deeplearning.ai

One hidden layer
Neural Network

Neural Network
Representation

Neural Network Representation

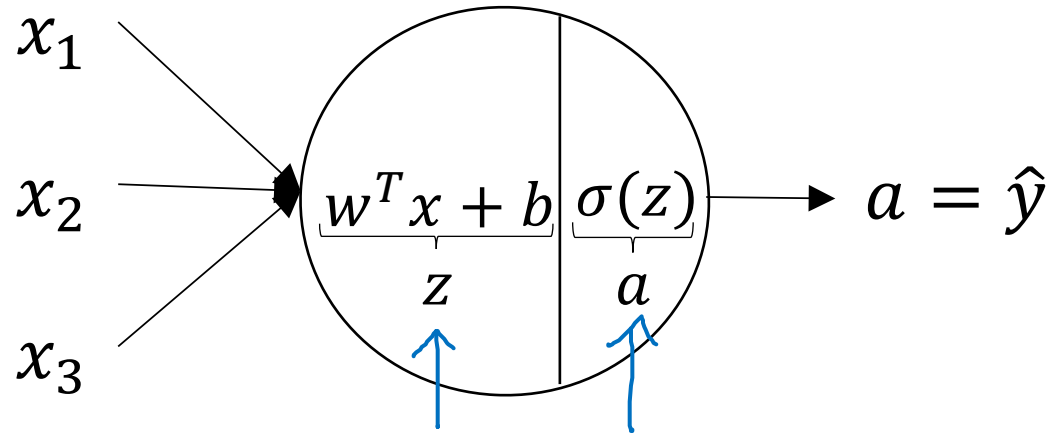$a^{[0]} = X$

$a^{[1]}$

$w^{[1]}, b^{[1]}$
$(4,3), (4,1)$

"2 layer NN"

$a_1^{[1]}$

$a_2^{[1]}$

$a_3^{[1]}$

$a_4^{[1]}$

x_1

x_2

x_3

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

$a^{[2]}$

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

"$\hat{y} = a$"

$\rightarrow$ Input layer

$\rightarrow$ Hidden layer

$\rightarrow$ Output layer

$a^{[1]} = \begin{bmatrix} a_1^{[1]} \\ a_2^{[1]} \\ \vdots \\ a_4^{[1]} \end{bmatrix}$

