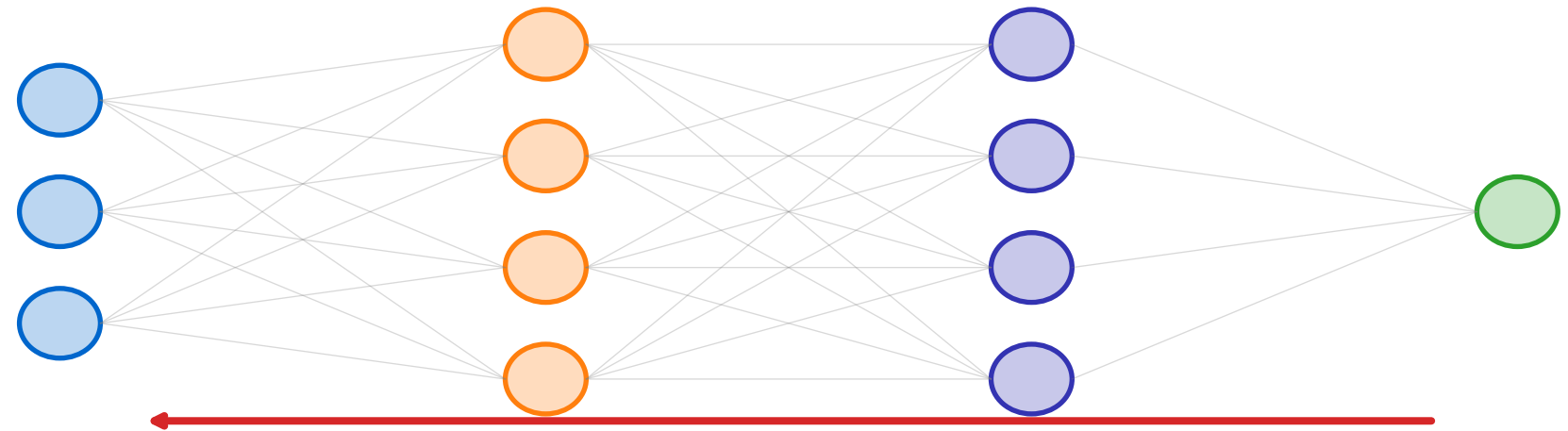


# Gradient Flow Through a 3-Layer MLP

Input                      Hidden 1                      Hidden 2                      Output

FORWARD:  $x \rightarrow z^{(1)} \rightarrow a^{(1)} \rightarrow z^{(2)} \rightarrow a^{(2)} \rightarrow \hat{y}$



BACKWARD: Gradient flows from loss to weights



0.1



0.2



0.3



0.4

Gradient magnitude decreases as it flows backward (vanishing gradient problem)

Backward Pass Equations:

$$\delta^{(L)} = \nabla_{\hat{y}} L \odot \sigma'(z^{(L)})$$
$$\delta^{(l)} = (W^{(l+1)})^T \delta^{(l+1)} \odot \sigma'(z^{(l)})$$
$$\frac{\partial L}{\partial W^{(l)}} = \delta^{(l)} (a^{(l-1)})^T$$
$$\frac{\partial L}{\partial b^{(l)}} = \delta^{(l)}$$