Answer 4 (a)

Here we calculate the total net input for h_1

$$net_{h_1} = w_1 \times i_1 + w_2 i_2 + w_3 i_3$$
$$= 0.04 \times 0.8 + 0.5 \times 0.09 + 0.07 \times 0.49$$
$$= 0.032 + 0.045 + 0.0343$$
$$net_{h_1} = 0.1113$$

Now we then squash it using the logistic function to get the output of h_1

$$Out_{h_1} = \frac{1}{1 + e^{-net_{h_1}}} = \frac{1}{1 + e^{-0.1113}} = \frac{1}{1 + 0.8947}$$
$$Out_{h_1} = 0.5278$$

Carrying out the same process for h_2

$$net_{h_2} = w_4 \times i_1 + w_5 i_2 + w_6 i_3$$
$$= 0.63 \times 0.8 + 0.89 \times 0.09 + 0.12 \times 0.49$$
$$= 0.504 + 0.0801 + 0.0588$$
$$net_{h_2} = 0.6429$$

$$Out_{h_2} = \frac{1}{1 + e^{-net_{h_2}}} = \frac{1}{1 + e^{-0.6429}} = \frac{1}{1 + 0.5258}$$
$$= 0.6554$$

Now we repeat this process for the output layer neurons using the output from the hidden layer neurons as input

$$net\,o_1 = w_7 \times out_{h_1} + w_8 \times out_{h_2}$$

$$= 0.34 \times 0.5278 + 0.03 \times 0.6554$$

$$= 0.1795 + 0.0197$$

$$net\,o_1 = 0.1992$$

$$out_{o_1} = \frac{1}{1+e^{-net\,o_1}} = \frac{1}{1+e^{-0.1992}} = \frac{1}{1+0.8194}$$

$$out_{o_1} = 0.5495$$

$$net_{o_2} = w_9 \times out_{h_1} + w_{10} \times out_{h_2}$$

$$\cancel{= 0.44 \times 0.1992 + 0.59 \times}$$

$$= 0.44 \times 0.5278 + 0.59 \times 0.6554$$

$$net_{h_2} = 0.23 + 0.387 = 0.62$$

$$out_{o_2} = \frac{1}{1+e^{-net_{h_2}}} = \frac{1}{1+e^{-0.62}} = \frac{1}{1+0.54}$$

$$= \frac{1}{1.54} = 0.65$$

The

Answer 4 (b)

The Backward pass

$$\frac{\partial E_{total}}{\partial Out_{O_1}} = -(target_{O_1} - Out_{O_1})$$

$$= -(0.8 - 0.5496)$$

$$\frac{\partial E_{total}}{\partial Out_{O_1}} = 0.25$$

Now,

$$\frac{\partial Out_{O_1}}{\partial net_{O_1}} = Out_{O_1}(1 - Out_{O_1})$$

$$= 0.5496(1 - 0.5496)$$

$$= 0.5496(0.45)$$

$$\frac{\partial Out_{O_1}}{\partial net_{O_1}} = 0.2475$$

Now $$\frac{\partial net_{O_1}}{\partial w_7} = Out_{h_1} = 0.5278$$

$$w_7^{+} = w_7 - \eta \times \frac{\partial E_{total}}{\partial w_7}$$

$$= 0.34 - 0.5 \times$$

$$\frac{\partial E_{total}}{\partial w_7} = \frac{\partial E_{total}}{\partial out_{o1}} \times \frac{\partial out_{o1}}{\partial net_{o1}} \times \frac{\partial net_{o1}}{\partial w_7}$$

$$= 0.25 \times 0.2475 \times 0.5278$$

$$\frac{\partial E_{total}}{\partial w_7} = 0.33$$

$$w_7^+ = w_7 - \eta \frac{\partial E_{total}}{\partial w_7}$$

$$= 0.34 - 0.5 \times 0.33$$

$$= 0.34 - 0.18$$

$$w_7^+ = 0.16$$

So. updated weight of w_7 is 0.16