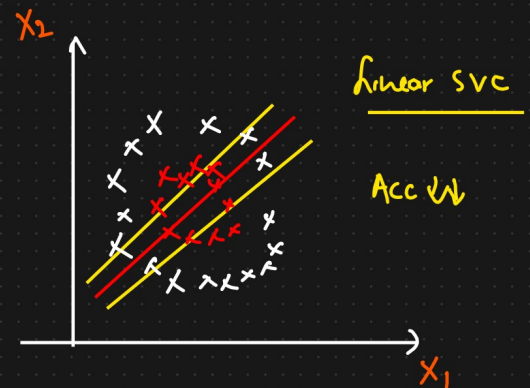
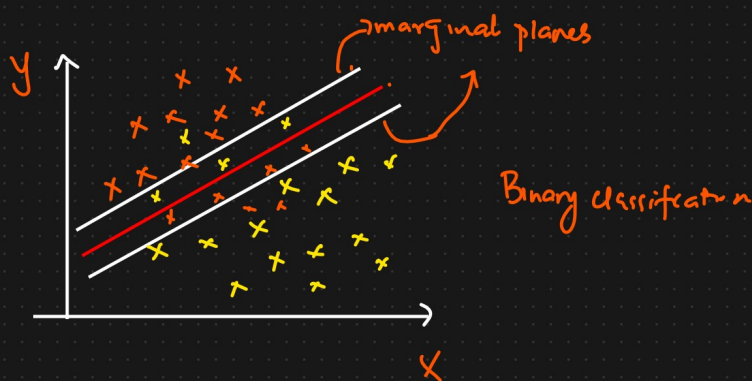


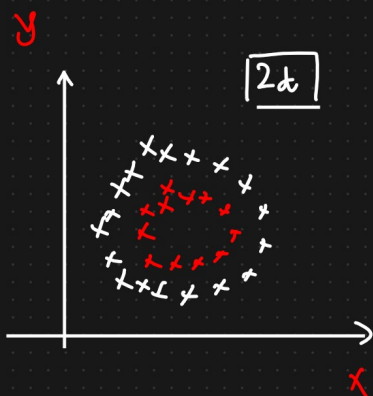
# SVM KERNELS



Linear SVC



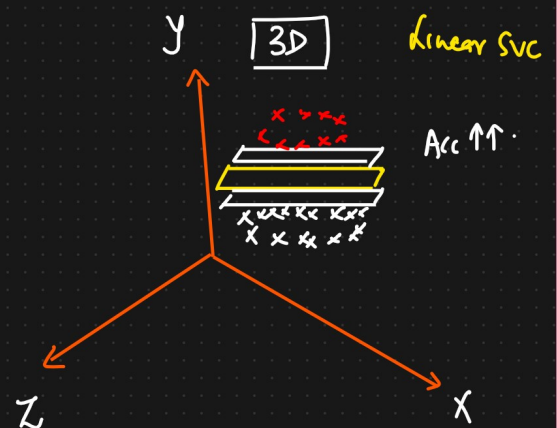
SVM Kernels



⇒ Transformations ⇒



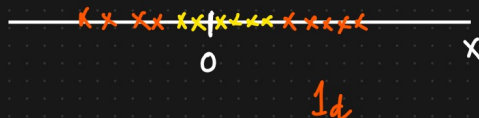
Mathematical  
formulas



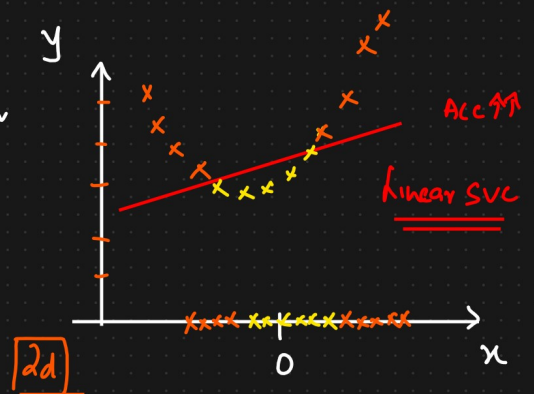
Dataset : 1d

SVM Kernel

Svc Linear SVC



⇒ Transformation  
 $y = x^2$



① Polynomial Kernel

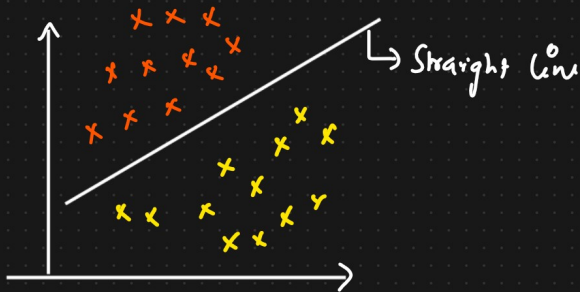
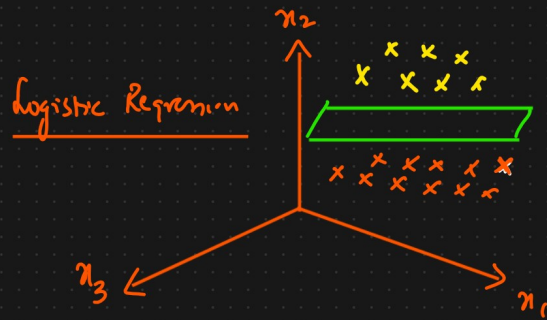
② RBF Kernel

