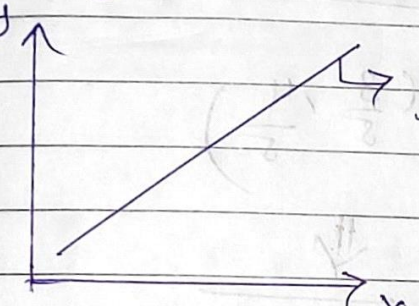
Machine learning

Support Vector Machine (SVM) :-

① classification → SVC → Support Vector Classifier

② Regression → SVR → Support Vector Regressor



$y = mx + c$

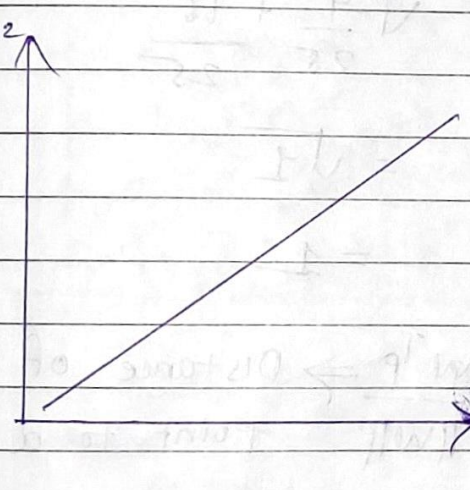
Another way to write equation:

$y = \beta_0 + \beta x$

$ax + by + c = 0 \Rightarrow y = \boxed{\frac{-a}{b}}x - \boxed{\frac{c}{b}}$

coefficient

Intercept



$ax_1 + bx_2 + c = 0$

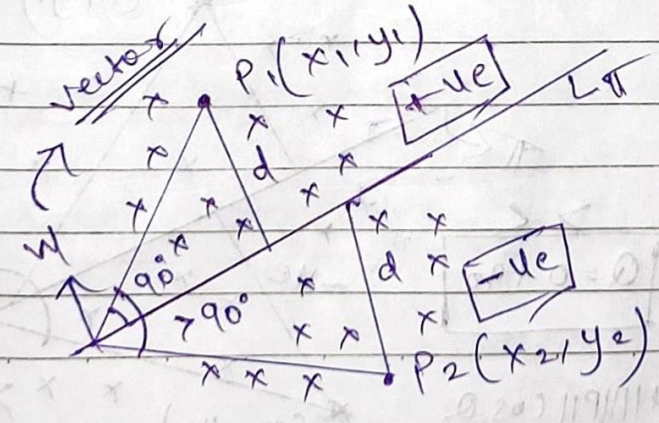
$w_1x_1 + w_2x_2 + b = 0$

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

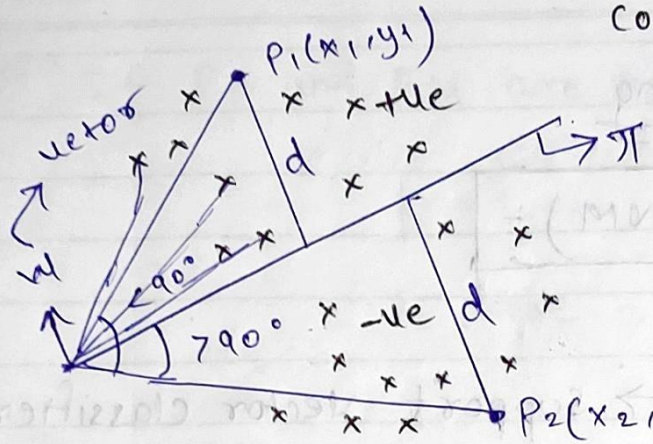
Matrix Multiplication

$\begin{bmatrix} w_1 \\ w_2 \end{bmatrix} \begin{bmatrix} x_1 & x_2 \end{bmatrix}$

Equation of a line passing through origin



unit vector :- vector which has magnitude of 1



$\cos 0 - 90 \Rightarrow$ +ve

$\cos > 90 \Rightarrow$ -ve

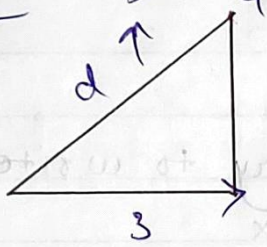
$$d = \frac{w^T p_1}{\|w\|}$$

$$\Downarrow$$

+ve or -ve

$$\|w\| \|p\| \cos\theta$$

Example :



