



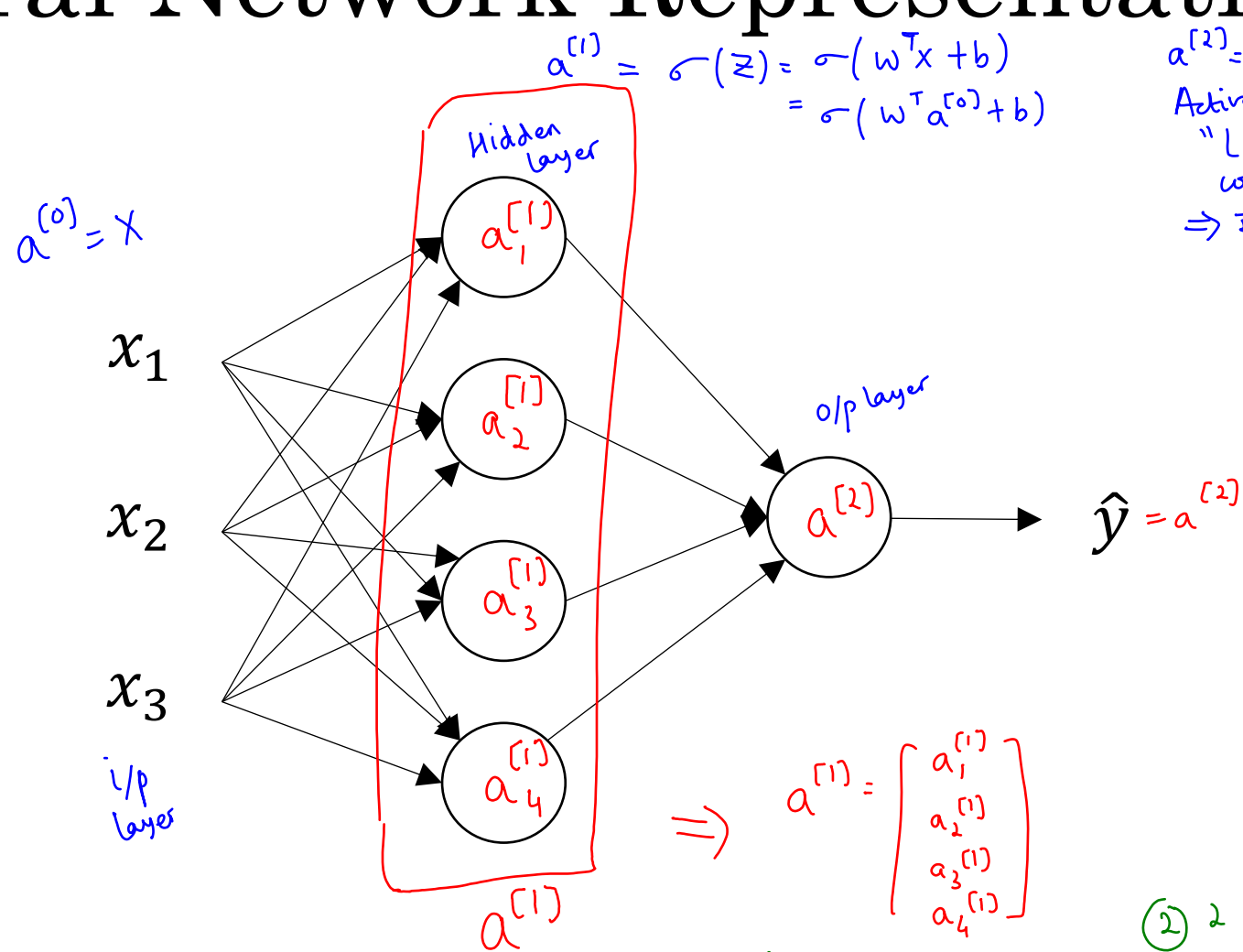
deeplearning.ai

One hidden layer  
Neural Network

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Neural Network  
Representation

