



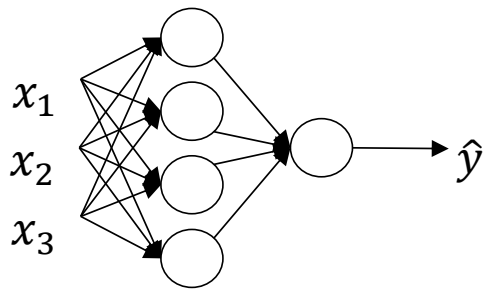
deeplearning.ai

One hidden layer  
Neural Network

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Vectorizing across  
multiple examples

# Vectorizing across multiple examples



$$\begin{array}{lcl}
 X & \longrightarrow & a^{[2]} = \hat{y} \\
 x^{(1)} & \longrightarrow & a^{[2](1)} = \hat{y}^{(1)} \\
 x^{(2)} & \longrightarrow & a^{[2](2)} = \hat{y}^{(2)} \\
 \vdots & & \vdots \\
 x^{(n)} & \longrightarrow & a^{[2](n)} = \hat{y}^{(n)}
 \end{array}$$

$a^{[2](i)}$   
 $\nwarrow \nearrow$  example  $i$   
 $\nwarrow \nearrow$  layer 2

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

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

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

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

$\rightarrow$  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  $m$ :

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

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

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

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

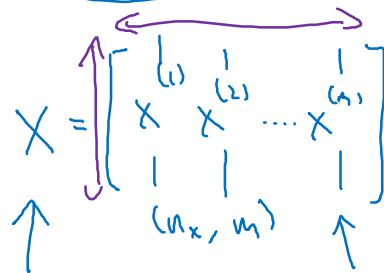


Diagram illustrating the input matrix  $X$ . It is a matrix with  $m$  columns (examples) and  $n_x$  rows (features). The elements are  $x^{(1)}, x^{(2)}, \dots, x^{(m)}$ . A purple double-headed arrow indicates the dimension  $(n_x, m)$ . A blue arrow points upwards from the matrix.



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

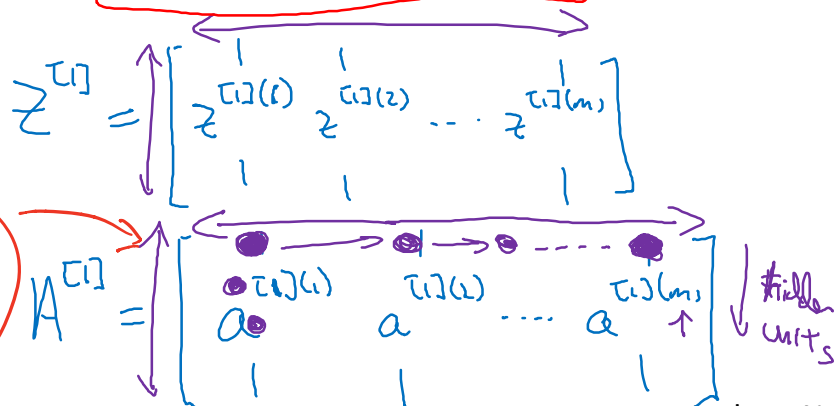


Diagram illustrating the vectorized computation. The matrix  $z^{[1]}$  is shown as a matrix with  $m$  columns and 1 row, containing elements  $z^{[1]}(1), z^{[1]}(2), \dots, z^{[1]}(m)$ . The matrix  $A^{[1]}$  is shown as a matrix with  $m$  columns and 1 row, containing elements  $a^{[1]}(1), a^{[1]}(2), \dots, a^{[1]}(m)$ . A purple double-headed arrow indicates the dimension "hidden units". A blue arrow points upwards from the matrix.