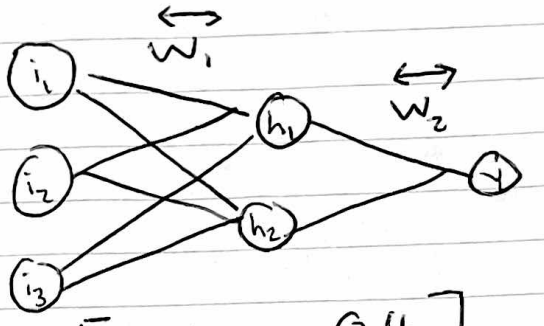
$\vec{x}_1 = [2, 3, 4]$ $\quad y_1 = 10$

$\vec{x}_2 = [6, 8, 3]$ $\quad y_2 = 15$



$$\overleftrightarrow{W_1} = \begin{bmatrix} 0.1 & 0.4 \\ 0.2 & 0.5 \\ 0.3 & 0.6 \end{bmatrix} \qquad \overleftrightarrow{W_2} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

Activation: Hidden: $f_1(x) = \frac{1}{1+e^{-x}}$

Output: $f_2(x) = x$

$\eta = 0.1$

$$\vec{x}_1 \cdot \overleftrightarrow{W}_1 = [2, 3, 4] \cdot \begin{bmatrix} 0.1 & 0.4 \\ 0.2 & 0.5 \\ 0.3 & 0.6 \end{bmatrix}$$

$$= [(0.2 + 0.6 + 1.2), (0.8 + 1.5 + 2.4)]$$

$$= [2, 4.7]$$

Hidden Activation: $f_1(\vec{x}_1 \cdot \overleftrightarrow{W}_1) = \left[\frac{1}{1+e^{-2}}, \frac{1}{1+e^{-4.7}}\right]$

$$= [0.88, 0.99]$$

$$f_1(\vec{x}_1 \cdot \overleftrightarrow{W}_1) \cdot \overrightarrow{W}_2 = [0.88, 0.99] \cdot \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

$$= 1.76 + 2.97$$

$$= 4.73$$

Output Activation: $f_2(f_1(\vec{x}_1 \cdot \overleftrightarrow{W}_1) \cdot \overrightarrow{W}_2) = 4.73$

Total Error: $\frac{1}{2}(10 - 4.73)^2$

$$= 13.89$$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{2(1,1)}} = \frac{\partial E_{total}}{\partial out_Y} \cdot \frac{\partial out_Y}{\partial Y} \cdot \frac{\partial Y}{\partial \overleftrightarrow{W}_{2(1,1)}}$$

$$\frac{\partial E_{total}}{\partial out_Y} = 2 * \frac{1}{2}(10 - 4.73) * (-1)$$
$$= -5.27$$

$$\frac{\partial out_Y}{\partial Y} = 1$$

$$\frac{\partial Y}{\partial \overleftrightarrow{W}_{2(1,1)}} = 1.76$$

$$\Rightarrow \frac{\partial E_{Total}}{\partial \overleftrightarrow{W}_{2(1,1)}} = (-5.27)(1)(1.76)$$
$$= -9.28$$

$$\overleftrightarrow{W}_{2(1,1)} = \overleftrightarrow{W}_{2(1,1)} - \eta \frac{\partial E_{Total}}{\partial \overleftrightarrow{W}_{2(1,1)}}$$
$$= 2 - 0.1 * (-9.28)$$
$$= 2.93$$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{2(2,1)}} = (-5.27)(1)(2.97)$$
$$= -15.65$$

$$\overleftrightarrow{W}_{2(2,1)} = 3 - 0.1 * (-15.65)$$
$$= 4.57$$

$$\overleftrightarrow{W}_2 = \begin{bmatrix} 2.93 \\ 4.57 \end{bmatrix}$$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(1,1)}} = \frac{\partial E_{total}}{\partial out_Y} \cdot \frac{\partial out_Y}{\partial Y} \cdot \frac{\partial Y}{\partial out_{h_1}} \cdot \frac{\partial out_{h_1}}{\partial h_1} \cdot \frac{\partial h_1}{\partial \overleftrightarrow{W}_{1(1,1)}}$$

$(\overleftrightarrow{W}_{2\,1,1})$

$\frac{\partial E_{total}}{\partial out_Y} = -5.27$ $\quad \frac{\partial out_Y}{\partial Y} = 1$ $\quad \frac{\partial Y}{\partial out_{h_1}} = 2$

$\frac{\partial out_{h_1}}{\partial h_1} = (out_{h_1})(1 - out_{h_1}) = (0.88)(1-0.88) = 0.11$

(i_1)

$\frac{\partial h_1}{\partial \overleftrightarrow{W}_{1(1,1)}} = 2$

$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(1,1)}} = (-5.27)(1)(2)(0.11)(2) = -2.32$

$\overleftrightarrow{W}_{1\,1,1} = 0.1 - 0.1 * (-2.32)$

$= 0.33$

$\frac{\partial E_{Total}}{\partial \overleftrightarrow{W}_{1(2,1)}} = (-5.27)(1)(2)(0.11)(3)$

$= -3.48$

$\overleftrightarrow{W}_{1(2,1)} = 0.2 - 0.1 * (-3.48)$

$= 0.55$

$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(3,1)}} = (-5.27)(1)(2)(0.11)(4)$

$= -4.64$

$\overleftrightarrow{W}_{1(3,1)} = 0.3 - 0.1 * (-4.64) = 0.76$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(1,2)}} = (-5.27)(1)(3)((0.99)(1-0.99))(2)$$

$$= -0.31$$

$$\overleftrightarrow{W}_{1(1,2)} = 0.4 - 0.1(-0.31)$$

$$= 0.43$$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(2,2)}} = (-5.27)(1)(3)(0.0099)(3)$$

$$= -0.47$$

$$\overleftrightarrow{W}_{1(2,2)} = 0.5 - 0.1(-0.47)$$

$$= 0.55$$

$$\frac{\partial E_{total}}{\partial \overleftrightarrow{W}_{1(3,2)}} = (-5.27)(1)(3)(0.0099)(4)$$

$$= -0.63$$

$$\overleftrightarrow{W}_{1(3,2)} = 0.6 - 0.1(-0.63)$$

$$= 0.66$$

$$\overleftrightarrow{W}_1 = \begin{bmatrix} 0.33 & 0.43 \\ 0.55 & 0.55 \\ 0.76 & 0.66 \end{bmatrix}$$

$$\therefore \overleftrightarrow{W}_1 = \begin{bmatrix} 0.33 & 0.43 \\ 0.55 & 0.55 \\ 0.76 & 0.66 \end{bmatrix}, \overleftrightarrow{W}_2 = \begin{bmatrix} 2.93 \\ 4.57 \end{bmatrix}$$