LOG EXPRESSION: (Q3: NUMERICAL PRECISION)

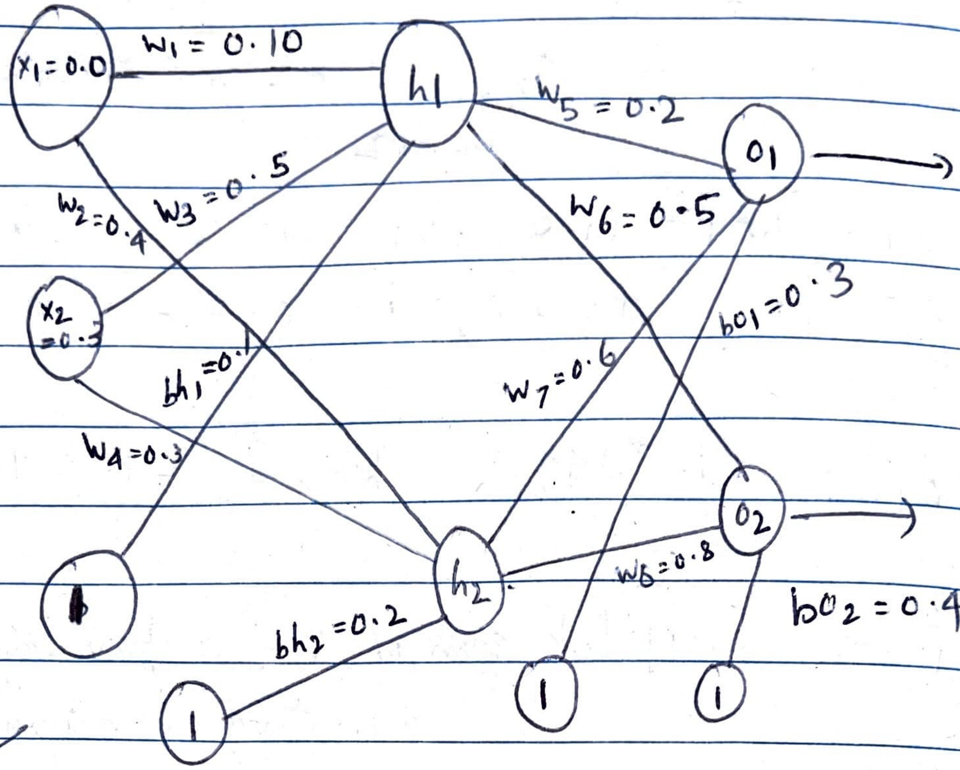
$$-\log\left(\frac{e^x}{e^x+e^y}\right)$$

$$= -\left[\log(e^x) - \log(e^x+e^y)\right]$$

$$= -\left[\cancel{\log(e^x)} - \left[\cancel{\log(e^x)} + \log(1+e^y/e^x)\right]\right]$$

$$= \log(1+e^{y-x})$$

QUES 4: MANUAL BACK PROPOGATION



FORWARD PASS

$$h_1 = w_1 x_1 + w_3 x_2 + b \times b_{h1}$$
$$= (0.1)(0.0) + (0.5)(0.3) + 1 \times 0.1$$
$$= 0.05$$

$$h_2 = w_2 x_1 + w_4 x_2 + b \times b_{h2}$$
$$= (0.4)(0.0) + (0.3)(0.3) + 1 \times 0.2$$
$$= -0.11$$

$$\text{hidden o/p 1} = \text{sigmoid}(h_1) = \frac{1}{1+e^{-0.05}} = 0.5124$$

$$\text{hidden o/p 2} = \text{sigmoid}(h_2) = \frac{1}{1+e^{-(-0.11)}} = 0.4725$$

$$\hat{O}_1 = W_5 \times (\text{hidden o/p } 1) + W_7 \times (\text{hidden o/p } 2) + b \times b_{o_1}$$
$$= 0.2 \times 0.5124 + 0.6 \times 0.4725 + 1 \times 0.3$$
$$= 0.10248 + 0.2835 + 0.3$$
$$= 0.38598 + 0.3 = 0.68598$$
(Same value as activation fn is linear)

$$\hat{O}_2 = W_6 \times (\text{hidden o/p } 1) + W_8 \times (\text{hidden o/p } 2) + b \times b_{o2}$$
$$= 0.5 \times 0.5124 + 0.8 \times 0.4725 + 1 \times 0.4$$
$$= 0.2562 + 0.378 + 0.4$$
$$= 1.0342$$
(Same value as activation fn is linear)

