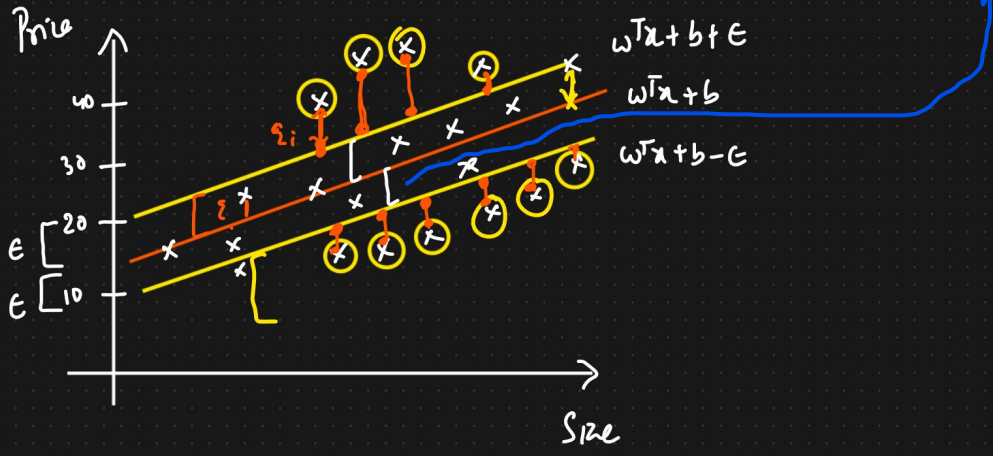
Soft margin

{How many points we want to avoid misclassification}

{Summation of the distance of the incorrect data points from the marginal plane}

Support Vector Regression

ϵ : Marginal Error



Cost function

$$\underset{w,b}{\text{Min}} \quad \frac{\|w\|}{2} + \left[C \sum_{i=1}^{n} \xi_i \right]$$

C : hyperparameter

$\sum_{i=1}^{n} \xi_i$ → Hinge loss

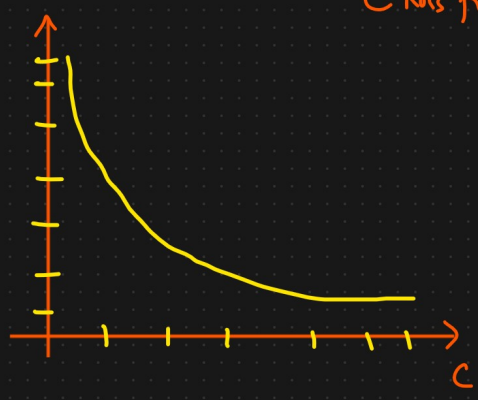
Relationship with C:
- C ↑↑
- Loss function ↓↓

Constraint :

$$|y_i - w_i x_i| \leq \epsilon + \xi$$

⇓

Loss function



ϵ → margin Error

ξ_i → Error above the margin