1. Perceptron
2. Multilayer Perceptron
3. Feed Forward Neural Net → Notation, Mathematics
4. Practical with Keras
5. Back Propagation → Calculas
   Derivation / Min, Max
   Neat session

Neurolab

DL

ANN

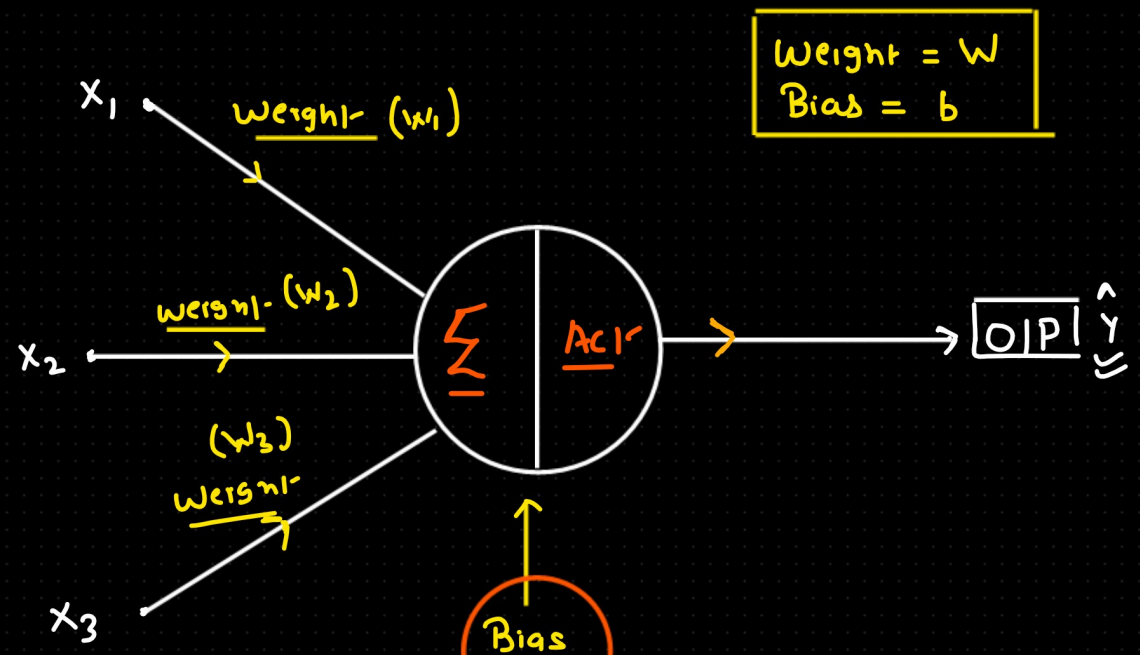
BP ⇒ Practical

LR, LR, RF, XG

code ⇒ Google Colab

tensorflow, Pytorch

Perceptron



$$\Sigma \Rightarrow x_1 w_1 + x_2 w_2 + x_3 w_3 + b \Rightarrow W^T X + b$$

Sigmoid fln $\Rightarrow$ Act^r $(W^T X + b) \Rightarrow$ O/P

Acf fln

1. Step fln
2. Sigmoid fln
3. tanh fln

$Y = mx + C$

LR $\Rightarrow$ $Y = m_1 x_1 + m_2 x_2 + m_3 x_3 + C$

Logreg $\Rightarrow$ Sigmoid fln. $\Rightarrow \frac{1}{1+e^{-x}} = \frac{1}{1+e^{-(y)}}$

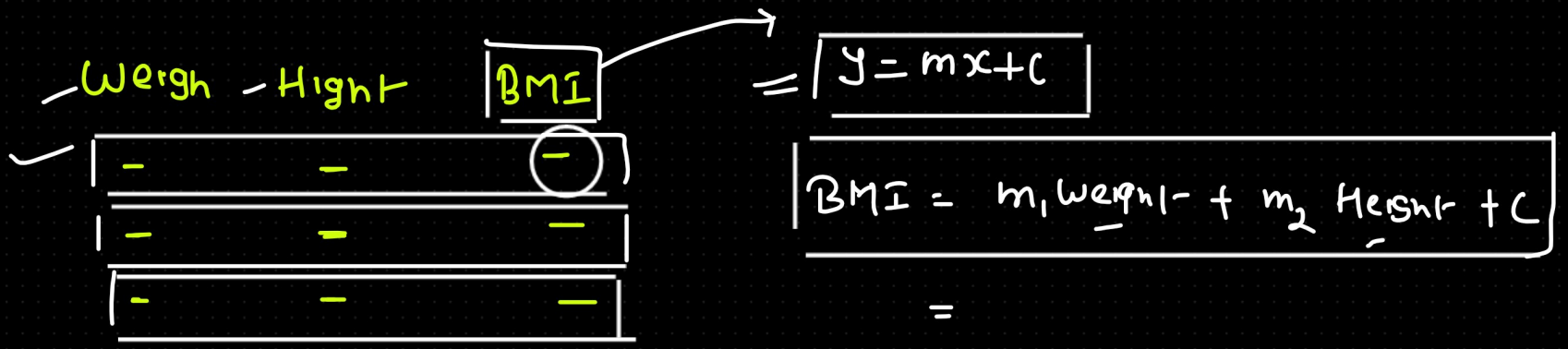
Multilayer Perceptron

1. Input layer
2. Hidden layer
3. Output layer

Feed forward NN => Linear Algebra → Dot Product, Vector, Matrix, Matrix operations

