

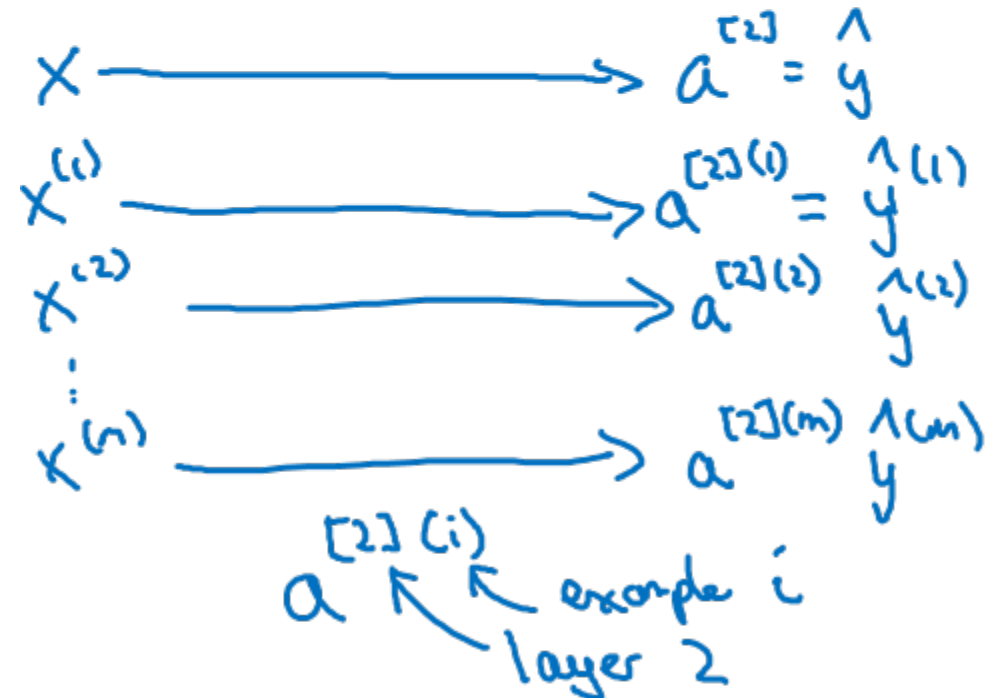
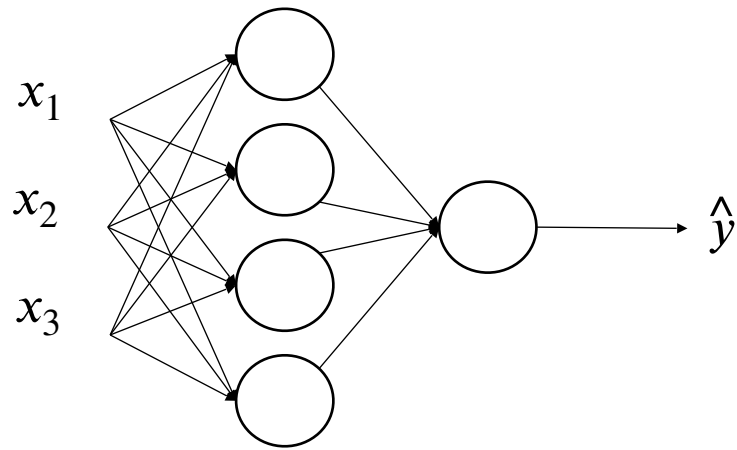


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One hidden layer Neural Network

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

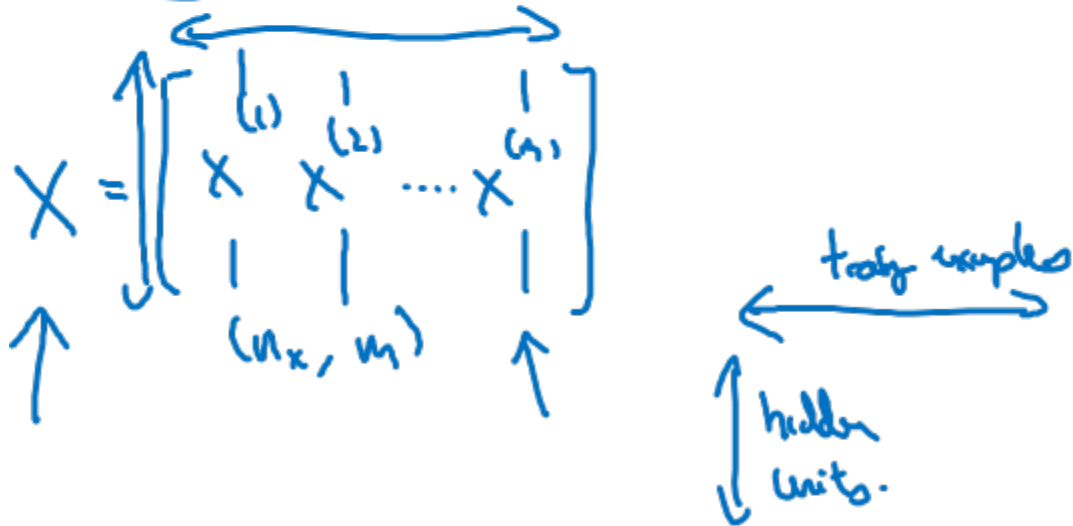
for $i = 1$ to m :

