AGENDA

i) Brief Review ✓

ii) Classification problem statement {Graphical Analysis}
→ functions | Linear Inequality | Linear & Non Linear eq. ✓
Regression problem statement {Graphically}.

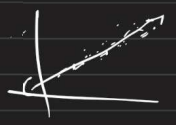
iii) Perceptron ✓
eg.

iv) Frequently Used Terms {Intro}

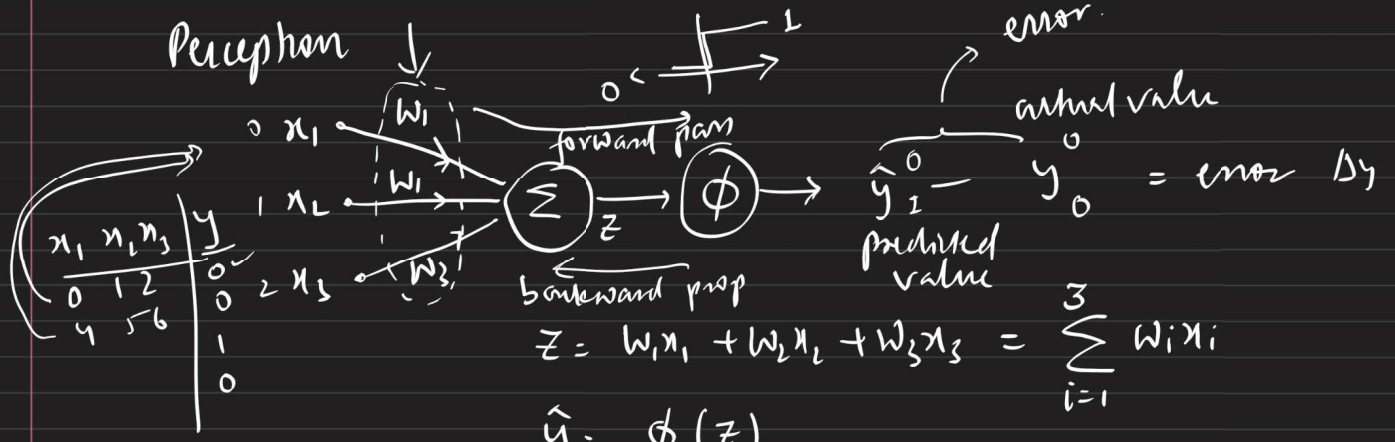
v) Drawbacks of Perceptron {Proof with Python} Later

