



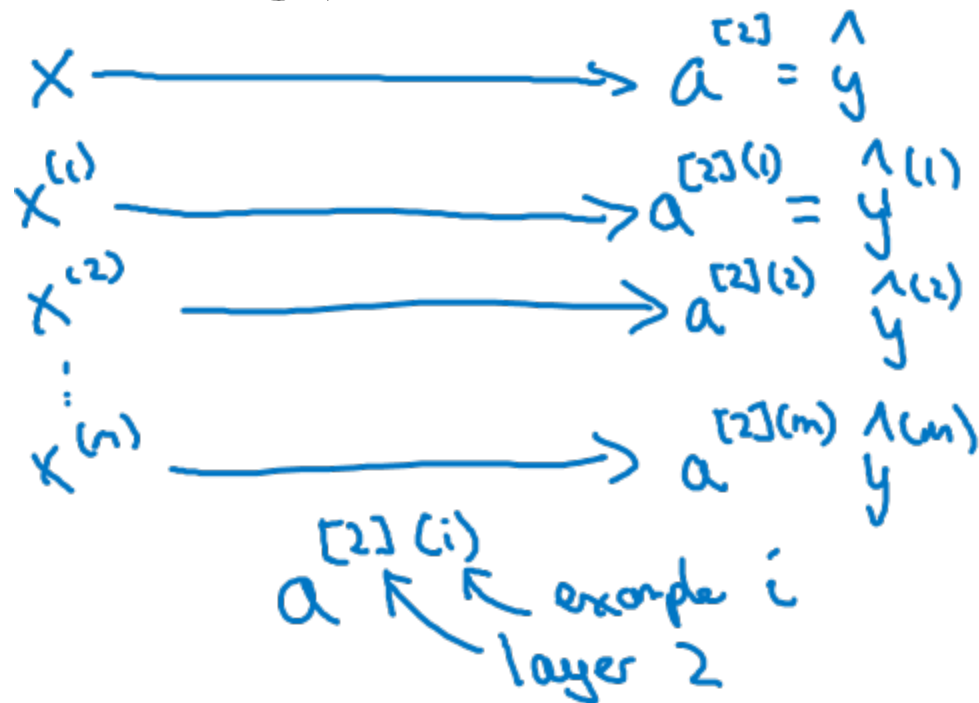
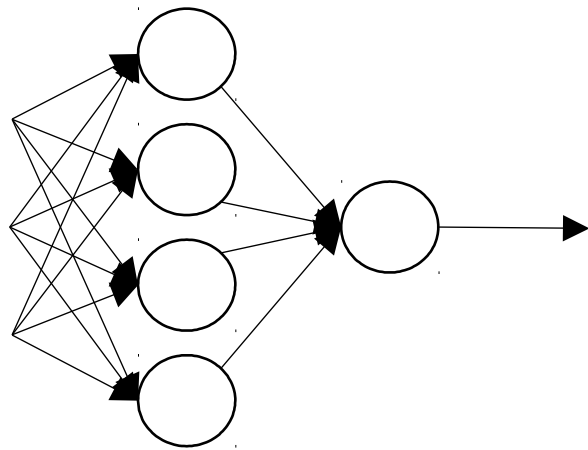
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# One hidden layer Neural Network

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Vectorizing across  
multiple examples

# Vectorizing across multiple examples



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

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

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

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

for  $i = 1$  to  $n$ ,  
 $z^{[1](i)} = W^{[1]}x^{(i)} + b^{[1]}$   
 $a^{[1](i)} = \sigma(z^{[1](i)})$   
 $z^{[2](i)} = W^{[2]}a^{[1](i)} + b^{[2]}$   
 $a^{[2](i)} = \sigma(z^{[2](i)})$

