input
layer

hidden layers

output
layer
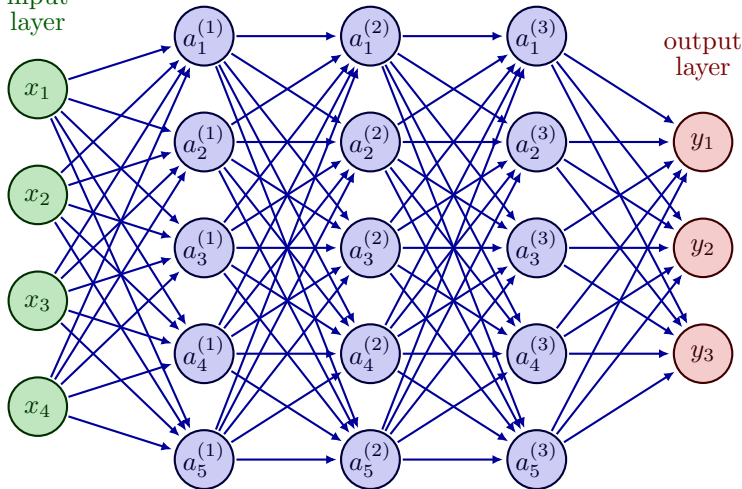
x_1 x_2 x_3 x_4

$a_1^{(1)}$ $a_2^{(1)}$ $a_3^{(1)}$ $a_4^{(1)}$ $a_5^{(1)}$

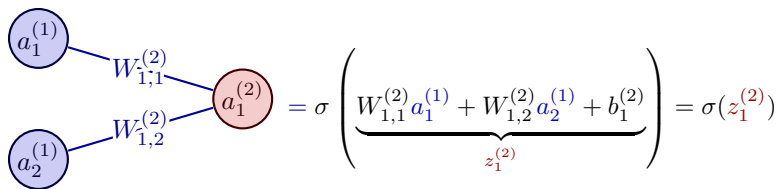$a_1^{(2)}$ $a_2^{(2)}$ $a_3^{(2)}$ $a_4^{(2)}$ $a_5^{(2)}$

$a_1^{(3)}$ $a_2^{(3)}$ $a_3^{(3)}$ $a_4^{(3)}$ $a_5^{(3)}$

y_1 y_2 y_3

$$a_1^{(1)} = \sigma\left(\underbrace{W_{1,1}^{(1)}a_1^{(0)} + b_1^{(1)}}_{z_1^{(1)}}\right) = \sigma(z_1^{(1)})$$

$$a_2^{(1)} = \sigma\left(\underbrace{W_{2,1}^{(1)}a_1^{(0)} + b_2^{(1)}}_{z_2^{(1)}}\right) = \sigma(z_1^{(2)})$$

$$\begin{bmatrix} a_1^{(1)} \\ a_2^{(1)} \end{bmatrix} = \sigma\left(\begin{bmatrix} W_{1,1}^{(1)} \\ W_{2,1}^{(1)} \end{bmatrix}\begin{bmatrix} a_1^{(0)} \end{bmatrix} + \begin{bmatrix} b_1^{(1)} \\ b_2^{(1)} \end{bmatrix}\right) = \sigma\left(\begin{bmatrix} z_1^{(1)} \\ z_2^{(1)} \end{bmatrix}\right)$$

$$\mathbf{a}^{(1)} = \sigma\left(\mathbf{W}^{(1)} \cdot \mathbf{a}^{(0)} + \mathbf{b}^{(1)}\right) = \sigma(\mathbf{z}^{(1)})$$

$$a_1^{(2)} = \sigma\left(\underbrace{W_{1,1}^{(2)}a_1^{(1)} + W_{1,2}^{(2)}a_2^{(1)} + b_1^{(2)}}_{z_1^{(2)}}\right) = \sigma(z_1^{(2)})$$

$$\left[a_1^{(2)}\right] = \sigma\left(\left[W_{1,1}^{(2)}, W_{1,2}^{(2)}\right]\begin{bmatrix}a_1^{(1)}\\a_2^{(1)}\end{bmatrix} + \left[b_1^{(1)}\right]\right) = \sigma\left(\left[z_1^{(2)}\right]\right)$$

$$\mathbf{a}^{(2)} = \sigma\left(\quad \mathbf{W}^{(2)} \quad \cdot \quad \mathbf{a}^{(1)} + \mathbf{b}^{(1)}\right) = \sigma(\mathbf{z}^{(2)})$$

$$\mathbf{a}^{(2)} = \sigma \left(W_{1,1}^{(2)} \sigma \left(W_{1,1}^{(1)} a_1^{(0)} + b_1^{(1)} \right) + W_{1,2}^{(2)} \sigma \left(W_{1,1}^{(1)} a_1^{(0)} + b_1^{(1)} \right) + b \right.$$