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Ex-03

Task-1) $L = (f_\theta(X) - Y)^2$

$\frac{dL}{dw_1} = 2[f(x)-y] \cdot \frac{df_\theta}{dw_1} \overset{(I)}{\Rightarrow} \frac{dL}{dw_1} = 2[f(x)-y]\, w_2^T\, \delta'(w_1 x + b_1)\, x$

$\frac{dL}{dw_2} = 2[f(x)-y] \cdot \frac{df_\theta}{dw_2} \overset{(II)}{\Rightarrow} \frac{dL}{dw_2} = 2[f(x)-y]\, \left(\delta(w_1 x + b_1)\right)^T$

$\frac{dL}{db_1} = 2[f(x)-y] \cdot \frac{df_\theta}{db_1} \overset{(III)}{\Rightarrow} \frac{dL}{db_1} = 2[f(x)-y]\left(w_2^T \circ \delta'(w_1 x + b_1)\right)$

$\frac{dL}{db_2} = 2(f(x)-y) \cdot \frac{df_\theta}{db_2} \overset{(IV)}{\Rightarrow} \frac{dL}{db_2} = 2[f(x)-y]$

$f_\theta = w_2 \delta(w_1 x + b_1) + b_2$

$\frac{df_\theta}{dw_1} = w_2 \frac{d\,\delta(w_1 x + b_1)}{dw_1} = w_2 \left[\delta'(w_1 x + b_1)\right] \frac{d(w_1 x + b_1)}{dw_1}$

$= w_2\, \delta'(w_1 x + b_1)\, x$ (I)

$\frac{df_\theta}{dw_2} = \delta(w_1 x + b_1)$ (II)

$\frac{df_\theta}{db_1} = w_2 \frac{d\,\delta(w_1 x + b_1)}{db_1} = w_2\, \delta'(w_1 x + b_1) \frac{d(w_1 x + b_1)}{db_1} =$

$w_2\, \delta'(w_1 x + b_1)$ (III)

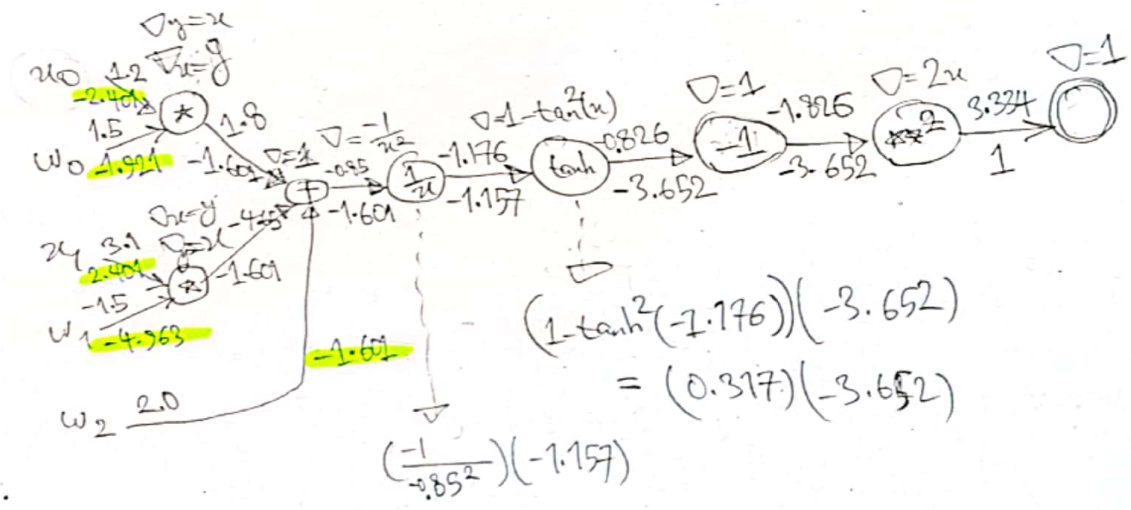
$\frac{df_\theta}{d2} = 1$ (IV)

Task 3

$$\text{Tanh}(x) = \frac{2}{1+e^{-2x}} - 1 = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$\frac{d\,\text{Tanh}(x)}{dx} = \frac{(e^x+e^{-x})(e^x+e^{-x}) - (e^x-e^{-x})(e^x-e^{-x})}{(e^x+e^{-x})^2}$$

$$= \frac{(e^x+e^{-x})^2}{(e^x+e^{-x})^2} - \frac{(e^x-e^{-x})^2}{(e^x+e^{-x})^2} = 1 - \tanh^2(x)$$



$$\nabla \text{downStream} = \nabla_{\text{local}}(\text{input}) * \nabla_{\text{upStream}}$$