Andrew Ng
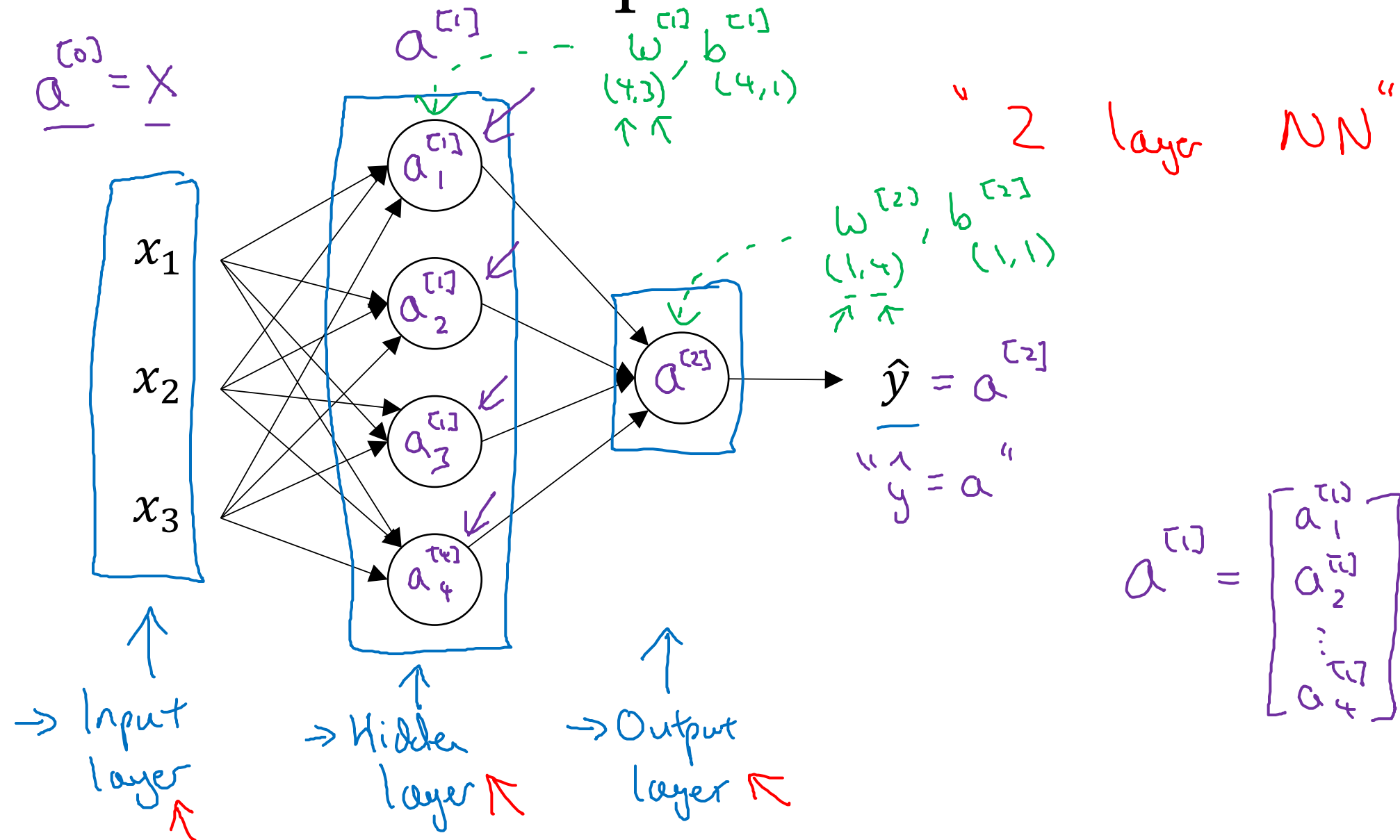
deeplearning.ai

One hidden layer
Neural Network

Computing a
Neural Network's
Output

Neural Network Representation
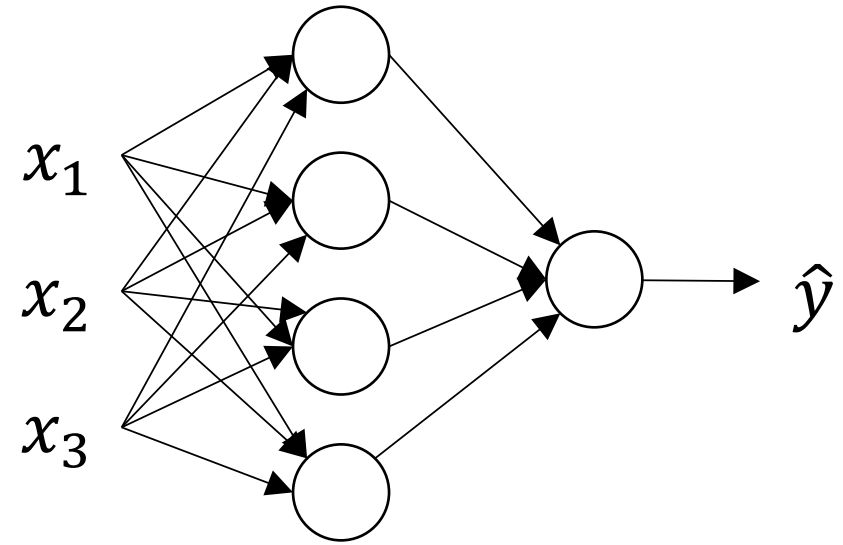
