Backward Propagation

1. $\frac{dL}{dA_2} = 2(A_2 - y) = 2(0{,}555 - 18) \approx -34$

2. $\frac{dL}{dZ_2} = \frac{dL}{dA_2} \cdot \text{sigmoid}'(Z_2)$ where $\text{sigmoid}'(z) = \sigma(z)(1-\sigma(z))$

$\sigma'(Z_2) = \sigma(Z_2)(1-\sigma(Z_2)) \approx 0{,}555 \cdot (1 - 0{,}555) \approx 1{,}1 \cdot 10^{-8}$

$\frac{dL}{dZ_2} = \frac{dL}{dA_2} \cdot \sigma'(Z_2) \approx -34 \cdot 1{,}1 \cdot 10^{-8} \approx -3{,}7 \cdot 10^{-7}$

3. $\frac{dL}{dW_2} = dZ_2 \cdot A_1^T = -3{,}7 \cdot 10^{-7} \cdot [3{,}9;\ 12{,}1;\ 20{,}3]$

$dW_2 = [-1{,}4 \cdot 10^{-6},\ -4{,}5 \cdot 10^{-6},\ -7{,}5 \cdot 10^{-6}]$

4. $\frac{dL}{db_2} = \frac{dL}{dZ_2} = -3{,}7 \cdot 10^{-7}$

5. $\frac{dL}{dA_1} = W_2^T \cdot \frac{dL}{dZ_2} = [0{,}2;\ 0{,}4;\ 0{,}6]^T \cdot (-3{,}7 \cdot 10^{-7})$

$dA_1 \approx [-7{,}4 \cdot 10^{-8};\ -1{,}5 \cdot 10^{-7};\ -2{,}2 \cdot 10^{-7}]$

6. $\frac{dL}{dZ_1} = \frac{dL}{dA_1} \cdot \text{ReLU}'(Z_1)$ where $\text{ReLU}'(x) = 1$ if $x > 0$, else 0

$\frac{dL}{dZ_1} = dA_1 \cdot \text{ReLU}'(Z_1)$, all $Z_1 > 0$, $\text{ReLU}' = 1$, then $dZ_1 = dA_1$

7. $\frac{dL}{dW_1} = \frac{dL}{dZ_1} \cdot X^T$

$dW_{1\,row1} = -7{,}4 \cdot 10^{-8} \cdot [20, 3, 4] = [-1{,}5 \cdot 10^{-6}, -2{,}2 \cdot 10^{-7}, -3 \cdot 10^{-7}]$

$dW_{1\,row2} = -1{,}5 \cdot 10^{-7} [20, 3, 4] = [-3 \cdot 10^{-6}, -4{,}5 \cdot 10^{-7}, -6 \cdot 10^{-7}]$

$dW_{1\,row3} = -2{,}2 \cdot 10^{-7} [20, 3, 4] = [-4{,}4 \cdot 10^{-6}, -6{,}6 \cdot 10^{-7}, -8{,}8 \cdot 10^{-7}]$

8. $\frac{dL}{db_1} = \frac{dL}{dZ_1} = [-7{,}4 \cdot 10^{-8}, -1{,}5 \cdot 10^{-7}, -2{,}2 \cdot 10^{-7}]$