1.

a) $a_1^{(1)} = 2$

$z_1^{(1)} = 0.880797$

b) $a_3^{(1)} = 8$

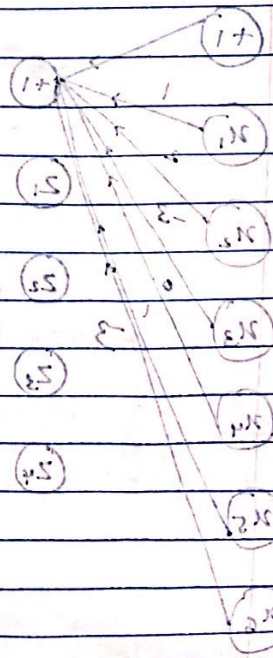
$z_3^{(1)} = 0.9996645$

c) $b_2^{(1)} = 3.642966$

d) $\hat{y}_2^{(1)} = 0.26152113$

e) $0.63027784$

f) $0.58249322$



2. (a) $E_{TOTAL} : \sum \frac{1}{2}(y - \hat{y})^2$

$$\frac{\partial E_{TOTAL}}{\partial w_5} = \frac{\partial E_{TOTAL}}{\partial y_{1out}} \times \frac{\partial y_{1out}}{\partial y_1} \times \frac{\partial y_1}{\partial w_5}$$

$\Rightarrow$ ~~$\frac{\partial E_{TOTAL}}{}$~~

$y_{1,out} = z$

$y_1 =$

$$\frac{\partial Loss}{\partial \beta_{2,1}} = \frac{\partial L}{\partial \hat{y}_2} \times \frac{\partial \hat{y}_2}{\partial b_2} \times \frac{\partial b_2}{\partial \beta_{2,1}}$$

$$\Rightarrow \frac{\partial}{\partial \hat{y}_2}\left[-y \log \hat{y}_1 - y_2 \log \hat{y}_2 - y_3 \log \hat{y}_3\right] \times \frac{\partial}{\partial b_2}\left[\frac{\exp(b_2)}{(\exp(b1)+\exp(b_2)+\exp(b3))}\right]$$

$$+ \frac{\partial}{\partial \beta_{2,1}}\left[\beta_0 + \sum_{j=1}^{4} \beta_{j,i} z_j\right]$$

$$= \frac{-y_2}{\hat{y}_2} \cdot \frac{\exp(b_2)(\exp(b1)+\exp(b2)+\exp(b_3)) - (\exp(b_2))^2}{(\exp(b1)+\exp(b2)+\exp(b_3))^2} \times z_1$$

$$\Rightarrow \frac{-y_2}{\hat{y}_2} \times \frac{\exp(b_2)(\exp(b1)+\exp(b_3))}{(\exp(b1)+\exp(b2)+\exp(b3))^2} \times z_1$$

$$= -0.65045$$

$$\beta_{2,1} = \beta_{3,1} - \varepsilon \frac{\partial L}{\partial \beta_{2,1}} = 1 + 0.65045 = 1.65045$$

(b) $1.7384 \Rightarrow 1 - \left(\frac{-y_2}{\hat{y}_2} \frac{\exp(b_2)(\exp(b_1)+\exp(b_3))}{(\exp(b1)+\exp(b_2)+\exp(b_3))^2}\right)$

2.

(c) $$\frac{\partial L}{\partial \alpha_{3,4}} = \frac{\partial L}{\partial \hat{y}_1} \times \frac{\partial \hat{y}_1}{\partial b_1} \times \frac{\partial b_1}{\partial z_3} \times \frac{\partial z_3}{\partial a_3} \times \frac{\partial a_3}{\partial \alpha_{3,4}}$$

$$+ \frac{\partial L}{\partial \hat{y}_2} \times \frac{\partial \hat{y}_2}{\partial b_2} \times \frac{\partial b_2}{\partial z_3} \times \frac{\partial z_3}{\partial a_3} \times \frac{\partial a_3}{\partial \alpha_{3,4}}$$

$$+ \frac{\partial L}{\partial \hat{y}_3} \times \frac{\partial \hat{y}_3}{\partial b_3} \times \frac{\partial b_3}{\partial z_3} \times \frac{\partial z_3}{\partial a_3} \times \frac{\partial a_3}{\partial \alpha_{3,4}} \quad \text{(1)}$$

$$\alpha_{3,4} = \alpha_{3,4} - \eta \left[ \frac{\partial L}{\partial \alpha_{3,4}} \right] \quad \text{(2)}$$

(d) $$\alpha_{2,0} = \alpha_{2,0} - \eta \left[ \frac{\partial L}{\partial \alpha_{2,0}} \right]$$

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