# Vectorizing across multiple examples

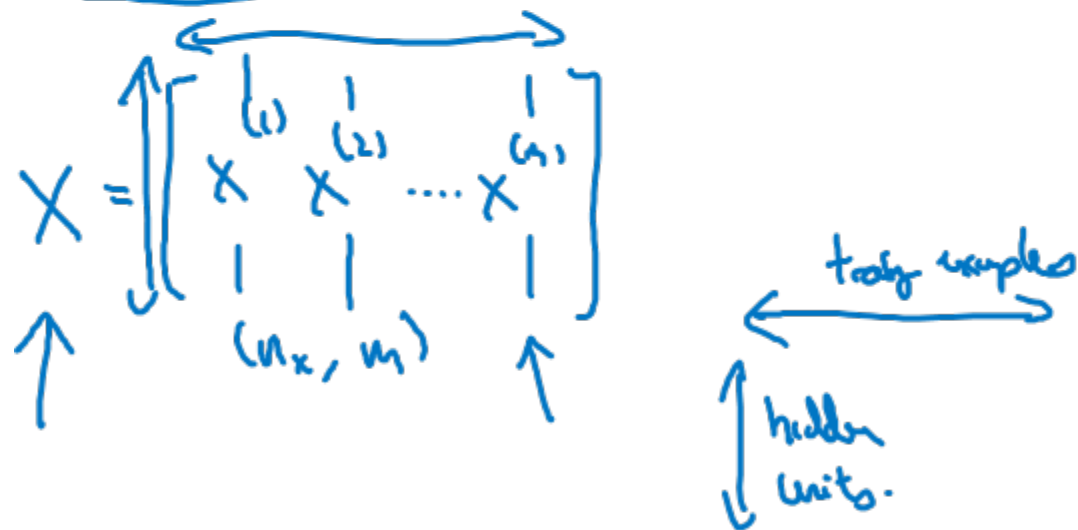
for  $i = 1$  to  $m$ :

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

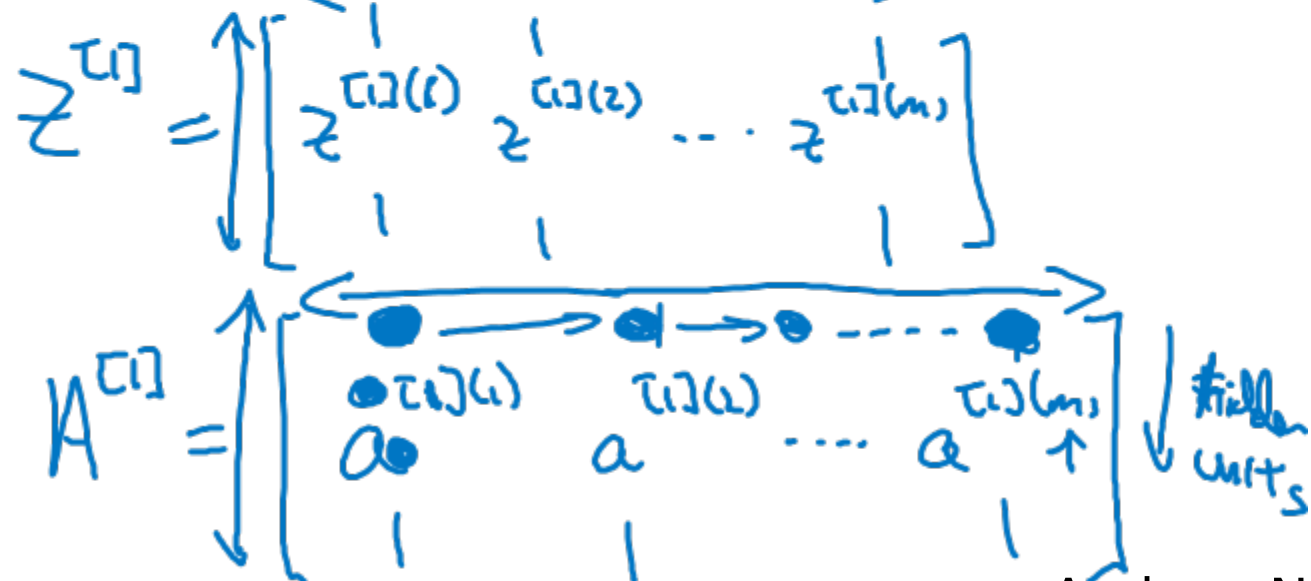
$$a^{[1]}(i) = \sigma(z^{[1]}(i))$$

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

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



$$\begin{aligned} z^{[1]} &= W^{[1]}X + b^{[1]} \\ \rightarrow A^{[1]} &= \sigma(z^{[1]}) \\ \rightarrow z^{[2]} &= W^{[2]}A^{[1]} + b^{[2]} \\ \rightarrow A^{[2]} &= \sigma(z^{[2]}) \end{aligned}$$





