# Q - 2.



Input to H1 = $(i1 \times 0.3) + (i2 \times 0.2)$

$= (10 \times 0.3) + (20 \times 0.2)$

$= 3 + 4 = 7$

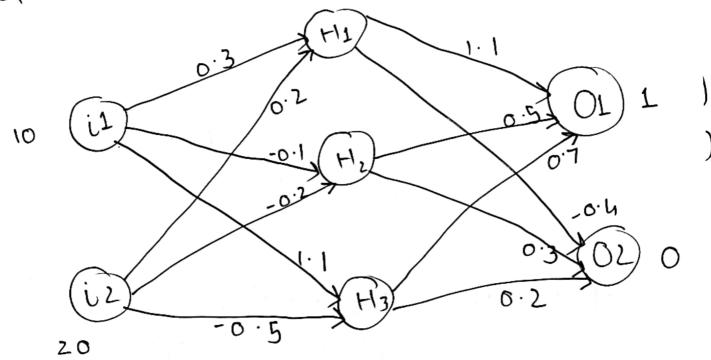out H1 = sigmoid $(7) = 0.9990$

Input to H2 = $(i1 \times -0.1) + (i2 \times -0.2)$

$= (10 \times -0.1) + (20 \times -0.2)$

$= -1 - 4$

$= -5$

out H2 = sigmoid $(-5) = 0.0066$

Input to H3 $= (i1 \times 1.1) + (i2 \times -0.5)$

$= (10 \times 1.1) + (20 \times -0.5)$

$= 11 + (-10)$

$= 1$

out H3 $=$ sigmoid $(1) = 0.731$

Input to O1 $= (H1 \times 1.1) + (H2 \times 0.5)$
$+ (H3 \times 0.7)$

$= (0.9990 \times 1.1) + (0.0066 \times 0.5) )$
$+ (0.731 \times 0.7)$

$= 1.0989 + 0.0033$
$+ 0.5117$

$= 1.6139$

out O1 $=$ sigmoid $(1.6139) = 0.8339$

Input to O2 $= (H1 \times -0.4) + (H2 \times 0.3) +$
$(H3 \times 0.2)$

$= (0.9990 \times -0.4) + (0.0066 \times 0.3)$
$+ (0.731 \times 0.2)$

$= -0.3996 + 0.00198 + 0.1462$

$= -0.3996 + 0.14818$

$$O2 \rightarrow \quad 0.437.$$

$$= \quad -0.25142.$$

$$\text{out } O2 = \text{sigmoid } (-0.2514) = 0.437$$

$$\delta O1 = (1 - \text{out } O_1) \text{ out } L (1 - \text{out } O1)$$

$$= (1 - 0.8339)(0.8339)(1 - 0.8339)$$

$$= (0.1661)(0.8339)(0.1661)$$

$$= (0.1385)(0.1661)$$

$$= 0.023$$

$$\delta O2 = (1 - \text{out } O_2) \text{ out } O_2 (1 - \text{out } O_2)$$

$$= (1 - 0.437)(0.437)(-0.437)$$

$$= (0.563)(0.437)(-0.437)$$

$$= 0.246 \times -0.437.$$

$$= -0.1075.$$

updating weights (output layer)

