



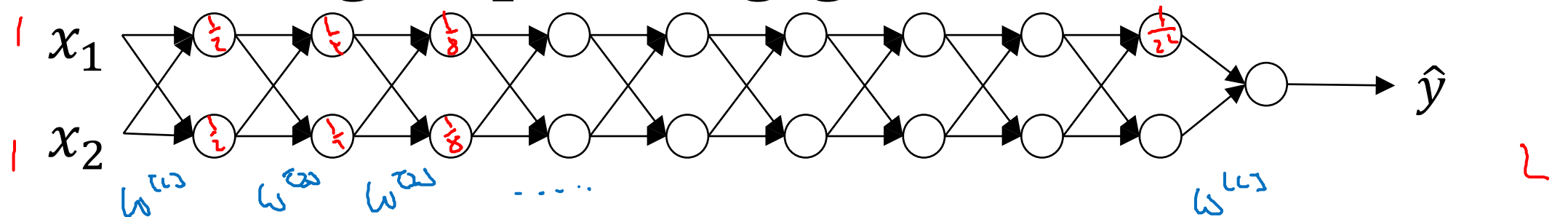
deeplearning.ai

Setting up your  
optimization problem

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Vanishing/exploding  
gradients

# Vanishing/exploding gradients



$g(z) = z$        $b^{(L)} = 0$

$\hat{y} = w^{(L)} \left( w^{(L-1)} w^{(L-2)} \dots \left( w^{(2)} w^{(1)} x \right) \right)$

$w^{(1)} > I$

$w^{(2)} < I \quad \begin{bmatrix} 0.9 & \\ & 0.9 \end{bmatrix}$

$w^{(2)} = \begin{bmatrix} 1.5 & 0 \\ 0 & 1.5 \end{bmatrix}$

$0.5$   
 $0.5$   
 $6.5$

$z^{(1)} = w^{(1)} x$

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

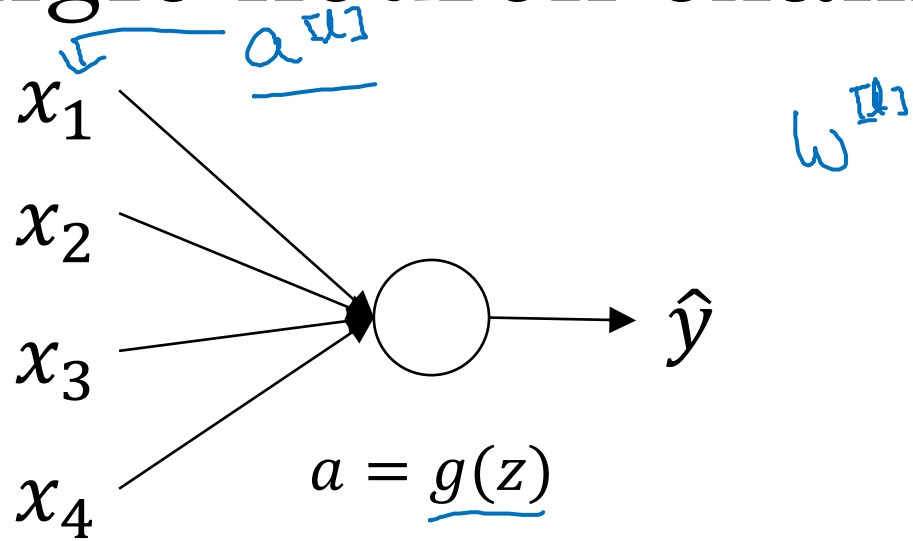
$a^{(2)} = g(z^{(2)}) = g(w^{(2)} a^{(1)})$

$\hat{y} = w^{(L)} \left[ \begin{bmatrix} 1.5 & 0 \\ 0 & 1.5 \end{bmatrix}^{L-1} x \right]$

$6.5$   
 $0.5$

$1.5^{L-1} x$   
 $0.5^{L-1} x$

# Single neuron example



$$z = w_1 x_1 + w_2 x_2 + \dots + w_n x_n$$

large  $n \rightarrow$  Smaller  $w_i$

$$\text{Var}(w_i) = \frac{1}{n} \frac{2}{n}$$

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

ReLU  $g^{[2]}(z) = \text{ReLU}(z)$

Other variants:

tanh

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

Xavier initialization ↑

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

↑