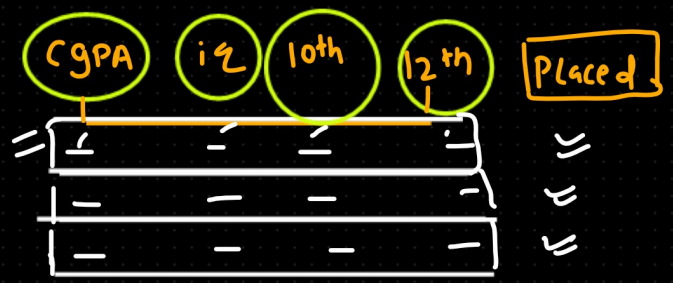
BackPropagation => Calculas

derivation, min-max, fln



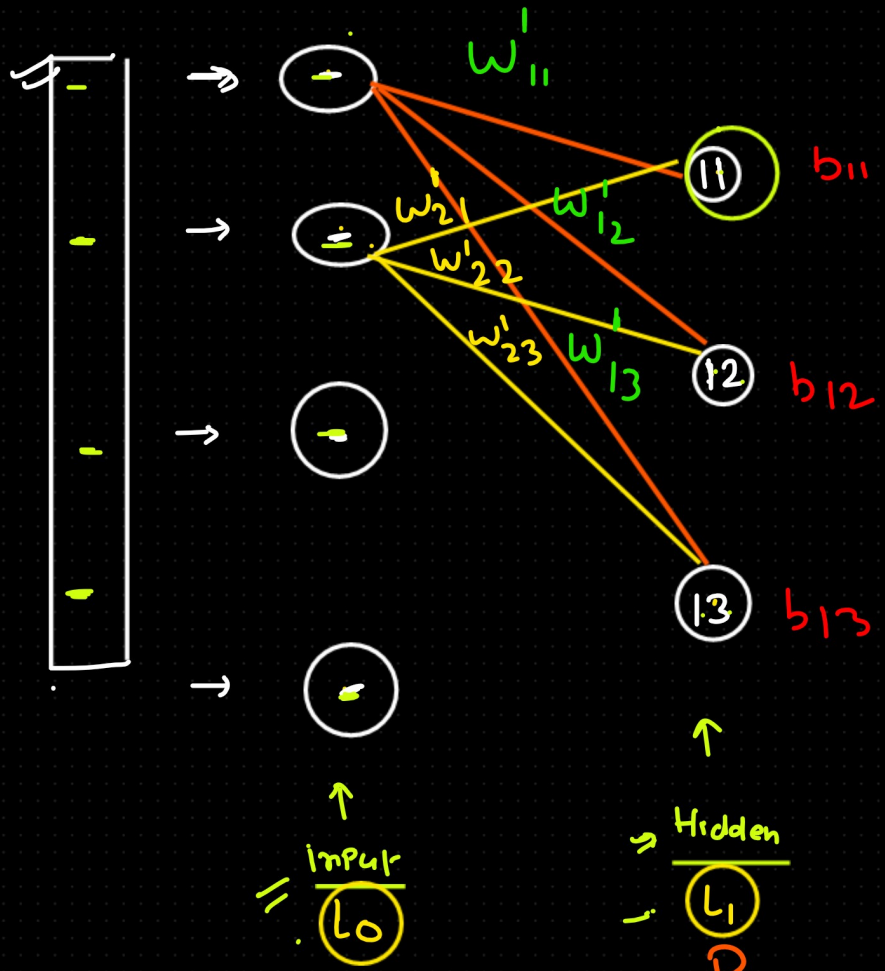
Notations

= Data ⇒ MxN { M ⇒ rows, N ⇒ Columns } N=4



Complexity

Combination



= Edge = Weight

= H_1 (Hidden Layer)

= H_2 (Hidden Layer)

