For. Prop. in a Deep NN

Given input example x:

$z^{[1]} = W^{[1]} \overset{a^{[0]}}{x} + b^{[1]}$

$a^{[1]} = g^{[1]}(z^{[1]})$

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

$a^{[2]} = g^{[2]}(z^{[2]})$

$\vdots$

$z^{[4]} = W^{[4]} a^{[3]} + b^{[4]}$

$a^{[4]} = g^{[4]}(z^{[4]}) = \hat{y}$

FORWARD PROPAGATION

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

Vectorised:

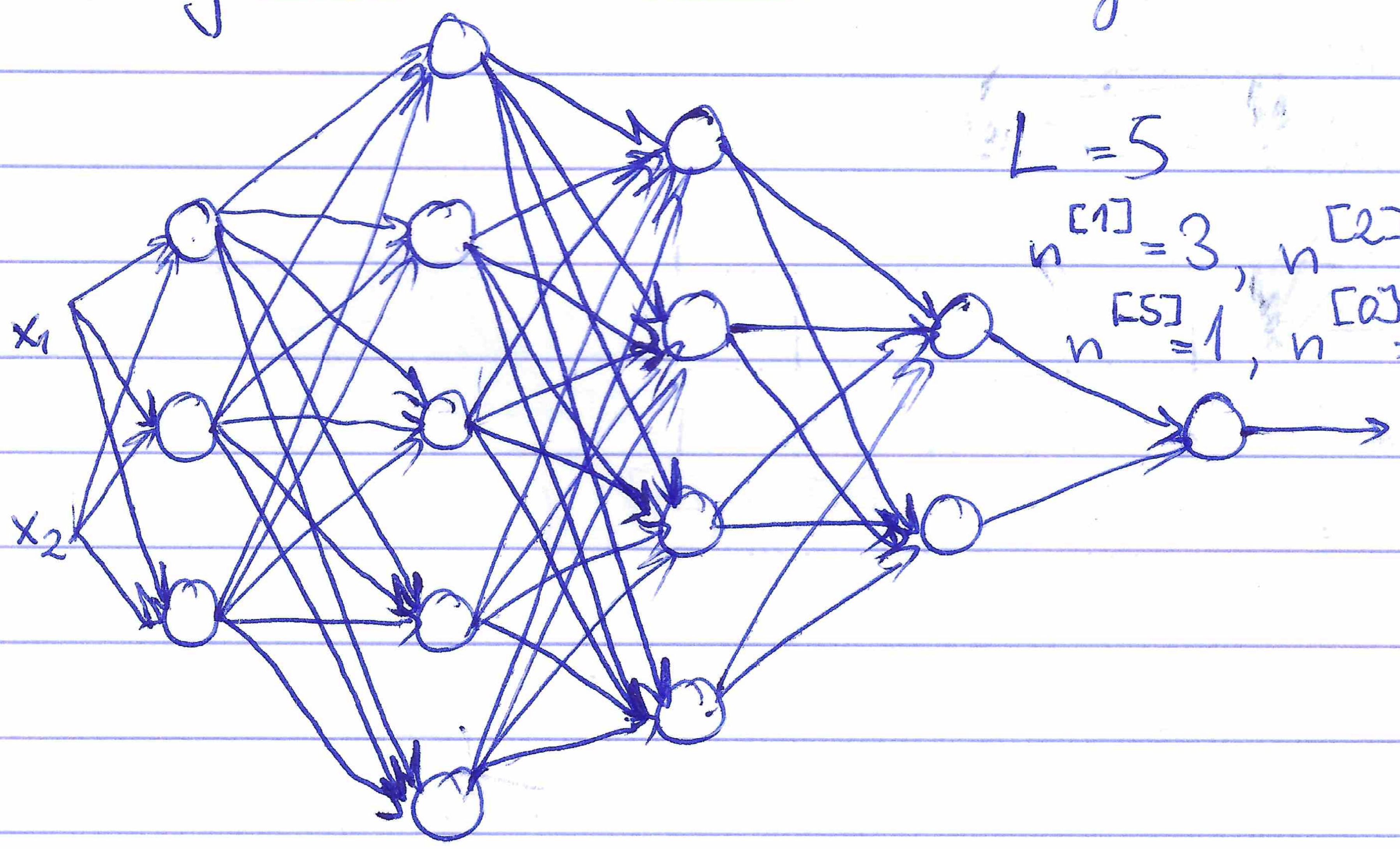
$$\left.\begin{aligned} Z^{[1]} &= W^{[1]} \overset{A^{[0]}}{X} + b^{[1]} \\ A^{[1]} &= g^{[1]}(Z^{[1]}) \\ Z^{[2]} &= W^{[2]} A^{[1]} + b^{[2]} \\ A^{[2]} &= g^{[2]}(Z^{[2]}) \end{aligned}\right\} \text{for } l = 1:4$$

$\hat{Y} = g(Z^{[4]}) = A^{[4]}$

$A^{[0]} = X$

$$\boxed{\begin{aligned} Z^{[l]} &= W^{[l]} A^{[l-1]} + b^{[l]} \\ A^{[l]} &= g^{[l]}(Z^{[l]}) \end{aligned}}$$

Getting the Matrix Dimensions Right



$L = 5$

$n^{[1]} = 3,\ n^{[2]} = 5,\ n^{[3]} = 4,\ n^{[4]} = 2,$

$n^{[5]} = 1,\ n^{[0]} = n_x = 2$

$z^{[1]} = W^{[1]} x + b^{[l]}$

(3,1) (2,1) (3,1)

$(n^{[1]},1)\ (n^{[1]},n^{[0]})\ (n^{[0]},1)\ (n^{[1]},1)$

$[\vdots] = [\vdots]$

$(n^{[1]}, n^{[0]})$

$W^{[1]}: (n^{[1]}, n^{[0]})$

$W^{[2]}: (5,3)\ (n^{[2]}, n^{[1]})$

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

(5,1) (5,3) (3,1) (5,1)

$(n^{[2]},1)$

$W^{[3]}: (4,5)$

$W^{[4]}: (2,4),\ W^{[5]}: (1,2)$

$z^{[l]} = g^{[l]}(a^{[l]})$

$W^{[l]}: (n^{[l]}, n^{[l-1]})$

$b^{[l]}: (n^{[l]}, 1)$

$dW^{[l]}: (n^{[l]}, n^{[l-1]})$

$db^{[l]}: (n^{[l]}, 1)$