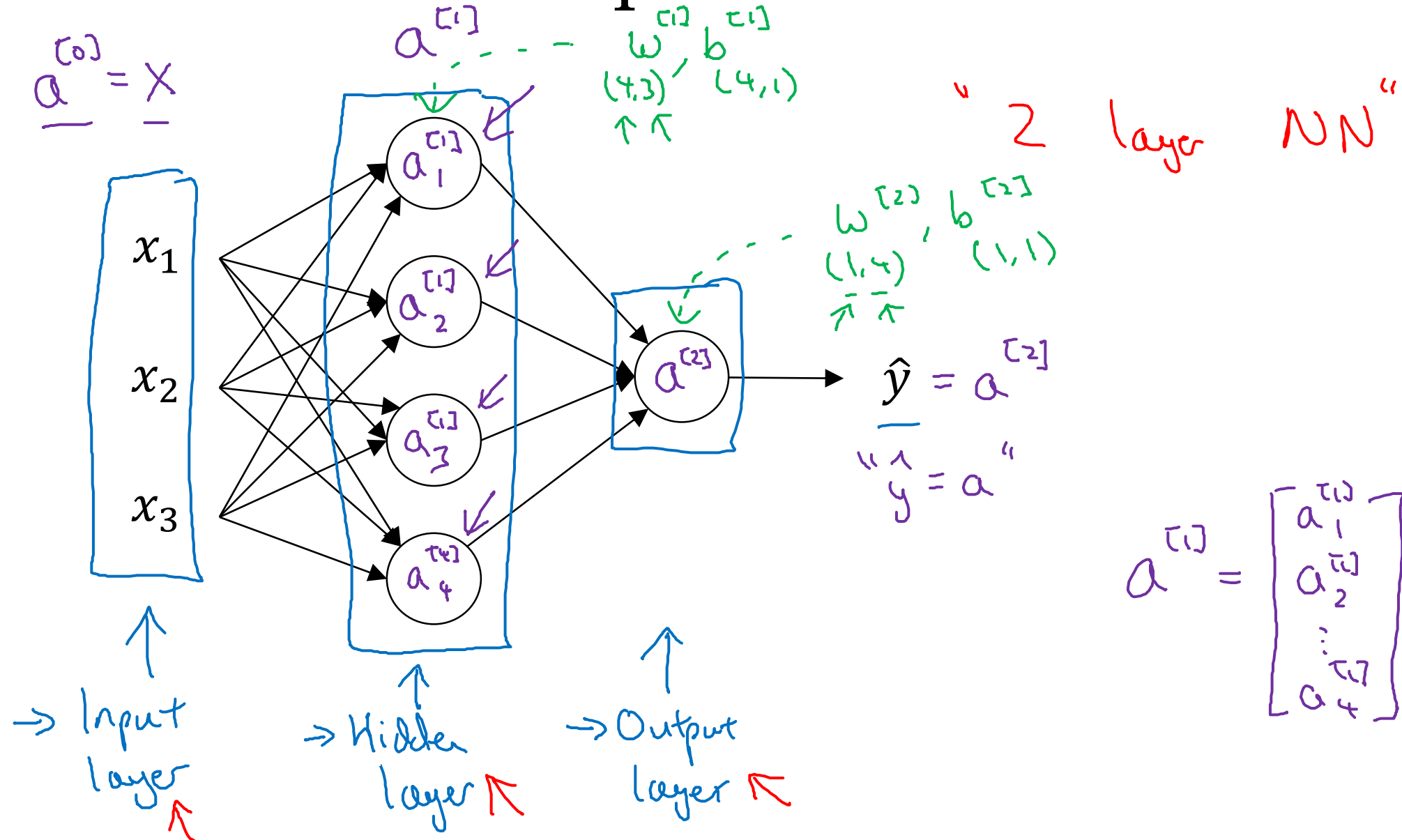deeplearning.ai

One hidden layer Neural Network

Neural Network Representation

# Neural Network Representation

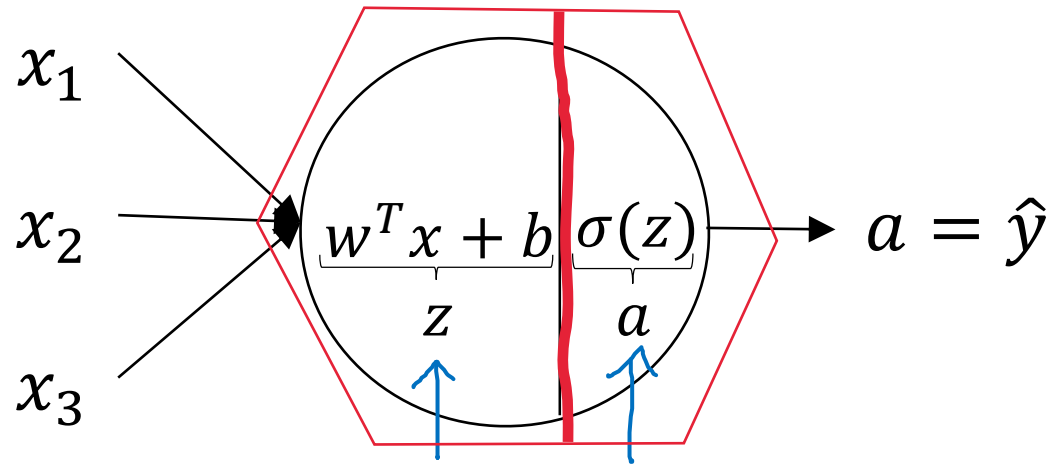One hidden layer
Neural Network

Computing a