# Neural Network Representation



## Notation

This is a 2 layer NN  
 not a 3 layer NN  
 (i/p layer is not counted)

① There are 2 params associated at each layer  
 layer 1  $\rightarrow w^{(1)}, b^{(1)}$   $w$  is  $4 \times 3$   
 $b$  is  $4 \times 1$

② 2 params at layer 2  
 $w^{(2)}, b^{(2)}$   
 $\downarrow \quad \downarrow$   
 $1 \times 4 \quad 1 \times 1$



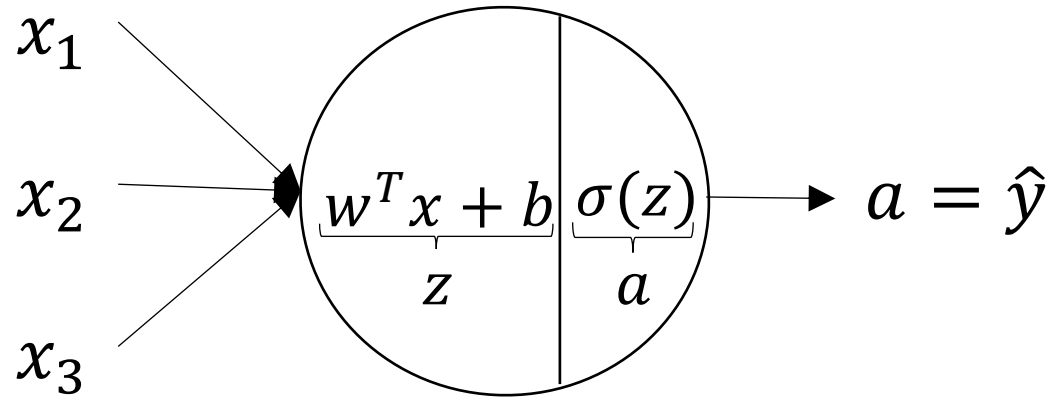
deeplearning.ai

# One hidden layer Neural Network

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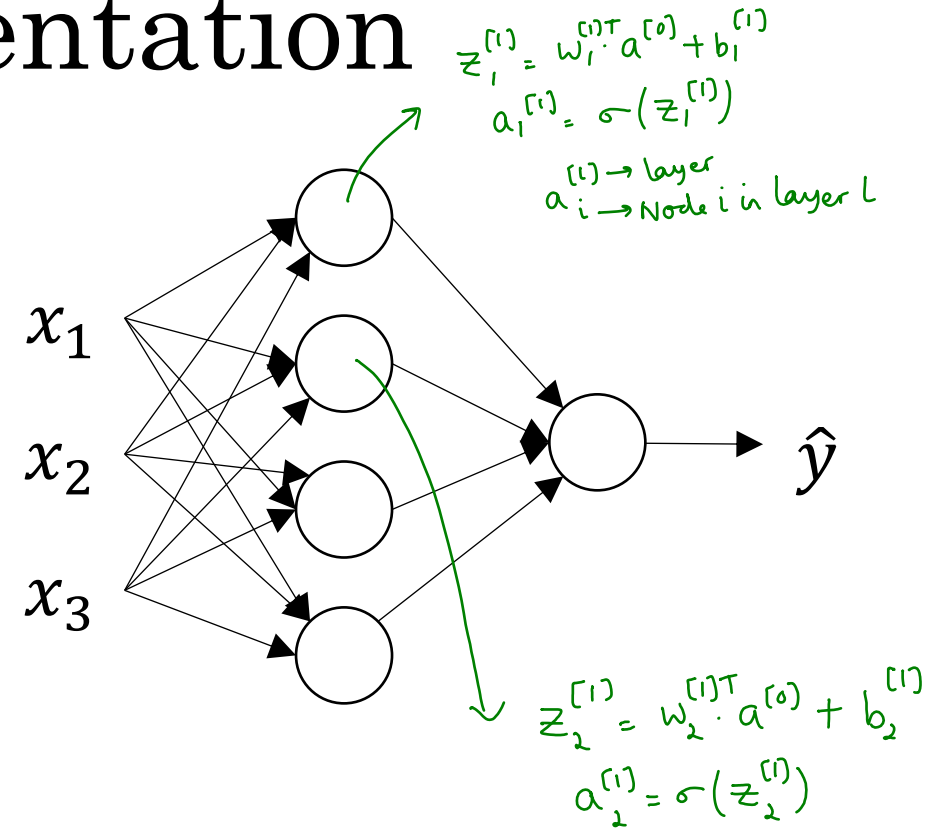
Computing a  
Neural Network's  
Output