$$E_1 = \frac{1}{2} * (0.68598 - 0.01)^2 = 0.22847$$

$$E_2 = \frac{1}{2} * (1.0342 - 0.99)^2 = 0.00097$$

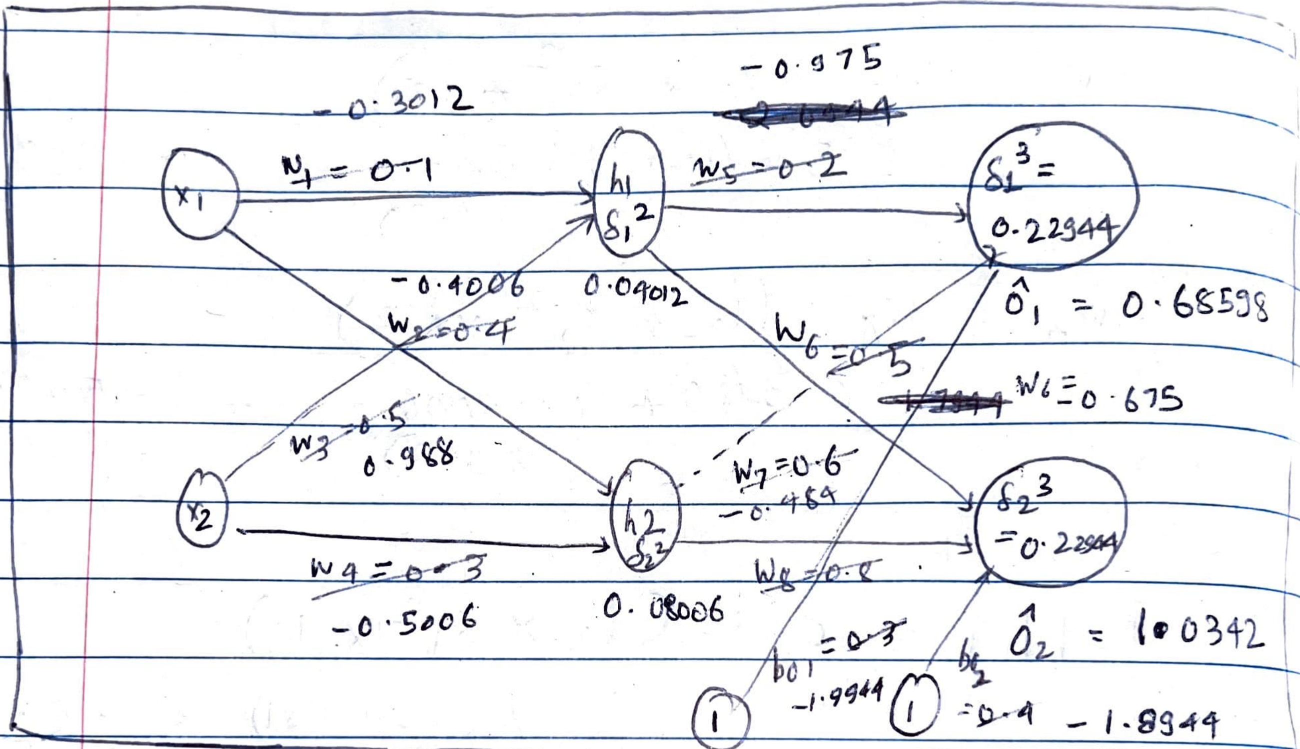
$$E = E1 + E2 = 0.22944$$

Q4: MANUAL BACKWARD PASS

b) BACKWARD PASS :

- LR = 10 , E = 0.22944

$\delta_i^x \rightarrow x \rightarrow$ Layer, $i \rightarrow$ Subscript



δ_1^3 = error * derivative (linear fn)

= 0.22944 × 1 = 0.22944

δ_2^3 = error * derivative (linear fn)

= 0.22944 × 1 = 0.22944

$W_5 = W_5 - lr * \delta_1^3 \times$ hidden o/p1 $= 0.2 - 10 * (0.22944) \times 0.5124$

$W_6 = W_6 - lr * \delta_2^3 \times$ hidden o/p2 $= 0.5 - 10 * (0.22944) \times 0.5124$

W5 = ~~-2.0944~~ , W_6 = ~~-1.7944~~ 0.5124

$$\boxed{\begin{aligned} W_5 &= -0.975 \\ W_6 &= -0.675 \end{aligned}}$$

$$\boxed{\begin{aligned} W_7 &= -0.484 \\ W_8 &= -0.284 \end{aligned}}$$

$\times$ hidden o/p 2

$W_7 = W_7 - lr * \delta_1^3 = 0.6 - 10 \times (0.22944) \times 0.4725 = \boxed{-\cancel{1.6944}}$

$W_8 = W_8 - lr * \delta_2^3 \times$ hidden o/p 2 $= 0.8 - 10 (0.22944) \times 0.4725 = \boxed{-\cancel{1.4944}}$

$bo_1 = bo_1 - lr * \delta_1^3 \times 1 = 0.3 - 10 * (0.22944) \times 1$

$bo_2 = bo_2 - lr * \delta_2^3 \times 1 = 0.4 - 10 * (0.22944) \times 1$

$bo_1 = -1.9944$, $bo_2 = -1.8944$

$\delta_1^2 \rightarrow$ (weighted sum of δ from prev layer) $\times$ derivative of action fn

$= (0.2 \times \delta_1^3 + 0.5\, \delta_2^3) \times$ (hidden o/p1) (1 − hidden op1)

$= (0.2 \times 0.22944 + 0.5 \times 0.22944)(0.5124)(1 - 0.5124)$

$= \underline{0.04012}$

$\delta_2^2 = (0.6 \times \delta_1^3 + 0.8 \times \delta_2^3)$ (hidden o/p2) (1 − hidden o/p 2)

$= (0.6 \times 0.22944 + 0.8 \times 0.22944)$ $(0.4725)(1 - 0.4725)$

$= \underline{0.08006}$

$w_1 = w_1 - lr * (\delta_1^2 \times 0)$

$= 0.1 - 10 * (0.04012 \times 0) = \cancel{-0.3012}$

0.1

$w_2 = w_2 - lr * \delta_2^2$

$= 0.4 - (10 * 0.08006) \times 0 = \cancel{-0.4006}$

0.4

$w_3 = w_3 - (lr * \delta_1^2 * x2)$

$= 0.5 - (10 * 0.04012 \times 0.3) = 0.0988$

$w_4 = w_4 - (lr * \delta_2^2 \times 0.3)$

$= 0.3 - (10 * 0.08006 \times 0.3) = -0.5006$

$bh_1 = 0.1 - (lr \times \delta_1^2 \times 1)$

$= 0.1 - (10 \times 0.04012 \times 1) = -0.3012$

$bh_2 = 0.2 - (10 \times \delta_2^2 \times 1)$

$= 0.2 - (10 \times 0.08006 \times 1)$

$= -0.6006$