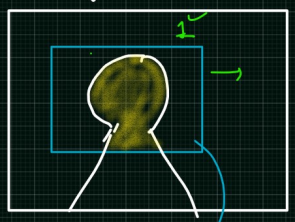
Object classification → dog / cat

person → 90%



dog → 70%

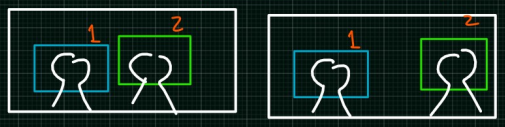
cat → 30%

Object detection

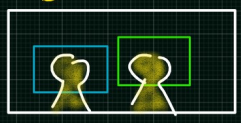
dog → 90%

cat → 70%

Object tracking



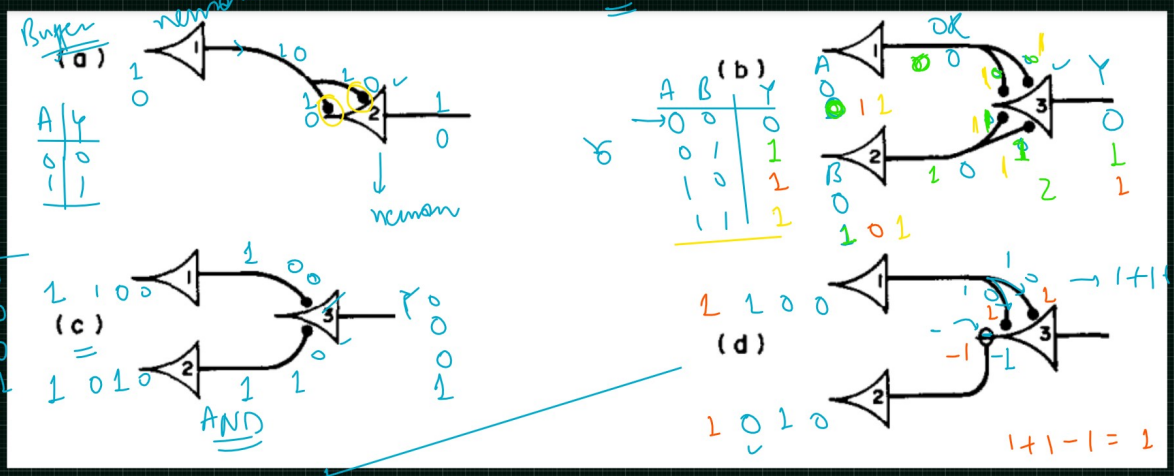
Object Segmentation → Pixel wise classification



Major app → Healthcare ← Cancer cells in a tissue

Brain Tumour Segmentation

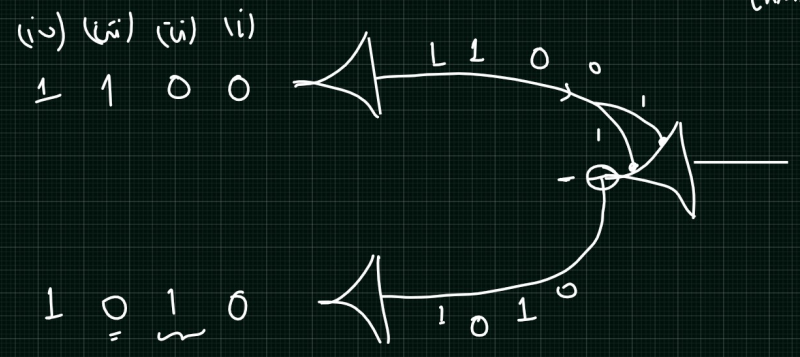
threshold = 2



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

A - B $A \cap B'$



A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

$A \cap B'$

A and (not B)