③ Sigmoid Kernel

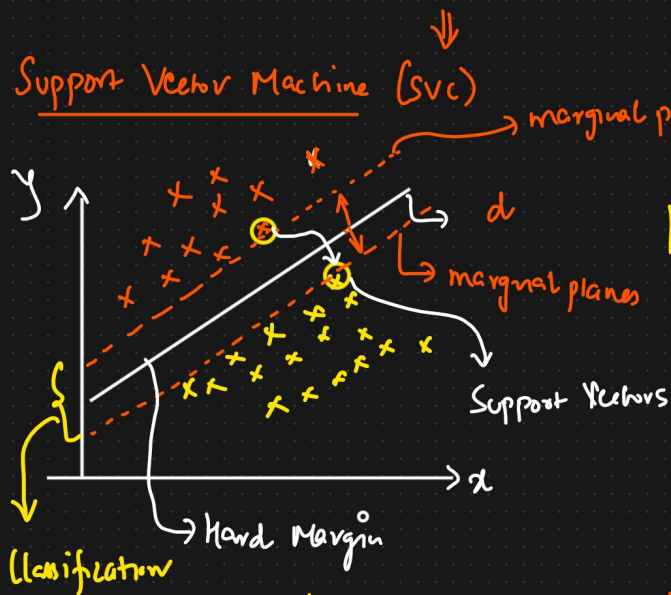
# Support Vector Machines ML Algorithms.

① SVC (Support Vector Classifier)

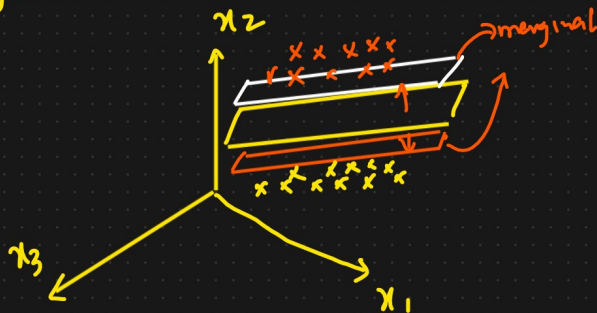
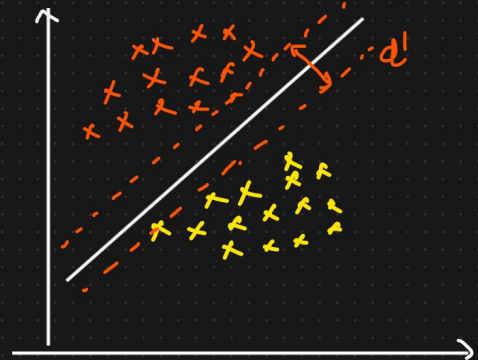
② SVR (Support Vector Regressor)



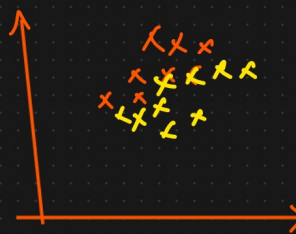
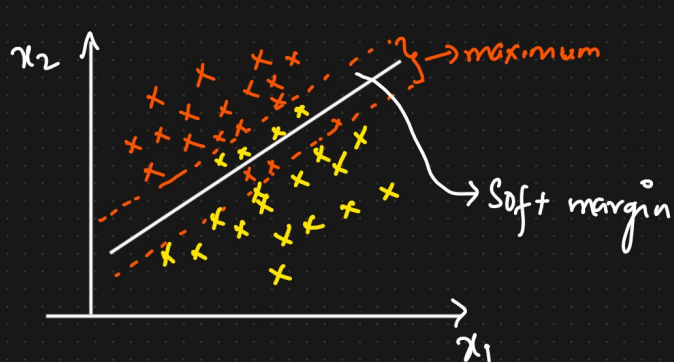
① Support Vector Machine (SVC)



