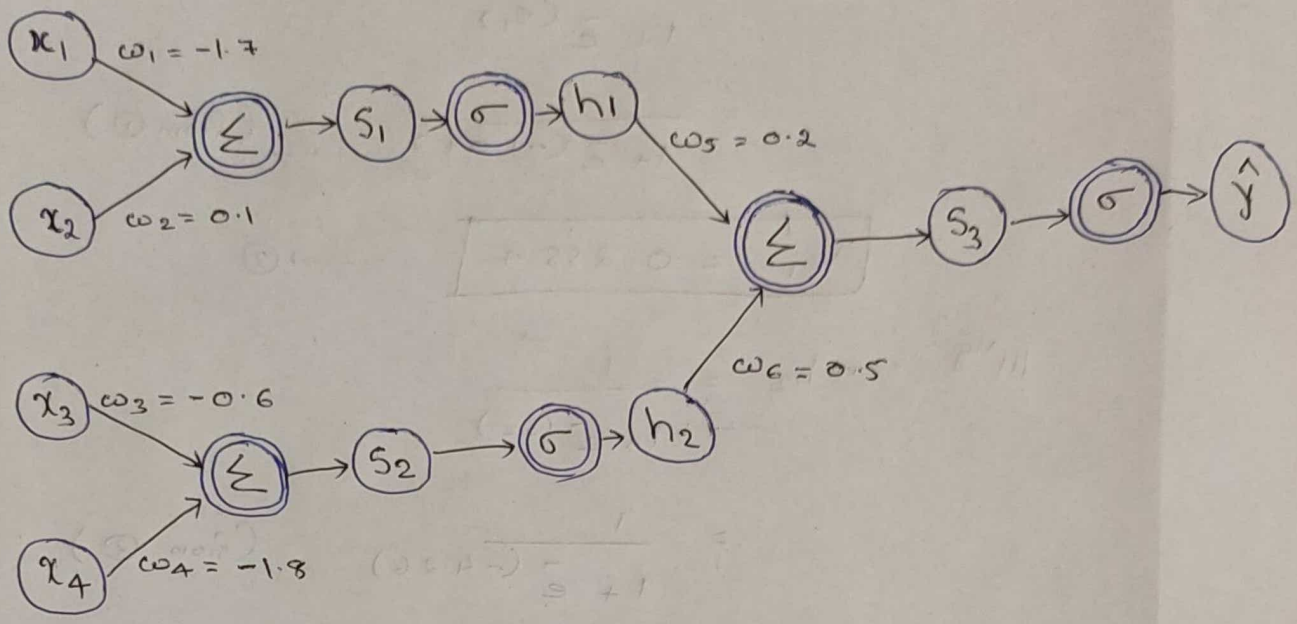
① Qn No: 1



Given

Input variables ; $(x_1, x_2, x_3, x_4) = (0.7, 1.2, 1.1, 2)$

weight ; $(\omega_1, \omega_2, \omega_3, \omega_4, \omega_5, \omega_6) = (-1.7, 0.1, -0.6, -1.8, -0.2, 0.5)$

Loss $L(y, \hat{y}) = \|\hat{y} - y\|^2$.

$\frac{\partial L}{\partial \hat{y}} = 2\|\hat{y} - y\|$

Output $\hat{y} = 0.5$

Forward propo

Variables.

$s_1 = x_1 \omega_1 + x_2 \omega_2$

$= (0.7)(-1.7) + (1.2)(0.1)$.

$= -1.19 + 0.12$

$\boxed{s_1 = -1.07}$ ⟶ ①

$s_2 = x_3 \omega_3 + x_4 \omega_4$

$= (1.1)(-0.6) + (-1.8)(2)$

$\boxed{s_2 = -4.26}$ ⟶ ②

w.r.t, Transfer function $h_1 = \frac{1}{1 + e^{-x_1 w_1 + x_2 w_2}}$.

$$h_1 = \frac{1}{1 + e^{-(s_1)}}$$

$$= \frac{1}{1 + e^{-(-1.07)}} \quad \text{(from ①)}$$

$$\boxed{h_1 = 0.2554.} \longrightarrow ③$$

III^{rly} $$h_2 = \frac{1}{1 + e^{-(s_2)}}$$

$$= \frac{1}{1 + e^{-(-4.26)}} \quad \text{(from ②)}.$$

$$\boxed{h_2 = 0.0139.} \longrightarrow ④$$

$$s_3 = h_1 w_5 + h_2 w_6.$$

$$= (0.2554)(-0.2) + (0.0139)(0.5)$$

$$\boxed{s_3 = -0.04413} \longrightarrow ⑤$$

output $$\hat{y} = \frac{1}{1 + e^{-s_3}}$$

$$= \frac{1}{1 + e^{-(-0.04413)}}$$

$$\boxed{\hat{y} = 0.4889.} \longrightarrow ⑥.$$

Using Backpropogation, find loss:.

$$\frac{\partial L}{\partial w_1} = \frac{\partial L}{\partial \hat{y}} \times \frac{\partial \hat{y}}{\partial s_3} * \frac{\partial s_3}{\partial h_1} \times \frac{\partial h_1}{\partial s_1} \times \frac{\partial s_1}{\partial w_1} \rightarrow ⑦$$

given $$\frac{\partial L}{\partial \hat{y}} = 2 \| \hat{y} - y \|$$

$$= 2 \| 0.4889 - 0.5 \|$$

$$= 2 \times 0.0111 \implies 0.0222. \rightarrow ⑧$$

$$\frac{\partial \hat{y}}{\partial s_2} = \hat{y}(1-\hat{y}) \quad \text{(8)}$$

$$= 0.4889\ (1-0.4889) \qquad \text{(from (6))}$$

$$= 0.2498 \longrightarrow (9)$$

$$\frac{\partial s_3}{\partial h_1} = w_5 \Rightarrow -0.2. \longrightarrow (10)$$

$$\frac{\partial h_1}{\partial s_1} = (h_1)(1-h_1)$$

$$= (0.2554)(1-0.2554)$$

$$= 0.1901 \longrightarrow (11)$$

$$\frac{\partial s_1}{\partial w_1} = x_1 \Rightarrow 0.7 \longrightarrow (12)$$

Put values (8), (9), (10), (11), (12) in (7)

$$\therefore \frac{\partial L}{\partial w_1} = (0.0222)(0.2498)(-0.2)(0.1901)(0.7)$$

$$\boxed{\frac{\partial L}{\partial w_1} = -0.00014.}$$