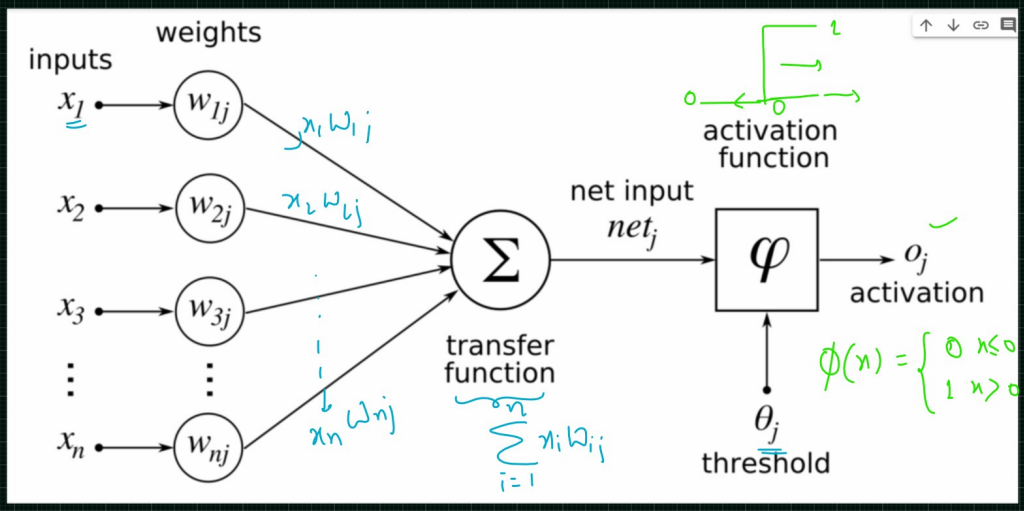
A − B

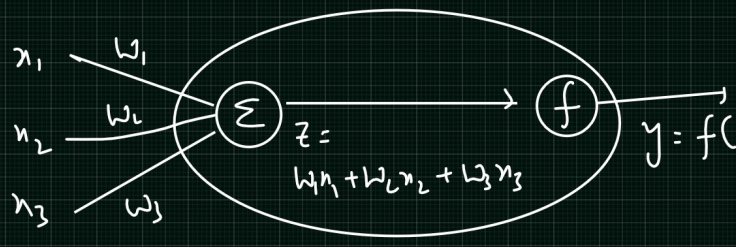
(i) 0

(ii) $0+0-1 = -1 \leq 2$, $Y = 0$

(iii) $1+1-0 = 2 = 2$, $Y = 1$

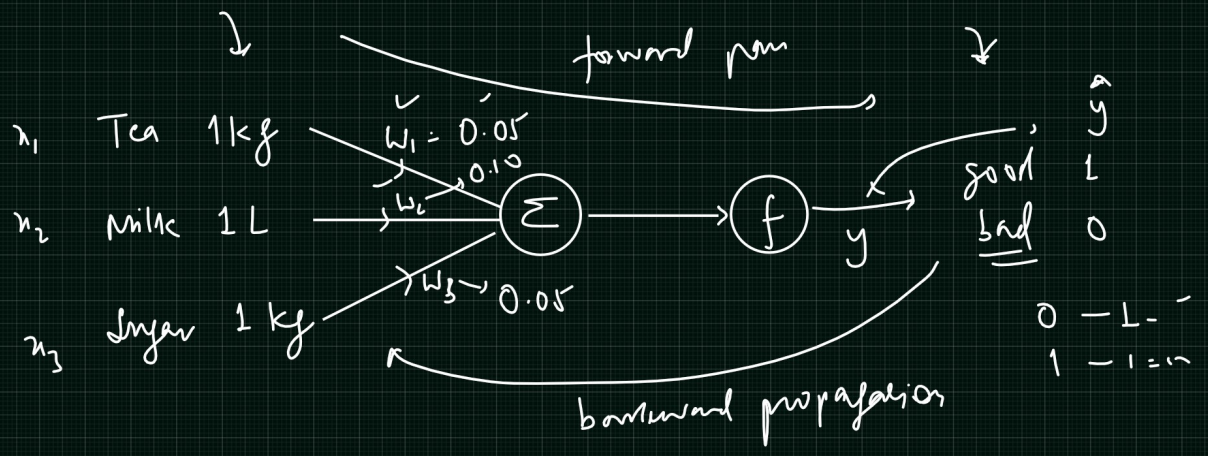
(iv) $1+1-1 = 1 \leq 2$, $Y = 0$





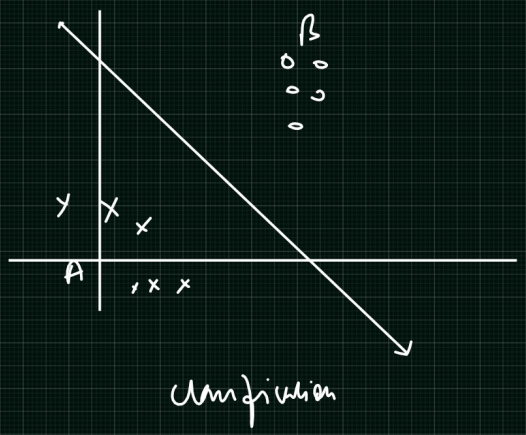
Perceptron unit

Binary Classifier



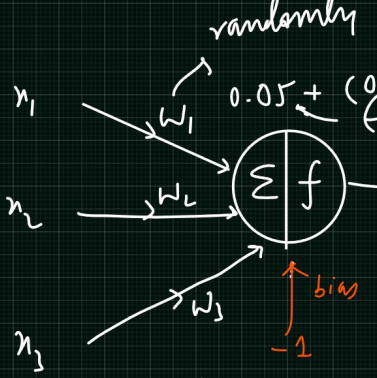
$$z = x_1 w_1 + x_2 w_2 + x_3 w_3$$

$$y = f(z) = \begin{cases} 0 \\ 1 \end{cases}$$