$$\Rightarrow \frac{\sqrt{9+16}}{\sqrt{25}}$$

$$d = \frac{5}{}$$

$\left(\frac{3}{5}, \frac{4}{5}\right)$

$$\Downarrow$$

$$\sqrt{\frac{9}{25} + \frac{16}{25}}$$

$$= \sqrt{1}$$

$$= 1$$

$\cos 95, \cos 91, \cos 120, \cos 140$

$$\Downarrow$$

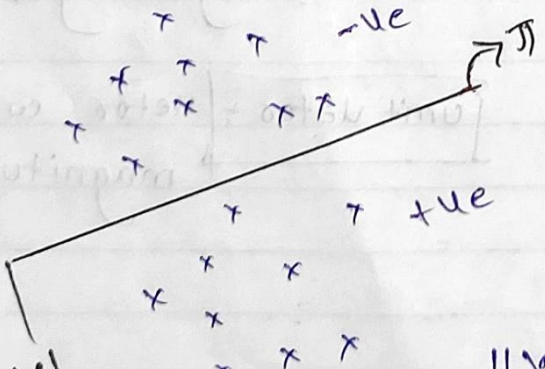
-ve

$\cos$ below 90 or 90

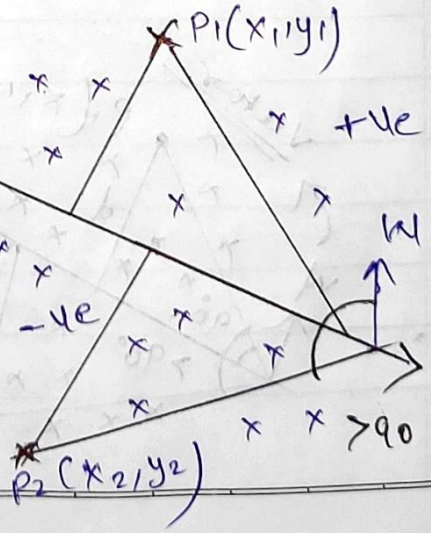
$$\Downarrow$$

+ve

$\frac{w^T p}{\|w\|}$ $\Rightarrow$ Distance of a ~~plane~~ point to a plane



$Q = 0 + 90$



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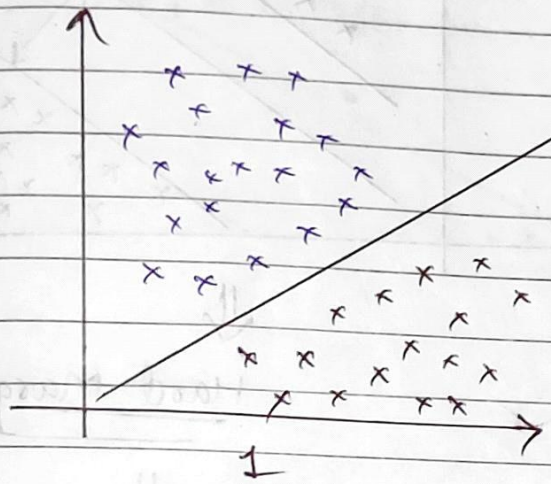
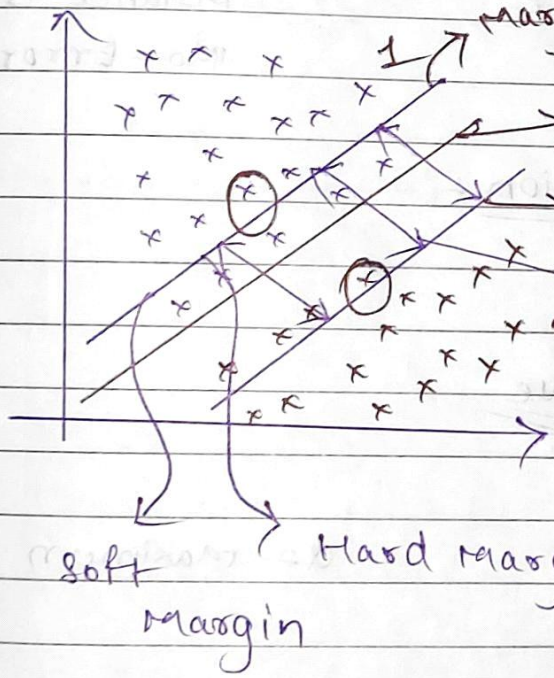
Geometric Intuition Behind Support Vetor Machine:



