



deeplearning.ai

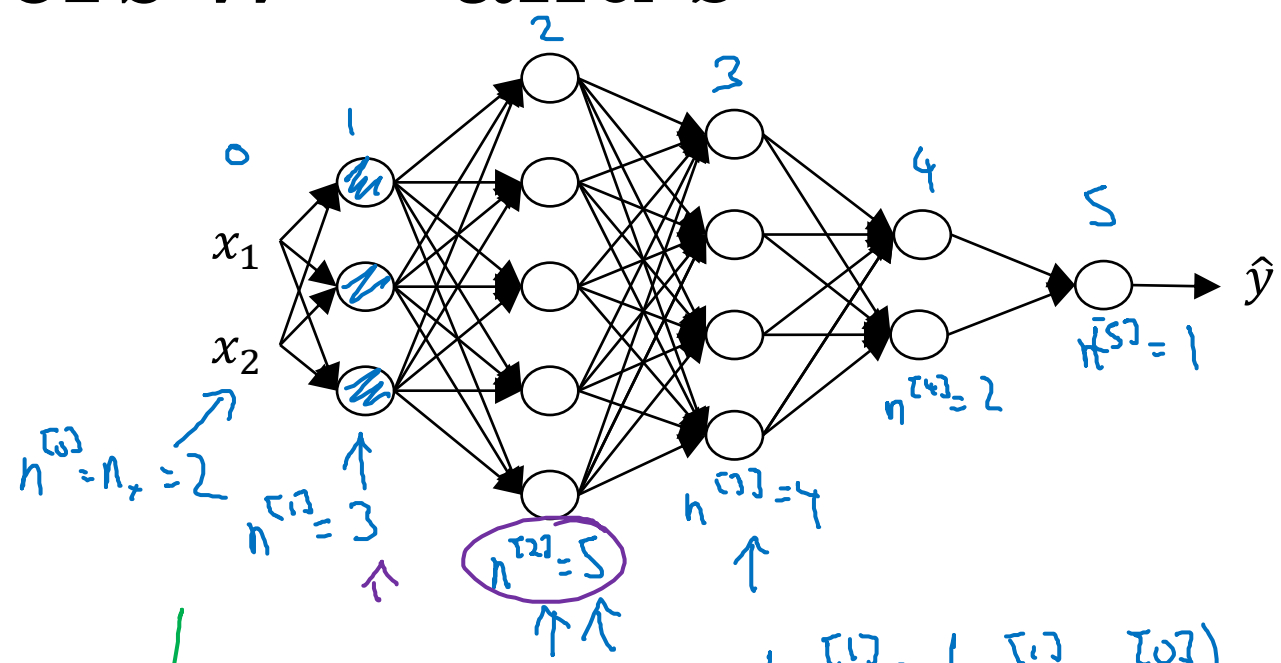
# Deep Neural Networks

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Getting your matrix  
dimensions right

# Parameters $W^{[l]}$ and $b^{[l]}$

$\downarrow$   
 $z^{[L]} = g^{[L]}(a^{[L]})$   
 $\uparrow$   
 $\downarrow$   
 $a^{[L]}$



$L=5$

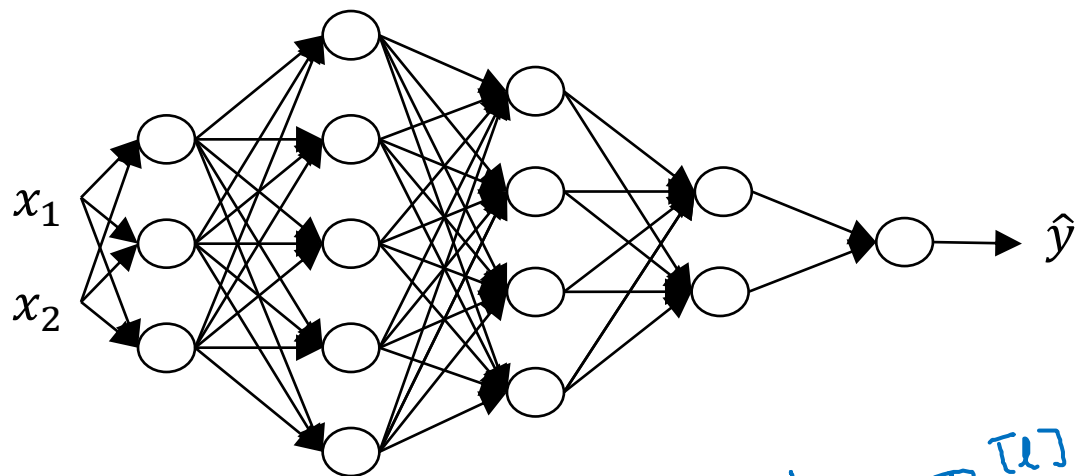
$\rightarrow W^{[L]}: (n^{[L]}, n^{[L-1]})$   
 $\rightarrow b^{[L]}: (n^{[L]}, 1)$   
 $\rightarrow \Delta W^{[L]}: (n^{[L]}, n^{[L-1]})$   
 $\rightarrow \Delta b^{[L]}: (n^{[L]}, 1)$

$\downarrow$   
 $z^{[1]} = \boxed{W^{[1]} \cdot x} + \boxed{b^{[1]}}$   
 $(3,1) \leftarrow (3,2) \quad (2,1)$   
 $(n^{[1]}, 1) \quad (n^{[1]}, n^{[0]}) \quad (n^{[0]}, 1)$   
 $(3,1)$   
 $(n^{[1]}, 1)$

$\begin{bmatrix} \cdot \\ \cdot \\ \cdot \end{bmatrix} = \begin{bmatrix} \cdot & \cdot \\ \cdot & \cdot \\ \cdot & \cdot \end{bmatrix} \begin{bmatrix} \cdot \\ \cdot \end{bmatrix}$

$W^{[1]}: (n^{[1]}, n^{[0]})$   
 $W^{[2]}: (5, 3) \quad (n^{[2]}, n^{[1]})$   
 $z^{[2]} = \boxed{W^{[2]} \cdot a^{[1]}} + \boxed{b^{[2]}}$   
 $\uparrow \quad \uparrow \quad \uparrow$   
 $\rightarrow (5,1) \quad (5,3) \quad (3,1)$   
 $(5,1)$   
 $(n^{[2]}, 1)$   
 $W^{[3]}: (4, 5)$   
 $W^{[4]}: (2, 4)$ ,  $W^{[5]}: (1, 2)$

# Vectorized implementation



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

$(n^{[1]}, 1)$     $(n^{[1]}, n^{[0]})$     $(n^{[0]}, 1)$     $(n^{[1]}, 1)$

$$[z^{[1](1)} \ z^{[1](2)} \ \dots \ z^{[1](m)}]$$

$$Z^{[1]} = W^{[1]} \cdot X + b^{[1]}$$

$(n^{[1]}, m)$     $(n^{[1]}, n^{[0]})$     $(n^{[0]}, m)$     $(n^{[1]}, 1)$   
 $\uparrow$     $\uparrow$     $\uparrow$     $(n^{[0]}, m)$

$$z^{[2]}, a^{[2]} : (n^{[2]}, 1)$$

$$z^{[2]}, A^{[2]} : (n^{[2]}, m)$$

$$l=0 \quad A^{[0]} = X = (n^{[0]}, m)$$

$$dz^{[2]}, dA^{[2]} : (n^{[2]}, m)$$