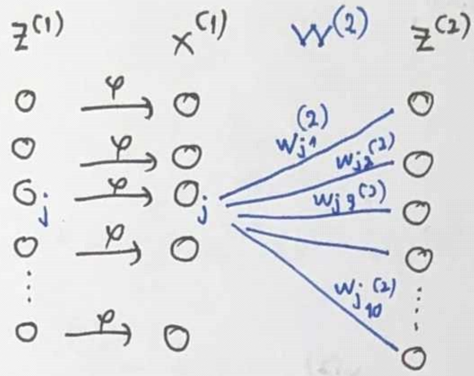
Now we focus on $\partial_j^{(1)} = \dfrac{\partial \mathcal{L}_n}{\partial z_j^{(1)}}$.



We have, by the Chain Rule,

$$\partial_j^{(1)} = \frac{\partial \mathcal{L}_n}{\partial z_j^{(1)}} = \frac{\partial \mathcal{L}_n}{\partial x_j^{(1)}} \cdot \frac{\partial x_j^{(1)}}{\partial z_j^{(1)}}$$

$$= \left(\sum_{k=1}^{10} \frac{\partial \mathcal{L}_n}{\partial z_k^{(2)}} \cdot \frac{\partial z_k^{(2)}}{\partial x_j^{(1)}} \right) \cdot \frac{\partial x_j^{(1)}}{\partial z_j^{(1)}}.$$

$$= \left[\sum_{k=1}^{10} \partial_k^{(2)} \cdot \frac{\partial z_k^{(2)}}{\partial x_j^{(1)}} \right] \cdot \frac{\partial x_j^{(1)}}{\partial z_j^{(1)}}.$$

We have $x_j^{(1)} = \varphi(z_j^{(1)}) \Longrightarrow \dfrac{\partial x_j^{(1)}}{\partial z_j^{(1)}} = \varphi'(z_j^{(1)})$

We have
$$z_k^{(2)} = \left(W^{(2)T} x^{(1)} + b^{(2)} \right)_k$$
$$= \sum_{i=1}^{K} (W^{2})^T_{ki} x_i^{(1)} + b_k^{(2)} = \sum_{i=1}^{K} w_{ik}^{(2)} x_i^{(1)} + b_k^{(2)}$$

Hence
$$\frac{\partial z_k^{(2)}}{\partial x_j^{(1)}} = \sum_{i=1}^{K} \frac{\partial}{\partial x_j^{(1)}} \left[w_{ik}^{(2)} x_i^{(1)} \right] + b_k^{(2)}$$
$$= w_{jk}^{(2)}$$

Now
$$\partial_j^{(1)} = \left(\sum_{k=1}^{10} \partial_k^{(2)} \cdot w_{jk} \right) \varphi'(z_j^{(1)})$$
$$= \left(\sum_{k=1}^{10} w_{jk}^{(2)} \partial_k^{(2)} \right) \varphi'(z_j^{(1)})$$

Observe that $\partial^{(1)} = W^{(2)} \partial^{(2)} \odot \varphi'(z^{(1)})$.