Support Vector Machine

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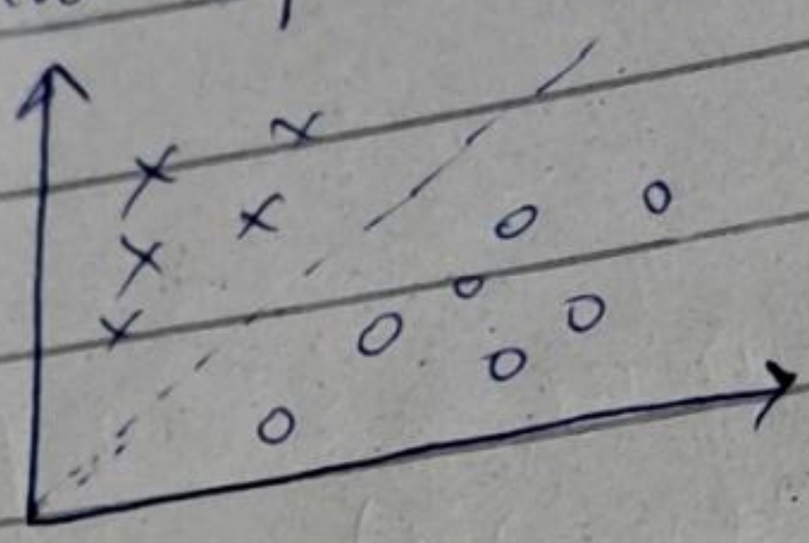
SVM:-

SVM is the versatile machine learning algorithm, Supervised learning algorithm. It is used for both regression and classification tasks.

→ finding the optimal hyperplane.



Hyperplane:-

It is a plane that linearly divide the n-dimensional data points in two components.

Linear SVM:-

find a hyperplane defined by:-

$$w.x + b = 0$$

where,

→ $w \in R^d$ is the weight vector

→ $b \in \mathbb{R}$ is the bias

Decision Rule,

$$f(x) = \text{Sign}(w \cdot x + b)$$

Margin:-

The distance between hyperplane and the closest data points.

classified point (x_i, y_i), margin constraint is

$$y_i(w \cdot x_i + b) \geq 1$$

The maximum margin is achieved by minimizing $\|w\|$.

Optimization Problem:-

$$\min_{w,b} \frac{1}{2}\|w\|^2 \quad \text{Subject to } y_i(w \cdot x_i + b) \geq 1$$

Non-linear SVM:-

Kernel function:-

$$k(x_i, x_j) = \phi(x_i) \cdot \phi(x_j)$$

functions,

→ Linear $k(w_i, x_j) = x_i \cdot x_j$

→ Polynomial : $k(x_i, x_j) = (x_i \cdot x_j + C)^d$

→ Radial Basis function : $k(x_i, x_j) = \exp(-\gamma \|x_i - x_j\|$

→ $f(x) = \text{sign}\left(\sum_{i=1}^{n} \alpha_i y_i k(x_i, x) + b\right)$.