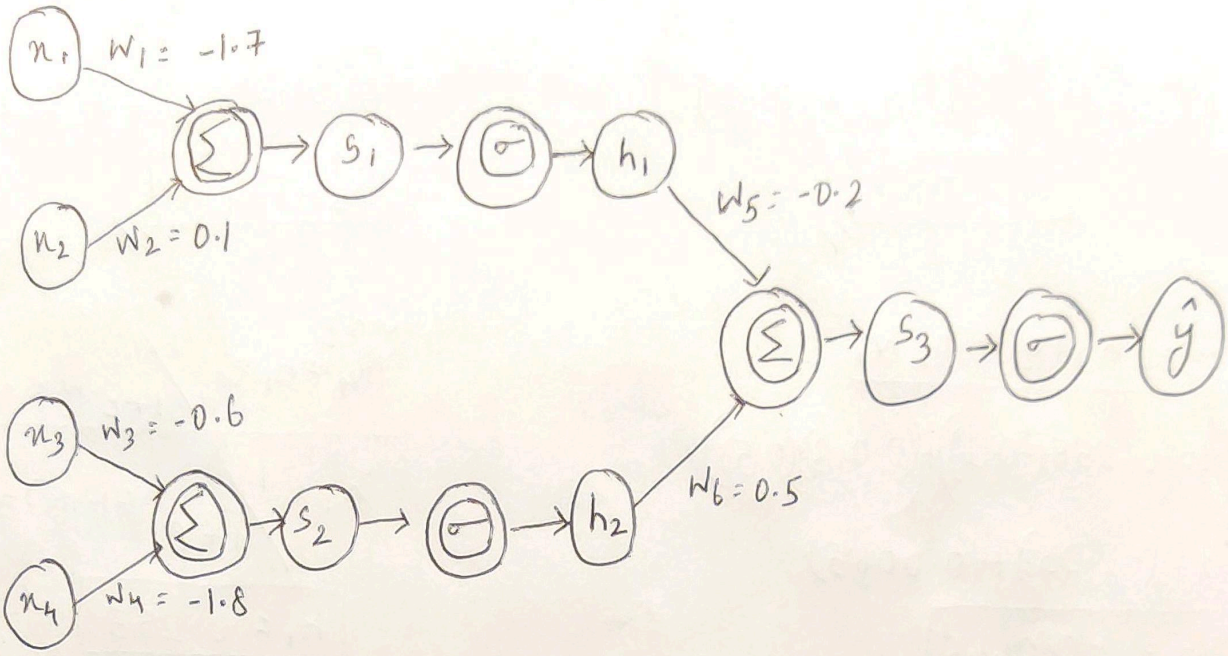
1.)



Given :-

Inputs = $(x_1, x_2, x_3, x_4) = (0.7, 1.2, 1.1, 2)$

Weights : $W_1 = -1.7$ $W_4 = -1.8$
$W_2 = 0.1$ $W_5 = -0.2$
$W_3 = -0.6$ $W_6 = 0.5$

Activation function $\sigma(z) = \frac{1}{1+e^{-z}}$

Hidden Layer $h_1 = \frac{1}{1+e^{-w_1 x_1 - w_2 x_2}}$

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

$\frac{\partial L}{\partial w_1} = ?$

$\boxed{y = 0.5}$

$S_1 = x_1 w_1 + x_2 w_2$

$S_1 = (0.7)(-1.7) + (1.2)(0.1)$

$S_1 = (-1.19) + (0.12)$

$\boxed{S_1 = -1.07}$ //

$S_2 = x_3 w_3 + x_4 w_4$

$S_2 = (1.1)(-0.6) + (2)(-1.8)$

$S_2 = (-0.66) + (-3.6)$

$\boxed{S_2 = -4.26}$ //

$S_3 = h_1 w_5 + h_2 w_6$

$S_3 = (0.255(-0.2)) + ((0.013)(0.5))$

$S_3 = (-0.051) + (0.0065)$

$\boxed{S_3 = -0.0445}$ //

Gin:

$h_1 = \frac{1}{1+e^{-w_1 x_1 - w_2 x_2}}$

$h_1 = \frac{1}{1+e^{-(-1.19)-(0.12)}}$

$\boxed{h_1 = 0.255}$ //

$h_2 = \frac{1}{1+e^{-w_3 x_3 - w_4 x_4}}$

$h_2 = \frac{1}{1+e^{-(-0.66)-(-3.6)}}$

$\boxed{h_2 = 0.013}$ //

$\hat{y} = \frac{1}{1+e^{-h_1 w_5 - h_2 w_6}}$

$= \frac{1}{1+e^{-(0.255)(-0.2)-(0.013)(0.5)}}$

$= \frac{1}{1+e^{-(-0.051)-(0.0065)}}$

$= \frac{1}{1+e}$ //

$\boxed{\hat{y} = 0.4889}$

Given the gradient of an Loss function $\|\hat{y}-y\|_2^2$ is $2\|\hat{y}-y\|$

Using backward propagation,

$$\boxed{\frac{\delta E}{\delta w_1} = \frac{\delta E}{\delta \hat{y}} \times \frac{\delta \hat{y}}{\delta s_3} \times \frac{\delta s_3}{\delta h_1} \times \frac{\delta h_1}{\delta s_1} \times \frac{\delta s_1}{\delta w_1}} \quad - (A)$$

$$\frac{\delta E}{\delta \hat{y}} = 2\|\hat{y}-y\| \quad - (1)$$

$$\sigma'(x) = \sigma(x)\,[1-\sigma(x)] \quad - (2)$$

$$\left.\begin{aligned} \frac{\delta s_3}{\delta h_1} &= w_5 \\ \frac{\delta s_1}{\delta w_1} &= x_1 \end{aligned}\right\} \quad - (3)$$

Substituting (1), (2), & (3) in (A)

$$\frac{\delta E}{\delta w_1} = 2\|\hat{y}-y\| \times \sigma'(s_3) \times w_5 \times \sigma'(s_1) \times x_1$$

$$= 2\left[\|0.4889-0.5\|2\right] \times \sigma(s_3)\left[1-\sigma(s_3)\right] \times$$

$$\times(-0.2) \times \sigma(s_1)\left[1-\sigma(s_1)\right] \times 0.7$$

$$\sigma(s_3) = \frac{1}{1+e^{-s_3}} = \frac{1}{1+e^{-(-0.0445)}}, \quad \sigma(s_1) = \frac{1}{1+e^{-s_1}} = \frac{1}{1+e^{-(1.07}}$$

$$\boxed{\sigma(s_3) = 0.4889} \qquad \boxed{\sigma(s_1) = 0.2554}$$

$$\frac{\delta E}{\delta w_1} = 2\left[\|-0.0111\|\right] \times \left[(0.4889)(1-0.4889)\right] \times (0.2) \times$$

$$\left[(0.2554)(1-0.2554)\right] \times (0.7)$$

$$\boxed{\frac{\delta E}{\delta w_1} = -0.0017}$$