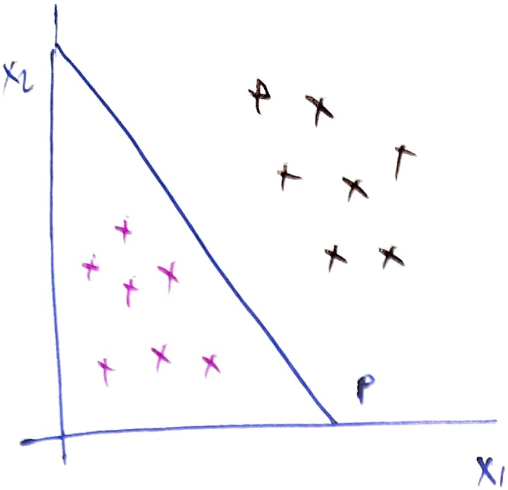
dependent on no. of rows

Linear Discriminant Function.



Can I draw a line to classify two classes?
or
hyperplane

Decision boundary -

$$2x_1 + 3x_2 = 7$$

$$2x_1 + 3x_2 - 7 = 0$$

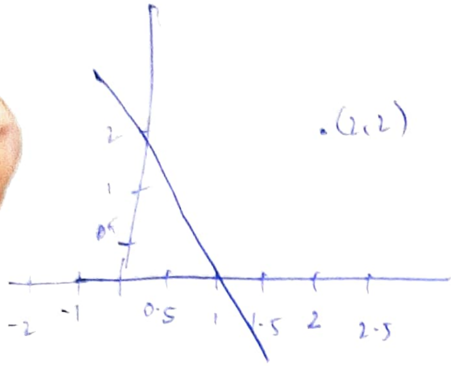
$$w_1 x_1 + w_2 x_2 + b = 0$$

$$w^T x + b = 0$$ - Eq^n of hyperplane

$$w = \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}, \quad x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Decision rule -

$$\hat{y} = \begin{cases} +1 & \text{if } w^T x + b \geq 0 \\ -1 & \text{if } w^T x + b < 0 \end{cases}$$



$$2x+y-2=0$$

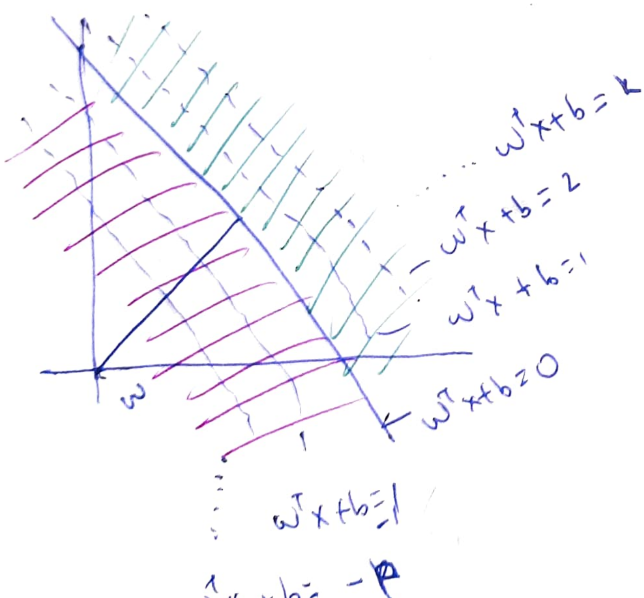
$(2,2)$ - $2(2)+2-2=4 > 0$ +ve class

$(-1,-1)$ $= -3 < 0$ $\Rightarrow$ -ve class

$$g(x)=\hat{y}=\begin{cases} +1, & w^T x+b>0 \\ -1, & w^T x+b<0 \\ 0, & w^T x+b=0 \end{cases}$$

on (Hyperplane)

Geometric Interpretation



+ve side -

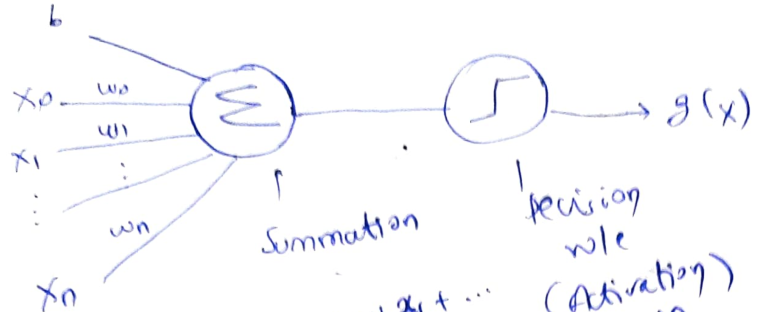
$w^T x+b=k$

-ve side -

$w^T x+b=-p$

w is $\perp$ to all lines

Perceptron ≈ Neuron

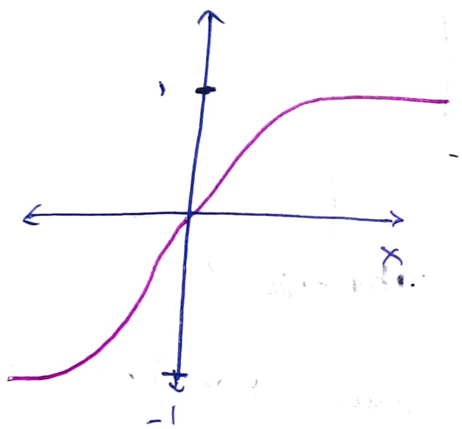


$\{-1, 1\}$

$b + w_0x_0 + w_1x_1 + \dots w_nx_n$

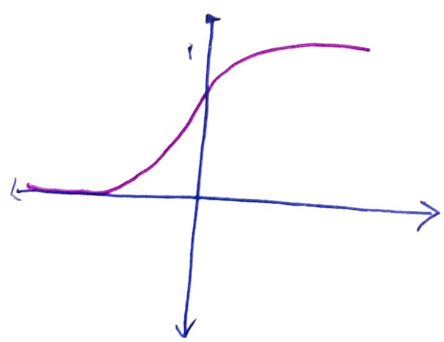
Activation fns -

① Tanh : $[-1, 1]$



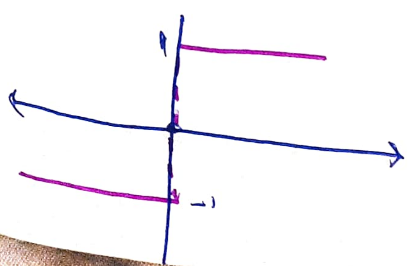
$$f(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

② Sigmoid : $[0, 1]$



$$f(x) = \frac{1}{1 + e^{-x}}$$

③ Binary step fn



$$f(x) = \begin{cases} 1 & x > 0 \\ -1, & x < 0 \end{cases}$$

Generalized Discriminant fns

1. Linear case -

$$g(x) = w^T x + b \times 1$$

$$A = \begin{bmatrix} w_0 \\ w_1 \\ \vdots \\ w_n \\ b \end{bmatrix}, \quad y = \begin{bmatrix} x_0 \\ x_1 \\ \vdots \\ x_n \\ 1 \end{bmatrix}$$

$$g(x) = A^T y$$

2. Non linear case

Transform into higher dim space.

$$y = \phi(x)$$

$$x^2 = \begin{bmatrix} x_0^2 \\ x_1^2 \\ \vdots \\ x_n^2 \\ 1^2 \end{bmatrix}$$

$$g(x) = A^T Y$$

why this ?

In some higher dim space, non linear data will be linear.