

神经网络 Neural Network

激励函数 activation function == Sigmoid == logistic

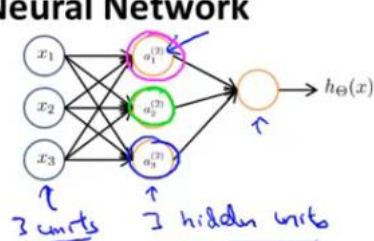
权重 == 参数

weights == parameters

hint layer 隐藏层

forward propagation 前向传播

## Neural Network



$\rightarrow a_i^{(j)}$  = "activation" of unit  $i$  in layer  $j$   
 $\rightarrow \Theta^{(j)}$  = matrix of weights controlling function mapping from layer  $j$  to layer  $j + 1$

$$\Theta^{(1)} \in \mathbb{R}^{3 \times 4}$$

$$\rightarrow a_1^{(2)} = g(\Theta_{10}^{(1)} x_0 + \Theta_{11}^{(1)} x_1 + \Theta_{12}^{(1)} x_2 + \Theta_{13}^{(1)} x_3)$$

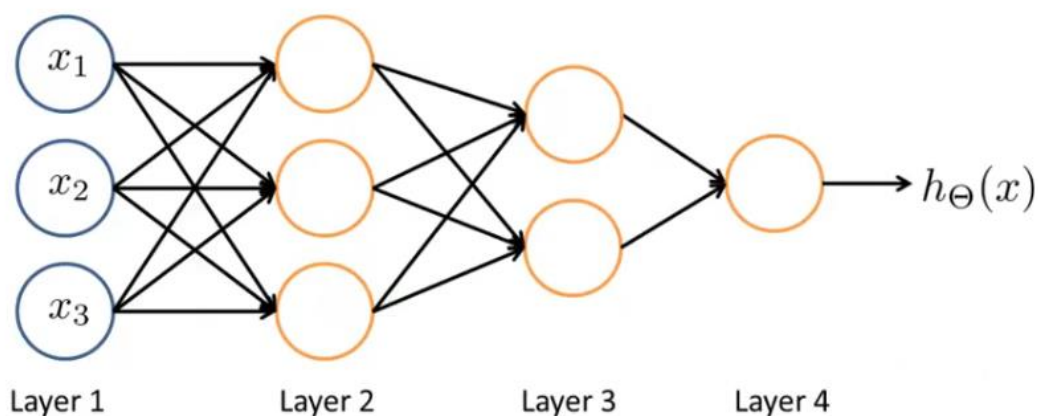
$$\rightarrow a_2^{(2)} = g(\Theta_{20}^{(1)} x_0 + \Theta_{21}^{(1)} x_1 + \Theta_{22}^{(1)} x_2 + \Theta_{23}^{(1)} x_3)$$

$$\rightarrow a_3^{(2)} = g(\Theta_{30}^{(1)} x_0 + \Theta_{31}^{(1)} x_1 + \Theta_{32}^{(1)} x_2 + \Theta_{33}^{(1)} x_3)$$

$$h_{\Theta}(x) = a_1^{(3)} = g(\Theta_{10}^{(2)} a_0^{(2)} + \Theta_{11}^{(2)} a_1^{(2)} + \Theta_{12}^{(2)} a_2^{(2)} + \Theta_{13}^{(2)} a_3^{(2)})$$

> If network has  $s_j$  units in layer  $j$ ,  $s_{j+1}$  units in layer  $j + 1$ , then  $\Theta^{(j)}$  will be of dimension  $s_{j+1} \times (s_j + 1)$ .

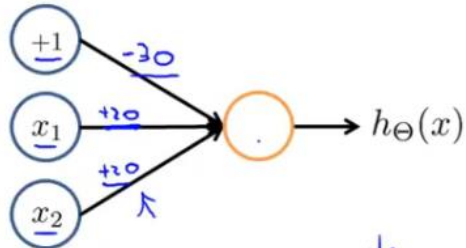
## Other network architectures



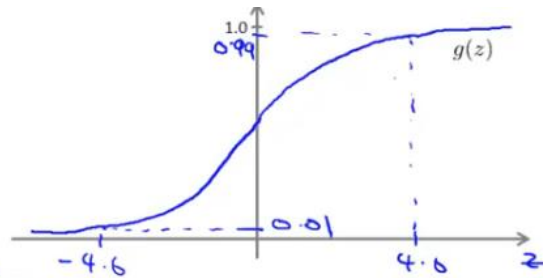
## Simple example: AND

$\Rightarrow x_1, x_2 \in \{0, 1\}$

$\Rightarrow y = x_1 \text{ AND } x_2$



$$\Rightarrow h_{\Theta}(x) = g(\underbrace{-30}_{\omega_{10}^{(1)}} + \underbrace{20}_{\omega_{11}^{(1)}}x_1 + \underbrace{20}_{\omega_{12}^{(1)}}x_2) \leftarrow$$



$x_1$	$x_2$	$h_{\Theta}(x)$
0	0	$g(-30) \approx 0$
0	1	$g(-10) \approx 0$
1	0	$g(-10) \approx 0$
1	1	$g(10) \approx 1$

$h_{\Theta}(x) \approx x_1 \text{ AND } x_2$

