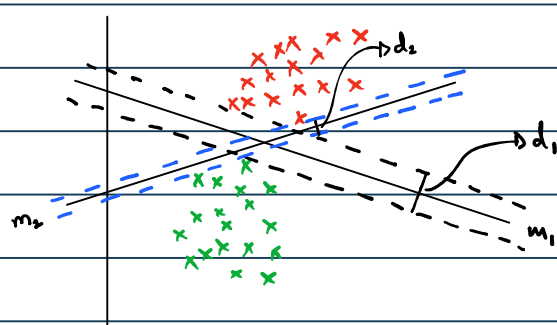


Hard Margin SVM

Thursday 2 May 2024 10:58 AM

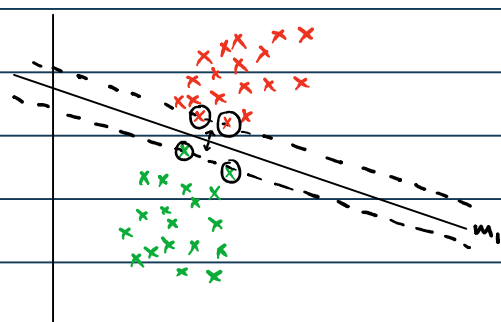


m_1 better than m_2
as $d_1 > d_2$ (margin)

→ SVM not only intends to classify the points, it also looks increase the margin b/w the classes as much as possible.
The line which produces maximum margin will be the best model.

→ Maximum margin classifier
→ linearly separable classes

What are support vectors?

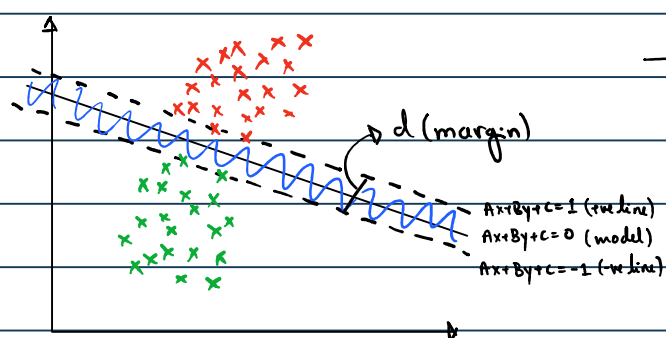


→ Every data point is a vector
→ Support vectors are data points that are closer to the hyperplane & influence the position & orientation of the hyperplane.

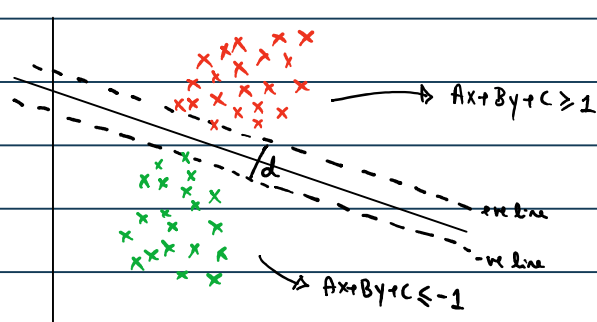
→ greater the margin better the classification

Using these support vectors, we maximize the margin of the classifier. The points help build SVM.

The Math



→ find a line which maximizes the margin b/w the classes given no point should lie within the Blue region/area or no point should cross the two outer line segments.



$x=1$
 $x=-1$

Note: in SVM
Yes → 1
No → -1

Note: Only the middle line is the model, the other two line segment

are the for mathematical formulation during training.

$$\arg \max \left(\frac{2}{\|w\|} \right) \text{ s.t. } \left\{ \begin{array}{l} y_i (Ax_i + Bx_i + C) \geq 1 \end{array} \right.$$

$$\arg \max_{A, B, C} \left(\frac{2}{\sqrt{A^2 + B^2}} \right) \text{ s.t. } \left\{ \begin{array}{l} y_i (A x_{i1} + B x_{i2} + C) \geq 1 \\ \text{for all } x_i \rightarrow \text{row} \end{array} \right\}$$

formulation during training.

Constrained optimization

X cannot cross the -ve margin
X " " " " +ve "

Prediction

1) query point

2) dot product query point with model coefficients if $\begin{cases} > 0 \text{ +ve} \\ < 0 \text{ -ve} \end{cases}$

```
from sklearn.svm import SVC
svc(kernel='linear', C=1)
```

The problem

