Øving 2

$$w_{kj} := w_{kj} - \alpha \frac{\partial C}{\partial w_{kj}} = w_{kj} - \alpha \delta_k a_j \quad (1)$$

$$\delta_k = \frac{\partial C}{\partial z_k} = \frac{\partial C}{\partial z_k} = -(t_k - y_k)$$

$$w_{ji} := w_{ji} - \alpha \frac{\partial C}{\partial w_{ji}} \quad (2)$$

activation from previous layer

$$\delta_j = \frac{\partial C}{\partial z_j}, \quad \boxed{\frac{\partial C}{\partial w_{ji}^{l}} = a_i^{l-1} \delta_j^{l}, \quad \delta_j^{l} = \frac{\partial C}{\partial z_j^{l}}}$$

$-(t_k - y_k)$

$$w_{ji} := w_{ji} - \alpha a_i \delta_j, \quad a_i = x_i$$

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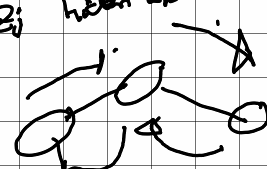
gradient in output

$f(z_j)$ hidden layer activation func

$$\frac{\partial C}{\partial z_j} = \sum_k \frac{\partial C}{\partial z_k} \frac{\partial z_k}{\partial a_j} \frac{\partial a_j}{\partial z_j} = \delta_j$$



hidden layer activation function

$$z_j = \sum w_{ij} x_i$$

$f'(z)$

$$\frac{\partial C}{\partial z_i} = \sum_k \frac{\partial C}{\partial z_k} \frac{\partial z_k}{\partial z_j} \Rightarrow f'(z) \sum_k \delta_k x_i = \delta_k$$

Task 1b

$$w_{kj} := w_{kj} - \alpha \delta_k a_i$$

$$= \begin{bmatrix} w_{11} & \cdots & w_{1j} \\ \vdots & \ddots & \vdots \\ w_{k,1} & \cdots & w_{kj} \end{bmatrix} - \alpha \begin{bmatrix} \delta_1 \\ \vdots \\ \delta_k \end{bmatrix} \begin{bmatrix} a_1 & \cdots & a_j \end{bmatrix}$$

$$w_{ji} := w_{ji} - \alpha \delta_j x_i$$

$$= \begin{bmatrix} w_{11} & \cdots & w_{1,j} \\ \vdots & \ddots & \vdots \\ w_{j,1} & \cdots & w_{i,j} \end{bmatrix} - \alpha \begin{bmatrix} \delta_1 \\ \vdots \\ \delta_j \end{bmatrix} \begin{bmatrix} x_1 & \cdots & x_j \end{bmatrix}$$

Task 3b

$$f(x) = 1{,}7159 \tanh\left(\frac{2}{3}x\right)$$

$$\frac{\partial f(x)}{\partial x} = 1{,}7159 \frac{\partial}{\partial x} \frac{\sinh(\overbrace{\tfrac{2}{3}x}^{=x})}{\cosh(\frac{2}{3}x)} =$$

$$= 1{,}7159 \frac{\cosh x \cosh x - \sinh x \sinh x}{\cos^2 x} \cdot \left(\frac{2}{3} + \frac{2}{3}\right)$$

$$= 1{,}7159 \cdot \frac{4}{3} \cdot \frac{\cos^2 x - \sinh^2 x}{\cosh^2 x}$$

$$= \frac{1}{\cosh^2 x} \cdot \frac{4}{3} \cdot 1{,}7159 \Bigg|_{x = \frac{2}{3}z}$$

$$\Rightarrow \frac{\partial f}{\partial x} = \frac{4/3 \cdot 1{,}7159}{\cosh^2\left(\frac{2}{3}x\right)} = \frac{4/3 \cdot 1{,}7159}{\cosh\left(\frac{4}{3}x\right)} + 1$$