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Explanation  
for vectorized  
implementation

# Justification for vectorized implementation

$$z^{[1]}(1) = w^{[1]} x^{(1)} + b^{[1]} \quad , \quad z^{[1]}(2) = w^{[1]} x^{(2)} + b^{[1]} \quad , \quad z^{[1]}(3) = w^{[1]} x^{(3)} + b^{[1]}$$

$\uparrow$        $\uparrow$        $\uparrow$   
 $0$        $0$        $0$

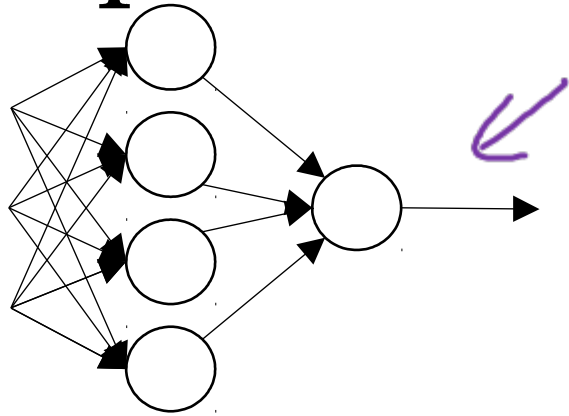
$$w^{[1]} = \begin{bmatrix} \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \end{bmatrix} \quad w^{[1]} x^{(1)} = \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix} \quad w^{[1]} x^{(2)} = \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix} \quad w^{[1]} x^{(3)} = \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix}$$

$$w^{[1]} \begin{bmatrix} | & | & | & \dots \\ x^{(1)} & x^{(2)} & x^{(3)} & \dots \\ | & | & | & \dots \end{bmatrix} = \begin{bmatrix} \bullet & \bullet & \bullet & \dots \\ \bullet & \bullet & \bullet & \dots \\ \bullet & \bullet & \bullet & \dots \\ \bullet & \bullet & \bullet & \dots \end{bmatrix} = \begin{bmatrix} | & | & | & \dots \\ z^{[1]}(1) & z^{[1]}(2) & z^{[1]}(3) & \dots \\ | & | & | & \dots \\ +b^{[1]} & +b^{[1]} & +b^{[1]} & \dots \end{bmatrix} = z^{[1]}$$

$\uparrow$        $\uparrow$        $\uparrow$   
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 $0$        $0$        $0$

# Recap of vectorizing across multiple examples



$$X = \begin{bmatrix} | & | & \dots & | \\ x^{(1)} & x^{(2)} & \dots & x^{(m)} \\ | & | & \dots & | \end{bmatrix}$$

$$\underline{A^{[1]}} = \begin{bmatrix} | & | & \dots & | \\ a^{[1]}(1) & a^{[1]}(2) & \dots & a^{[1]}(m) \\ | & | & \dots & | \end{bmatrix}$$

for  $i = 1$  to  $m$

$$\rightarrow z^{[1]}(i) = W^{[1]}x^{(i)} + b^{[1]}$$

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

$$\rightarrow z^{[2]}(i) = W^{[2]}a^{[1]}(i) + b^{[2]}$$

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

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

$$A^{[1]} = \sigma(Z^{[1]})$$

$$Z^{[2]} = W^{[2]}A^{[1]} + b^{[2]}$$

$$A^{[2]} = \sigma(Z^{[2]})$$

$$x = a^{[0]} \quad x^{(i)} = a^{[0]}(i)$$

$$W^{[1]}A^{[0]} + b^{[1]}$$