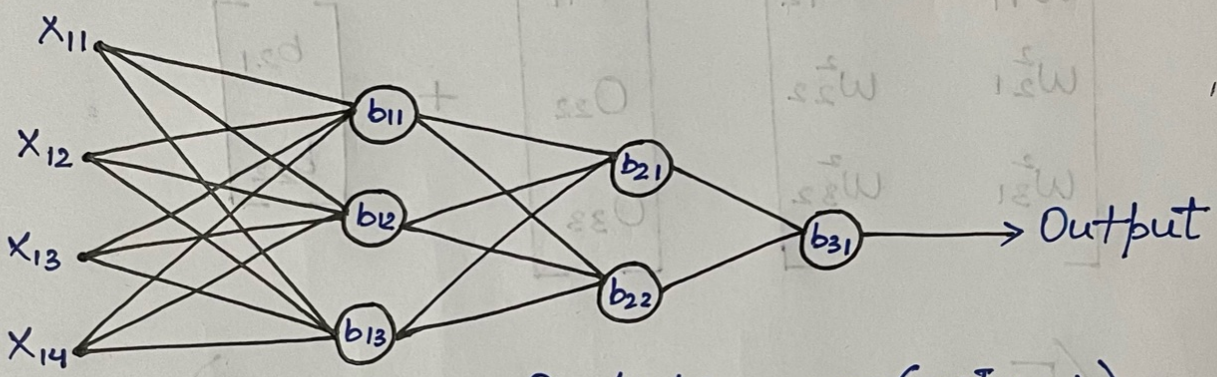
FORWARD PROPAGATION

Forward propagation is the process of computing and passing input data through a neural network in order to generate an output prediction.

Let's understand forward propagation with help of an example :



Prediction $\rightarrow \sigma(w^T X + b)$

Layer # 1

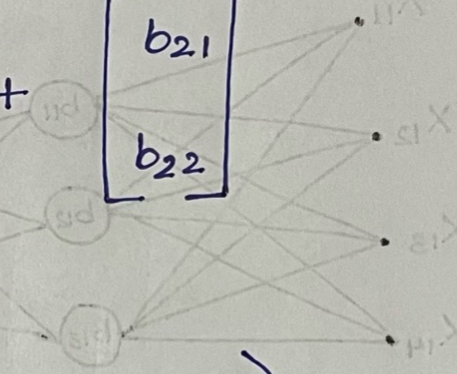
$$\begin{bmatrix} w'_{11} & w'_{12} & w'_{13} \\ w'_{21} & w'_{22} & w'_{23} \\ w'_{31} & w'_{32} & w'_{33} \\ w'_{41} & w'_{42} & w'_{43} \end{bmatrix}^T \begin{bmatrix} x_{11} \\ x_{12} \\ x_{13} \\ x_{14} \end{bmatrix} + \begin{bmatrix} b_{11} \\ b_{12} \\ b_{13} \end{bmatrix}$$

$$\sigma\left(\begin{bmatrix} w'_{11}x_{11} + w_{21}x_{12} + w_{31}x_{13} + w_{41}x_{14} \\ w'_{12}x_{11} + w_{22}x_{12} + w_{32}x_{13} + w_{42}x_{14} \\ w'_{13}x_{11} + w_{23}x_{12} + w_{33}x_{13} + w_{43}x_{14} \end{bmatrix} + \begin{bmatrix} b_{11} \\ b_{22} \\ b_{13} \end{bmatrix} \right)$$

$$\Rightarrow \begin{bmatrix} O_{11} \\ O_{12} \\ O_{13} \end{bmatrix}$$

Layer #2

$$\begin{bmatrix} w_{11}^2 & w_{12}^2 \\ w_{21}^2 & w_{22}^2 \\ w_{31}^2 & w_{32}^2 \end{bmatrix}^T \begin{bmatrix} O_{11} \\ O_{22} \\ O_{33} \end{bmatrix} + \begin{bmatrix} b_{21} \\ b_{22} \end{bmatrix}$$



$$\Rightarrow \sigma\left(\begin{bmatrix} w_{11}O_{11} + w_{21}O_{12} + w_{31}O_{13} + b_{21} \\ w_{12}O_{11} + w_{22}O_{12} + w_{32}O_{13} + b_{22} \end{bmatrix}\right) = \begin{bmatrix} O_{21} \\ O_{22} \end{bmatrix}$$

Layer #3

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

$$\sigma\left(\begin{bmatrix} w_{11}O_{21} + w_{21}O_{22} + b_{31} \end{bmatrix}\right) = \hat{y}_i$$