



$$a_1 = (0.35)(0.1) + (0.8)(0.9) = 0.755$$

$$y_3 = \frac{1}{1 + e^{-0.755}} = 0.68$$

$$a_2 = (0.35)(0.8) + (0.9)(0.6) = 0.68$$

$$y_4 = \frac{1}{1 + e^{-0.68}} = 0.6637$$

$$a_3 = y_5 = (0.3)(0.68) + (0.66)(0.9) = 0.801$$

$$y_5 = \frac{1}{1 + e^{-0.801}} = \boxed{0.69} \text{ output}$$

$$y_{\text{desired}} = 0.5$$

$$\text{error} = 0.5 - 0.69 = -0.19$$

update weights \Rightarrow

$$\Delta W_{ji} = \eta \delta_j o_i$$

t_j : correct output
for unit j

learning
rate

error
measure
at unit j

$$\delta_j = o_j (1 - o_j) (t_j - o_j)$$

$$\delta_j = o_j (1 - o_j) \sum_k \delta_k w_{kj}$$

$$\begin{aligned}\delta_5 &= y(1-y)(y_{\text{target}} - y) \\ &= (0.69)(1-0.69)(0.5-0.69) \\ &= -0.0406\end{aligned}$$

for hidden unit \Rightarrow

$$\begin{aligned}\delta_3 &= y_3(1-y_3)(w_{35})(\delta_5) \\ \Rightarrow & (0.68)(1-0.68)(0.3)(-0.0406) \\ &= -0.002\end{aligned}$$

$$\begin{aligned}\delta_4 &= y_4(1-y_4)(w_{45})(\delta_5) \\ &= (0.66)(1-0.66)(0.9)(-0.0406) \\ &= -0.0082\end{aligned}$$

$$\begin{aligned}\Delta w_{45} &= \eta \delta_5 y_4 \\ &= (1)(-0.0406)(0.6637) \\ &= -0.0269\end{aligned}$$

$$\begin{aligned}w_{45}(\text{new}) &= \Delta w_{45} + w_{45}(\text{old}) \\ &= -0.0269 + (0.9) \\ &= 0.8731\end{aligned}$$

$$\begin{aligned}w_{14} &= \eta \delta_4 x_{14} = (1)(-0.0082)(0.35) \\ &= -0.00287\end{aligned}$$

$$\begin{aligned}w_{14}(\text{new}) &= \Delta w_{14} + w_{14} = -0.00287 + 0.4 \\ &= 0.3971\end{aligned}$$

$$\Delta W_{35} = \cancel{\eta \delta_5 y_3}$$

$$\begin{aligned} & \eta \delta_5 y_3 \\ &= (1)(-0.0406)(0.68) \\ &= -0.027 \end{aligned}$$

$$\begin{aligned} W_{35}(\text{new}) &= (0.3) + (-0.027) \\ &= 0.273 \end{aligned}$$

$$\begin{aligned} \Delta W_{13} &= \eta \delta_3 x_1 \\ &= (1)(-0.002)(0.35) \\ &= -0.0007 \end{aligned}$$

$$\begin{aligned} W_{13}(\text{new}) &= -0.0007 + 0.1 \\ &= 0.09 \end{aligned}$$

$$\begin{aligned} \Delta W_{23} &= (1)(\delta_3) y_3 \\ &= (1)(-0.002)(0.68) \end{aligned}$$

$$\begin{aligned} &= -0.00136 \\ W_{23}(\text{new}) &= -0.00136 + 0.8 = 0.79 \\ \Delta W_{24} &= (1)(-0.0082)(0.9) \\ &= -0.00738 \end{aligned}$$

$$\begin{aligned} W_{24}(\text{new}) &= (-0.00738) + (0.6) \\ &= 0.59 \end{aligned}$$

$$W_{13} = 0.09 \quad W_{14} = 0.39$$

$$W_{23} = 0.79 \quad W_{24} = 0.59$$

$$W_{35} = 0.27$$

$$W_{45} = 0.87$$

epoch \Rightarrow 2

apply forward pass

$$a_1 = (0.35)(0.099) + (0.9)(0.7976) \\ = 0.7525$$

$$y_3 = 0.6797$$

$$a_2 = (0.39)(0.35) + (0.59)(0.9) \\ = 0.67$$

$$y_4 = 0.667$$

$$a_3 = (0.27)(0.67) + (0.8)(0.66) \\ = 0.7631$$

$$y_5 = \frac{1}{1 + e^{-z}} = 0.6820$$

$$\text{error} = y_{\text{target}} - y_5 \\ = 0.5 - 0.68 \\ = -0.182$$