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

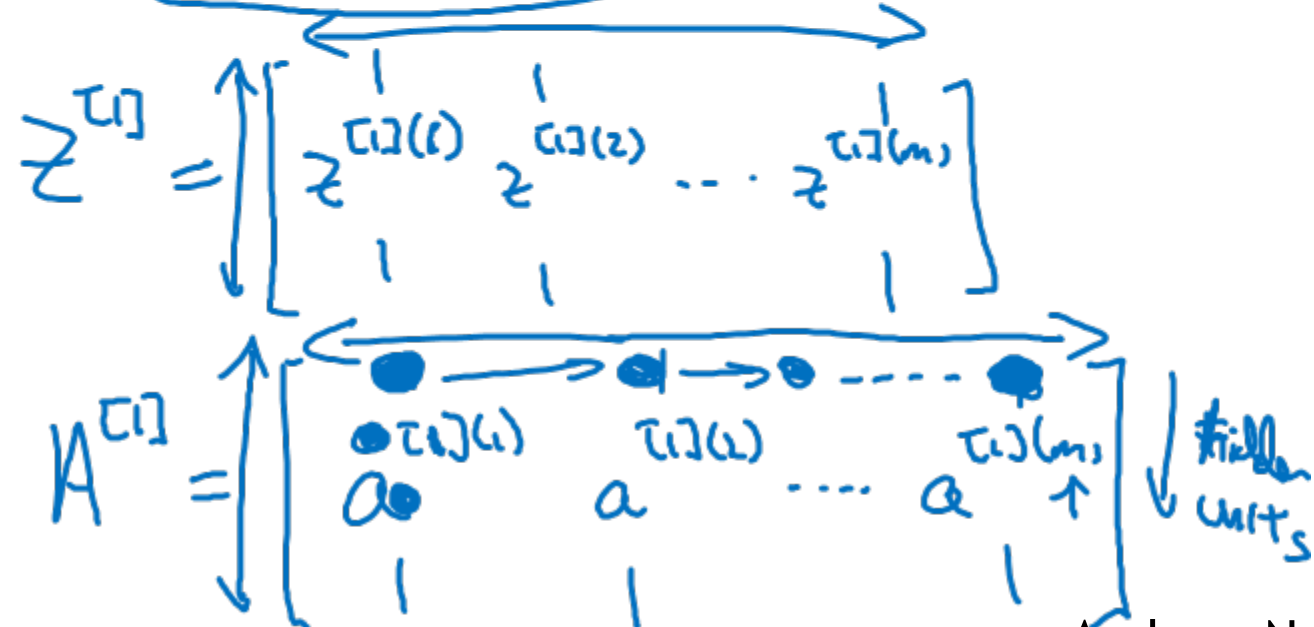
$$a^{[1]}(i) = \sigma(z^{[1]}(i))$$

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

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



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





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One hidden layer Neural Network

**Explanation
for vectorized
implementation**

Justification for vectorized implementation

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

\uparrow \uparrow \uparrow
 0 0 0

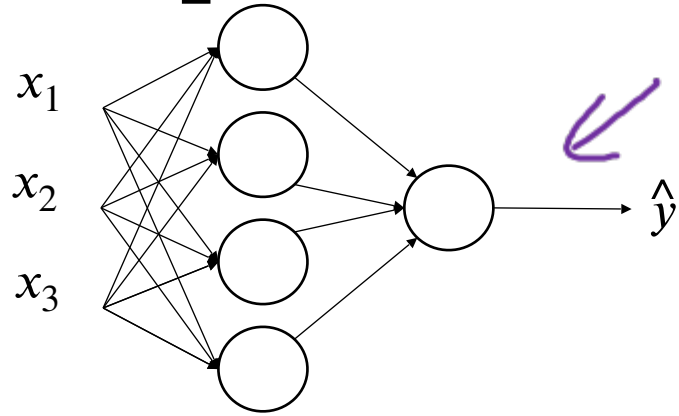
$$w^{[1]} = \begin{bmatrix} \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \end{bmatrix} \quad w^{[1]} x^{(1)} = \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix} \quad w^{[1]} x^{(2)} = \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix} \quad w^{[1]} x^{(3)}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

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

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 0 0 0

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 0 0 0

Recap of vectorizing across multiple examples



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

A purple arrow points from this matrix towards the right.

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

A purple checkmark is next to this matrix.

for $i = 1$ to m

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

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

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

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

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

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

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

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

$A^{[1]}$

$x = a^{[1]}$ $x^{(i)} = a^{[1](i)}$

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