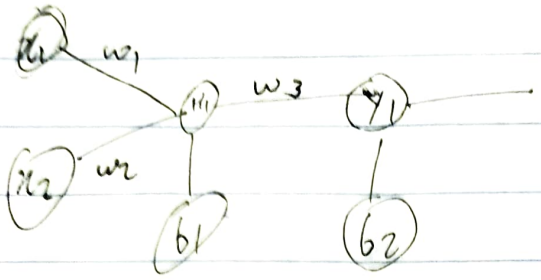
Name :- Suraj Kothawade
SJSU ID :- 016728790



To calculate Hidden layer :-

$H_1 = x_1 w_1 + x_2 w_2 + b_1$

and activation function is sigmoid :- $\frac{1}{1+e^{-x}}$

Lets assume the following.

$x_1 = 0.05$ $b_1 = 0.40$ / Target $T_1 = 0.99$

$x_2 = 0.10$ $b_2 = 0.60$

Initial weights :- $w_1 = 0.10$, $w_2 = 0.20$, $w_3 = 0.30$

Foword Step :-

$H_1 = x_1 w_1 + x_2 w_2 + b_1 = 0.05 \times 0.1 + 0.1 \times 0.2 + 0.4$

$= 0.425$

out $H_1 = \frac{1}{1+e^{-H}} = \frac{1}{1+e^{-0.425}} = 0.60467$

$Y_1 = \text{out} H_1 w_3 + b_2 = 0.6 \cancel{4}0467 \times \frac{0.3}{\cancel{0.3}} + 0.6$

$Y_1 = 0.78140$

$$out_{y_1} = \frac{1}{1+e^{-y_1}} = \frac{1}{1+e^{-0.78140}} = 0.6854.$$

Calculating total error:-

$$E_{Total} = \frac{1}{2}(\text{Target} - out_{H_1})^2$$

$$= \frac{1}{2}(0.99 - 0.68)^2 = 0.048$$

Backward Pass:-

Lets consider error at $w_3 = \frac{\partial E_{Total}}{\partial w_3} = -0.51 \times 0.2176 \times 0.6049$

$$= 0.060$$

$$\frac{\partial E_{Total}}{\partial w_3} = \frac{\partial E_{Total}}{\partial out_{y_1}} \times \frac{\partial out_{y_1}}{\partial y_1} \times \frac{\partial y_1}{\partial w_3}$$

However,

$$= 2 \times \frac{1}{2}(1 - out_{y_1}) \times -1 = 0.31$$

$$\frac{\partial out_{y_1}}{\partial y_1} = out_{y_1}(1 - out_{y_1}) \cdot 1 = 0.2176$$

$$\frac{\partial y_1}{\partial w_3} = out_{H_1} = 0.60467$$

Updating w_3

$$w_3 = w_3 - \eta \frac{\partial E_{total}}{\partial w_2} = 0.30 - 0.5(-0.040) = 0.32$$

Similarly lets calculate error at w_2 and w_1 and update.

$$\frac{\partial E_{Total}}{\partial w_1} = \frac{\partial E_{total}}{\partial out_{H_1}} \times \frac{\partial out_{H_1}}{\partial H_1} = \frac{\partial H_1}{\partial w_1}$$

$$= 0.02 \times 0.25 \times 0.05$$

$$= 0.00025$$

$$\frac{\partial E_{total}}{\partial out_{H_1}} = \frac{\partial E_1}{\partial out_{H_1}} \times \frac{\partial out_{H_1}}{\partial x_1} = \frac{\partial x_1}{\partial out_{H_1}}$$

$$= -0.31 \times 0.2176 \times 0.30$$

$$= -0.02$$

$$\frac{\partial out_{H_1}}{\partial H_1} = out_{H_1}(1 - out_{H_1}) = 0.25$$

$$\frac{\partial H_1}{\partial w_1} = x_1 = 0.05$$

updating w_1 :- $w_1 = w_1 - \eta \frac{\partial E_{total}}{\partial w_1} = 0.10 - 0.5(-0.02)$

$$w_1 = 0.1012$$

$$\frac{\partial E_{total}}{\partial out_{H_1}} = -0.02$$

$$\frac{\partial out_{H_1}}{\partial net_{H_1}} = 0.24$$

$$\frac{\partial net_{H_1}}{\partial w_2} = x_2 = 0.10$$

$$= -0.02 \times 0.24 \times 0.60$$

$$= -0.00048$$

updated weights :- $w_1 = 0.60017$, $w_2 = -0.00048$, $w_3 = 0.00024$