Neural Network's
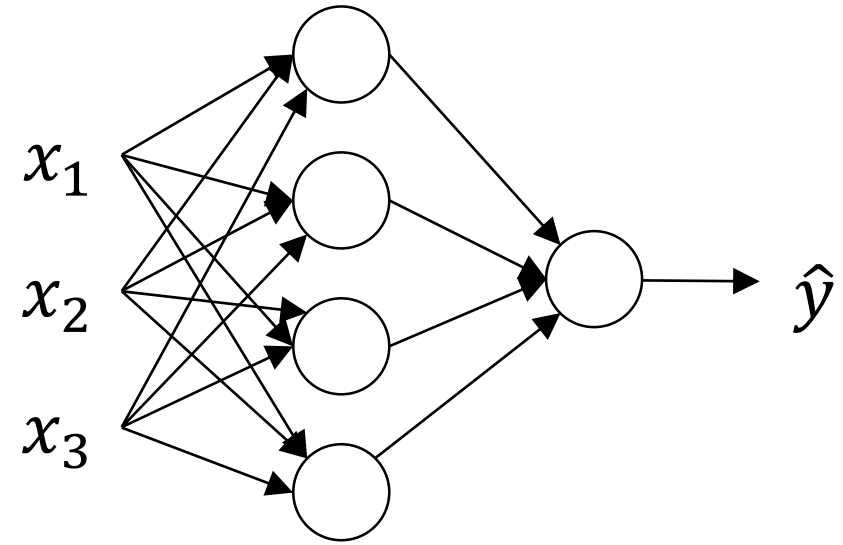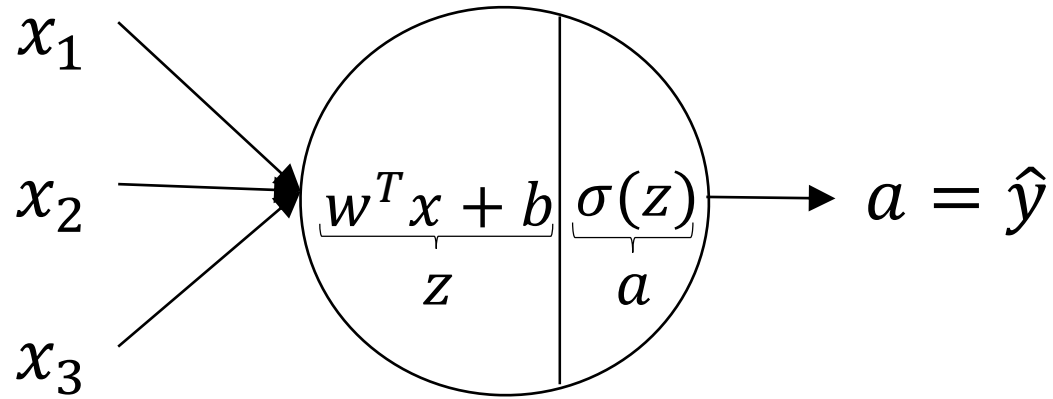Output

deeplearning.ai

# Neural Network Representation

$x_1$

$x_2$ —→ $\underbrace{w^T x + b}_{z} \mid \underbrace{\sigma(z)}_{a}$ —→ $a = \hat{y}$

