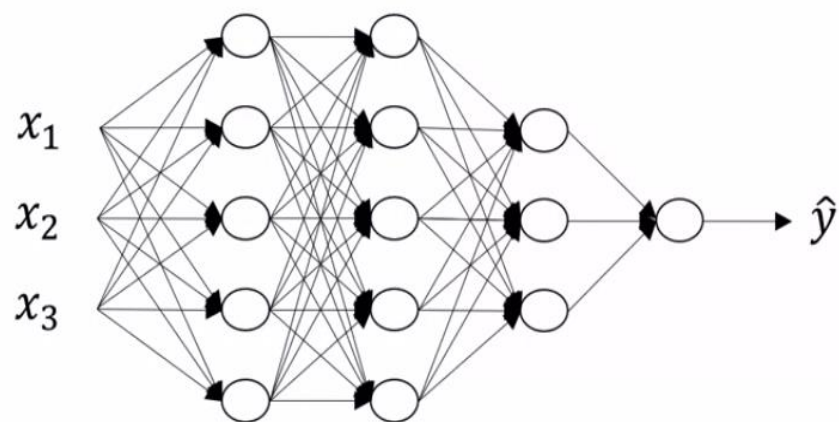


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WEEK 4

## NEURAL NETWORKS AND DEEP LEARNING

### Deep neural network notation



16  $L = 4$  (layers)

17  $n^{[L]} = \# \text{ units in layer } L$

18  $n^{[1]} = 5$

Notes  $n^{[4]} = 1 = n^{[L]}$

$n^{[0]} = n_x = 3$

$$\begin{aligned}
 a^{[L]} &= \text{activation in layer } L \\
 a^{[L]} &= g^{[L]}(z^{[L]}) \\
 W^{[L]} &= \text{wts for } z^{[L]} \\
 x &= a^{[0]} \\
 \hat{y} &= a^{[L]}
 \end{aligned}$$

## FORWARD PROPAGATION IN DEEP NETWORK

For layer 1:

$$\begin{aligned}
 x : z^{[1]} &= W^{[1]} x + b^{[1]} \\
 a^{[1]} &= g(z^{[1]}) \\
 \text{or } z^{[1]} &= W^{[1]} a^{[0]} + b^{[1]}
 \end{aligned}$$

## GENERIZED NOTATION FOR SINGLE TRAINING EXAMPLE

Generalized (for single training ex)

$$\begin{aligned}
 z^{[L]} &= W^{[L]} a^{[L-1]} + b^{[L]} \\
 a^{[L]} &= g^{[L]}(z^{[L]})
 \end{aligned}$$

## VECTORIZED NOTATION FOR ENTIRE TRAINING SET

Vectorized (entire training set)

$$Z^{[l]} = W^{[l]} A^{[l-1]} + b^{[l]}$$
$$A^{[l]} = g^{[l]}(Z^{[l]})$$

## DIMENSIONS FOR GENARALIZED FORWARD PROPAGATION

$$Z^{[l]} = W^{[l]} x + b^{[l]}$$

$\Rightarrow$

dimensions  $\Rightarrow \begin{pmatrix} n^{[l]} \\ 1 \end{pmatrix} = \begin{pmatrix} n^{[l]} & n^{[l-1]} \end{pmatrix} \begin{pmatrix} n^{[l-1]} \\ 1 \end{pmatrix} + \begin{pmatrix} n^{[l]} \\ 1 \end{pmatrix}$

General

# DIMENSIONS FOR VECTORIZED FORWARD PROPAGATION

18

Vectorized:-

Notes

$$Z^{[l]} = W^{[l]} X + b^{[l]}$$
$$(n^{[l]}, 1) = (n^{[l]}, n^{[l-1]}) \cdot (n^{[l-1]}, m) + (n^{[l]}, 1)$$

$\hookrightarrow (n^{[l]}, m)$

- Dimension of  $b^{[l]}$  changes from  $(n^{[l]}, 1)$  to  $(n^{[l]}, m)$  due to python broadcasting.
- $(n^{[l]}, m)$  means  $n$  training examples stacked horizontally.