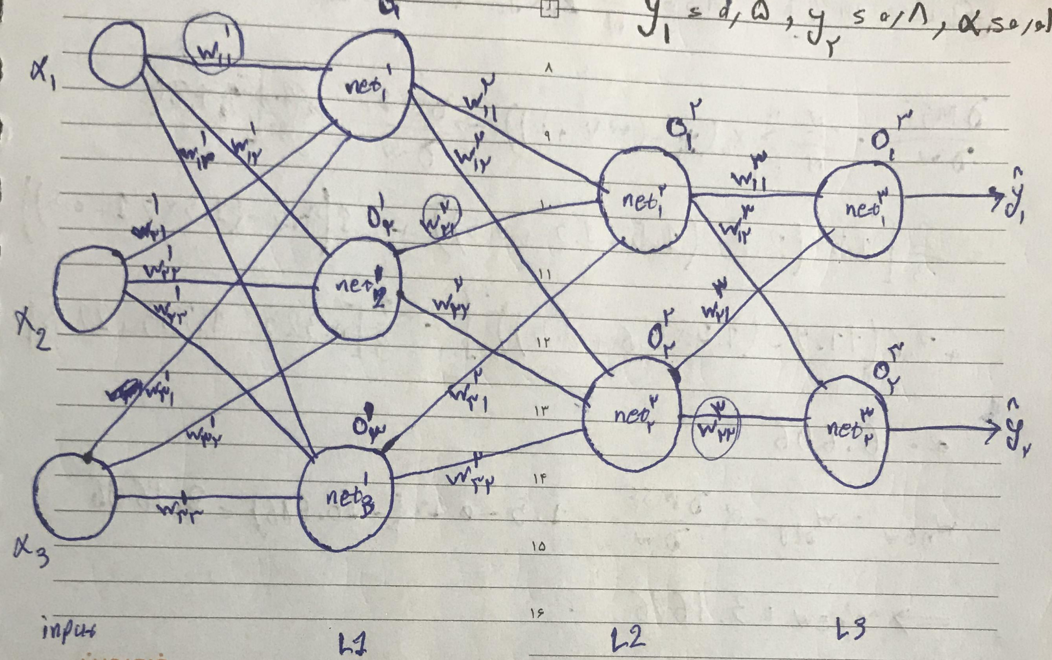
$y_1 = 0.5$, $y_2 = 0.8$, $\alpha = 0.01$



$net_1^1 = w_{11}^1 x_1 + w_{21}^1 x_2 + w_{31}^1 x_3 + b_1^1 = (0.1 \times 0.3) + (0.2 \times 0.5) + (0.2 \times 0.8) + 0.2 = 0.49$

$\Rightarrow O_1^1 \xRightarrow{Relu} \begin{cases} 0 & net \leq 0 \\ net & net > 0 \end{cases} \Rightarrow O_1^1 = net_1^1 = 0.49$

$net_2^1 = w_{12}^1 x_1 + w_{22}^1 x_2 + w_{32}^1 x_3 + b_2^1 = (0.4 \times 0.3) + (0.1 \times 0.5) + (0.2 \times 0.8) + 0.2 = 0.53$

$\Rightarrow O_2^1 = 0.53$

$net_3^1 = w_{13}^1 x_1 + w_{23}^1 x_2 + w_{33}^1 x_3 + b_3^1 = (0.2 \times 0.3) + (0.3 \times 0.5) + (0.1 \times 0.8) + 0.1 = 0.39$

$\Rightarrow O_3^1 = 0.39$

$$net_1^2 = w_{11}^2 O_1^1 + w_{21}^2 O_2^1 + w_{31}^2 O_3^1 + b_1^2 = (0.1 \times 0.49) + (0.2 \times 0.53) + (0.2 \times 0.39) + 0.1$$

$$= 0.333 \Rightarrow \tanh = \frac{e^{net} - e^{-net}}{e^{net} + e^{-net}} \Rightarrow O_1^2 = \tanh(net_1^2) = \frac{e^{0.333} - e^{-0.333}}{e^{0.333} + e^{-0.333}}$$

$$= 0.321 \Rightarrow O_1^2 = 0.321$$

$$net_2^2 = w_{12}^2 O_1^1 + w_{22}^2 O_2^1 + w_{32}^2 O_3^1 + b_2^2 = (0.4 \times 0.49) + (0.1 \times 0.53) + (0.2 \times 0.39)$$

$$+ 0.4 = 0.727 \Rightarrow O_2^2 = \tanh(net_2^2) = \frac{e^{0.727} - e^{-0.727}}{e^{0.727} + e^{-0.727}} = 0.621$$

$$\Rightarrow O_2^2 = 0.621$$

$$net_1^3 = w_{11}^3 O_1^2 + w_{21}^3 O_2^2 + b_1^3 = (0.5 \times 0.321) + (0.1 \times 0.621) + 0.5 = 0.7226$$