Logistic Regression



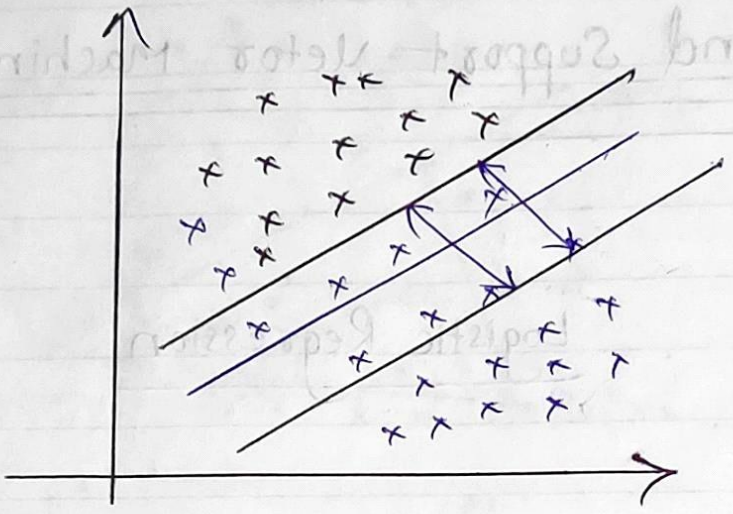
Support Vector classifier

SVC

Hard Margin → No Error between Margin

Soft Margin → Error Between a Margin

Teacher's Signature.....

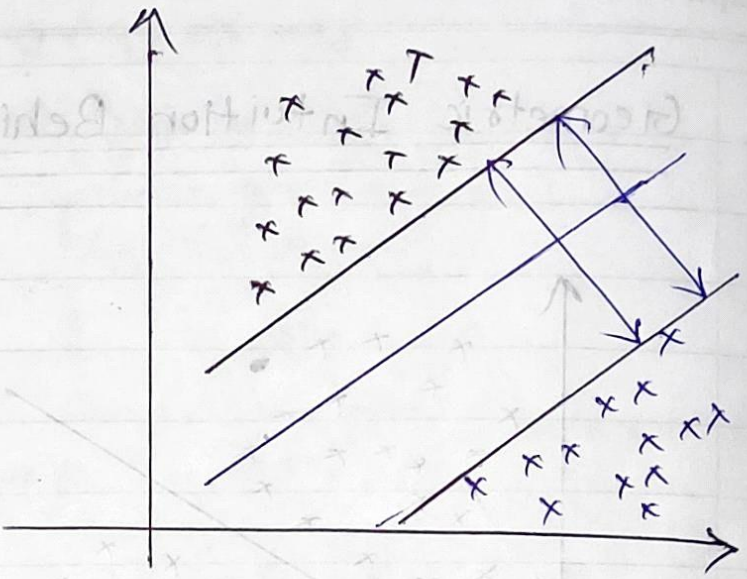


⇓

Soft Margin

⇓ Short distance

Error is there



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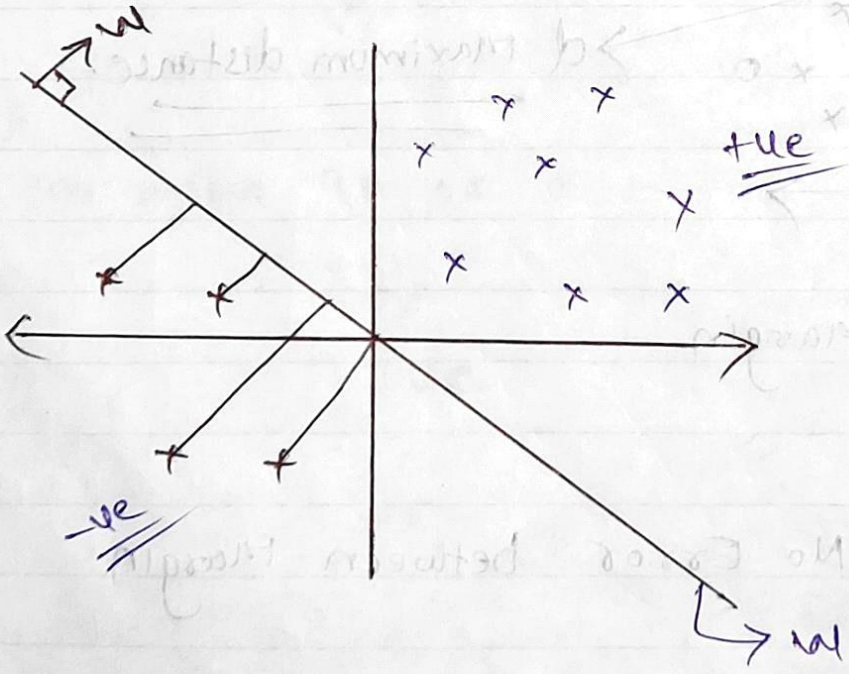
Hard Margin