** = trainable Parameter

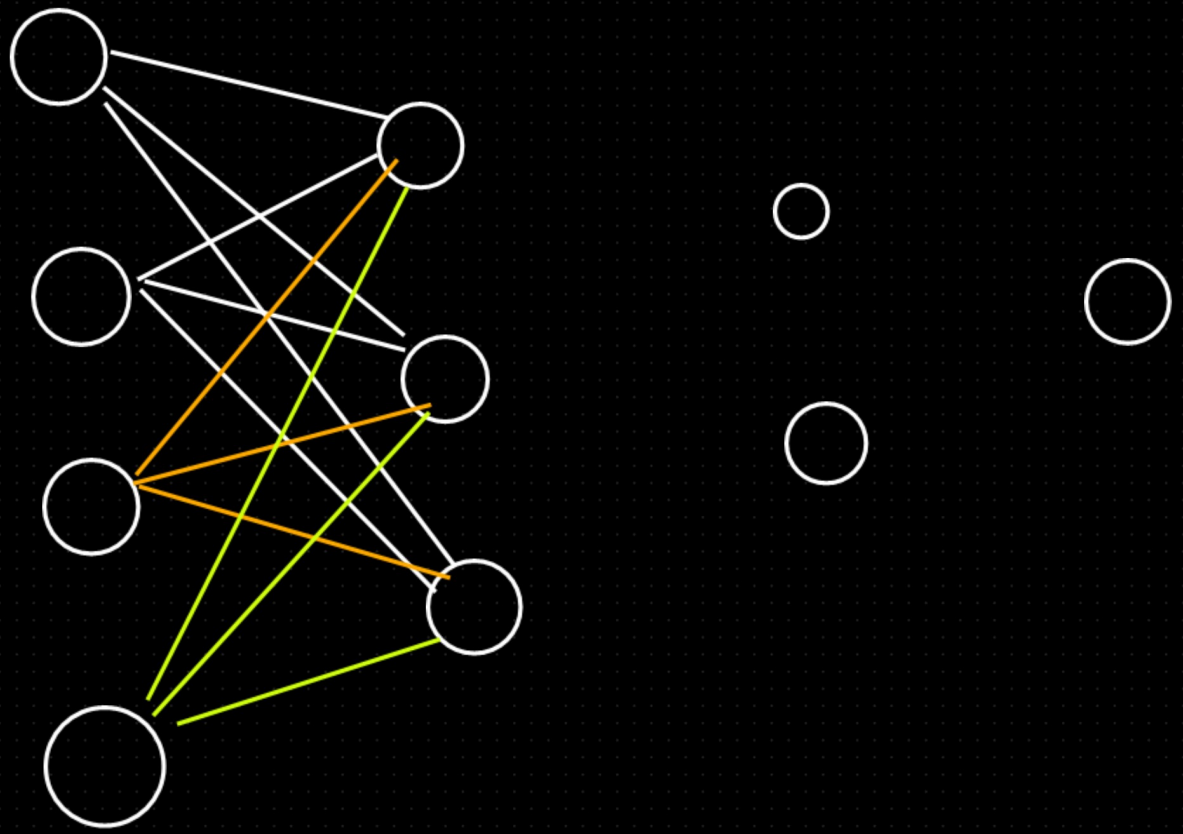
Weight = w_{ij}

bias = b_{ij}

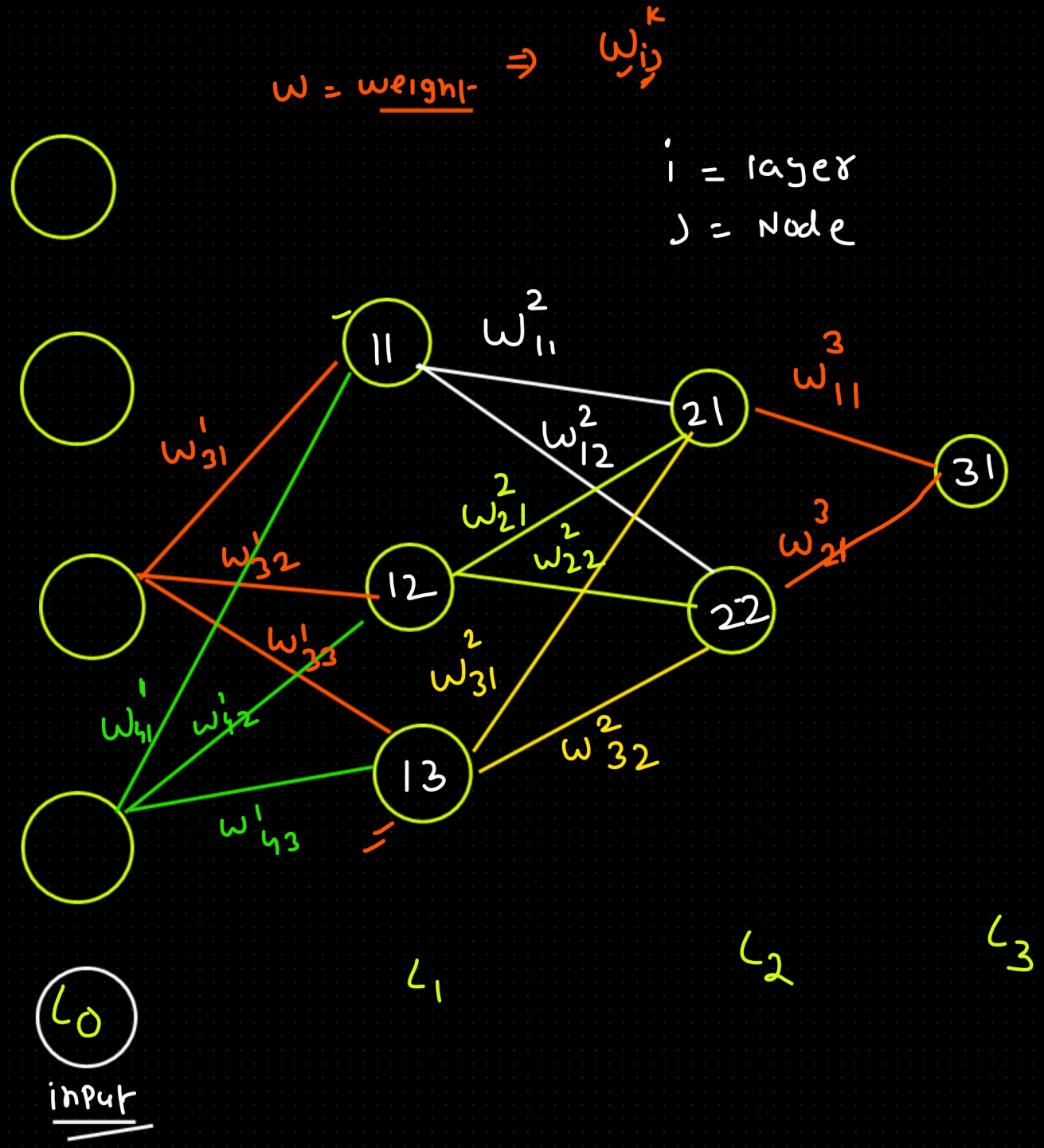
output = o_{ij}

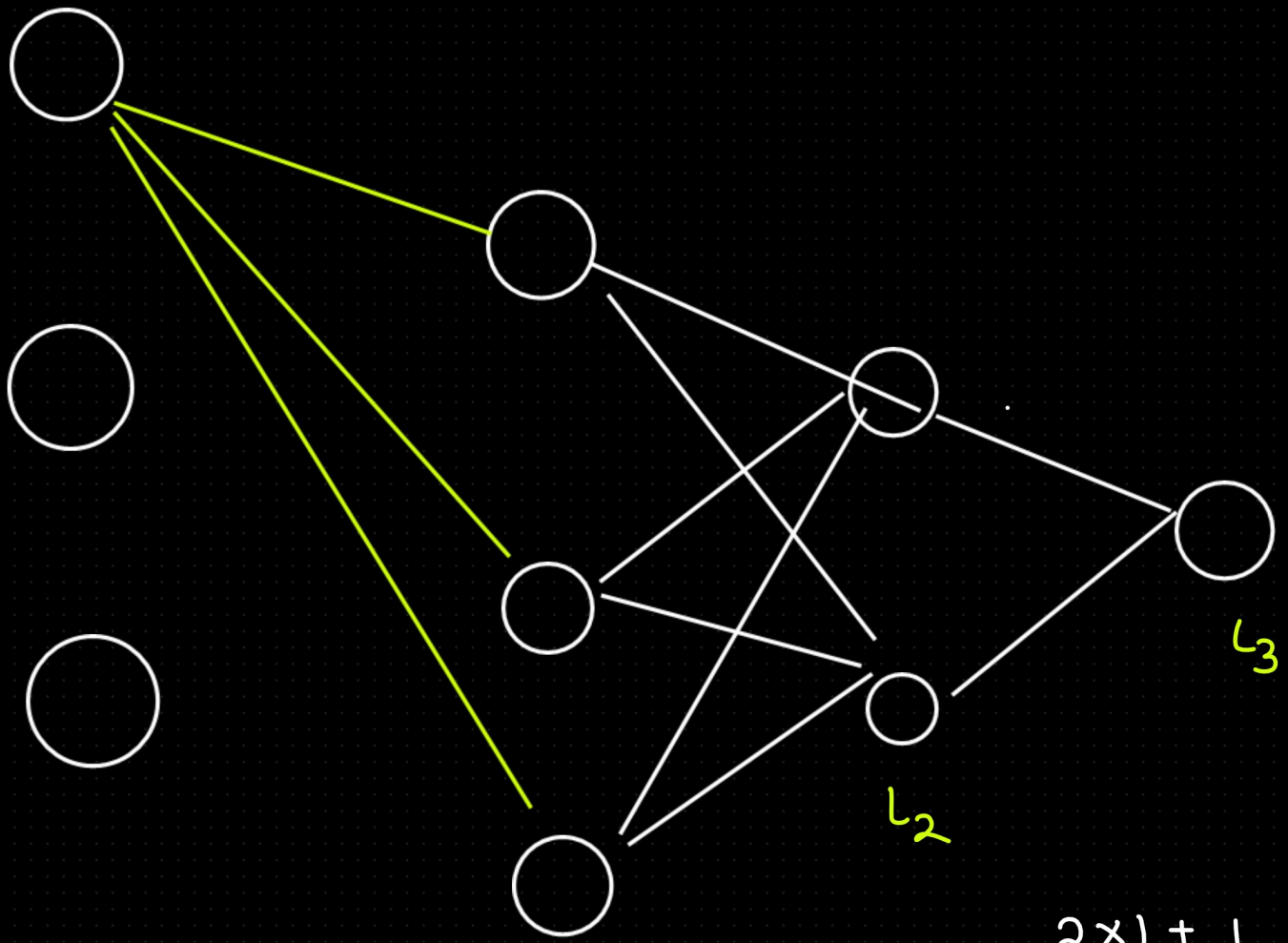
{ i = layer, j = Node No }

w_{ij}



$4 \times 3 = \boxed{12}$


w = weight
$\Rightarrow w_{ij}^{k}$
i = layer
j = Node
11
12
13
21
22
31
w_{11}^{2}
w_{12}^{2}
w_{21}^{2}
