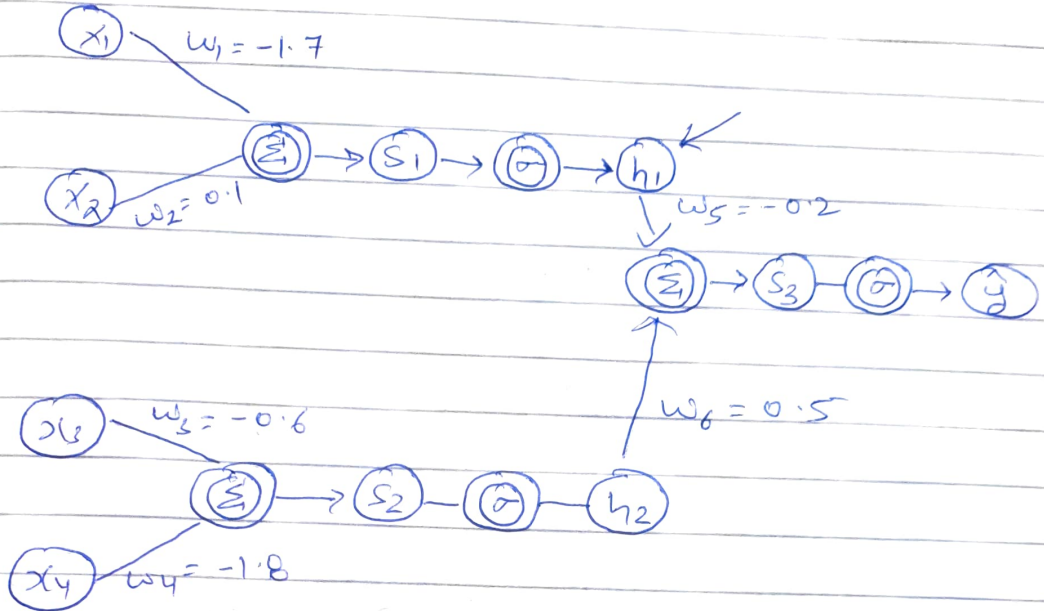


# # DL-Assignment

Q1) Given :-



$$\sigma(x) = \frac{1}{1+e^{-x}} ; h_1 = \frac{1}{1+e^{-x_1 w_1 - x_2 w_2}}$$

$$[x_1, x_2, x_3, x_4] = [0.7, 1.2, 1.1, 2] ; y = 0.5$$

$$L_2 = \|\hat{y} - y\|^2, \frac{\partial L}{\partial w_1} = 2 \|\hat{y} - y\|$$

Computing :-

$$\begin{aligned} s_1 &= x_1 w_1 + x_2 w_2 \\ &= (0.7)(-1.7) + (1.2)(0.1) \\ &= -1.19 + 0.12 = -1.07 \end{aligned}$$

$$\begin{aligned} s_2 &= x_3 w_3 + x_4 w_4 \\ &= (1.1)(-0.6) + (-1.8)(2) \\ s_2 &= -4.26 \end{aligned}$$

also

$$\begin{aligned} h_1 &= \frac{1}{1+e^{-x_1 w_1 - x_2 w_2}} \\ &= \frac{1}{1+e^{-(0.7)(-1.7) - (1.2)(0.1)}} \end{aligned}$$

$$h_1 = \frac{1}{1 + e^{(1.19)(-0.12)}} = \frac{1}{1 + 0.8669}$$

$$\boxed{h_1 = 0.5356}$$

$$h_2 = \frac{1}{1 + e^{-s_1}} = \frac{1}{1 + e^{+1.07}}$$

$$\boxed{h_2 = 0.2554}$$

$$s_2 = \frac{1}{1 + e^{-s_2}} = \frac{1}{1 + e^{4.26}}$$

$$\boxed{h_2 = 0.0139}$$

also

$$s_3 = h_1 w_5 + h_2 w_6$$

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

$$s_3 = -0.05108 + 0.00695$$

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

$$\hat{y} = \frac{1}{1 + e^{-s_3}} = \frac{1}{1 + e^{0.04413}}$$

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

Now using Back propagation

$$\frac{\partial E}{\partial w_1} = \frac{\partial E}{\partial \hat{y}} \times \frac{\partial \hat{y}}{\partial s_3} \times \frac{\partial s_3}{\partial h_1} \times \frac{\partial h_1}{\partial s_1} \times \frac{\partial s_1}{\partial w_1}$$

given

$$\frac{\partial E}{\partial \hat{y}} = 2 \|\hat{y} - y\| \dots \textcircled{a}$$

also we know :-

$$\sigma'(x) = \sigma(x) [1 - \sigma(x)] \dots \textcircled{b}$$

$$\boxed{\frac{\partial s_3}{\partial h_1} = w_5} ; \boxed{\frac{\partial s_1}{\partial w_1} = x_1} \dots \textcircled{c}$$

using (a) & (b), (c)

$$\begin{aligned}\frac{\partial E}{\partial w_1} &= 2 \| \hat{y} - y \| \times \sigma'(s_3) \times w_5 \times \sigma'(s_1) \times 0.1 \\ &= 2 [ \| 1.254 - 0.5 \| ] \times \sigma(s_3) (1 - \sigma(s_3)) \\ &\quad \times (-0.2) \times \sigma(s_1) [1 - \sigma(s_1)] \times (0.7) \\ &= \cancel{2 \times 0.754}\end{aligned}$$

$$\sigma(s_3) = \frac{1}{1 + e^{-s_3}} = \frac{1}{1 + e^{0.04413}} = 0.4889$$

$$\sigma(s_1) = \frac{1}{1 + e^{-s_1}} = 0.2554$$

∴

$$\begin{aligned}&= 2 \times \cancel{0.754} \times 0.2554 [1 - 0.2554] \times -0.2 \\ &\quad \times 0.4889 [1 - 0.4889] \times 0.7\end{aligned}$$

$$\boxed{\frac{\partial E}{\partial w_1} = -0.476}$$