$$w^{+}_{H1-O1} = w_{H1-O1} + \eta \, \delta O1 \, \text{out } H1$$

$$= 1.1 + 0.2 (0.023)(0.9990)$$

$$= 1.1 + 0.0045$$

$$= 1.1045.$$

$$w^+_{H1-O2} = w_{H1-O2} + \eta\, S_{O_2}\, \text{out}\, H_1$$

$$= -0.5 + 0.2(-0.1075)(0.9990)$$

$$= -0.5 + (-0.0215)(0.9990)$$

$$= -0.5 + (-0.0214)$$

$$= \cancel{0.4786}$$

$$= -0.4214$$

$$w^+_{H2-O1} = w_{H2-O1} + \eta\, S_{O_1}\, \text{out}\, H2$$

$$= 0.5 + 0.2(0.023)(0.0066)$$

$$= 0.5 + (0.0046)(0.0066)$$

$$= 0.5 + 0.000$$

$$= 0.5$$

$$w^+_{H2-O2} = w_{H2-O2} + \eta\, S_{O_2}\, \text{out}\, H2$$

$$= 0.3 + 0.2(-0.1075)(0.0066)$$

$$= 0.3 + (-0.0215)(0.0066)$$

$$= 0.3 + (-0.000)$$

$$= 0.3$$

$$w^+_{H3-O1} = w_{H3-O1} + \eta\, \delta_{O_1}\, \text{out}\, H3$$

$$= 0.7 + 0.2\,(0.023)(0.731)$$

$$= 0.7 + (0.0046)(0.731)$$

$$= 0.7 + 0.003$$

$$= 0.703$$

$$w^+_{H3-O2} = w_{H3-O2} + \eta\, \delta_{O_2}\, \text{out}\, H3$$

$$= 0.2 + (0.2)(-0.1075)(0.731)$$

$$= 0.2 + (-0.0215)(0.731)$$

$$= 0.2 - 0.015$$

$$= 0.185.$$

Now, calculating hidden layer errors.

$$\delta_{H1} = (1 - \text{out}\, H_1)\, \text{out}\, H_1\, (\delta_{O_1} w_{H1-O1}$$
$$+ \delta_{O_2} w_{H1-O2})$$

$$= (1 - 0.9990)(0.9990)\big((0.023 \times 1.1) +$$
$$(-0.1075 \times -0.4)\big)$$

$$= (0.001)(0.9990)(0.0253 + 0.043)$$

$$= (0.0009)(0.0683)$$

$$= 0.00006$$

$$\delta_{H_2} = (1 - \text{out } H_2) \text{ out } H2 \left( \delta_{O_1} w_{H2-O1} + \delta_{O_2} w_{H_2-O_2} \right)$$

$$= (1 - 0.596)(0.596$$

$$= (1 - 0.0066)(0.0066)$$
$$\left( (0.023 \times 0.5) + \left( \begin{array}{c} -0.1075 \times 0.3 \end{array} \right) \right.$$

$$= (0.9934)(0.0066) \left( 0.0115 + \right.$$

$$\begin{array}{c} (-0.032) \end{array}$$

$$= (0.0065)(-0.02)$$

$$= \cancel{0.0001\cancel{3}} = 0. \quad 0.00013$$


$$\delta_{H3} = (1 - \text{out } H_3) \text{ out } h3 \left( \delta_{O_1} w_{H3-O1} \right.$$
$$+ \delta_{O_2} w_{H_3-O_2}$$

$$= (1 - 0.731)(0.731)(0.023 \times 0.7)$$
$$+ (-0.1075 \times 0.2)$$

$$= (0.269)(0.731) \left( 0.0161 - 0.0215 \right)$$

$$= (0.196)(-0.0054)$$

$$= -0.001$$

Updating weights of hidden layer

$$w^+_{i1-H1} = w_{i1-H1} + \eta \delta_{H1} \text{ input } i1$$

$$= 0.3 + 0.2(0.00006)(10)$$

$$= 0.3 + 0.00012$$

$$= 0.30012$$

$$w^+_{i1-H2} = w_{i1-H2} + \eta \delta H_2 \text{ input } i1$$

$$= -0.1 + 0.2(-0.00013)10$$

$$= -0.10026$$

$$w^+_{i1-H3} = w_{i1-H3} + \eta \delta_{H3} \text{ input } i1$$

$$= 1.1 + 0.2(-0.001)(10)$$

$$= 1.1 + (-0.0002)(10)$$

$$= 1.102$$

$$w^+_{i2-H1} = w_{i2-H1} + \eta \delta_{H1} \text{ input } i2$$

$$= 0.2 + 0.2(0.00006)(20)$$

$$= 0.20024$$

$$w^+_{i2-H2} = w_{i2-H2} + \eta \delta_{H2} \text{ input } i2$$

$$= -0.2 + 0.2(-0.00013)20$$

$$= -0.20026$$

$$w^+_{i2-H3} = w_{i2-H3} + \eta\, \delta_{H3}\, \text{input}\, i2$$

$$= -0.5 + (0.2)(-0.001)(20)$$

$$= -0.5 - 0.004$$

$$= -0.504$$