Vectorisation:

$$X = \begin{bmatrix} \vdots & \vdots & & \vdots \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ \vdots & \vdots & & \vdots \end{bmatrix}, \quad Z^{[1]} = \begin{bmatrix} \vdots & \vdots & & \vdots \\ z^{[1](1)} & z^{[1](2)} & \cdots & z^{[1](m)} \\ \vdots & \vdots & & \vdots \end{bmatrix}$$

(n_x, m) $\rightarrow A^{[0]}$

Vectorisation

$$\begin{cases} Z^{[1]} = W^{[1]} X + b^{[1]} \\ A^{[1]} = \sigma(Z^{[1]}) \\ Z^{[2]} = W^{[2]} A^{[1]} + b^{[2]} \\ A^{[2]} = \sigma(Z^{[2]}) \end{cases}$$

$$A^{[1]} = \begin{bmatrix} \vdots & \vdots & & \vdots \\ a^{[1](1)} & a^{[1](2)} & \cdots & a^{[1](m)} \\ \vdots & \vdots & & \vdots \end{bmatrix}$$

hidden units

train. examples

Explanation for Vectorised Implementation

E.g. for first train example:

(simplification)

$$z^{[1](1)} = W^{[1]} x^{(1)} + \cancel{b^{[1]}}^{0}, \quad z^{[1](2)} = W^{[1]} x^{(2)} + \cancel{b^{[1]}}^{0}, \quad z^{[1](3)} = W^{(1)} x^{(3)} + \cancel{b}$$

$$W^{[1]} = \begin{bmatrix} - & - \\ - & - \\ - & - \\ - & - \\ - & - \end{bmatrix}, \quad W^{[1]} x^{(1)} = \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}, \quad W^{[1]} x^{(2)} = \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}, \quad W^{[1]} x^{(3)} = \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}$$

$$W^{[1]} \begin{bmatrix} \vdots & \vdots & \vdots \\ x^{(1)} & x^{(2)} & x^{(3)} \\ \vdots & \vdots & \vdots \end{bmatrix} = \begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix} = \begin{bmatrix} \vdots & \vdots & \vdots \\ z^{[1](1)} & z^{[1](2)} & z^{[1](3)} \\ \vdots & \vdots & \vdots \end{bmatrix}$$

X

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