x_1

x_2

x_3

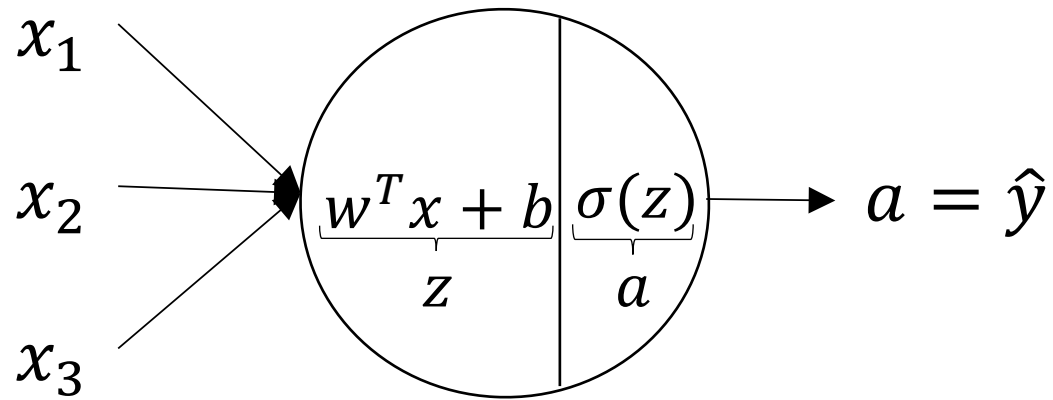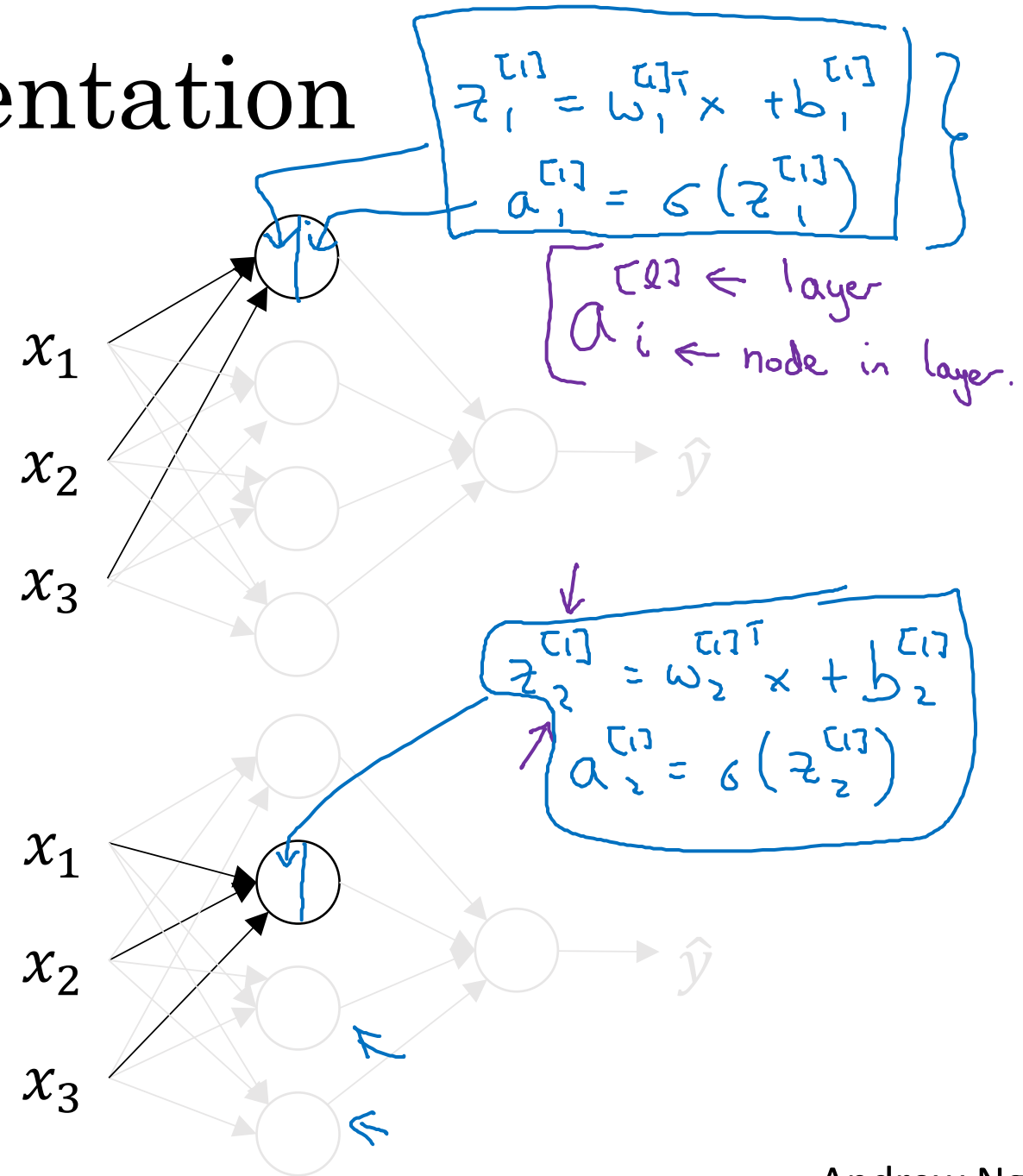$$\underbrace{w^T x + b}_{z} \Big| \underbrace{\sigma(z)}_{a} \longrightarrow a = \hat{y}$$