w_{22}^{2}
w_{31}^{2}
w_{32}^{2}
w_{11}^{3}
w_{21}^{3}
w_{31}^{1}
w_{32}^{1}
w_{33}^{1}
w_{41}^{1}
w_{42}^{1}
w_{43}^{1}
L_0
L_1
L_2
L_3
input



W

$4 \times 3 = 12 + 3$

1st

$3 \times 2 - 6 + 2$

8

$2 \times 1 + 1$

$2 + 1 = 3$

$15 + 8 + 3 = 26$

Trainable Parameter

$y = mx + c$

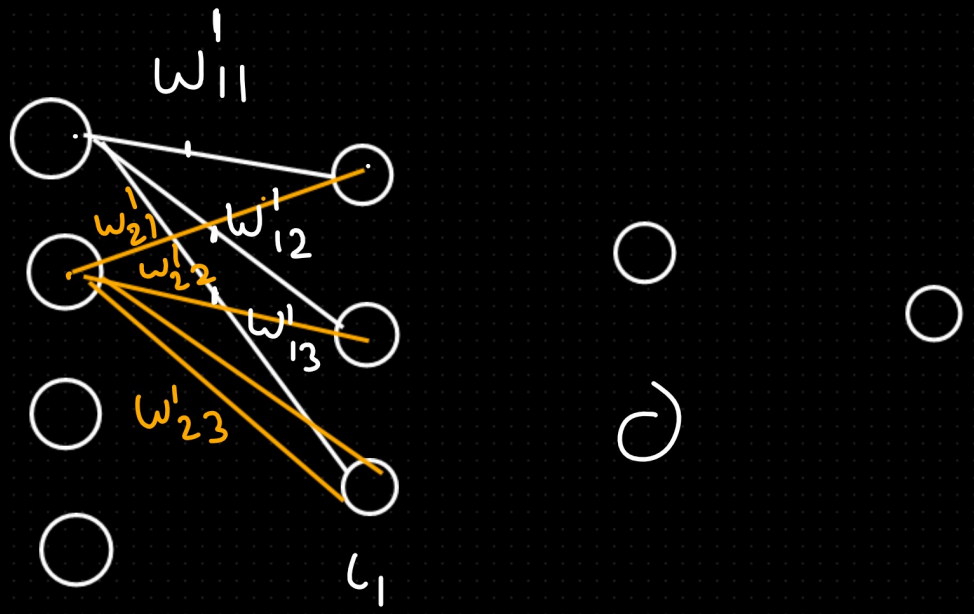
$y = m_1x_1 + m_2x_2 + m_3x_3 + m_4x_4 + c$

