$$\frac{dy_1}{dw_5} = 1 - out\,H_1 \cdot w_5^{(1-1)} + 0 + 0$$

$$= out\,H_1$$

$$\boxed{\frac{dy_1}{dw_5} = 0.59}$$

$$\frac{dE_{Total}}{dw_5} = \frac{dE_{Total}}{dout\,y_1} \cdot \frac{dout\,y_1}{dy_1} \cdot \frac{dy_1}{dw_5}$$

$$= 0.74 \cdot 0.1868 \cdot 0.59$$

$$\boxed{\frac{dE_{Total}}{dw_5} = 0.082} \quad \text{change in } w_5$$

Updating $w_5$

$$w_5 = w_5 - \eta \cdot \frac{dE_{Total}}{dw_5}$$

$$= 0.4 - 0.5 \cdot 0.0821$$

$$\boxed{w_5 = 0.3589}$$

$w_6 = 0.405$
$w_7 = 0.511$
$w_8 = 0.56$

} new weights

Now Hidden Layers

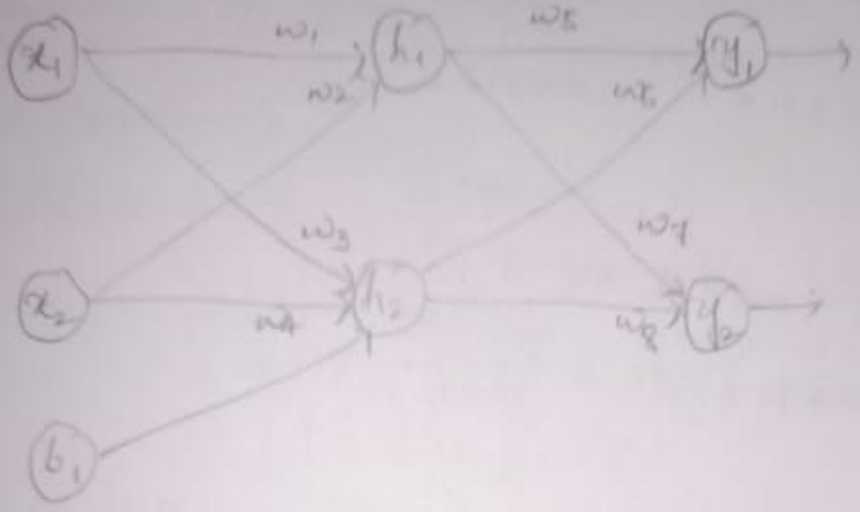
$$\frac{dE_{Total}}{dw_1} = \frac{dE_{Total}}{dout\,H_1} \cdot \frac{dout\,H_1}{dH_1} \cdot \frac{dH_1}{dw_1}$$

$$\downarrow$$

$$\frac{dE_{Total}}{dout\,H_1} = \frac{dE_1}{dout\,H_1} + \frac{dE_2}{}$$

# Feed-forward / Back propagation in Neural Networks

i/p layer  Hidden layer  output layer




$h_1 = x_1 w_1 + x_2 w_2 + b_1$

Activation function Sigmoid $= 1/1+e^{-x}$

$R_1 = 1/1+e^{-H_1}$

Ex

| | | Target Values | |
|---|---|---|---|
| $x_1 = 0.05$ | $w_1 = 0.15$ | $T_1$ | $T_2$ |
| $x_2 = 0.10$ | $b_2 = 0.60$ | 0.01 | 0.99 |

Weights

$w_1 = 0.15$
$w_2 = 0.20$
$w_3 = 0.25$
$w_4 = 0.30$
$w_5 = 0.40$
$w_6 = 0.46$
$w_7 = 0.50$
$w_8 = 0.55$

$E_1 = \frac{1}{2}(T_1 - \text{output } y_1)^2$

$E_2 = \frac{1}{2}(T_2 - \text{output } y_2)^2$

Back Pass: To update weights

Let consider $w_5$:

$$\text{Error of } w_5 = \frac{d\,E_{total}}{dw_5}$$

$$\frac{dE_{Total}}{dw_5} = \frac{dE_{Total}}{d\,out\,y_1} \cdot \frac{d\,out\,y_1}{dy_1} \cdot \frac{dy_1}{dw_5}$$

Total Error:

$$E_{Total} = \frac{1}{2}(T_1 - out\,y_1)^2 + \frac{1}{2}(T_2 - out\,y_2)^2$$

$$\frac{dE_{Total}}{d\,out\,y_1} = \frac{2}{2}(T_1 - out\,y_1)^{2-1} \cdot -1 + 0$$