$z = w^T x + b$

$a = \sigma(z)$

x_1

x_2

x_3

$\hat{y}$

Andrew Ng

Neural Network Representation

x_1

x_2

x_3

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

$a = \hat{y}$

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

$$a = \sigma(z)$$

x_1

x_2

x_3

$\hat{y}$

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

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

$$a_i^{[\ell]} \leftarrow \text{layer}$$
$$a_i \leftarrow \text{node in layer.}$$

x_1

x_2

x_3

$\hat{y}$

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

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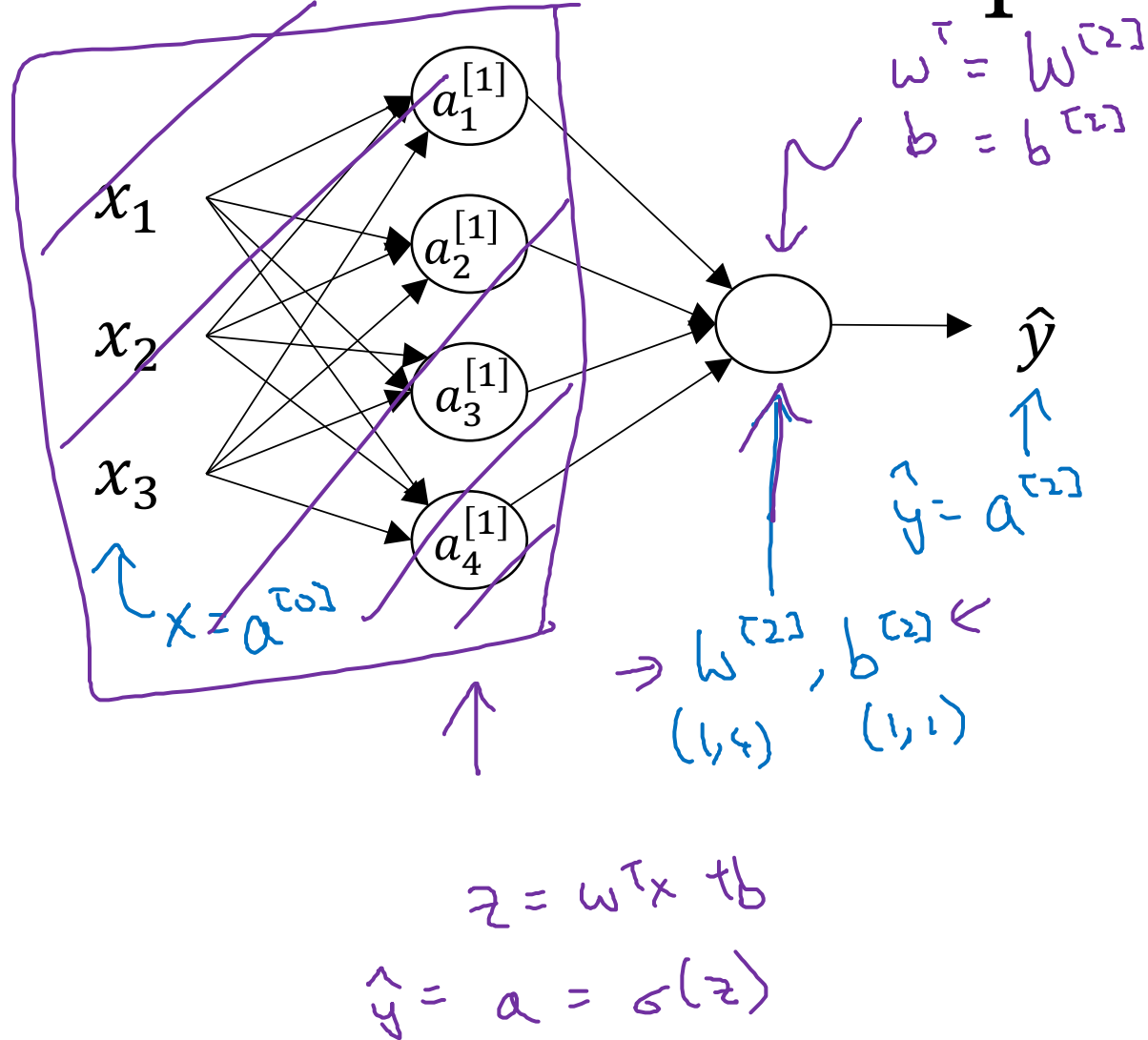
Andrew Ng