G.D. ⇒ optimizer ⑤ $m_1\ m_2\ m_3\ m_4\ c$

↓

trainable

loss ↓

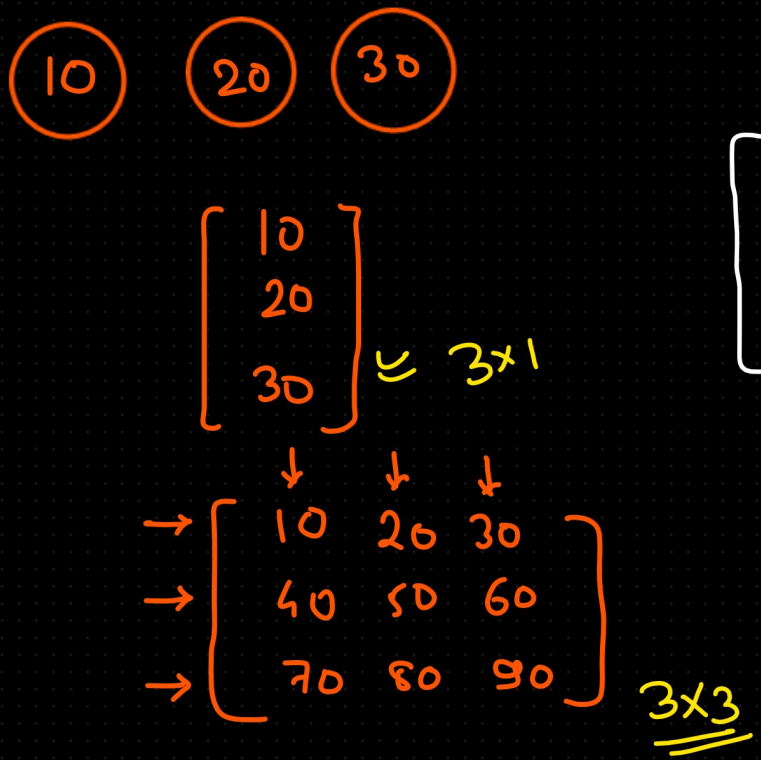


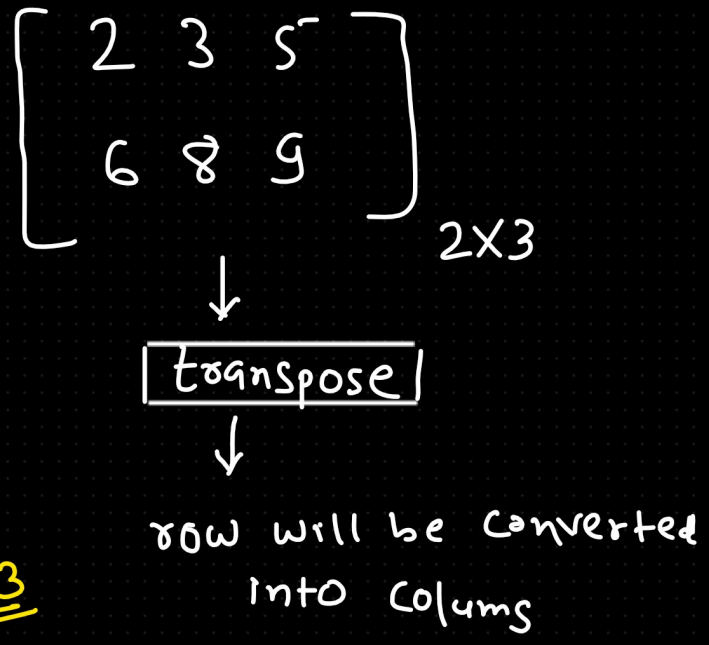
Transpose

Vector

Matrix

Matrix multiplication operation





$$\begin{bmatrix} 2 & 3 & 5 \\ 6 & 8 & 9 \end{bmatrix}_{2\times3} \xrightarrow{\text{transpose}} \begin{bmatrix} 2 & 6 \\ 3 & 8 \\ 5 & 9 \end{bmatrix}_{3\times2}$$

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 5 & 2 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 1\times5 + 2\times3 & 1\times2 + 2\times1 \\ 3\times5 + 4\times3 & 3\times2 + 4\times1 \end{bmatrix}$$

$$= \begin{bmatrix} 5+6 & 2+2 \\ 15+12 & 6+4 \end{bmatrix}$$

$$= \begin{bmatrix} 11 & 4 \\ 27 & 10 \end{bmatrix}$$

$$y = mx + c$$

$$\equiv \quad y = m_1 x_1 + m_2 x_2 + m_3 x_3 + m_4 x_4 + m_5 x_5 + c$$

$$\left\{ \begin{bmatrix} m_1 \\ m_2 \\ m_3 \\ m_4 \\ m_5 \end{bmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} + [c] \right\}$$

$$\equiv$$

$$M^T X + C$$

$$\begin{bmatrix} m_1 & m_2 & m_3 & m_4 & m_5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix}$$