$x_3$

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

$$a = \sigma(z)$$

$x_1$

$x_2$ —→ $\hat{y}$

$x_3$

# Neural Network Representation



$z_1^{[1]} = w_1^{[1]T} x + b_1^{[1]}$

$a_1^{[1]} = \sigma(z_1^{[1]})$

$a_i^{[l]} \leftarrow \text{layer}$

$a_i \leftarrow \text{node in layer.}$

$z_2^{[1]} = w_2^{[1]T} x + b_2^{[1]}$

$a_2^{[1]} = \sigma(z_2^{[1]})$

$x_1$

$x_2$

$x_3$

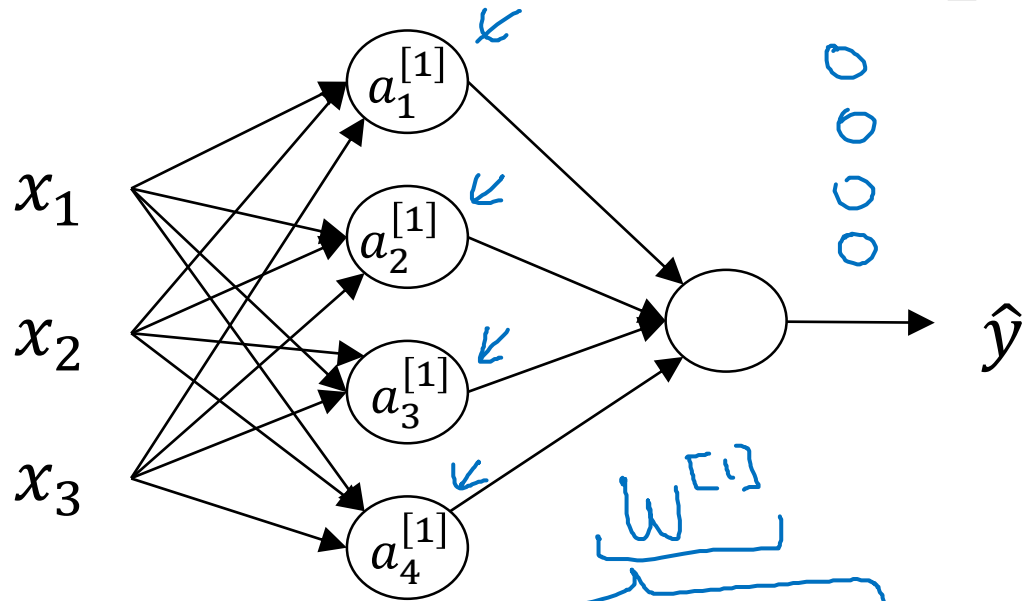$\underbrace{w^T x + b}_{z} \Big| \underbrace{\sigma(z)}_{a}$

