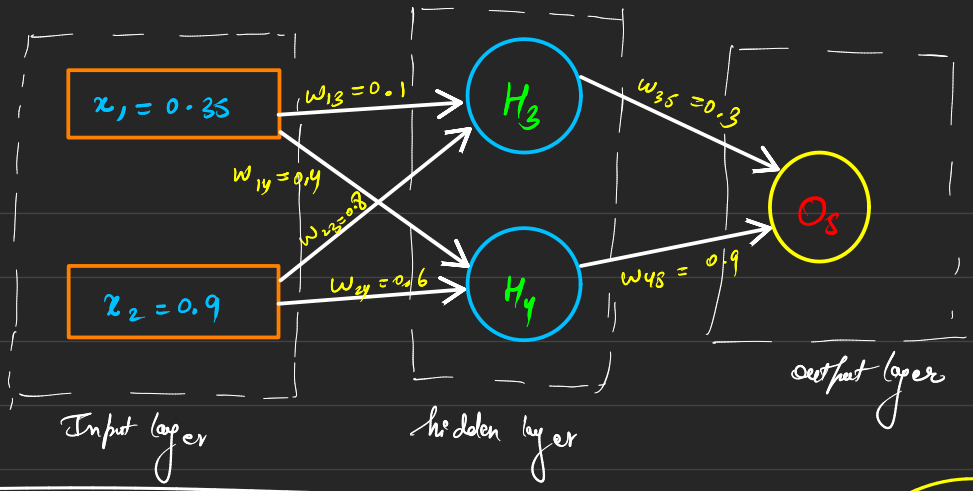



**given :-**

* actual output ($Y$) = 0.5
* learning rate = 1
* Activation fnc ⇒ Sigmoid fnc.

* Activation fnc

$$Y_j = \frac{1}{1+e^{-a_j}}$$

sigmoid function

(1) performing **Forward Pass** :-

$$a_j = \sum_{i=1}^{N} (w_{ij} * x_i)$$

N = no. of connected nodes

* **for $H_3$** :-

$$a_3 = w_{13} * x_1 + w_{23} * x_2$$
$$= (0.1)(0.35) + (0.8)(0.9)$$
$$a_3 = 0.755$$

$$\therefore Y_3 = \frac{1}{1+e^{-0.755}} \Rightarrow Y_3 = 0.68$$

* **for $H_4$** :-

$$a_4 = w_{14} x_1 + w_{24} x_2$$
$$= (0.4)(0.35) + (0.6)(0.9)$$
$$a_4 = 0.68$$

$$\therefore Y_4 = \frac{1}{1+e^{-0.68}} \Rightarrow Y_4 = 0.6637$$

* for $O_5$ :-

$$a_5 = w_{35}\, y_3 + w_{45}\, y_4$$
$$= (0.3)(0.68) + (0.9)(0.6637)$$
$$\boxed{a_5 = 0.801}$$

$$\therefore \quad y_5 = \frac{1}{1 + e^{-0.801}} \Rightarrow \boxed{y_5 = 0.69}$$

predicted value (output)

## (2) Calculate Error :-

$$\text{Error} = y_{\text{actual}} - y_{\text{predicted}}$$
$$= 0.5 - 0.69$$
$$\boxed{\text{Error} = -0.19}$$

our main aim is to decrease these error
∴ we will do backward pass to change the weights of interconnections
∴ making model more accurate.

## (3) perform Backward pass :-

* weight change formula

$$\boxed{\Delta w_{ij} = \eta\, \delta_j\, O_i}$$

* $\eta \Rightarrow$ learning rate
* $\delta_j \Rightarrow$ Error measure for unit $j$
* $O_i \Rightarrow$ predicted output at unit $i$

* if $j$ is output unit

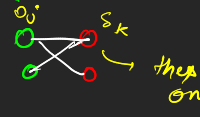
$$\delta_j = O_j(1 - O_j)(T_j - O_j)$$

($T_j$ → Target output; $O_j$ → predicted output)