$$\equiv$$

Dot Product

Forward Propogation

$L_0 \Rightarrow$ I/P
$L_1 L_2 \Rightarrow$ HL
$L_3 \Rightarrow$ O/P

CGPA	iq	10th	12th	Placed
—	—	—	—	—
—	—	—	—	—

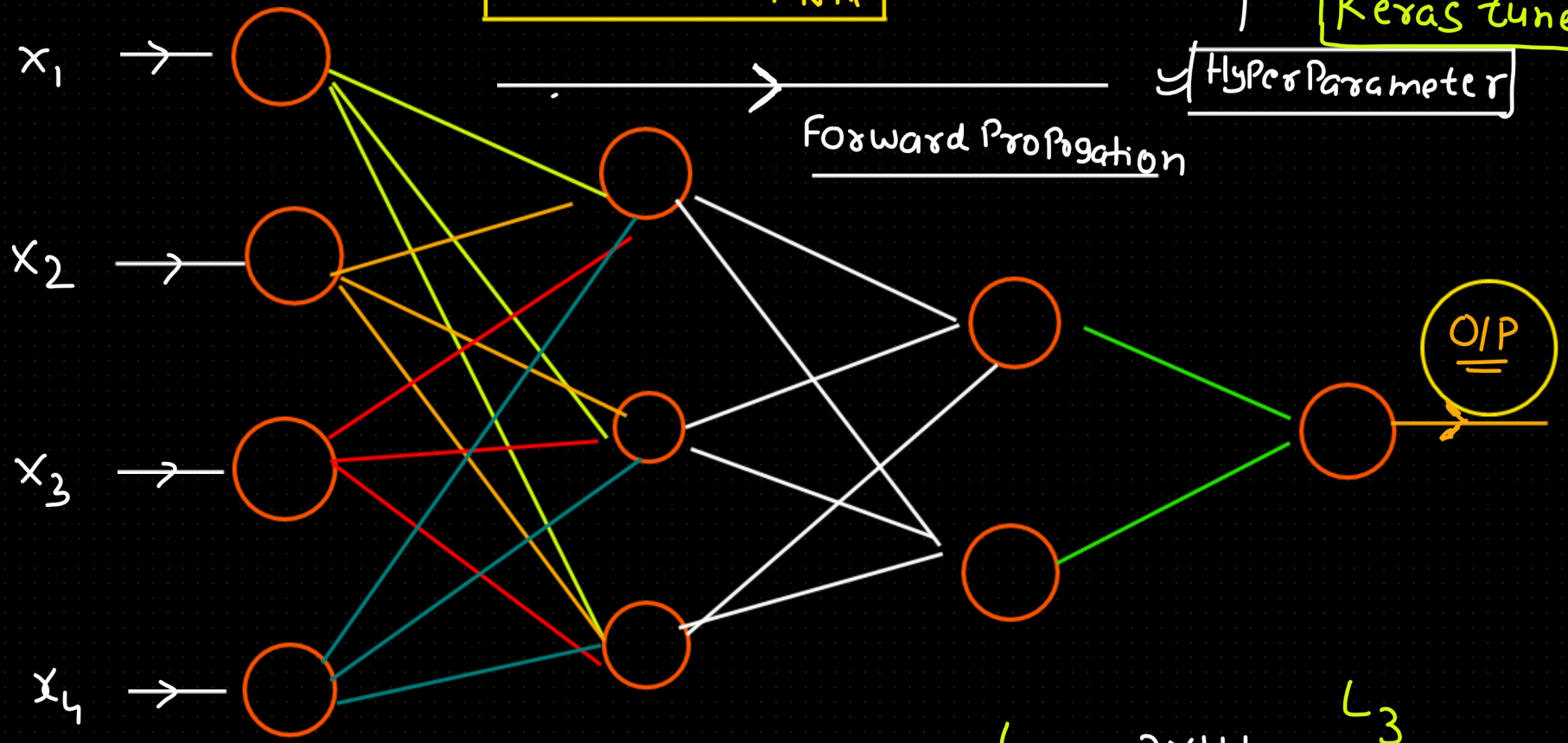
Input layer = No. of Col

Hidden layer, No. of Neuron

↑ Keras tuner

↳ HyperParameter

fully connected NN



≡ FP ⇒ Calculation

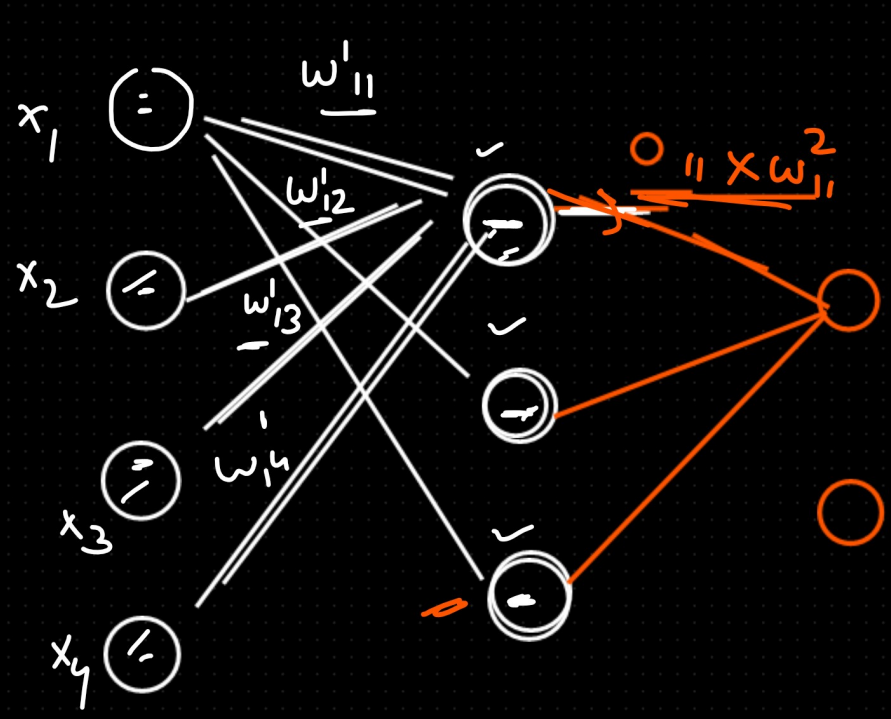
Loss

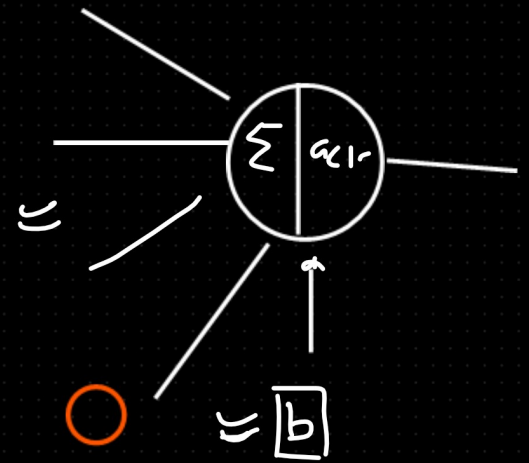
BP ⇒ Optimizer ⇒ Updating trainable Parameters

