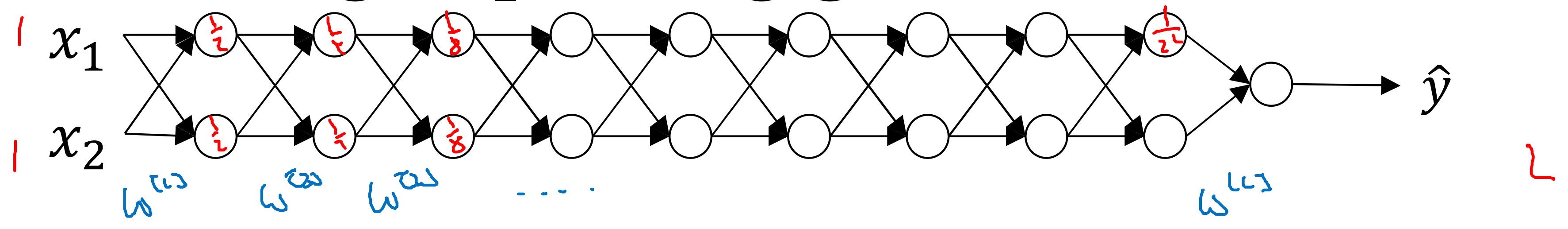
deeplearning.ai

Setting up your optimization problem

Vanishing/exploding gradients

Vanishing/exploding gradients

$L=150$



$g(z) = z$. $b^{[l]} = 0$.

$$\hat{y} = W^{[L]} \underbrace{W^{[L-1]} W^{[L-2]} \cdots \overset{a^{[3]}}{\boxed{W^{[3]} \boxed{W^{[2]} W^{[1]} x}}}}$$

1.5^L

0.5^L

$z^{[1]} = W^{[1]} x$

$a^{[1]} = g(z^{[1]}) = z^{[1]}$

$a^{[2]} = g(z^{[2]}) = g(W^{[2]} a^{[1]})$

$W^{[l]} > I$

$W^{[l]} < I \quad \begin{bmatrix} 0.9 & \\ & 0.9 \end{bmatrix}$

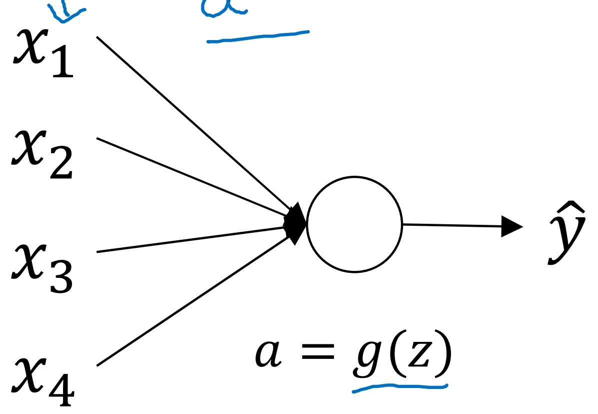
$$W^{[l]} = \begin{bmatrix} \overset{0.5}{\cancel{1.5}} & 0 \\ 0 & \underset{0.5}{\cancel{1.5}} \end{bmatrix}$$

$$\hat{y} = \underbrace{W^{[L]} \begin{bmatrix} \overset{0.5}{\cancel{1.5}} & 0 \\ 0 & \underset{0.5}{\cancel{1.5}} \end{bmatrix}^{L-1}} x$$

$1.5^{L-1} x$

$0.5^{L-1} x$

Single neuron example



$w^{[l]}$

$z = w_1 x_1 + w_2 x_2 + \cdots + w_n x_n \cancel{+b}$

Large $n \rightarrow$ Smaller w_i

$\mathrm{Var}(w_i) = \cancel{\frac{1}{n}} \quad \frac{2}{n}$

$W^{[l]} = $ np.random.randn(shape) $*$ $\boxed{\text{np.sqrt}\left(\frac{2}{n^{[l-1]}}\right)}$

ReLU $\qquad g^{[l]}(z) = \mathrm{ReLU}(z)$

Other variants:

tanh $\boxed{\sqrt{\frac{1}{n^{[l-1]}}}}$

Xavier initialization

$\sqrt{\frac{2}{n^{[l-1]} + n^{[l]}}}$

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