USAMA SARWAR
FA17-BCS-090-B

Question # 01

Input.

$x_1 = 1$ $\quad x_3 = 5$

$x_2 = 4$

Desired Outputs.

$O1 = 0.1$

$O_2 = 0.05$

~~Input to hidden layer~~ **Activation Function** : Sigmoid (Binary)

~~$w_1 x_1 + w_3 x_2 + w_5 x_3 + b_1 = Z_{h1}$~~ **To adjust** : w_{10}, w_5

Formulas:

$$h_1 = x_1 w_1 + x_2 w_3 + x_3 w_5 + b_1$$

$$\Rightarrow H_1 = y(h_1) = \frac{1}{1+\exp^{(-x)}}$$

$$h_2 = x_1 w_2 + x_2 w_4 + x_3 w_6 + b_1$$

$$H_1 = y(h_1)$$

Now putting the values we get

$h_1 = 4.3$

Applying Activation Function

$H_1 = 0.9866$

$h_2 = 5.3$

$H_2 = 0.9950$

Now for output layer

$$O1 = H_1 w_7 + H_2 w_9 + b_2$$

$$O_1 = y(O1) \Rightarrow \text{Activation Function}$$

$$O_2 = H_1 w_8 + H_2 w_{10} + b_2$$

$$O_2 = y(O_2) \Rightarrow \text{Activation Function}$$

Now Putting value

$$O_1 = (0.9866)(0.7) + (0.9950)(0.9) + 0.5$$

$$O_1 = 2.08612$$

$$O_1 = \frac{1}{1+\exp(-O_1)} = 0.8895$$

$$O_2 = (0.9866)(0.8) + (0.9950)(0.1) + 0.5$$

$$O_2 = 1.38828$$

$$O_2 = \frac{1}{1+\exp(-O_2)} = 0.8003$$

Now calculating Errors.

$$E_{total} = \sum \frac{1}{2}(target - output)^2$$

$$= E_{o_1} + E_{o_2}$$

$$E_{o_1} = \frac{1}{2}(target - output)^2$$

$$= \frac{1}{2}(0.1 - 0.8895)^2$$

$$\boxed{E_{o_1} = 0.311655}$$

$$E_{o_2} = \frac{1}{2}(0.05 - 0.8003)^2$$

$$\boxed{E_{o_2} = 0.2815}$$

$$\boxed{E_{total} = 0.593155}$$

Now readjusting weights.

Adjusting w_{10}

$$\frac{\delta E_{total}}{w_{10}} = \frac{\delta E_{total}}{\delta Out_{o1}} * \frac{\delta out_{o1}}{\delta net_{o1}} + \frac{\delta net_{o1}}{\delta w_5}$$

$Out_{o1} = O_1$ (After Activation)

$net_{o1} = o1$ (Before Activation)

$$\frac{\delta E_{total}}{\delta out_{o_1}} = out_{o_1} - target_{o1}$$

$$= (0.8895 - 0.1)$$

$$\boxed{\frac{\delta E_{total}}{\delta out_{o_1}} = 0.7895}$$

$$\frac{\delta out_{o1}}{\delta net_{o1}} = Out_{o_1}(1 - out_{o_1})$$

$$= O_1(1 - O_1)$$

$$= 0.8895(1 - 0.8895)$$

$$= 0.09828975$$

$$\frac{\delta E_{total}}{\delta out_2} = out_{o_2} - target_{o2}$$

$$= (0.8003 - 0.05) = 0.7503$$

$$\frac{\delta out_{o_2}}{\delta net_{o_2}} = out\ O_2(1 - out_{O_2})$$

$$= 0.8003(1 - 0.8003) = 0.15981991$$

$$\frac{\delta net_{O_2}}{w_{10}} = H_2 = 0.9950$$

After calculation / Multiplication we get

$$\frac{\delta E_{out}}{w_{10}} = 0.7193$$

Question # 02.

Step 1

Avg

Custumer	
1	4
2	2.5
3	4
4	2.75
5	3

Step 2 Similarly :-

$$Sim(C_1, C_2) = (5-4)(3-2.5)+(3-4)(1-2.5)+(4-4)(2-2.5)+(4-4)(4-2.5)$$

$$Sim(C_1, C_2) = \sqrt{(5-4)^2+(3-4)^2+(4-4)^2+(4-4)^2} \times \sqrt{(3-2.5)^2+(1-2.5)^2+(2-2.5)^2+(4-2.5)^2}$$

$$\boxed{Sim(C_1, C_2) = 0.632455}$$

$$Sim(C_1, C_3) = (5-4)(4-4)+(3-4)(3-4)+(4-4)(4-4)+(4-4)(5-4)$$

$$= \sqrt{(5-4)^2+(3-4)^2+(4-4)^2+(4-4)^2} \times \sqrt{(4-4)^2+(3-4)^2+(4-4)^2+(5-4)^2}$$

$$\boxed{Sim(C_1, C_3) = 0.5}$$

~~$Sim(C_1, C_4) = (5-4)(3-2.75$~~

Similarly

$$Sim(C_1, C_4) = \frac{(5-4)(3-2.75)+(3-4)(3-2.75)+(4-4)(1-2.75)+(4-4)(4-2.75)}{\sqrt{(5-4)^2+(3-4)^2+(4-4)^2+(4-4)^2} \times \sqrt{(3-2.75)^2+(3-2.75)^2+(1-2.75)^2+(4-2.75)^2}}$$

$$\boxed{Sim(C_1, C_4) = 0}$$

$$Sim(C_1, C_5) = \frac{(5-4)(1-3)+(3-4)(5-3)+(4-4)(5-3)+(4-4)(1-3)}{\sqrt{(5-4)^2+(3-4)^2+(4-4)^2+(4-4)^2} \times \sqrt{(1-3)^2+(5-3)^2+(5-3)^2+(1-3)^2}}$$

$$\boxed{Sim(C_1, C_5) = -0.707106}$$