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Deep Neural Networks

Forward and backward
propagation

Forward propagation for layer l

$$\rightarrow \quad \quad \quad \leftarrow w^{[l]}, b^{[l]}$$

$$\rightarrow \quad \quad \quad \text{---} \text{---} \text{---}$$

$$z^{[l]} = w^{[l]} \cdot a^{[l-1]} + b^{[l]}$$

$$a^{[l]} = g^{[l]}(z^{[l]})$$

$$a^{[l-1]}$$

$$A^{[l-1]}$$

$$x = w^{[l]} \rightarrow \square \rightarrow \square \rightarrow \square \rightarrow \square$$

Vertauscht:

$$z^{[l]} = w^{[l]} \cdot A^{[l-1]} + b^{[l]}$$

$$A^{[l]} = g^{[l]}(z^{[l]})$$

Backward propagation for layer l

→



$$\frac{\partial z^l}{\partial z^{l+1}} = \frac{\partial z^l}{\partial z^{l+1}} * g'(z^{l+1})$$

$$\frac{\partial w^l}{\partial z^l} = \frac{\partial z^l}{\partial z^{l+1}} \cdot a^{l+1}$$

$$\frac{\partial b^l}{\partial z^l} = \frac{\partial z^l}{\partial z^{l+1}}$$

$$\frac{\partial a^{l+1}}{\partial z^l} = w^{l+1T} \cdot \frac{\partial z^l}{\partial z^{l+1}}$$

$$\frac{\partial z^l}{\partial z^{l+1}} = w^{l+1T} \frac{\partial z^{l+1}}{\partial z^{l+1}} * g'(z^{l+1})$$

$$\frac{\partial z^l}{\partial z^{l+1}} = \frac{\partial a^{l+1}}{\partial z^{l+1}} * g'(z^{l+1})$$

$$\frac{\partial w^l}{\partial z^l} = \frac{1}{n} \frac{\partial z^l}{\partial z^{l+1}} \cdot A^{l+1T}$$

$$\frac{\partial b^l}{\partial z^l} = \frac{1}{n} \text{np.sum}(\frac{\partial z^l}{\partial z^{l+1}}, \text{axis}=1, \text{keepdims}=\text{True})$$

$$\frac{\partial A^{l+1T}}{\partial z^l} = w^{l+1T} \cdot \frac{\partial z^l}{\partial z^{l+1}}$$

Summary

