Practical-1: Pen and paper solutions

Andrea Jemmett

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Exercise-1

Solution:

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial W_{out}} &= \frac{\partial}{\partial W_{out}} \frac{1}{2}(y_{out} - y_{gt})^2 \\ &= (y_{out} - y_{gt}) \cdot \frac{\partial}{\partial W_{out}}(y_{out} - y_{gt}) \\ &= (y_{out} - y_{gt}) \cdot \frac{\partial}{\partial W_{out}} f_3(W_{out} z_2) \\ &= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \cdot z_2.\end{aligned} \tag{1}$$

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial W_2} &= \frac{\partial}{\partial W_2} \frac{1}{2}(y_{out} - y_{gt})^2 \\ &= (y_{out} - y_{gt}) \cdot \frac{\partial}{\partial W_2} f_3(W_{out} \cdot f_2(W_2 z_1)) \\ &= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \frac{\partial}{\partial W_2} f_2(W_2 z_1) \\ &= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \cdot f_2'(s_2) \cdot z_1.\end{aligned} \tag{2}$$

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\begin{aligned}
\frac{\partial \mathcal{L}}{\partial W_1} &= \frac{\partial}{\partial W_1}\frac{1}{2}(y_{out} - y_{gt})^2 \\
&= (y_{out} - y_{gt}) \cdot \frac{\partial}{\partial W_1} f_3(W_{out} \cdot f_2(W_2 z_1)) \\
&= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \cdot \frac{\partial}{\partial W_1} f_2(W_2 z_1) \\
&= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \cdot f_2'(s_2) \cdot \frac{\partial}{\partial W_1} f_1(W_1 x_{in}) \\
&= (y_{out} - y_{gt}) \cdot f_3'(s_{out}) \cdot f_2'(s_2) \cdot f_1'(s_1) \cdot x_{in}.
\end{aligned} \tag{3}
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