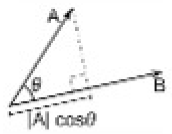
SVMSVC (Support Vector Classifier)

1. Dot Product

A.B= |A|cosθ *|B|

In SVM we just need the project of A not magnitude B



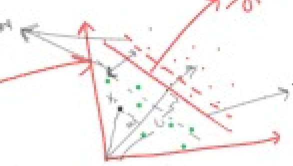
A.B = |A| cosθ * unit vector of B

y=wx+b

x=[x1,x2,x3] w=[w1,w2,w3]

w^T.x=w.x=w1x1+w2x2+w3x3

y=w1x1+w2x2+w3x3+b



Use of dot product in SVM

Consider a random point X and we want ti know whether it lies on the right side of the plane or left of the plane

X is my vector corresponding uska i will take w vector
and we take c which is the distance of w vector from origin to plane

no we calculate dot product

Xw=c so my point is on decision boundary(support vectors)
Xw>c so my point is in right side or positive class
Xw<c so my point is in negative class

the equation of margins are as below

$\overrightarrow{X}.\overrightarrow{w} - c \geq 0$

putting $-c$ as b, we get

$\overrightarrow{X}.\overrightarrow{w} + b \geq 0$

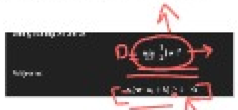
hence

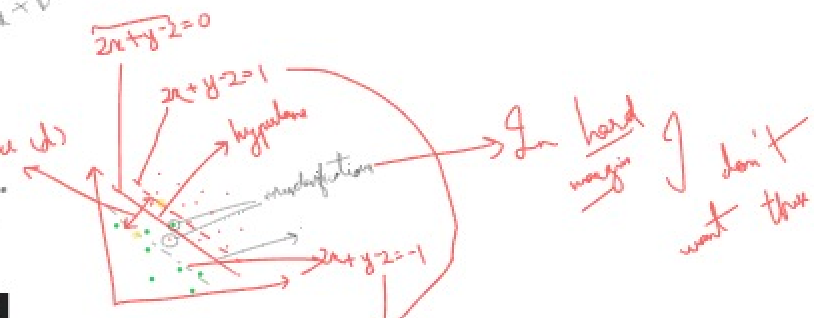
$$y = \begin{cases} +1 & \text{if } \overrightarrow{X}.\overrightarrow{w} + b \geq 0 \\ -1 & \text{if } \overrightarrow{X}.\overrightarrow{w} + b < 0 \end{cases}$$

margins

Optimization for svc

we maximize distance between
both margins by considering two points in the margin
so we take tow points lieing exactly on the margins and we find the dt product f their weights so our optim. function becomes





For all the ~~Red~~ Green points $\overrightarrow{w}.\overrightarrow{X} + b \leq -1$

For all the ~~Green~~ Red points $\overrightarrow{w}.\overrightarrow{X} + b \geq 1$

1. Hard Margin

Step 1

$x = x_1\ x_2 \quad w = w_1\ w_2$

$f(x) = w.x + b = 0 \qquad w = \underline{[1, 1]}, \quad b = -3$

$w_1x_1 + w_2x_2 + b$

$f(x) = x_1 + x_2 - 3$

Step 2 $D = \frac{1}{2}||w||^2$

$= \frac{1}{2}(\sqrt{1^2+1^2})^2$

$= \frac{1}{2} \times 2$

$D = 1$

Step 3 Update w_1, w_2, b using GD new

$w_1' w_2' b'$

Step 4 Repeat Step 1 to 3

Agenda: Maximize Distance [Hard Margin]

2. Soft margin

The role of c is if value of c is high so we have smaller margin distance, and less error allowed

If my c is low then the margin is larger, and allows more genralization