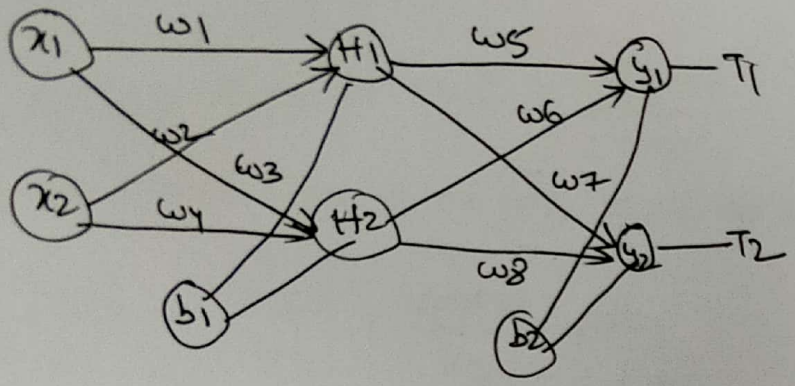

I/p		Bias	
$x_1 = 0.05$		$b_1 = 0.35$	
$x_2 = 0.10$		$b_2 = 0.60$	

Initial weights

$w_1 = 0.15$	$w_5 = 0.40$	$T_1 = 0.01$
$w_2 = 0.20$	$w_6 = 0.45$	$T_2 = 0.99$
$w_3 = 0.25$	$w_7 = 0.50$	
$w_4 = 0.30$	$w_8 = 0.55$	

$H_1 = x_1 * w_1 + x_2 * w_2 + b_1$

Activation function is Sigmoid $= \frac{1}{1+e^{-x}}$

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

Forward Pass

$H_1 = w_1 x_1 + w_2 x_2 + b_1 = 0.3775$

$out H_1 = \frac{1}{1+e^{-0.3775}} = 0.593269992$

$out H_2 = 0.596884378$

$y_1 = out H_1 * w_5 + out H_2 * w_6 + b_2 = 1.105905967$

$out y_1 = 0.751365507$

$out y_2 = 0.772928465$

Calculating Total Error

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

$= 1/2(0.01 - 0.751365)^2 + 1/2(0.99 - 0.772)^2$

$E_{total} = 0.298371109$

Backward Pass

To calculate error at $w_5 = \frac{\partial E_{total}}{\partial w_5}$

If ∂E_{total} there is no w_5, hence we cannot differentiate we will split it now

$$\frac{\partial E_{total}}{\partial w_5} = \frac{\partial E_{total}}{\partial out_{y_1}} + \frac{\partial out_{y_1}}{\partial y_1} + \frac{\partial y_1}{\partial w_5}$$

(1) (2) (3)

$$\frac{\partial E_{total}}{\partial out_{y_1}} = \frac{1}{2}(T_1 - out_{y_1})^2 + \frac{1}{2}(T_2 - out_{y_2})^2$$

$$\frac{\partial E_{total}}{\partial out_{y_1}} = 2 \cdot \frac{1}{2}(T_1 - out_{y_1})^{2-1} \cdot -1 + 0 = (out_{y_1} - T_1) = 0.74136507$$

} For term (1)

$$\partial out_{y_1} = \frac{1}{1+e^{-y_1}}$$

$$\frac{\partial out_{y_1}}{\partial y_1} = out_{y_1}(1 - out_{y_1}) = 0.75136(1 - 0.75136507) = 0.18681560$$

} For Term (2)

$\sigma(x) = \frac{1}{1+e^{-x}}$

$\frac{d}{dx}\sigma(x) = \frac{e^{-x}}{(1+e^{-x})}$

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

$= \frac{1}{1+e^{-x}}\left(1 - \frac{1}{1+e^{-x}}\right)$

$y_1 = out_{H_1} * w_5 + out_{H_2} * w_6 + b_2$

$\frac{\partial y_1}{\partial w_5} = out_{H_1} = 0.593269992$

} For term (3)

$\frac{\partial E_{total}}{\partial w_5} = (1) * (2) * (3) = 0.082167041$

$w_5 = w_5 - \eta \frac{\partial E_{total}}{\partial w_5}$

$w_5 = 0.35891648$

Now we are operating in the hidden layer

$$\frac{\partial E_{total}}{\partial w_1} = \frac{\partial E_{total}}{\partial out_{H1}} * \frac{\partial out_{H1}}{\partial H_1} * \frac{\partial H_1}{\partial w_1}$$

$$\frac{\partial E_{total}}{\partial out_{H1}} = \frac{\partial E_1}{\partial out_{H1}} + \frac{\partial E_2}{\partial out_{H2}}$$

$$\frac{\partial E_1}{\partial out_{H1}} = \frac{\partial E_1}{\partial y_1} * \frac{\partial y_1}{\partial out_{H1}}$$

$E_1 = \frac{1}{2}(T_1 - out_{y1})^2$

$E_2 = \frac{1}{2}(T_2 - out_{y2})^2$

$$\frac{\partial E_1}{\partial y_1} = \frac{\partial E_1}{\partial out_{y1}} * \frac{\partial out_{y1}}{\partial y_1}$$

$= (0.01 - 0.75136)^2 * (0.186815602)$

$= 0.71436507 * 0.186$

$= 0.138$

$$\frac{\partial y_1}{\partial out_{H1}} = w_5 = 0.40$$

$$\frac{\partial E_1}{\partial out_{H1}} = 0.138 * 0.40 = 0.055$$

$$\frac{\partial E_2}{\partial out_{H1}} = -0.019049119$$

$$\frac{\partial E_{total}}{\partial out_{H1}} = 0.055 + -0.019 = 0.03635$$

$$\frac{\partial out_{H1}}{\partial H_1} = out_{H1}(1 - out_{H1}) = 0.5932\,(1 - 0.5932) = 0.24300$$

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

$$\frac{\partial E_{total}}{\partial w_1} = (0.03635) * (0.24300) * (0.05) = 0.000438568$$

Updating w_1

$$w_1^* = w_1 - \eta\left(\frac{\partial E_{total}}{\partial w_1}\right)$$

$$w_1^* = 0.15 - \eta\,(0.000438)$$

$$w_1^* = 0.14978076$$