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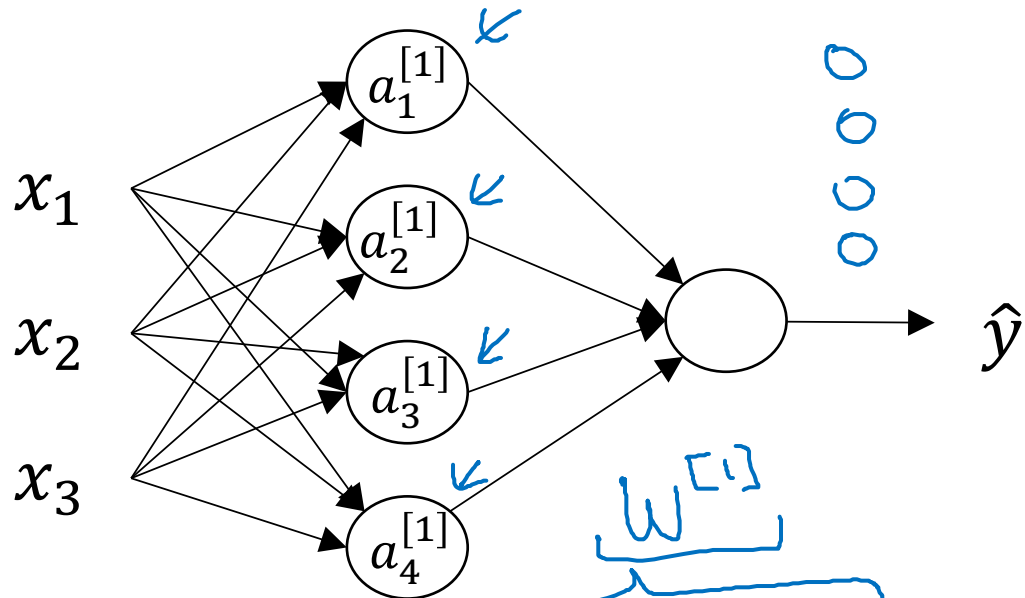
$$z_1^{[1]} = w_1^{[1]T} x + b_1^{[1]}, \quad a_1^{[1]} = \sigma(z_1^{[1]})$$

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

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

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

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

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

$W^{[1]} \quad (4,3) \qquad b^{[1]} \quad (4,1)$

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

Andrew Ng

Neural Network Representation learning

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

x_1
x_2
x_3

$a_1^{[1]}$
$a_2^{[1]}$
$a_3^{[1]}$
$a_4^{[1]}$

$\hat{y}$

$x = a^{[0]}$

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

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

$z = w^T x + b$
$\hat{y} = a = \sigma(z)$

Given input x:

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

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

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

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

Andrew Ng