$$= -(T_1 - out\,y_1)$$

$$= -(0.01 - 0.75)$$

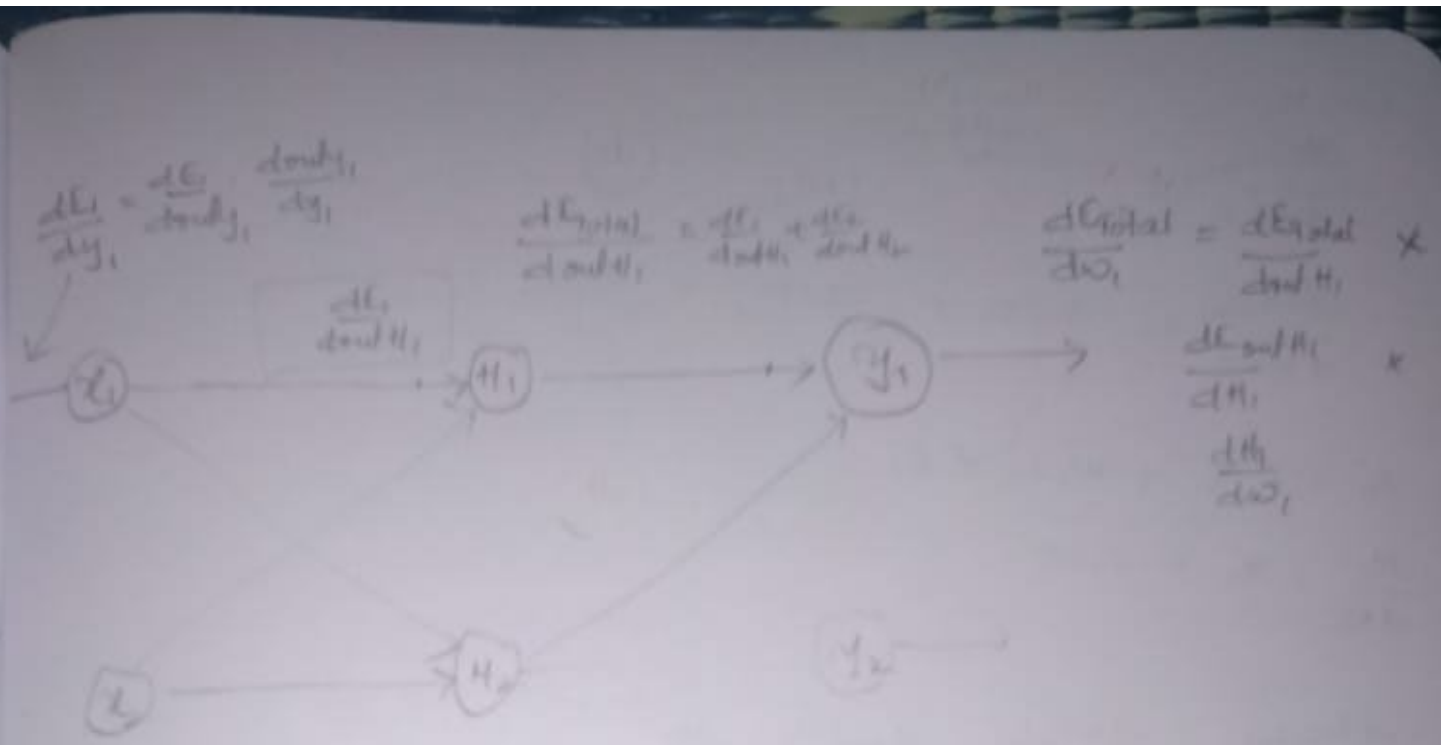
$$\boxed{\frac{dE_{Total}}{d\,out\,y_1} = 0.7413}$$

$$out\,y_1 = 1/1 + e^{-y_1}$$

$$\frac{d\,out\,y_1}{dy_1} = out\,y_1(1 - out\,y_1)$$

$$\frac{d\,out\,y_1}{dy_1} = 0.75(1 - 0.75)$$

$$\boxed{\frac{d\,out\,y_1}{dy_1} = 0.1875}$$




$$\frac{dE_1}{dy_1} = \frac{dE_1}{d\,out\,y_1} \cdot \frac{d\,out\,y_1}{dy_1}$$

$$\frac{dE_1}{dy_1} = \frac{dE_1}{d\,out\,H_1} \cdot \frac{d\,out\,H_1}{dy_1}$$

$$\frac{dE_1}{dy_1} = 0.74 \times 0.182 = 0.138$$

$$\frac{dy_1}{d\,out\,H_1} = w_5 = 0.40$$

$$\frac{dE_1}{d\,out\,H_1} = 0.138 \times 0.40 = 0.055$$

$$\frac{dE_2}{d\,out\,H_2} = -0.090$$

Forward Pass:

$h_1 = x_1 w_1 + x_2 w_2 + b_1$

$h_1 = (0.05 \times 0.15) + (0.10 \times 0.25) + 0.15$

$h_1 = 0.377$

output $h_1 = 1/1 + e^{-h_1} = 1/1 + e^{-0.377} = 0.5932$

Calculate $y_1$:

$y_1 = \text{output } h_1 \cdot w_5 + \text{output } h_2 \cdot w_5 + b_2$

$y_1 = 0.4 \times 0.59 + 0.596 \times 0.45 + 0.6$

$y_1 = 1.105$

output $y_1 = 1/1 + e^{-y_1}$

$= 1/1 + e^{-1.105}$

$y_1 = 0.75$ } Matching with o/p values 2 & 11.

11,4 $y_2 = 0.77$ }

So, Calculate Error total } Back pass & update weights.

Calculate Total energy:

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

$= \frac{1}{2} (T_1 - \text{output } y_1)^2 + \frac{1}{2} (T_2 - \text{output } y_2)^2$

$E_1$ $E_2$

$= 027 + 0.023$

$E_{total} = 0.29$