

### Forward Propagation

03 March 2022

06:07

$\text{c gpa}$  |  $i_1$  |  $10 \text{th m}$  |  $12 \text{th m}$  | placed |  $\hat{y}$  # of trainable parameters

7.2	72	69	81	1
8.1	92	75	76	0

$a^{[1]} = \sigma(a^{[0]} w^{[1]} + b^{[1]})$

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

$a^{[3]} = \sigma(a^{[2]} w^{[3]} + b^{[3]})$

$O_{31} = \hat{y}$

$\text{prediction} \rightarrow \sigma(w^T x + b) \rightarrow \hat{y}$

$\sigma((\sigma((\sigma(a^{[0]} w^{[1]} + b^{[1]})) w^{[2]} + b^{[2]})) w^{[3]} + b^{[3]})$

$a^{[3]} = \hat{y}$

Layer #1

$$= \begin{bmatrix} W_{11}^1 x_{i1} + W_{12}^1 x_{i2} + W_{13}^1 x_{i3} + W_{14}^1 x_{i4} \\ W_{12}^1 x_{i1} + W_{22}^1 x_{i2} + W_{23}^1 x_{i3} + W_{24}^1 x_{i4} \\ W_{13}^1 x_{i1} + W_{23}^1 x_{i2} + W_{33}^1 x_{i3} + W_{34}^1 x_{i4} \end{bmatrix} + \begin{bmatrix} b_{11} \\ b_{12} \\ b_{13} \end{bmatrix}$$

$$= \sigma \left( \begin{bmatrix} W_{11}^1 x_{i1} + W_{12}^1 x_{i2} + W_{13}^1 x_{i3} + W_{14}^1 x_{i4} + b_{11} \\ W_{12}^1 x_{i1} + W_{22}^1 x_{i2} + W_{23}^1 x_{i3} + W_{24}^1 x_{i4} + b_{12} \\ W_{13}^1 x_{i1} + W_{23}^1 x_{i2} + W_{33}^1 x_{i3} + W_{34}^1 x_{i4} + b_{13} \end{bmatrix} \right)$$

$$= \begin{bmatrix} O_{11} \\ O_{12} \\ O_{13} \end{bmatrix} \rightarrow a^{[1]}$$

Layer #2

$$= \sigma \left( \begin{bmatrix} W_{11}^2 O_{11} + W_{12}^2 O_{12} + W_{13}^2 O_{13} + b_{21} \\ W_{12}^2 O_{11} + W_{22}^2 O_{12} + W_{23}^2 O_{13} + b_{22} \end{bmatrix} \right) = \begin{bmatrix} O_{21} \\ O_{22} \end{bmatrix} \rightarrow a^{[2]}$$

Layer #3

$$= \sigma \left( \begin{bmatrix} W_{11}^3 O_{21} + W_{21}^3 O_{22} + b_{31} \end{bmatrix} \right) = \hat{y} = [O_{31}] \rightarrow a^{[3]}$$