classification

Regression



$$z = w_1 x_1 + w_2 x_2 + w_3 x_3$$

$\hat{y} = f(z)$ $\hat{y}$

error $= y - \hat{y}$

Perceptron Weight update rule

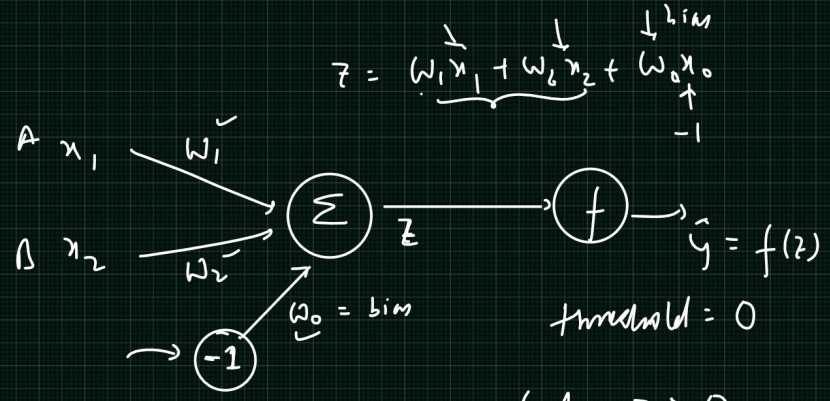
Perceptron learning rule

$$w_{new} = w_{old} + \eta (\text{error}) x$$

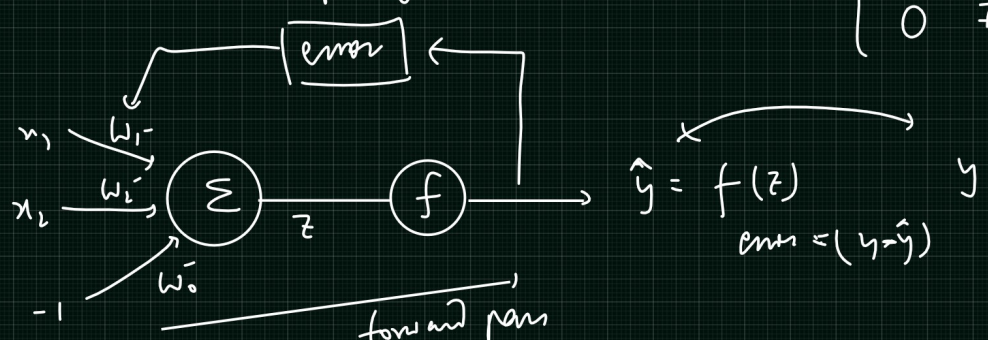
$$w_1 = w_1 + \eta (y - \hat{y}) x_1$$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1
		-

