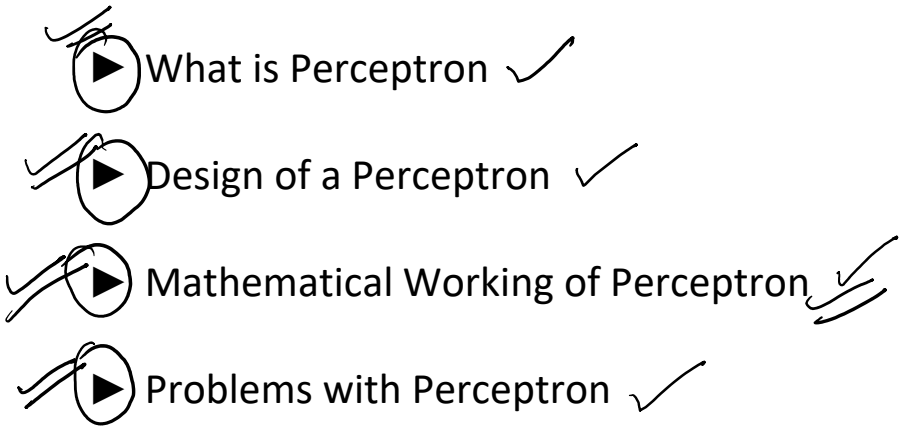
DAY 2 : PERCEPTRON

11 February 2025 18:25

WHAT YOU WILL STUDY IN TODAY VIDEO ?



Introduction

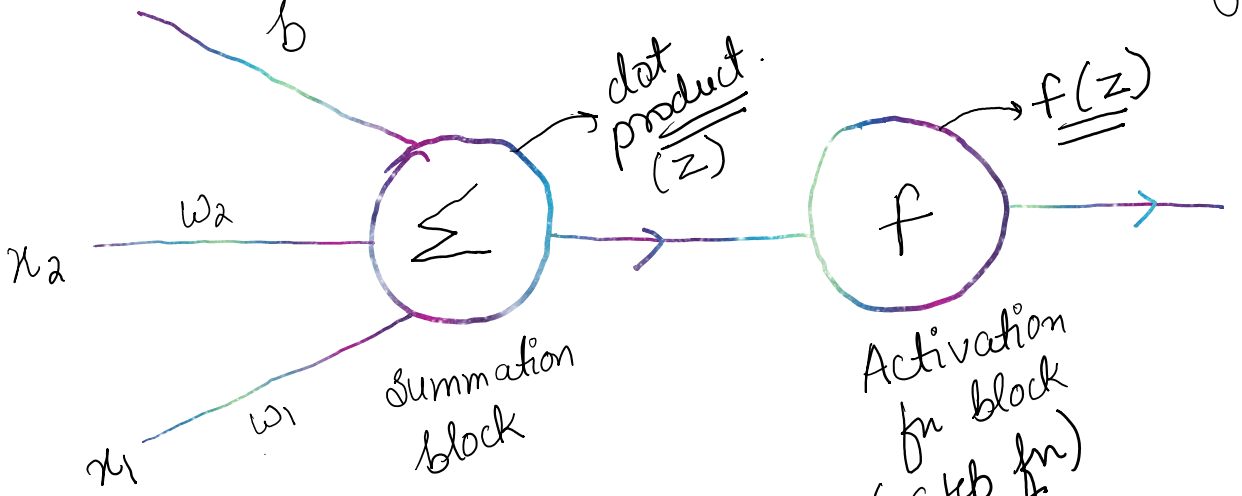
1. first ANN model
   → Artificial Neural Network
2. Single layer
3. Only Binary classification (Supervised learning)
4. Building block of neural Network

Design

Input

$w \rightarrow$ weight
$b \rightarrow$ bias

Output



bias → Shifter

Summation block

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

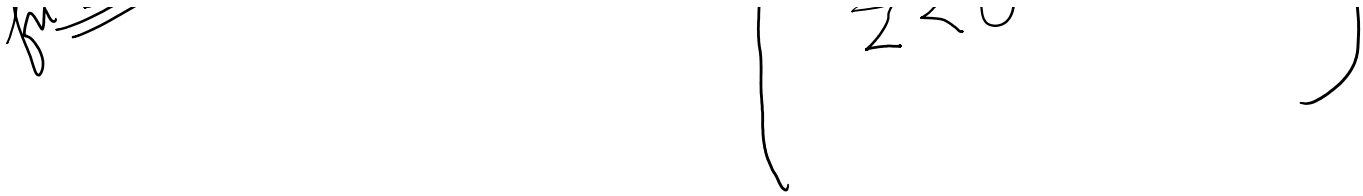
→ dot product

weighted sum

Activation fn block

$f(z) \Rightarrow$

$$\begin{cases} z \geq 0 \rightarrow 1 \\ z < 0 \rightarrow 0 \end{cases}$$



Mathematical Working

Notations

x_1, x_2 → inp features

w_1, w_2 → weights

b → bias

z → weighted sum

y → Actual value

$\hat{y}$ → Predicted value

$f(z)$ → Activation fn applied to z.