vi) MLP → {Multi Layer Perceptron}

vii) ANN → DNN
eg → ___



Perceptron



$$z = w_1x_1 + w_2x_2 + w_3x_3 = \sum_{i=1}^{3} w_i x_i$$

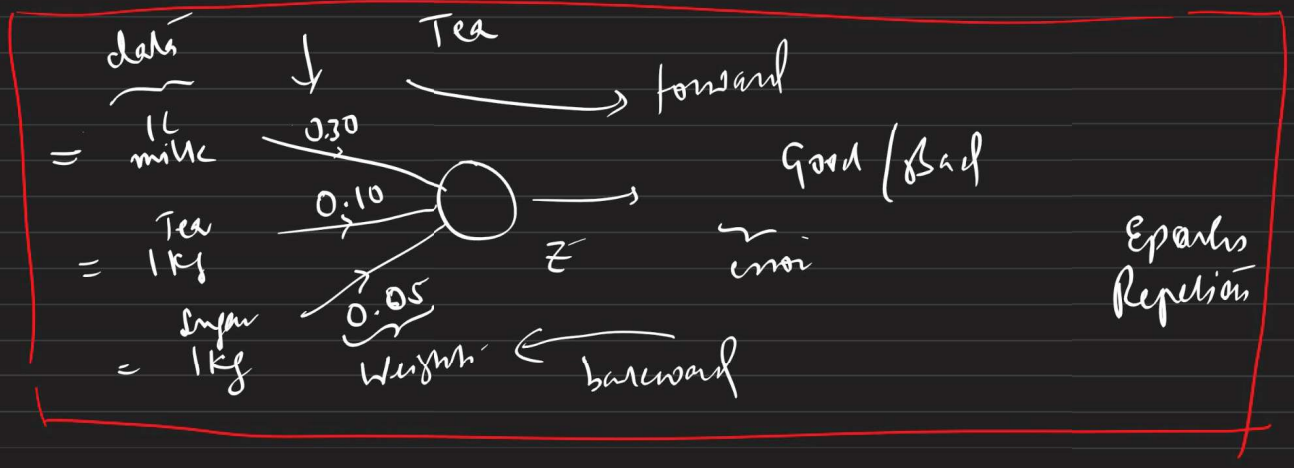
$$\hat{y} = \phi(z)$$

LTU → Linear Threshold Unit

TLU → Threshold Logic Unit

Perceptron Learning Rule

$$\boxed{w_{new} = w_{old} + \eta(y - \hat{y})x}$$



milk	Tea	Sugar	y (Label)	w_0	w_1	w_2	z	$\hat{y}$
→ 1L	1kg	1kg	0	0.30	0.10	0.05	0.45	1
2L	1kg	2kg		0.25	0.05	0.10		

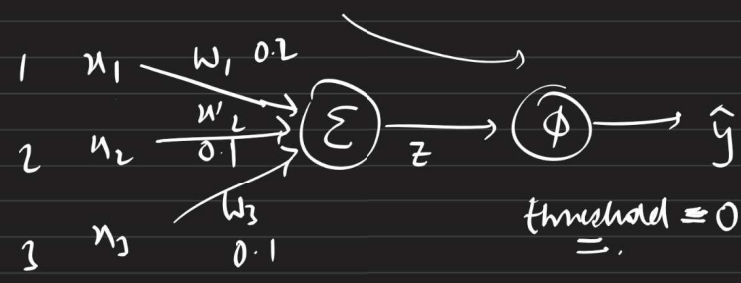
error = 1

$$\begin{pmatrix} 0.25 \\ 0.05 \\ 0.00 \end{pmatrix} = \begin{pmatrix} 0.30 \\ 0.10 \\ 0.05 \end{pmatrix} - \eta(\text{error}^2) \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} 0.5 \\ 0.5 \\ 0.5 \end{pmatrix}$$

0.5

1L Tea Sugar → {1kg} {1kg} {1kg} → y



$$\phi = \begin{cases} 1 & z \geq 0 \\ 0 & z < 0 \end{cases}$$

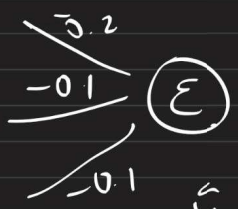
$$z = w_1x_1 + w_2x_2 + w_3x_3$$ } Linear combination of Wts & ips.

