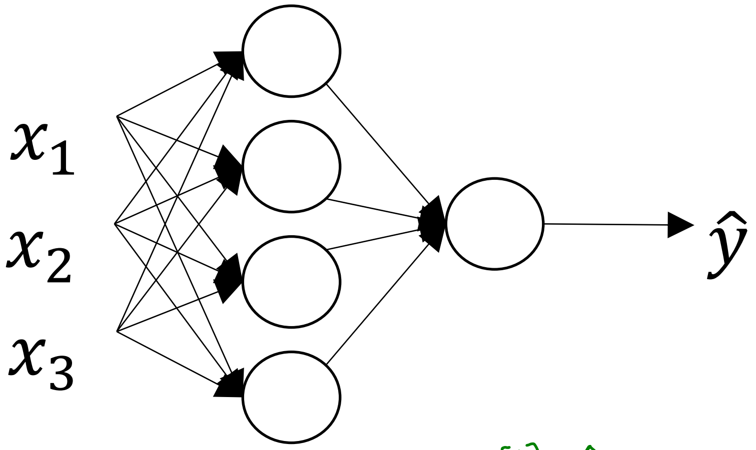
deeplearning.ai

One hidden layer Neural Network

Vectorizing across multiple examples

Vectorizing across multiple examples



$$z^{[1]} = W^{[1]}x + b^{[1]}$$
$$a^{[1]} = \sigma(z^{[1]})$$
$$z^{[2]} = W^{[2]}a^{[1]} + b^{[2]}$$
$$a^{[2]} = \sigma(z^{[2]})$$

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

$x^{(1)} \longrightarrow a^{[2](1)} = \hat{y}^{(1)}$

$x^{2} \longrightarrow a^{[2](2)} = \hat{y}^{(2)}$

$x^{3} \longrightarrow a^{[2](3)} = \hat{y}^{(3)}$

$\vdots$

$x^{m} \longrightarrow a^{[2](m)} = \hat{y}^{(m)}$

$a^{[2](i)}$ — $[2]$: layer 2; (i): example i

For m samples

for $i = 1$ to m

$z^{[1](i)} = W^{[1]T} \cdot x^{(i)} + b^{[1]}$

$a^{[1](i)} = \sigma(z^{[1](i)})$

$z^{[2](i)} = W^{[2]T} \cdot a^{[1](i)} + b^{[2]}$

$a^{[2](i)} = \sigma(z^{[2](i)})$

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Vectorizing across multiple examples

```
for i = 1 to m:
```

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

$$a^{[1](i)} = \sigma(z^{[1](i)})$$

$$z^{[2](i)} = W^{[2]}a^{[1](i)} + b^{[2]}$$

$$a^{[2](i)} = \sigma(z^{[2](i)})$$

No For loops

$$Z^{[1]} = W^{[1]T} \cdot X + b^{[1]}$$

$$A^{[1]} = \sigma(Z^{[1]})$$

$$Z^{[2]} = W^{[2]T} \cdot A^{[1]} + b^{[2]}$$

$$A^{[2]} = \sigma(Z^{[2]})$$

Note
w & b remain the same for all the training examples
$w^{[1]}$ is the same for $x^{(1)}$ or $x^{(2)}$....
$w^{[2]}$ is the same for $a^{(1)}$ or $a^{(2)}$....

where

$$Z^{[1]} = \begin{bmatrix} | & | & | & & | \\ z^{[1](1)} & z^{[1](2)} & z^{[1](3)} & \cdots & z^{[1](m)} \\ | & | & | & & | \end{bmatrix}$$

$(m \times m)$ why? → do dim Analysis of $z^{[1]} = w^{[1]T} \cdot x + b^{[1]}$

$$X = \begin{bmatrix} | & | & & | \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ | & | & & | \end{bmatrix}$$

(n_x, m)

Q = 2nd training example
1st layer
1st member of the layer

P = 1st training eg
1st layer
1st member of that layer

$$A^{[1]} = \begin{bmatrix} | & | & | & & | \\ a^{[1](1)} & a^{[1](2)} & a^{[1](3)} & \cdots & a^{[1](m)} \\ | & | & | & & | \end{bmatrix}$$

dim same as Z $(m \times m)$

hidden unit in layer "L"

training eg.

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One hidden layer Neural Network

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Explanation for vectorized implementation

Justification for vectorized implementation

PTO

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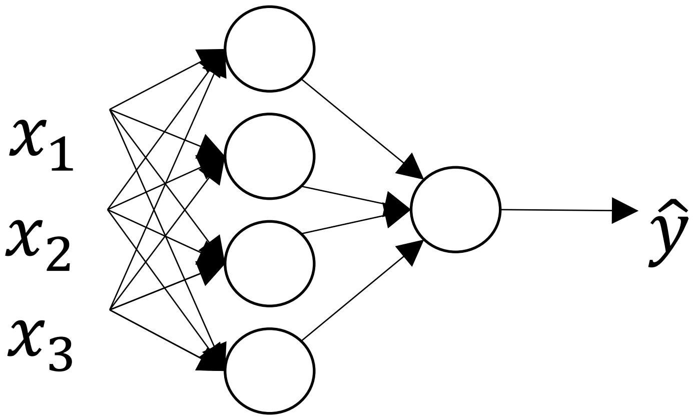
Recap of vectorizing across multiple examples



$$X = \begin{bmatrix} | & | & & | \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ | & | & & | \end{bmatrix}$$

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

```
for i = 1 to m
```

$$\boxed{z^{[1](i)} = W^{[1]}x^{(i)} + b^{[1]}}$$

$$\boxed{a^{[1](i)} = \sigma(z^{[1](i)})}$$

$$z^{[2](i)} = W^{[2]}a^{[1](i)} + b^{[2]}$$

$$a^{[2](i)} = \sigma(z^{[2](i)})$$

vectorize

$$Z^{[1]} = W^{[1]}X + b^{[1]}$$

vectorize

$$A^{[1]} = \sigma(Z^{[1]})$$

etc.

$$Z^{[2]} = W^{[2]}A^{[1]} + b^{[2]}$$

$$A^{[2]} = \sigma(Z^{[2]})$$

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