$$\Rightarrow O_1^3 = \sigma(net_1^3) = \frac{1}{1+e^{-net_1^3}} = \frac{1}{1+e^{-0.7226}} \approx 0.673 \Rightarrow \hat{y}_1 = O_1^3$$

$$net_2^3 = w_{12}^3 O_1^2 + w_{22}^3 O_2^2 + b_2^3 = (0.5 \times 0.321) + (0.5 \times 0.621) + 0.3 = 0.771$$

$$\Rightarrow O_2^3 = \sigma(net_2^3) = \frac{1}{1+e^{-0.771}} \approx 0.683 \Rightarrow \hat{y}_2 = O_2^3$$

$$W_{22(new)}^3 = W_{22(old)}^3 - \alpha \frac{dL}{dW_{22}^3} = W_{22(old)}^3 - \alpha \left[\frac{dL}{d\hat{y}_2} \underbrace{\cancel{\frac{d\hat{y}_2}{dO_2^3}}}_{1} \frac{\partial O_2^3}{dnet_2^3} \underbrace{\cancel{\frac{dnet_2^3}{dW_{22}^3}}}_{O_2^2} \right]$$

$$= W_{22}^3 - \alpha \left[\frac{-2}{N} \sum_{i=1}^{N} (y_i - \hat{y}_i) \times \left(\sigma(net_2^3)(1 - \sigma(net_2^3)) \right) \times O_2^2 \right] = 0.5 - (0.01)$$

$$\times \left[\left(\frac{-2}{2}\right) \left[(0.5 - 0.673) + (0.8 - 0.683) \right] \right] \times \left[0.683 \times (1 - 0.683) \right] \times 0.621$$

$$= 0.5 + \left(-8.852 \times 10^{-5} \right) \approx 0.499 \Rightarrow W_{22(new)}^3 \approx 0.499$$

$$w^2_{21(new)} = w^2_{21(old)} - \alpha \frac{\partial L}{\partial w^2_{21}} = w^2_{21(old)} - \alpha\left(\left[\frac{\partial L}{\partial \hat{y}_1}\cancel{\frac{\partial \hat{y}_1}{\partial o^3_1}}\frac{\partial o^3_1}{\partial net^3_1}\frac{\partial net^3_1}{\partial o^2_1}\frac{\partial o^2_1}{\partial net^2_1}\frac{\partial net^2_1}{\partial w^2_{21}}\right] + \left[\frac{\partial L}{\partial \hat{y}_2}\cancelto{1}{\frac{\partial \hat{y}_2}{\partial o^3_2}}\frac{\partial o^3_2}{\partial net^3_2}\frac{\partial net^3_2}{\partial o^2_1}\frac{\partial o^2_1}{\partial net^2_1}\frac{\partial net^2_1}{\partial w^2_{21}}\right]\right)$$

$$= w^2_{21(old)} - \alpha\left(\left[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_1)\left(\sigma(net^3_1)(1-\sigma(net^3_1))\right)(w^3_{11})(1-\tanh^2(net^2_1))(o^1_2)\right] + \left[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_2)\left(\sigma(net^3_2)(1-\sigma(net^3_2))\right)(w^3_{12})(1-\tanh^2(net^2_1))(o^1_2)\right]\right)$$

$$= 0.2 - 0.01\left[\left(\left[\frac{-2}{2}\left[(0.5-0.673)+(0.8-0.673)\right]\right]\times(0.673 - (1-0.673))\right)(0.5)(1-0.103)(0.53) + \left(\left[\frac{-2}{2}\left[0.5-0.683\right]+\left[0.8-0.683\right]\right]\times(0.683\times(1-0.683))\right](0.5)(1-0.103)(0.53)\right] = 0.2 - 0.01\left[(2.405\times10^{-3}) + (3.388\times10^{-3})\right] = 0.2 - 0.01\left[5.793\times10^{-3}\right] \approx 0.199$$