Data



$$f(z) = \begin{cases} 1 & z \geq 0 \\ 0 & z < 0 \end{cases}$$



bias -1

$$z = w_1 x_1 + w_2 x_2 + w_0 x_0$$

b

Let $z = 0 \Rightarrow$

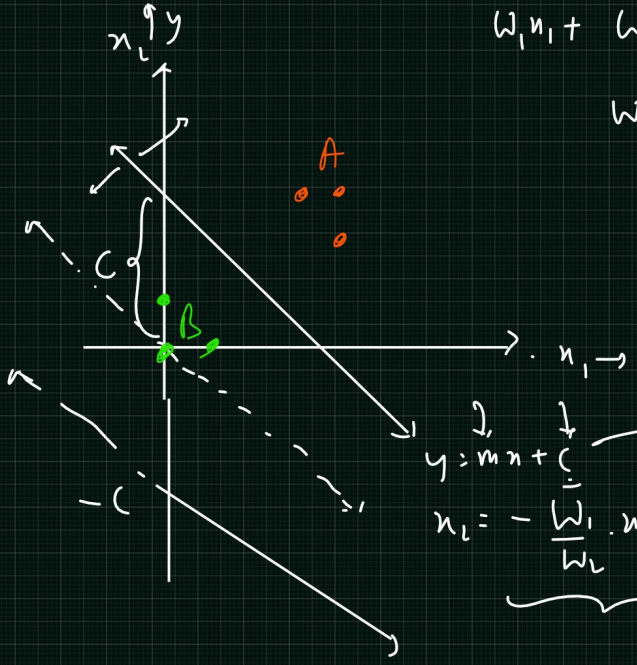
$$w_1 x_1 + w_2 x_2 + w_0 x_0 = 0$$

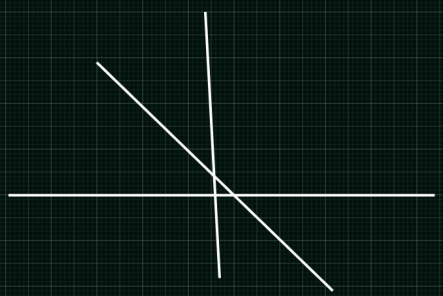
$$w_1 x_1 + w_2 x_2 - b = 0$$

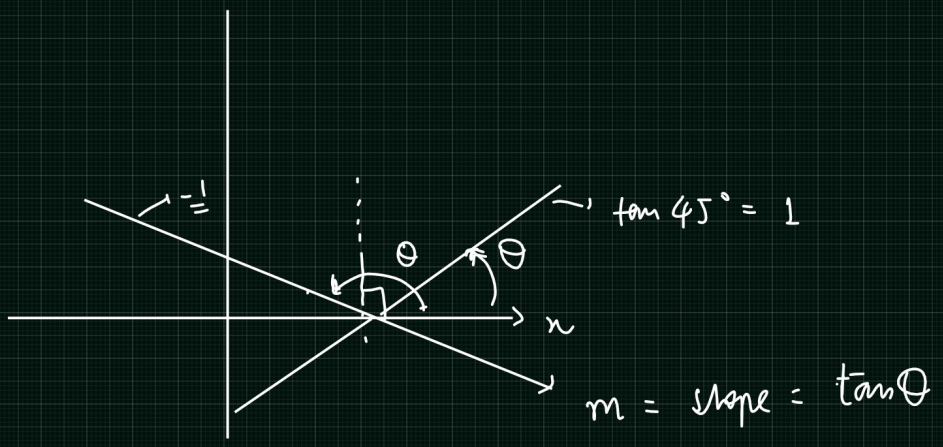
$$w_2 x_2 = -w_1 x_1 + b$$

$$x_2 = -\frac{w_1}{w_2} x_1 + \frac{b}{w_2}$$

$$y = m x + c$$







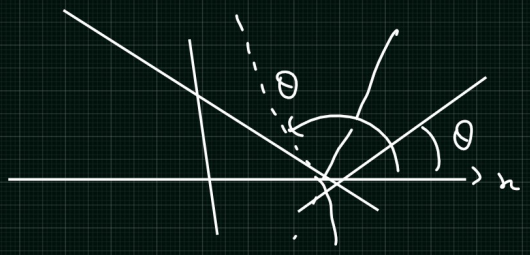
$\tan\theta$ — ve

$\theta > 90°$

$\tan\theta$ + ve

$\theta < 90°$

slope − ve



m , c

m ↑ rotation

c ↑ translation

	x_1	x_2	Y	$\hat{y}$	error
	A	B			
1	0	0	0		$y_1 - \hat{y}_1$
2	0	1	1		$y_2 - \hat{y}_1$
3	1	0	1		
4	1	1	1		

4×1

$$X = \begin{bmatrix} 0 & 0 & -1 \\ 0 & 1 & -1 \\ 1 & 0 & -1 \\ 1 & 1 & -1 \end{bmatrix}_{4 \times 3}$$