Layer1 Weight Matrix

$$\begin{bmatrix} w'_{11} & w'_{12} & w'_{13} \\ w'_{21} & w'_{22} & w'_{23} \\ w'_{31} & w'_{32} & w'_{33} \\ w'_{41} & w'_{42} & w'_{43} \end{bmatrix}^T \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} b_{11} \\ b_{12} \\ b_{13} \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} w'_{11}x_1 + w'_{21}x_2 + w'_{31}x_3 + w'_{41}x_4 \\ w'_{12}x_1 + w'_{22}x_2 + w'_{32}x_3 + w'_{42}x_4 \\ w'_{13}x_1 + w'_{23}x_2 + w'_{33}x_3 + w'_{43}x_4 \end{bmatrix} + \begin{bmatrix} b_{11} \\ b_{12} \\ b_{13} \end{bmatrix}$$





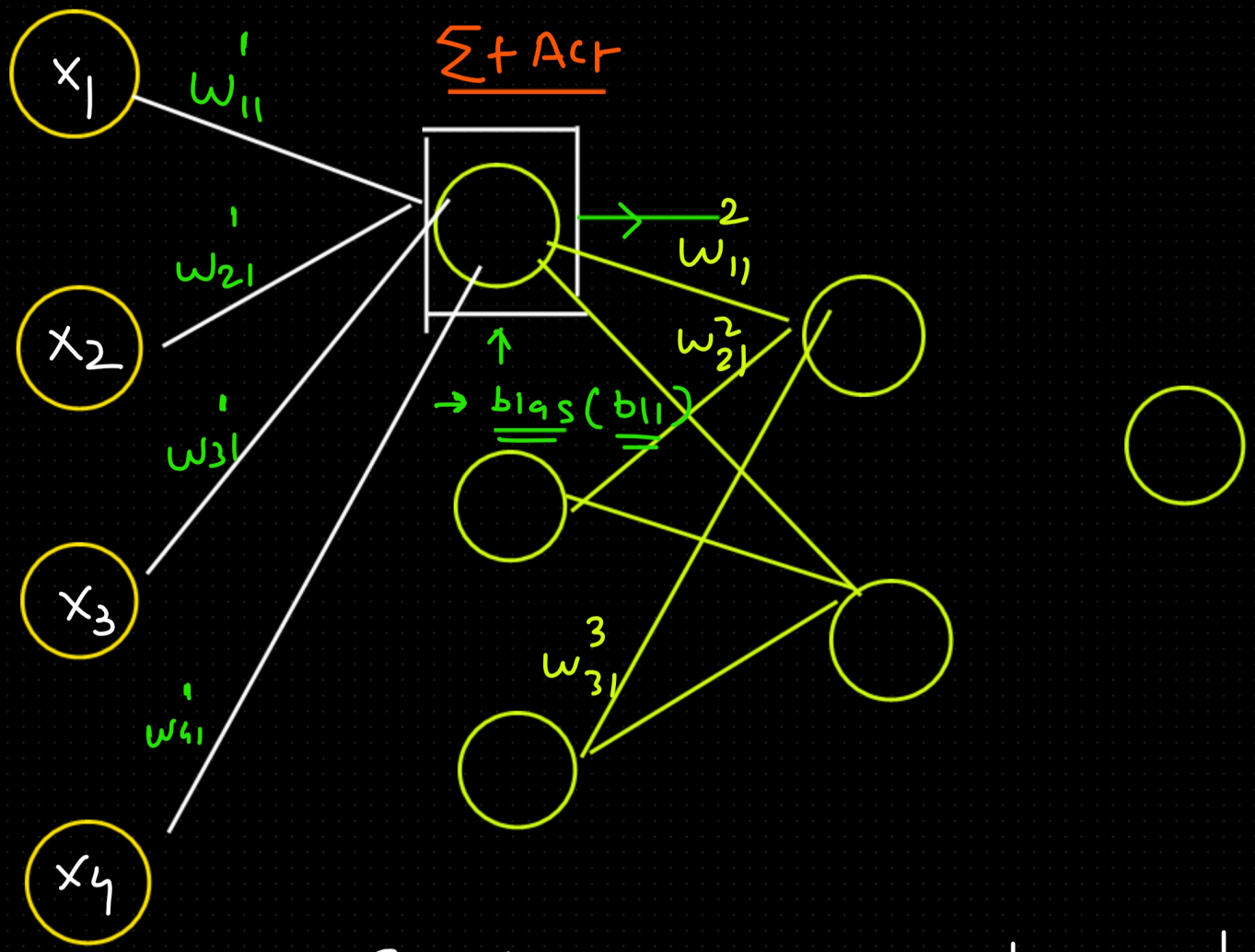
Activation fn

Act

$$\begin{pmatrix} w'_{11}x_1 + w'_{21}x_2 + w'_{31}x_3 + w'_{41}x_4 + b_{11} \\ w'_{12}x_1 + w'_{22}x_2 + w'_{32}x_3 + w'_{42}x_4 + b_{12} \\ w'_{13}x_1 + w'_{23}x_2 + w'_{33}x_3 + w'_{43}x_4 + b_{13} \end{pmatrix}$$