# Neural Network Representation

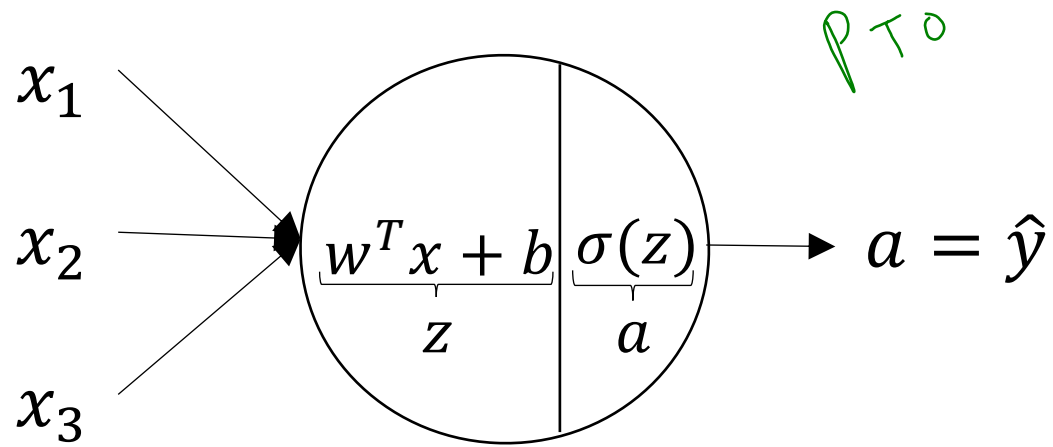


$$z = w^T x + b$$

$$a = \sigma(z)$$

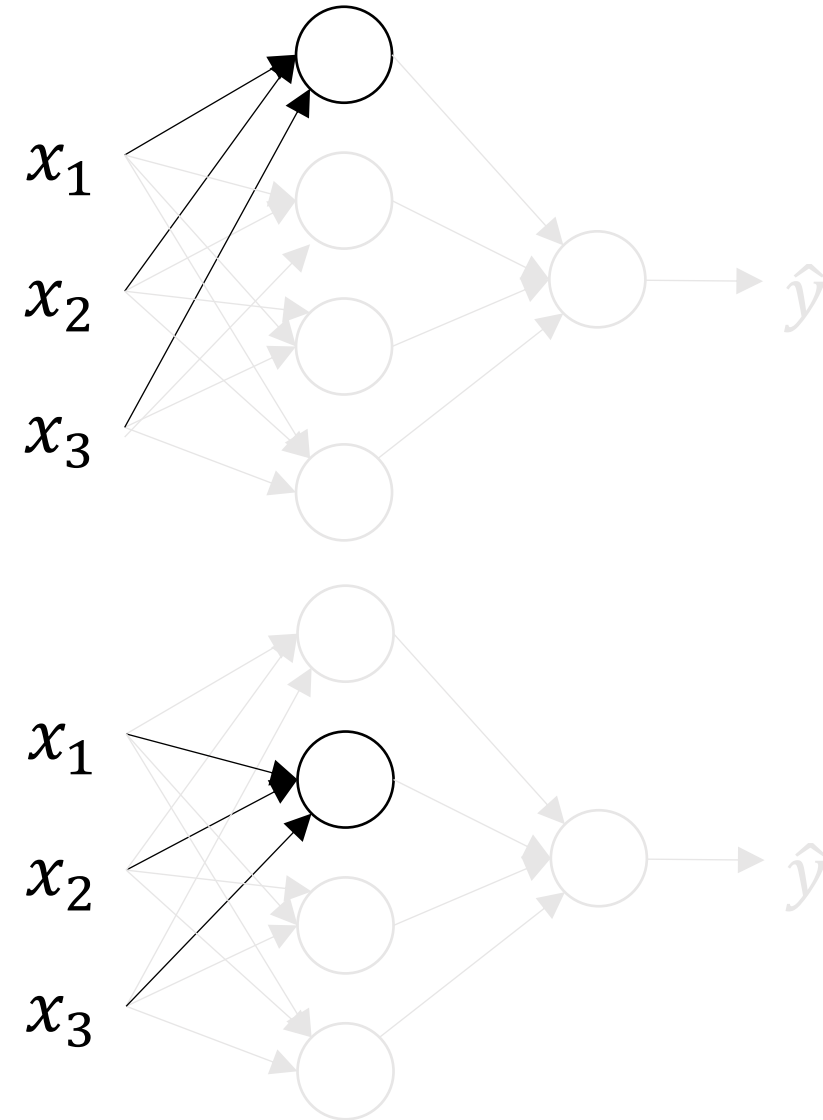


# Neural Network Representation

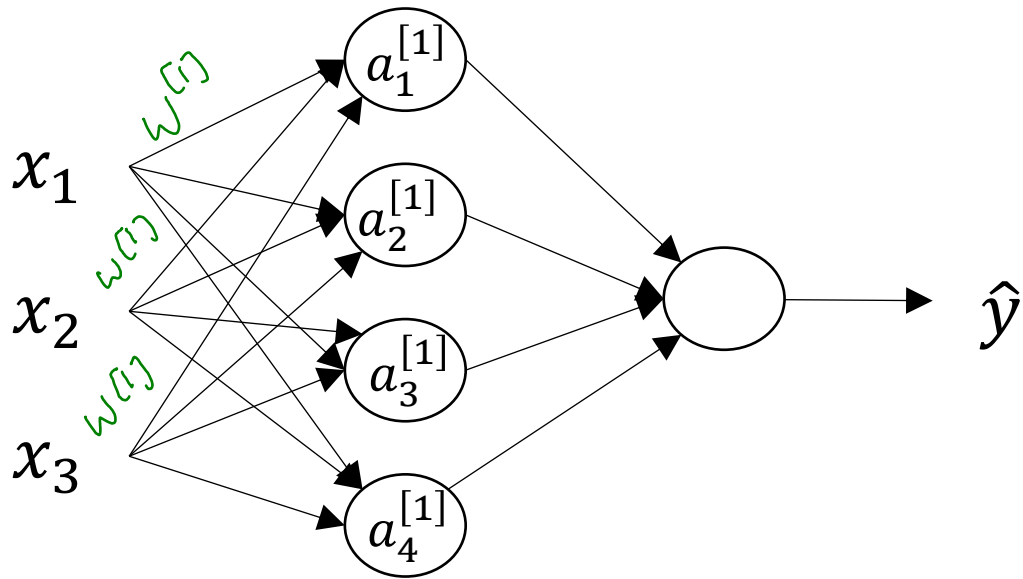


$$z = w^T x + b$$

$$a = \sigma(z)$$



# Neural Network Representation



$$z_1^{[1]} = w_1^{[1]T} x + b_1^{[1]}, \quad a_1^{[1]} = \sigma(z_1^{[1]})$$

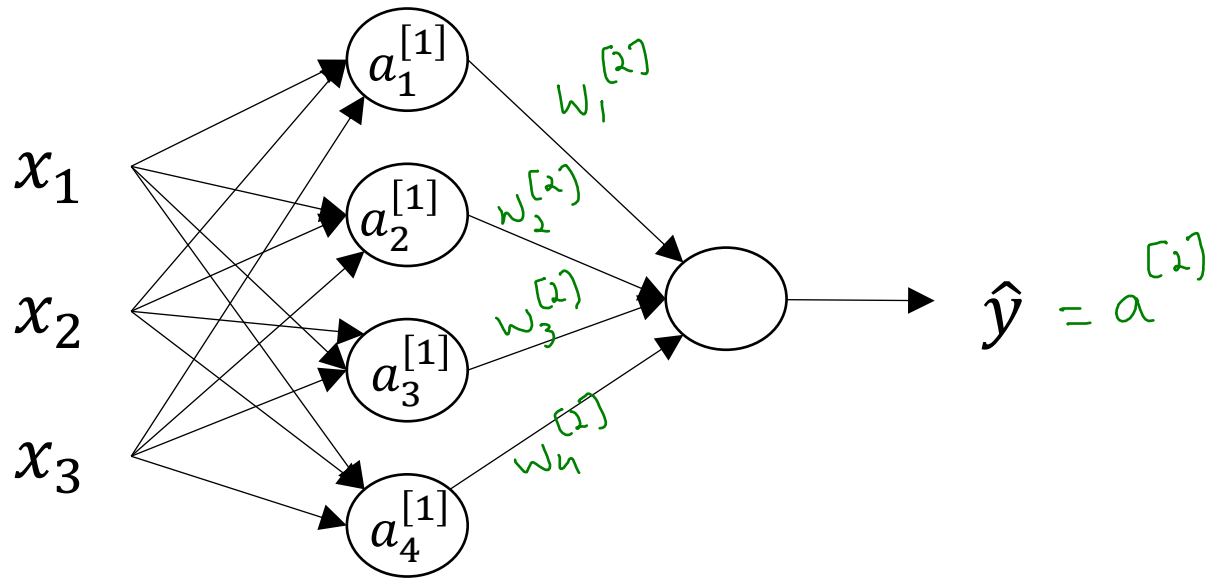
$$z_2^{[1]} = w_2^{[1]T} x + b_2^{[1]}, \quad a_2^{[1]} = \sigma(z_2^{[1]})$$

$$z_3^{[1]} = w_3^{[1]T} x + b_3^{[1]}, \quad a_3^{[1]} = \sigma(z_3^{[1]})$$

