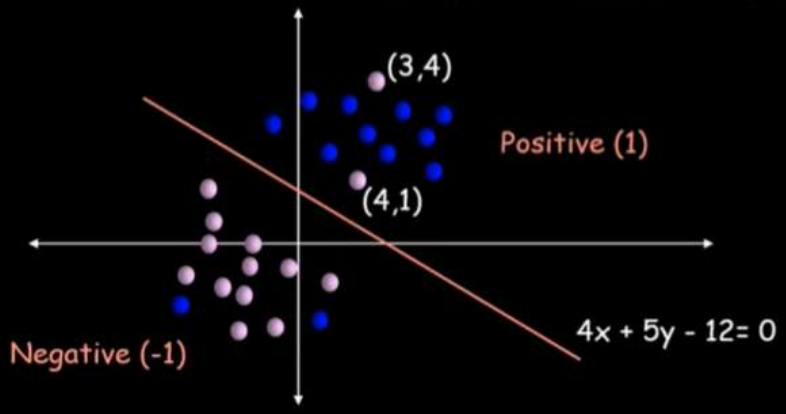
Hinge Loss formulation:

$$L(x,y,w) = \max(0,\ -y*(w*x + b))$$



For (4,1):

$-y * (w*x + b)$

$-(-1) * (4(4) + 5(1) - 12)$

$= 1 * (16 + 5 - 12) = 1*9 = 9$

$\max(0,9) = 9$

For (3,4):

$-y * (w*x + b)$

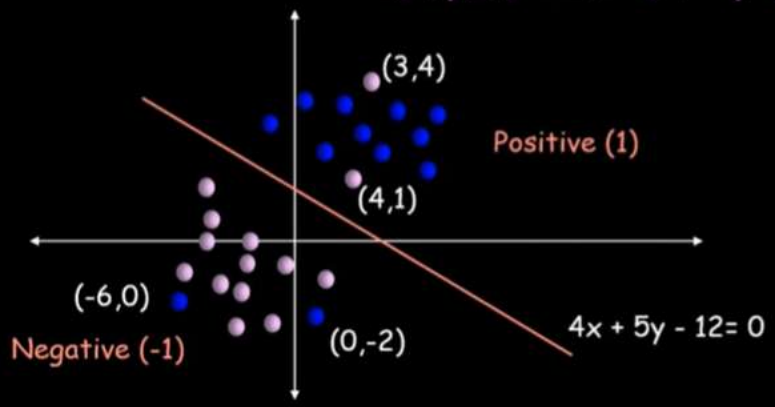
$-(-1) * (4(3) + 5(4) - 12)$

$= 1 * (12 + 20 - 12) = 1*20 = 20$

$\max(0,20) = 20$

Hinge Loss formulation:

$$L(x,y,w) = \max(0,\ -y*(w*x + b))$$



For (0,-2):

$-y * (w*x + b)$

$-(1) * (4(0) + 5(-2) - 12)$

$= -1 * (0 - 10 - 12) = -1*-22 = 22$

$\max(0,22) = 22$

For (-6,0):

$-y * (w*x + b)$

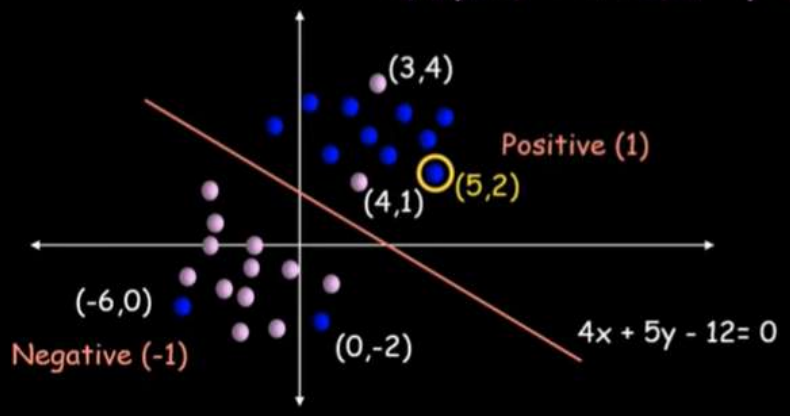
$-(1) * (4(-6) + 5(0) - 12)$

$= -1 * (-24 + 0 - 12) = -1*-36 = 36$

$\max(0,36) = 36$

Hinge Loss formulation:

$$L(x,y,w) = \max(0,\ -y*(w*x + b))$$



For (5,2):

$-y * (w*x + b)$

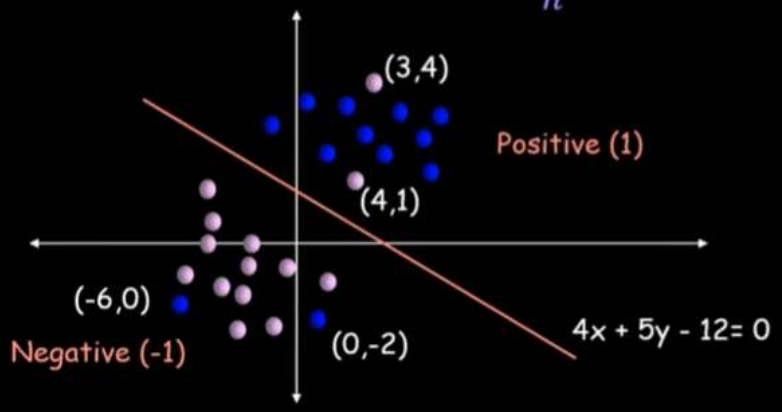
$-(1) * (4(5) + 5(2) - 12)$

$= -1 * (20 + 10 - 12) = -1*18 = -18$

$\max(0,-18) = 0$

Total Hinge loss for this classifier:

$$L(x,y,w) = \frac{1}{n}\sum \max(0,\ -y^*(w^*x + b))$$



$$L = \frac{1}{26}(9+20+22+36+0+0....)$$

$$L = 3.35$$

Loss can be reduced using Gradient Descent

We can find slope for that particular point by differentiating the loss function with weights $\left(\frac{\partial L}{\partial w}\right)$ and then adjust the current parameter using it.

We can update the weights and bias using the following formulation

$$w_{new} = w_{old} - \eta \frac{\partial L}{\partial w}$$

$$\text{where, } \frac{\partial L}{\partial w} = \frac{\partial(-y^*(w^*x + b))}{\partial w}$$

$$\frac{\partial L}{\partial w} = \frac{-y^*(\partial(w^*x) + \partial(b))}{\partial w}$$

$$\frac{\partial L}{\partial w} = -y^*(x) + 0 = -yx$$

$$w_{new} = w_{old} + \eta^* y^* x$$

We can update the weights and bias using the following formulation

$$b_{new} = b_{old} - \eta \frac{\partial L}{\partial b}$$

$$\text{where, } \frac{\partial L}{\partial b} = \frac{\partial(-y^*(w^*x + b))}{\partial b}$$

$$\frac{\partial L}{\partial b} = \frac{-y^*(\partial(w^*x) + \partial(b))}{\partial b}$$

$$\frac{\partial L}{\partial b} = -y^*(0) + 1 = -y$$

$$b_{new} = b_{old} + \eta^* y$$

Updates are made until the loss gets zero or gets nearly equal to zero