$$\Downarrow$$

$$\begin{bmatrix} o_{11} \\ o_{12} \\ o_{13} \end{bmatrix}$$



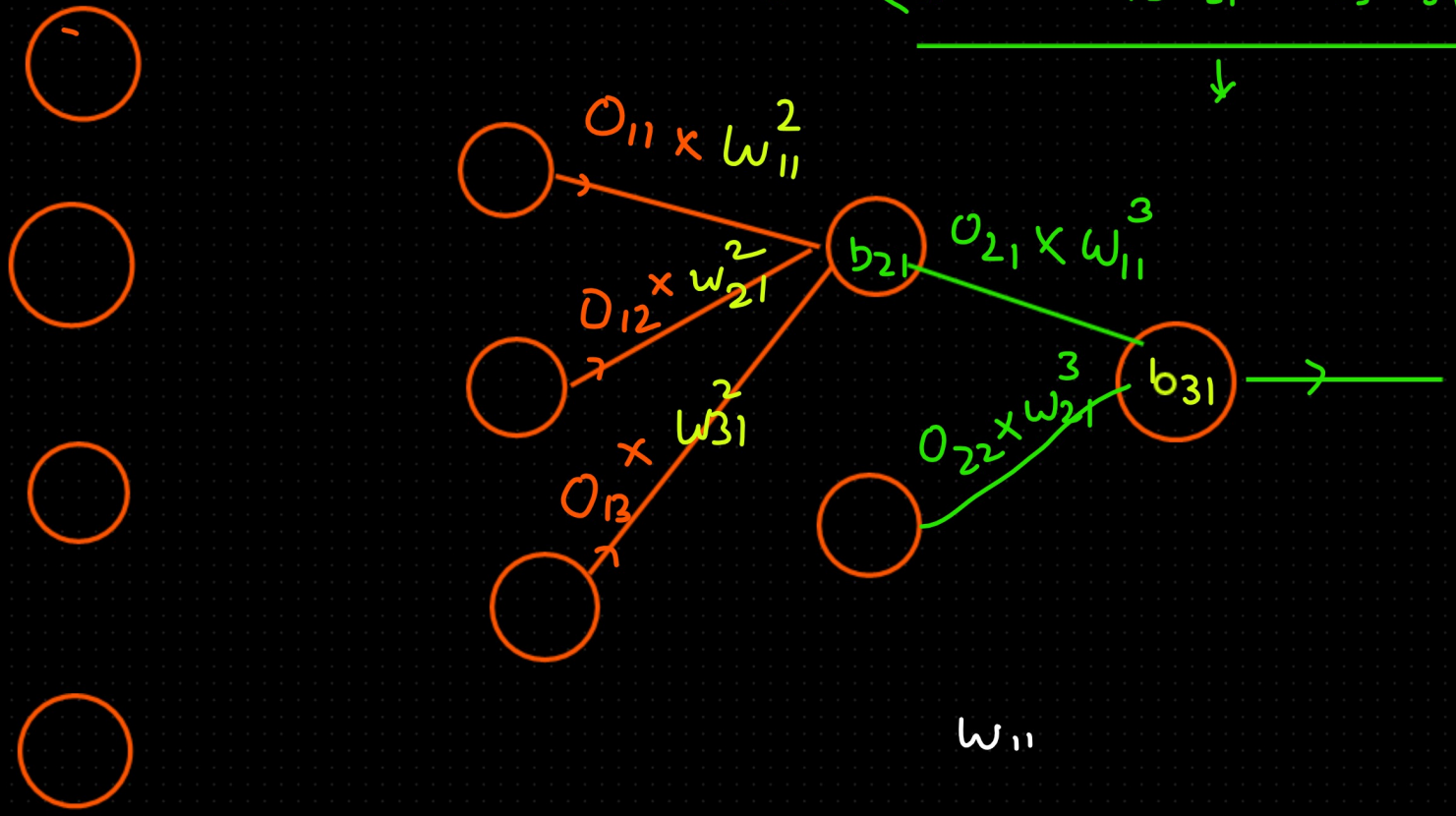
$$act\left(x_1 w^1_{11} + x_2 w^1_{21} + x_3 w^1_{31} + x_4 w^1_{41} + b_{11}\right)$$

$$\begin{bmatrix} w_{11}^{2} & w_{12}^{2} \\ w_{21}^{2} & w_{22}^{2} \\ w_{31}^{2} & w_{32}^{2} \end{bmatrix}^{T} \times \begin{bmatrix} o_{11} \\ o_{12} \\ o_{13} \end{bmatrix} + \begin{bmatrix} b_{21} \\ b_{22} \end{bmatrix}$$

<u>alt</u>

$$\left(\begin{bmatrix} w_{11}^{2} o_{11} + w_{21}^{2} o_{12} + w_{31}^{2} o_{13} + b_{21} \\ w_{12}^{2} o_{11} + w_{22}^{2} o_{12} + w_{32}^{2} o_{13} + b_{2} \end{bmatrix} \right) = \begin{bmatrix} o_{21} \\ o_{22} \end{bmatrix}$$

act $\sigma\left(o_{11}w_{11}^{2} + o_{12}w_{21}^{2} + o_{13}w_{31}^{2} + b_{21}\right)$



Layer 3

$$\begin{bmatrix} w_{11}^{3} \\ w_{21}^{3} \end{bmatrix}^{T} \begin{bmatrix} o_{21} \\ o_{22} \end{bmatrix} + \begin{bmatrix} b_{31} \end{bmatrix}$$

2×1 $\quad$ 2×1 $\quad$ 1×1

$\hat{y}$

act $\left(\begin{bmatrix} w_{11}^{3} o_{21} + w_{21}^{3} o_{22} + b_{31} \end{bmatrix} \right) =$ Output

$y = mx + c$

26 ⇒ trainable param

= BP ⇒ GD ⇒ SGD