

## TASK 1A

$$\begin{aligned}w_{ki} &:= w_{kj} - \alpha \frac{\partial \mathcal{L}}{\partial w_{kj}} \\&= w_{kj} - \alpha \frac{\partial \mathcal{L}}{\partial z_k} \frac{\partial z_k}{\partial w_{kj}} \\&= \underline{\underline{w_{kj} - \alpha \mathcal{J}_k a_j}} \quad \square\end{aligned}$$

$$\frac{\partial \mathcal{L}}{\partial z_k} = \mathcal{J}_k$$

$$z_k = \sum_j w'_{kj} a_j \Rightarrow \frac{\partial z_k}{\partial w_{kj}} = a_j$$

$$\begin{aligned}w_{ji} &:= w_{ji} - \alpha \frac{\partial \mathcal{L}}{\partial w_{ji}} \\&= w_{ji} - \alpha \frac{\partial \mathcal{L}}{\partial z_j} \frac{\partial z_j}{\partial w_{ji}} \\&= \underline{\underline{w_{ji} - \alpha \mathcal{J}_j x_i}} \quad \square\end{aligned}$$

$$\frac{\partial \mathcal{L}}{\partial z_j} = \mathcal{J}_j, \quad \frac{\partial z_j}{\partial w_{ji}} = x_i$$

$$\begin{aligned}\mathcal{J}_j &:= \frac{\partial \mathcal{L}}{\partial z_j} = \sum_k \frac{\partial \mathcal{L}}{\partial z_k} \frac{\partial z_k}{\partial z_j} \\&= \sum_k \frac{\partial \mathcal{L}}{\partial z_k} \frac{\partial z_k}{\partial a_j} \frac{\partial a_j}{\partial z_j} \\&= \frac{\partial a_j}{\partial z_j} \sum_k w_{kj} \mathcal{J}_k \\&= \underline{\underline{f'(z_j) \sum_k w_{kj} \mathcal{J}_k}} \quad \square\end{aligned}$$

$$z_j = \sum_i w_{ji} x_i \Rightarrow \frac{\partial z_j}{\partial w_{ji}} = x_i$$

$$a_j = f(z_j) \Rightarrow \frac{\partial a_j}{\partial z_j} = f'(z_j)$$