$$= 0.2 \times 1 + 0.1 \times 2 + 0.1 \times 3$$

$$= 0.7$$

Run SGD

$$\hat{y} = \phi(z) = \phi(0.7) = 1 = \text{class}$$



$$z = -0.7$$

$$\hat{y} = \phi(-0.7) = 0 \quad \text{class}$$

$\hat{y} \neq y$

pred actual

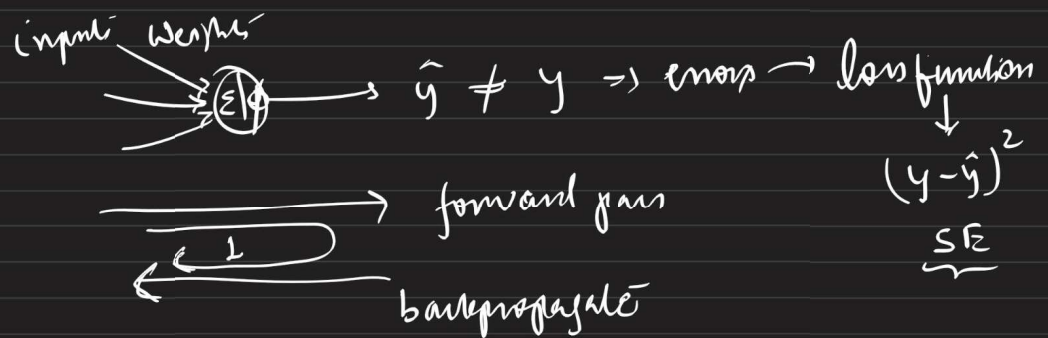
error

$$\Rightarrow \begin{cases} w_{new} = w_{old} + \eta(y - \hat{y})x \\ \quad\; = w_{old} + \eta\,\Delta w \end{cases}$$

learning rate $= 0 \to 1$

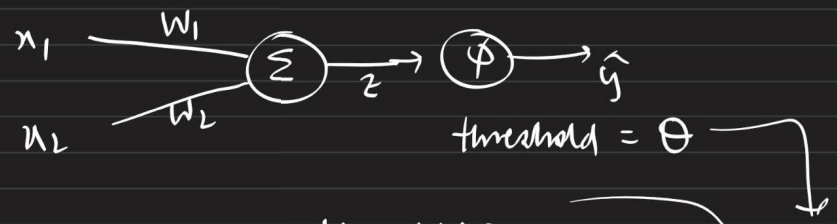
Δw or error $= y - \hat{y} \neq 0$

$$\left\{ w = w - \eta \frac{d\,\text{error}}{dw} \right\}$$



When loss function → 0 => model is trained.

→ activation functions → deciding factors / function



$$z = w_1x_1 + w_2x_2$$

$$\hat{y} = \phi(z) = \begin{cases} + & z \geq \theta \\ - & z < \theta \end{cases}$$

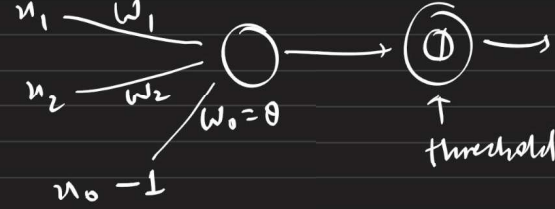
$$= \begin{cases} + & w_1x_1 + w_2x_2 \geq \theta \\ - & w_1x_1 + w_2x_2 < \theta \end{cases}$$

$$= \begin{cases} + & w_1x_1 + w_2x_2 - \theta \geq 0 \\ - & w_1x_1 + w_2x_2 - \theta < 0 \end{cases}$$

$$w_1x_1 + w_2x_2 + w_0x_0$$

θ ↓ w_0, $x_0 = 1$

assumption
$w_0 = \theta$
$x_0 = -1$



$$z = w_1 x_1 + w_2 x_2 = \begin{bmatrix} w_1 & w_2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} w_1 \\ w_1 \end{bmatrix}^T \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = w^T x$$