⇓

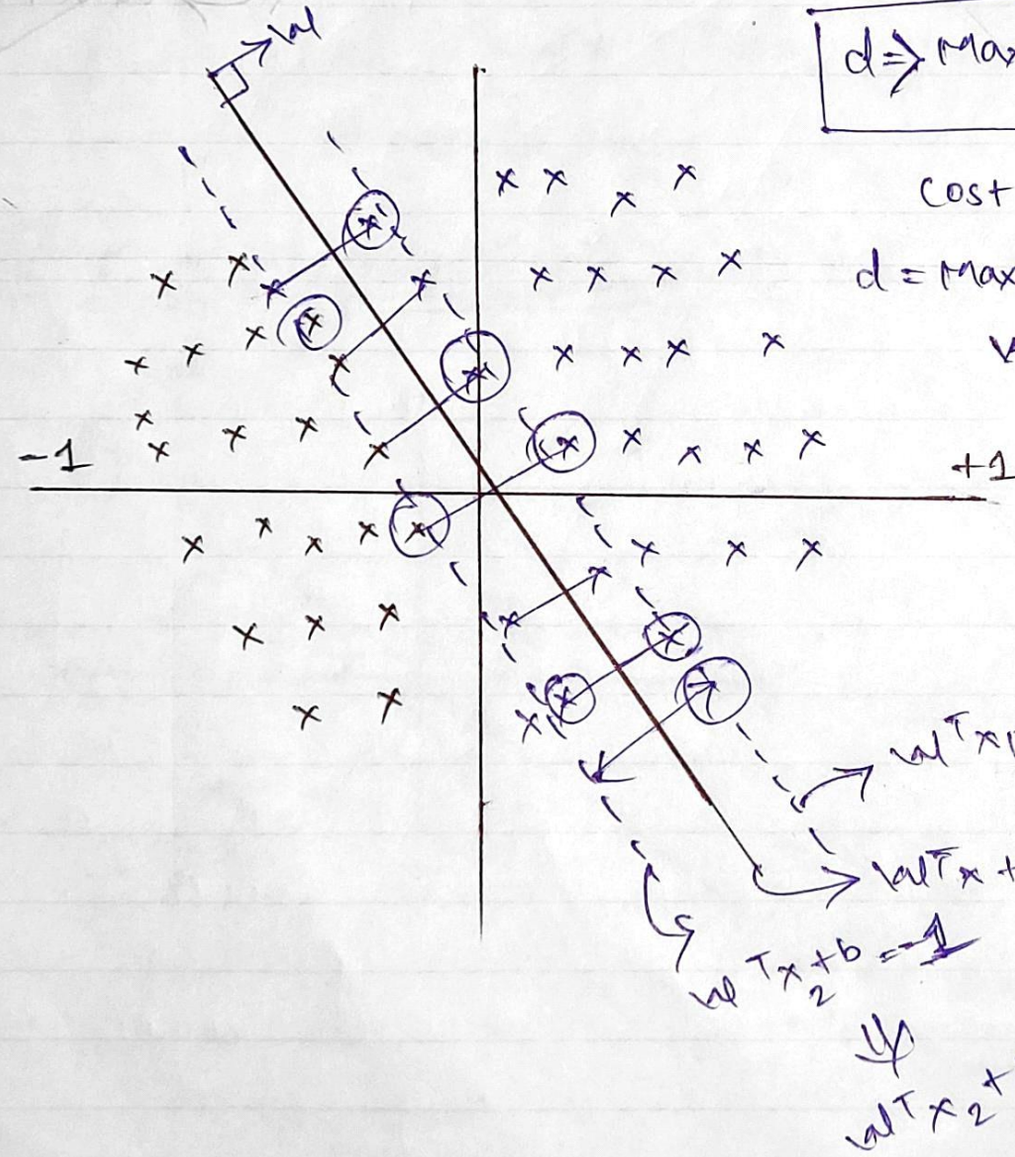
Distance is max

No-Error.