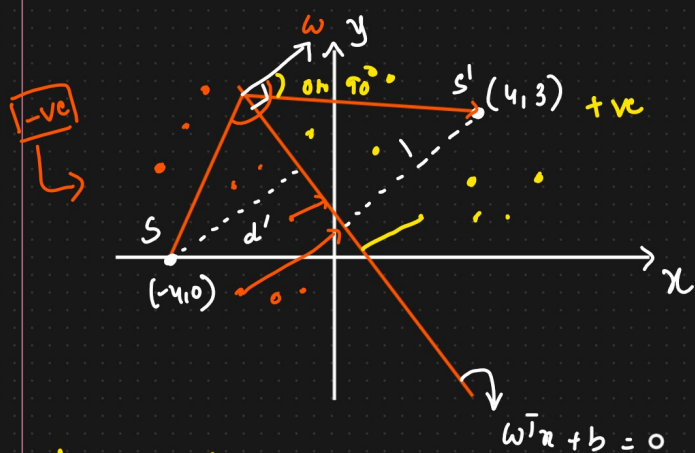
$$|d > d'|$$



# Soft Margin And Hard Margin In SVM



## Support Vector Machines (SVC) Maths Intuition



$$ax + by + c = 0$$

↓

$$w_1 x_1 + w_2 x_2 + b = 0$$

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

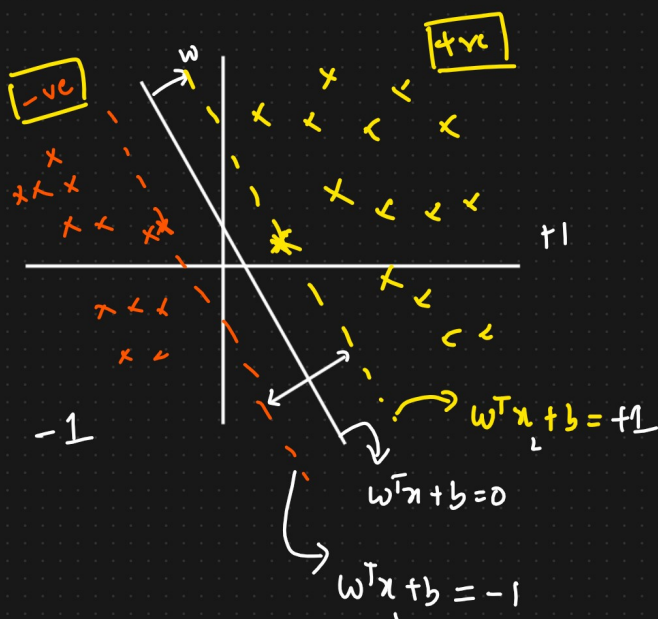
$$\downarrow$$

$$b = 0$$

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

$d = -ve$  below plane

$d = +ve$  above plane



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

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

$$\begin{matrix} (-) & (-) & (+) \end{matrix}$$

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

Unit vector { Magnitude of the vector is 1 }

## Cost function

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

Constraint such that

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

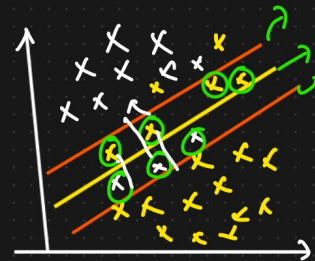
For all correct points

Constraint  $\rightarrow y_i * (w^T x + b) \geq 1$

Maximize  $\frac{2}{\|w\|}$   
 $w, b$

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

$C_i = 6$  ✓



## Cost function of SVM (svc)

Min  $\frac{\|w\|}{2}$   
 $w, b$

+  $\sum_{i=1}^n C_i \xi_i$

Hinge Loss

$\Downarrow$

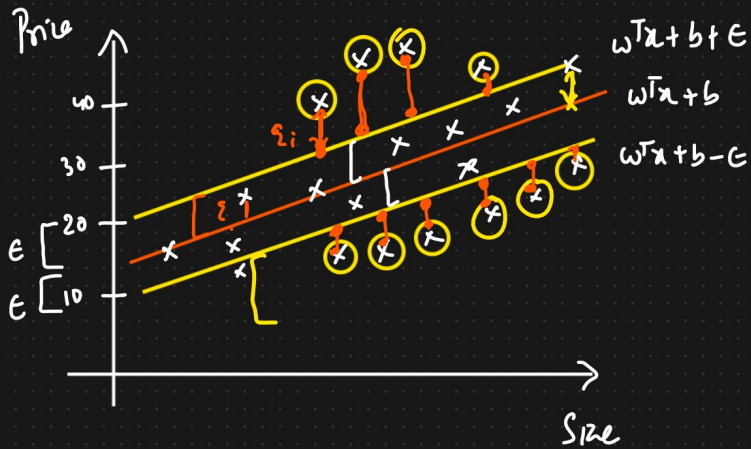
Soft Margin

{ how many points we want to avoid misclassification }

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

# Support Vector Regression

$\epsilon$  : Marginal Error



Cost function

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

Constraint :

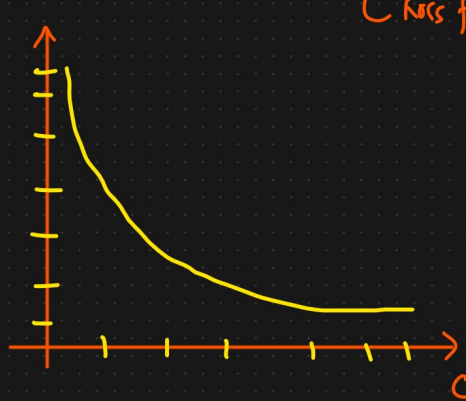
$$|y_i - w_i x_i| \leq \epsilon + \xi_i$$

$\Downarrow$   
loss function

$\epsilon \rightarrow$  margin Error

$\xi_i \rightarrow$  Error above the margin

loss function



Relationship  
 $\left\{ \begin{array}{l} C \uparrow \uparrow \\ \text{loss function} \downarrow \end{array} \right.$