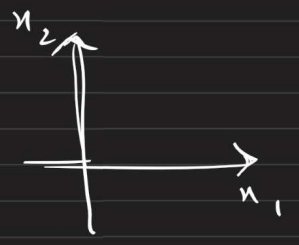
$$z = w^T x + w_0 x_0$$

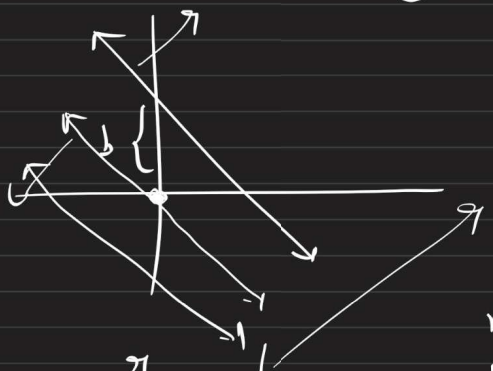
$$z = w^T x + b$$

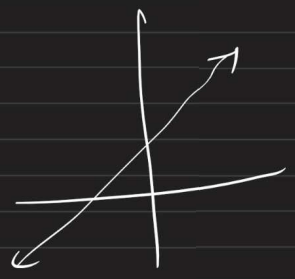
$$w_1 x_1 + w_2 x_2 - \theta = 0$$

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

$$x_2 = -m x_1 + b$$







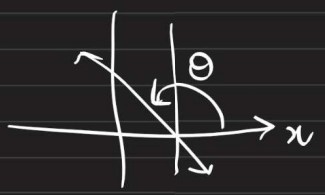
m → rotation

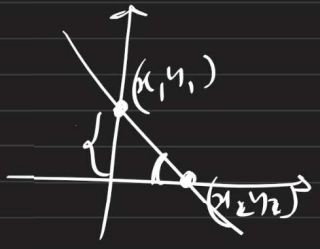
b → translation

$y = mx + c$

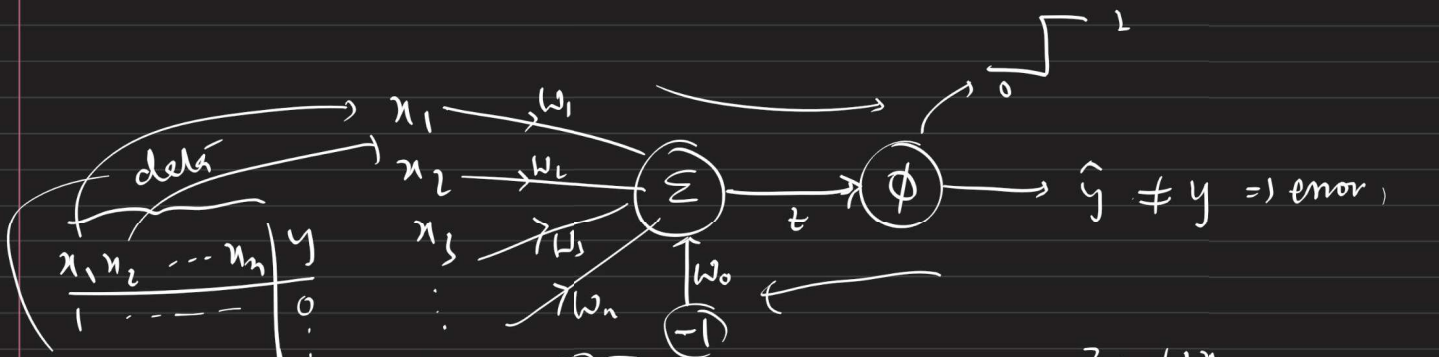
↳ slope $= \tan\theta$

$$= \frac{(y_2 - y_1)}{(x_2 - x_1)}$$





$$\frac{y_1 - y_2}{x_2 - x_1} = \frac{(y_1 - y_1)}{(x_2 - x_1)}$$



Randomly initialized

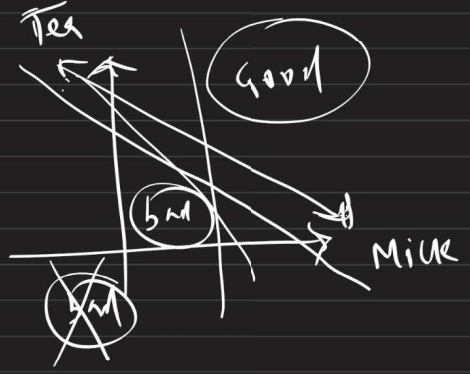
$z = w.x$

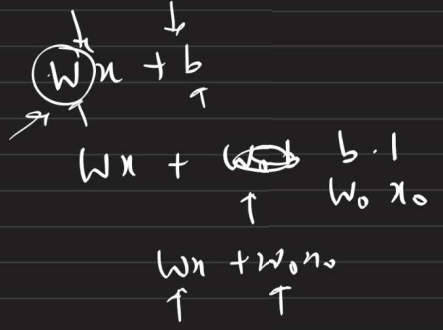
$0 \to 1$

$$w = w + \eta (\hat{y} - \hat{y}) x_i$$

$0 \to 1$

Perceptron Learning Rule





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