X with bias

$$W = \begin{bmatrix} w_1 \\ w_2 \\ w_0 \end{bmatrix}_{3 \times 1}$$

$$W_{new} = W_{old} + \eta \vec{X}^T \vec{e}$$

4×3 $\quad$ 4×1

3×4 $\quad$ 4×1

$$\begin{bmatrix} w_1 \\ w_2 \\ w_0 \end{bmatrix}_{3 \times 1} = \begin{bmatrix} w_1 \\ w_2 \\ w_0 \end{bmatrix}_{3 \times 1} + \eta \underbrace{\begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ -1 & -1 & -1 & -1 \end{bmatrix}}_{3 \times 4} \underbrace{\begin{bmatrix} y_1 - \hat{y}_1 \\ y_2 - \hat{y}_1 \\ y_3 - \hat{y}_3 \\ y_4 - \hat{y}_4 \end{bmatrix}}_{4 \times 1}$$

$$\begin{bmatrix} w_1 \\ w_2 \\ w_0 \end{bmatrix} = \begin{bmatrix} w_1 \\ w_2 \\ w_0 \end{bmatrix}_{3 \times 1} + \eta \begin{bmatrix} \Delta w_1 \\ \Delta w_2 \\ \Delta w_3 \end{bmatrix}_{3 \times 1}$$

FOR

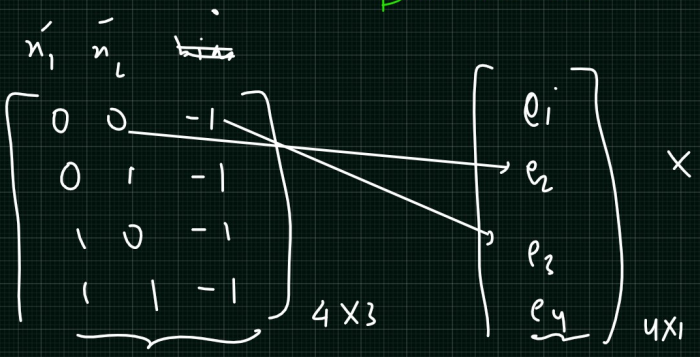
1

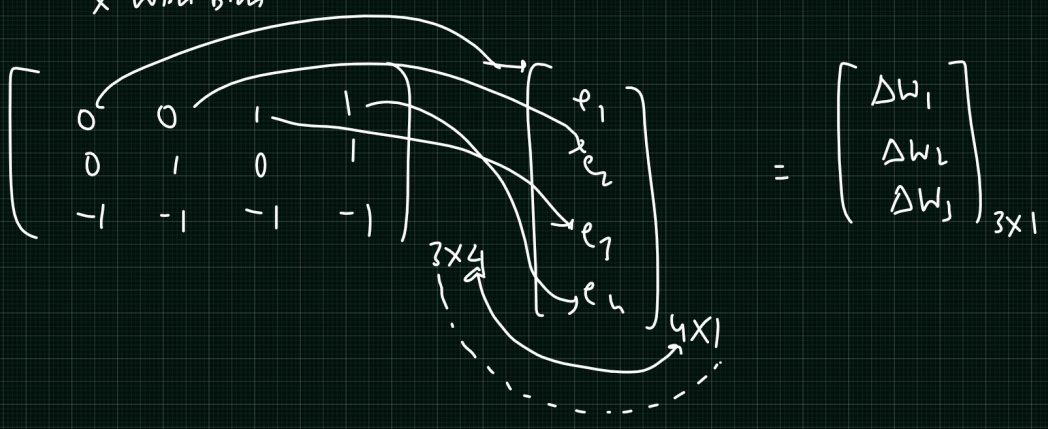
BACK

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}_{2 \times 4} \begin{bmatrix} 3 \\ 2 \\ 3 \\ 2 \end{bmatrix}_{4 \times 1}$$

$$\begin{pmatrix} 1 \times 3 + 1 \times 2 + 1 \times 3 + 1 \times 2 \\ (\qquad\qquad\qquad\qquad) \end{pmatrix}_{2 \times 1}$$

DOUBTS :-





$A_{r_1 c_1}$ $B_{r_2 c_2}$

$A \times B$ condition $c_1 = r_2$

$A + B$

Condition

$r_1 = r_2$

$c_1 = c_2$