$a = \hat{y}$

$z = w^T x + b$

$a = \sigma(z)$

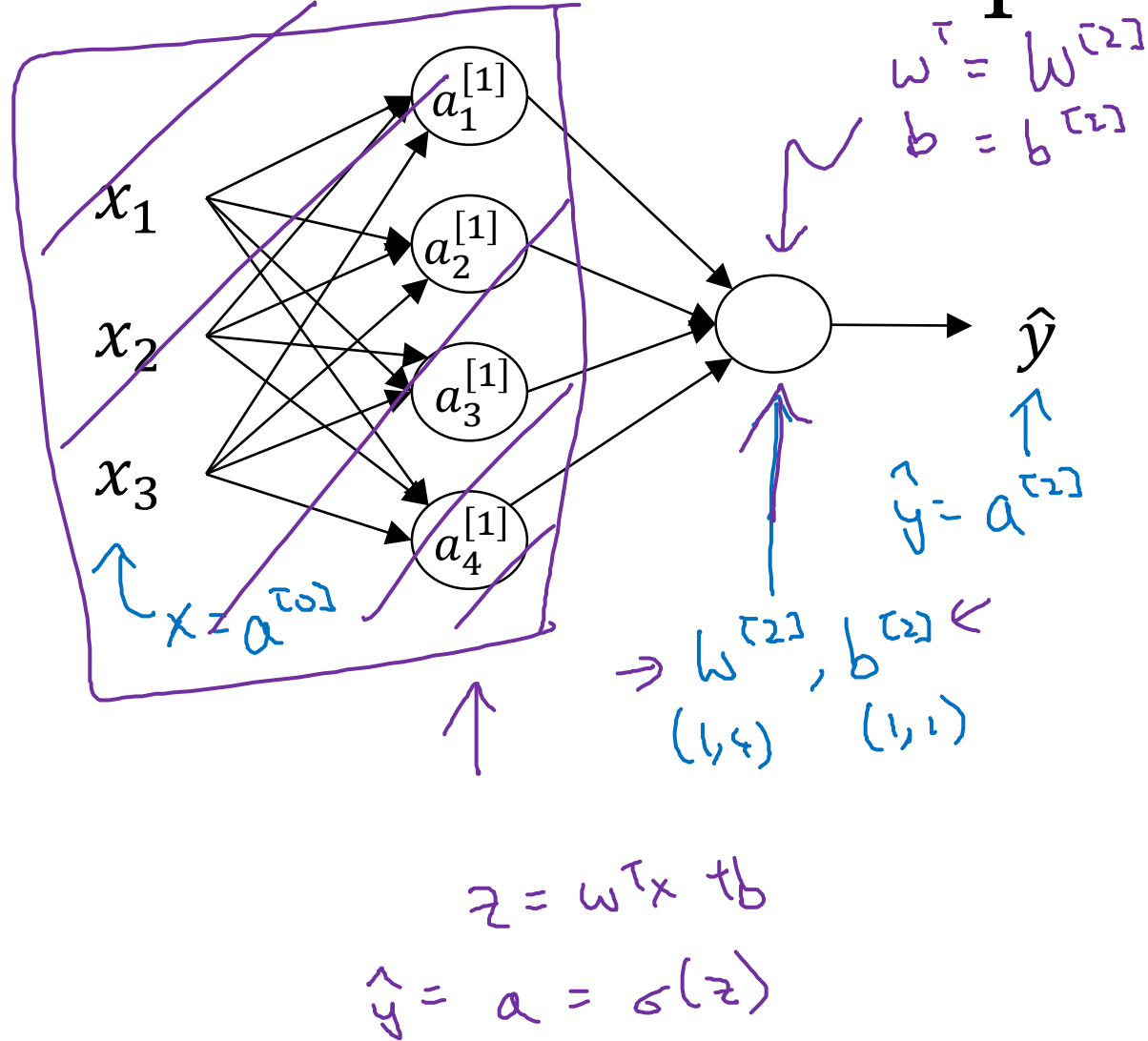Andrew Ng
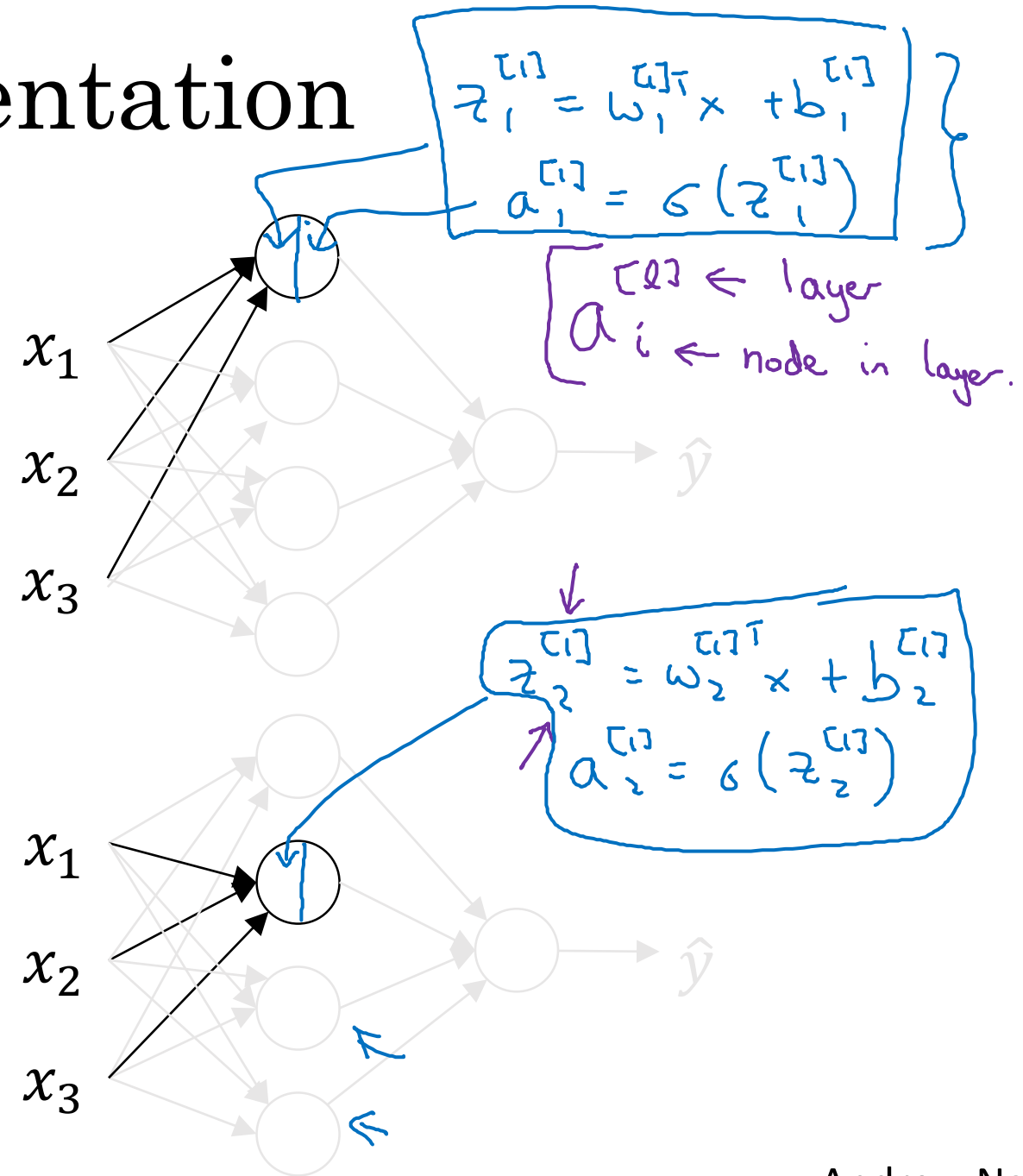
# Neural Network Representation