* if $j$ is any other unit (hidden)

$$\delta_j = O_j(1 - O_j) \sum_k \delta_k w_{kj}$$

($k$ → unit connected in forward)



## * Calculating measure of Error :-

① $\delta_5 = y_5 (1 - y_5)(y_{target} - y_5)$ (output unit)

$= (0.69)(1 - 0.69)(0.5 - 0.69)$

$= -0.0406$

$\delta_5 = -0.0406$

② $\delta_3 = y_3 (1 - y_3)[\delta_5 w_{35}]$

$= 0.68 (1 - 0.68)[(0.3)(-0.0406)]$

$= -0.00263$

$\delta_3 = -0.00263$

③ $\delta_4 = y_4 (1 - y_4)[\delta_5 w_{45}]$

$= 0.6639 (1 - 0.6639)[(0.9)(-0.0406)]$

$= -0.0082$

$\delta_4 = -0.0082$

## * Computing $\Delta w_{ij}$ :-

$\Delta w_{ij} = \eta \delta_j o_i$

* $\Delta w_{13} = 1 * (-0.00263) * (0.35)$ ($\delta_3$, $y_1$ → ②)

$= -0.0009275$

$\Delta w_{13} = -0.0009275$

* $\Delta w_{14} = 1 * (-0.0082) * (0.35)$

$= -0.0269$

$\Delta w_{14} = -0.0269$

* $\Delta w_{35} = 1 * (-0.0406) * (0.68)$

$= -0.027608$

$\Delta w_{35} = -0.027608$

* $\Delta w_{24} = (*0.9) * (-0.0082)$

$= -0.00738$

$\Delta w_{24} = -0.00738$

* $\Delta w_{45} = 1 * (-0.0408) * (0.6637)$

$= -0.0269$

$\Delta w_{45} = -0.0269$

* $\Delta w_{13} = 1 * (0.9) (-0.00265)$

$= -0.002385$

$\Delta w_{13} = -0.002385$

* Computing new weights :-

$$(w_{ij})_{new} = (w_{ij})_{old} + \Delta w_{ij}$$

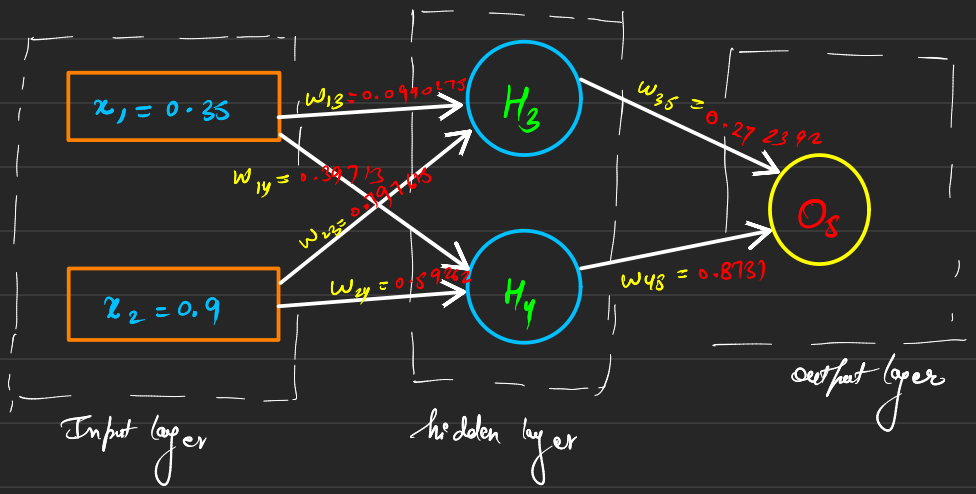
* $(w_{14})_{new} = 0.4 + (-0.00287)$

$= 0.39713$

* Ily

* $(w_{14})_{new} = 0.39713$
* $(w_{45})_{new} = 0.8731$
* $(w_{13})_{new} = 0.0990275$
* $(w_{24})_{new} = 0.59262$
* $(w_{35})_{new} = 0.272392$
* $(w_{23})_{new} = 0.797615$

∴




* Now do the same process all the way from ① forward pass to ② error calculation