$$\Rightarrow w^2_{21(new)} = 0.199$$

$$w^1_{11(new)} = w^1_{11(old)} - \alpha\frac{\partial L}{\partial w^1_{11}} = w^1_{11(old)} - \alpha\left(\left[\frac{\partial L}{\partial \hat{y}_1}\cancelto{1}{\frac{\partial \hat{y}_1}{\partial o^3_1}}\frac{\partial o^3_1}{\partial net^3_1}\frac{\partial net^3_1}{\partial o^2_1}\frac{\partial o^2_1}{\partial net^2_1}\frac{\partial net^2_1}{\partial o^1_1}\cancelto{1}{\frac{\partial o^1_1}{\partial net^1_1}}\frac{\partial net^1_1}{\partial w^1_{11}}\right] + \left[\frac{\partial L}{\partial \hat{y}_2}\cancelto{1}{\frac{\partial \hat{y}_2}{\partial o^3_2}}\frac{\partial o^3_2}{\partial net^3_2}\frac{\partial net^3_2}{\partial o^2_1}\frac{\partial o^2_1}{\partial net^2_1}\frac{\partial net^2_1}{\partial o^1_1}\cancelto{1}{\frac{\partial o^1_1}{\partial net^1_1}}\frac{\partial net^1_1}{\partial w^1_{11}}\right] + \left[\frac{\partial L}{\partial \hat{y}_1}\cancelto{1}{\frac{\partial \hat{y}_1}{\partial o^3_1}}\frac{\partial o^3_1}{\partial net^3_1}\frac{\partial net^3_1}{\partial o^2_2}\frac{\partial o^2_2}{\partial net^2_2}\frac{\partial net^2_2}{\partial o^1_1}\cancelto{1}{\frac{\partial o^1_1}{\partial net^1_1}}\frac{\partial net^1_1}{\partial w^1_{11}}\right] + \left[\frac{\partial L}{\partial \hat{y}_2}\cancelto{1}{\frac{\partial \hat{y}_2}{\partial o^3_2}}\frac{\partial o^3_2}{\partial net^3_2}\frac{\partial net^3_2}{\partial o^2_2}\frac{\partial o^2_2}{\partial net^2_2}\frac{\partial net^2_2}{\partial o^1_1}\cancelto{1}{\frac{\partial o^1_1}{\partial net^1_1}}\frac{\partial net^1_1}{\partial w^1_{11}}\right]\right)$$

ولادت حضرت امام محمد باقر علیه‌السلام (۵۷ هـ ق)

روز بزرگداشت سعدی

$$= w^1_{11}(old) - \alpha\Big(\Big[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_1)\big(\sigma(net^3_1)(1-\sigma(net^3_1))\big)(w^3_{11})(1-\tanh^2(net^2_1))$$

$$(w^2_{11})(x_1)\Big] + \Big[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_2)\big(\sigma(net^3_2)(1-\sigma(net^3_2))\big)$$

$$(w^3_{12})(1-\tanh^2(net^2_1))(w^2_{11})(x_1)\Big] + \Big[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_1)\big(\sigma(net^3_1)(1-\sigma(net^3_1))\big)$$

$$(w^3_{21})(1-\tanh^2(net^2_2))(w^2_{12})(x_1)\Big] + \Big[\frac{-2}{N}\sum_{i=1}^{N}(y_i-\hat{y}_2)\big(\sigma(net^3_2)(1-\sigma(net^3_2))\big)$$

$$(w^3_{22})(1-\tanh^2(net^2_2))(w^2_{12})(x_1)\Big]\Big) = ۰٫۱ - ۰٫۰۱\Big(\Big[\Big[\frac{-۲}{۲}\big((۰٫۵-۰٫۶۷۳)+$$

$$(۰٫۸-۰٫۶۷۳)\big)\Big](۰٫۶۷۳(۱-۰٫۶۷۳))(۰٫۵)(۱-۰٫۱۰۴)(۰٫۱)(۰٫۳)\Big] + \Big[\Big[\frac{-۲}{۲}\big((۰٫۵-۰٫۶۸۳)$$

$$+(۰٫۸-۰٫۶۸۳)\big)\Big](۰٫۶۸۳(۱-۰٫۶۸۳))(۰٫۵)(۱-۰٫۱۰۴)(۰٫۱)(۰٫۳)\Big] + \Big[\Big[\frac{-۲}{۲}\big($$

$$(۰٫۵-۰٫۶۷۳)+(۰٫۸-۰٫۶۷۳)\big)\Big]\Big](۰٫۶۷۳(۱-۰٫۶۷۳))(۰٫۱)(۱-۰٫۳۸۵)(۰٫۴)(۰٫۳)\Big]$$

$$+\Big[\Big[\frac{-۲}{۲}\big((۰٫۵-۰٫۶۸۳)+(۰٫۸-۰٫۶۸۳)\big)\Big]\Big](۰٫۶۸۳(۱-۰٫۶۸۳))(۰٫۵)(۱-۰٫۳۸۵)(۰٫۴)(۰٫۳)\Big]$$

$$= ۰٫۱ - ۰٫۰۱\Big[(۱٫۳۶۱\times ۱۰^{-۴}) + (۱٫۹۱۸\times ۱۰^{-۴}) + (۷٫۴۹۸\times ۱۰^{-۵})$$

$$+(۵٫۲۶۰\times ۱۰^{-۴})\Big] = ۰٫۱ - ۰٫۰۱\Big[۹٫۲۸۵۸\times ۱۰^{-۴}\Big] \approx ۰٫۰۹۹۹$$

$$\rightarrow w^1_{11}(new) \approx ۰٫۹۹۹$$