(2) SVM Mathematical Intuition :



d = maximum



Aim :

$d \Rightarrow$ Maximum

Cost function :

$d = \text{Maximum} \quad \frac{2}{\|w\|} \quad \left\{ \begin{matrix} \text{unit} \\ \text{vector} \end{matrix} \right.$

w, b

$\Downarrow$

Distance between margin plane

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constraint such that $y_i \begin{cases} 1 \iff w^T x + b \geq 1 \\ -1 \iff w^T x + b \leq -1 \end{cases}$

$\Updownarrow$

for all correct points

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

Maximize $\underset{w,b}{\frac{2}{\|w\|}}$ $\Rightarrow$ Minimize $\underset{w,b}{\frac{\|w\|}{2}}$ $\Rightarrow$ loss function

$\Downarrow$

Minimizing

cost function

Soft Margin

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

$\Rightarrow$ Summation of the distance of the incorrect data points from the marginal plane.

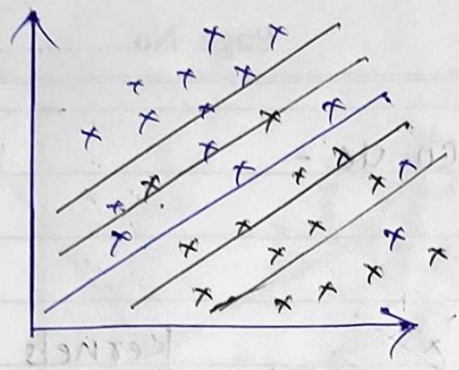
Hyperparameter :-

C_i = { How many points we can ignore for mis-classification }

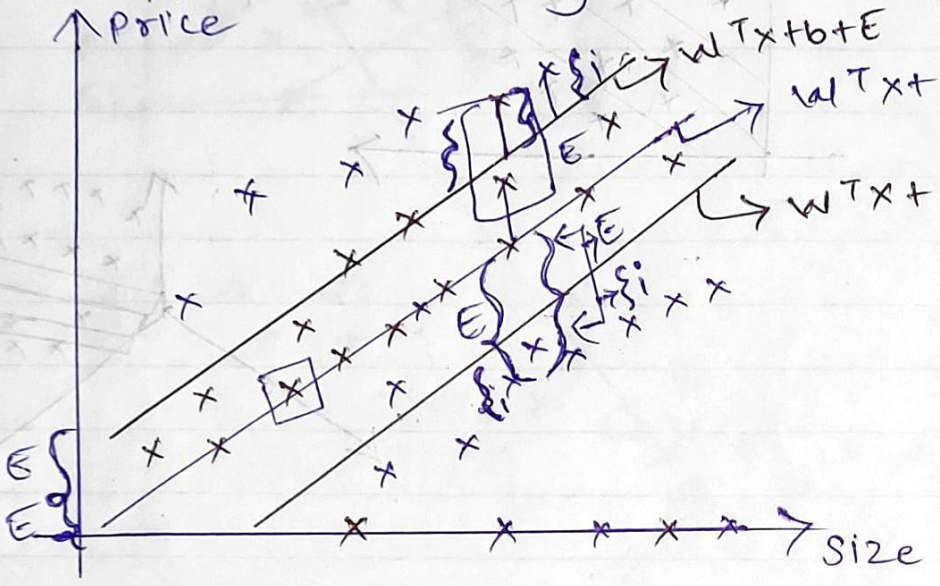
$\Downarrow$

Hyperparameter.

Teacher's Signature.....



(2) Support Vector Regression (SVR) :



$$[y_i - w_i x_i] \leq \varepsilon + \xi_i$$

Incorrect points.

Regression → Difference

ε → Marginal Error

⇓

Hyperparameter

Cost function

$$\text{Min}_{w,b} \quad \frac{\|w\|}{2} + \left[C_i \sum_{i=1}^{n} |\xi_i| \right] \Rightarrow \text{Hinge Loss}$$

constraint

$\hat{y}$

⇓

$$\text{MAE} \Leftarrow |y_i - w_i x_i| \leq \varepsilon + |\xi_i|$$

Loss function

* SVM outliers [yes]

⇓

Normalize standardization

ε → Margin of Error

ξ_i → Error above the margin

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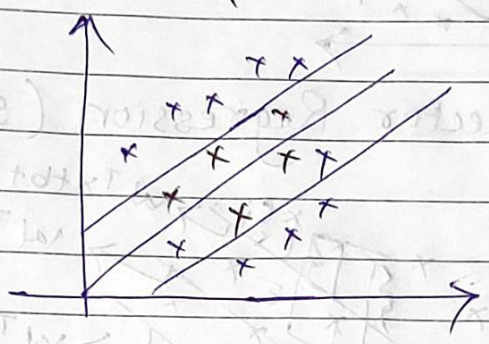
SVM Kernel, Roc and AUC curve:-

* SVM Kernel



Kernels

⇒ 2d → 3d.