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

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

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

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

$(w_1^{[1]})^T x$ $a^{[1]}$

$W^{[1]}$

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

$(4, 3)$

$b^{[1]}$ $(4,1)$

$$a^{[1]} = \begin{bmatrix} a_1^{[1]} \\ \vdots \\ a_4^{[1]} \end{bmatrix} = \sigma(z^{[1]})$$

Andrew Ng

# Neural Network Representation learning



$w^T = W^{[2]}$
$b = b^{[2]}$

$x = a^{[0]}$

$\hat{y} = a^{[2]}$

$W^{[2]}, b^{[2]}$
$(1,4) \quad (1,1)$

$z = w^T x + b$

$\hat{y} = a = \sigma(z)$

## Given input x:

$$z^{[1]} = W^{[1]} \overset{a^{[0]}}{x} + b^{[1]}$$
$(4,1) \quad (4,3) \ (3,1) \quad (4,1)$

$$a^{[1]} = \sigma(z^{[1]})$$
$(4,1) \qquad (4,1)$

$$z^{[2]} = W^{[2]} a^{[1]} + b^{[2]}$$
$(1,1) \quad (1,4) \ (4,1) \quad (1,1)$

$$a^{[2]} = \sigma(z^{[2]})$$
$(1,1) \qquad (1,1)$