$$z_4^{[1]} = w_4^{[1]T} x + b_4^{[1]}, \quad a_4^{[1]} = \sigma(z_4^{[1]})$$

$$\begin{bmatrix} w_1^{[1]T} \\ w_2^{[1]T} \\ w_3^{[1]T} \\ w_4^{[1]T} \end{bmatrix}_{4 \times 3} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}_{3 \times 1} + \begin{bmatrix} b_1^{[1]} \\ b_2^{[1]} \\ b_3^{[1]} \\ b_4^{[1]} \end{bmatrix}_{4 \times 1} = \begin{bmatrix} w_1^{[1]T} \cdot x + b_1^{[1]} \\ w_2^{[1]T} \cdot x + b_2^{[1]} \\ w_3^{[1]T} \cdot x + b_3^{[1]} \\ w_4^{[1]T} \cdot x + b_4^{[1]} \end{bmatrix}_{4 \times 1} = \begin{bmatrix} z_1^{[1]} \\ z_2^{[1]} \\ z_3^{[1]} \\ z_4^{[1]} \end{bmatrix}_{4 \times 1} = z^{[1]}$$

# Neural Network Representation learning



Given input  $x$ :

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

$\begin{matrix} (4,1) & (4,3) & (3,1) & (4,1) \end{matrix}$

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

$\begin{matrix} (4,1) & (4,1) \end{matrix}$

$$z^{[2]} = W^{[2]}a^{[1]} + b^{[2]}$$

$\begin{matrix} (1,1) & (1,4) & (4,1) & (1,1) \end{matrix}$

$$a^{[2]} = \sigma(z^{[2]})$$

$\begin{matrix} (1,1) & (1,1) \end{matrix}$   
 $\Rightarrow a^{[n]} = \sigma(z^{[n]})$