Prediction eqn

$$\hat{y} = f(w_1 x_1 + w_2 x_2 + b)$$

z

Problem

x_1 → Amt of cheese

x_2 → Amt of sauce

y → Tasty or Not (1) (0)

{ 1 → High! ; 0 → Low }

Data:

x_1	x_2	y
1	1	1
1	0	1
0	1	0
0	0	0

Training starts:

① Initialization Setup

$w_1 = 0.5$

$w_2 = -0.3$

$w_1 = 0.5$

$w_2 = -0.3$

$b = 0.1$

$\alpha = 0.1$ (learning rate)

② Get first row/item of data

$x_1 = 1$ $\quad y = 1$

$x_2 = 1$

Calculate Z (weighted sum)

$$Z = w_1 x_1 + w_2 x_2 + b$$
$$= 0.5 \times 1 + (-0.3 \times 1) + 0.1$$
$$= 0.3$$

Apply activation fn $\Rightarrow f(Z)$

$\Rightarrow f(0.3)$

Step fn.

$0.3 \geq 0 \rightarrow 1$

$\hat{y} = 1$ $=$ $y = 1$

Compare

{ Correct Prediction }

{ No weight update }

③ Get second row of data

$x_1 = 1$ $\quad y = 1$

$x_2 = 0$

$$Z = 0.5 \times 1 + (-0.3 \times 0) + 0.1$$
$$Z = 0.6$$

$\sigma(0.6)$

$z = 0.6$

$f(z) = f(0.6)$

$0.6 \geq 0 \longrightarrow 1$

$\hat{y} = 1$

{ Correct Prediction }

④ Get 3rd data/row

$x_1 = 0 \quad y = 0$

$x_2 = 1$

$z = -0.2$

$f(z) = -0.2 < 0 \longrightarrow 0$

$\hat{y} = 0$

{ Correct Prediction }

⑤ Get 4th row of data

$x_1 = 0 \quad y = 0$

$x_2 = 0$

$z = 0 + 0 + 0.1$

$z = 0.1$

$f(0.1) \Rightarrow 0.1 \geq 0 \longrightarrow 1$

$\hat{y} = 1$

{ Weights updation needed }

{ wrong Prediction }

⑥ Weights updation

$(y - \hat{y}) x_1$

⑥ Weights updation

* $w_{1_{new}} = w_{1_{old}} + \alpha(y - \hat{y})x_1$

$w_{1_{new}} = 0.5 + 0.1(0-1)\times 0$

$\boxed{w_{1_{new}} = 0.5}$ (no change)

* $w_{2_{new}} = -0.3 + 0.1(0-1)\times 0$

$\boxed{w_{2_{new}} = -0.3}$ (no change)

* $b_{new} = b_{old} + \alpha(y - \hat{y})$

$b_{new} = 0.1 + 0.1(0-1)$

$\boxed{b_{new} = 0}$ (change)

Training Done. →

$$\begin{cases} w_1 = 0.5 \\ w_2 = -0.3 \\ b = 0 \end{cases}$$

Prediction fn.

$$\boxed{z = w_1 x_1 + w_2 x_2} \Leftarrow \text{eqn}$$

$Z =$

(weighted Sum)

Prediction Phase.

$x_1 = 1$

$x_2 = 0$

$Z = 0.5 \times 1 + (-0.3 \times 0)$

$Z = 0.5$

$f(z) = f(0.5)$

$0.5 \geq 0 \longrightarrow 1$

Output = 1

{ Tasty Sandwich }

Question:

Q. Does Perceptron requires loss fn or optimizer ?

Ans. No

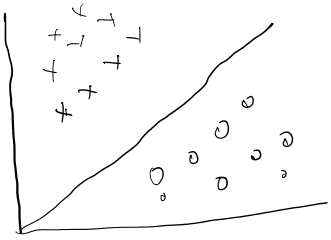
① Misclassification error basis

②

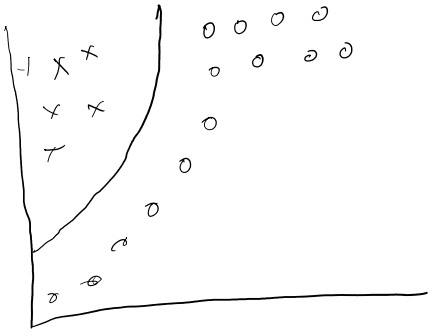
Problems.

① Unable to solve non-linear problem

eg. AND gate, OR gate → solve. (linear decision boundary)



XOR gate → not solve (curve decision boundary)



② Only Binary Supervised Classification

Regression X → Step fn. =

fix.

↓

.0

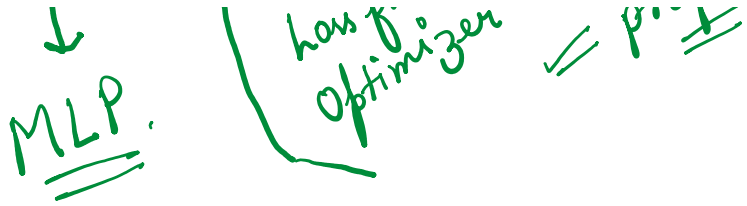
Multi Layer Perceptron

forward prop

Backward prop.

loss fn

optimizer


MLP.
loss
optimizer