

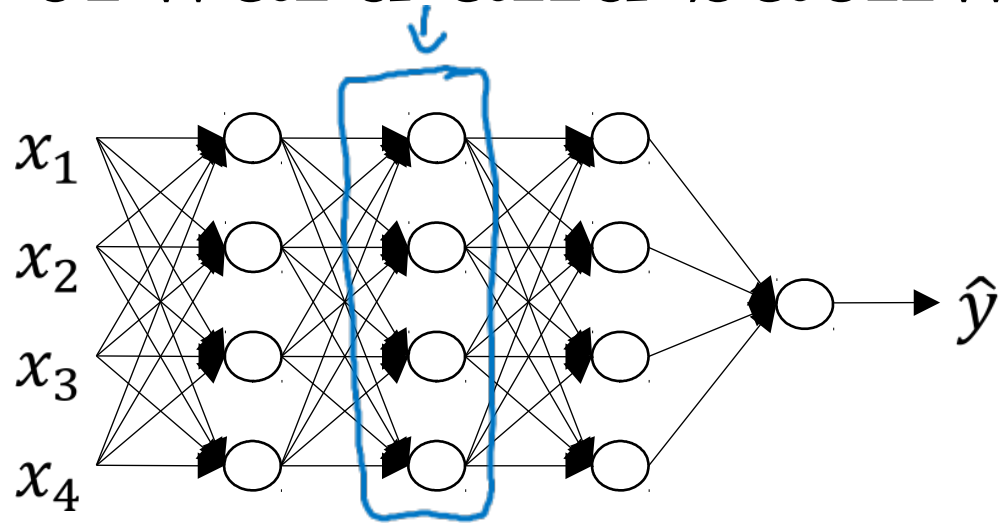


Deep Neural Networks

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Building blocks of
deep neural networks

Forward and backward functions



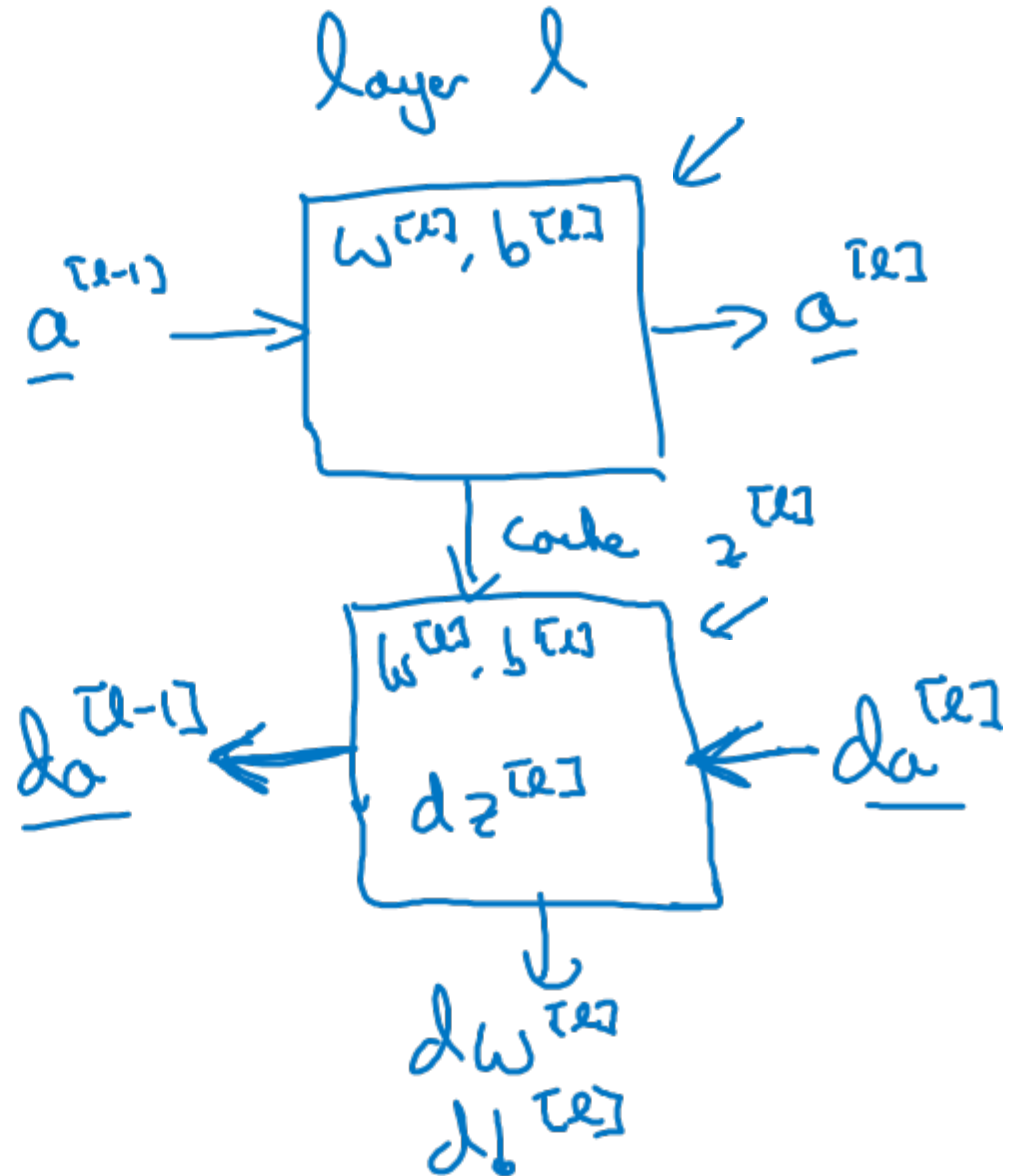
layer l : $W^{[l]}, b^{[l]}$

→ Forward: Input $a^{[l-1]}$, output $a^{[l]}$

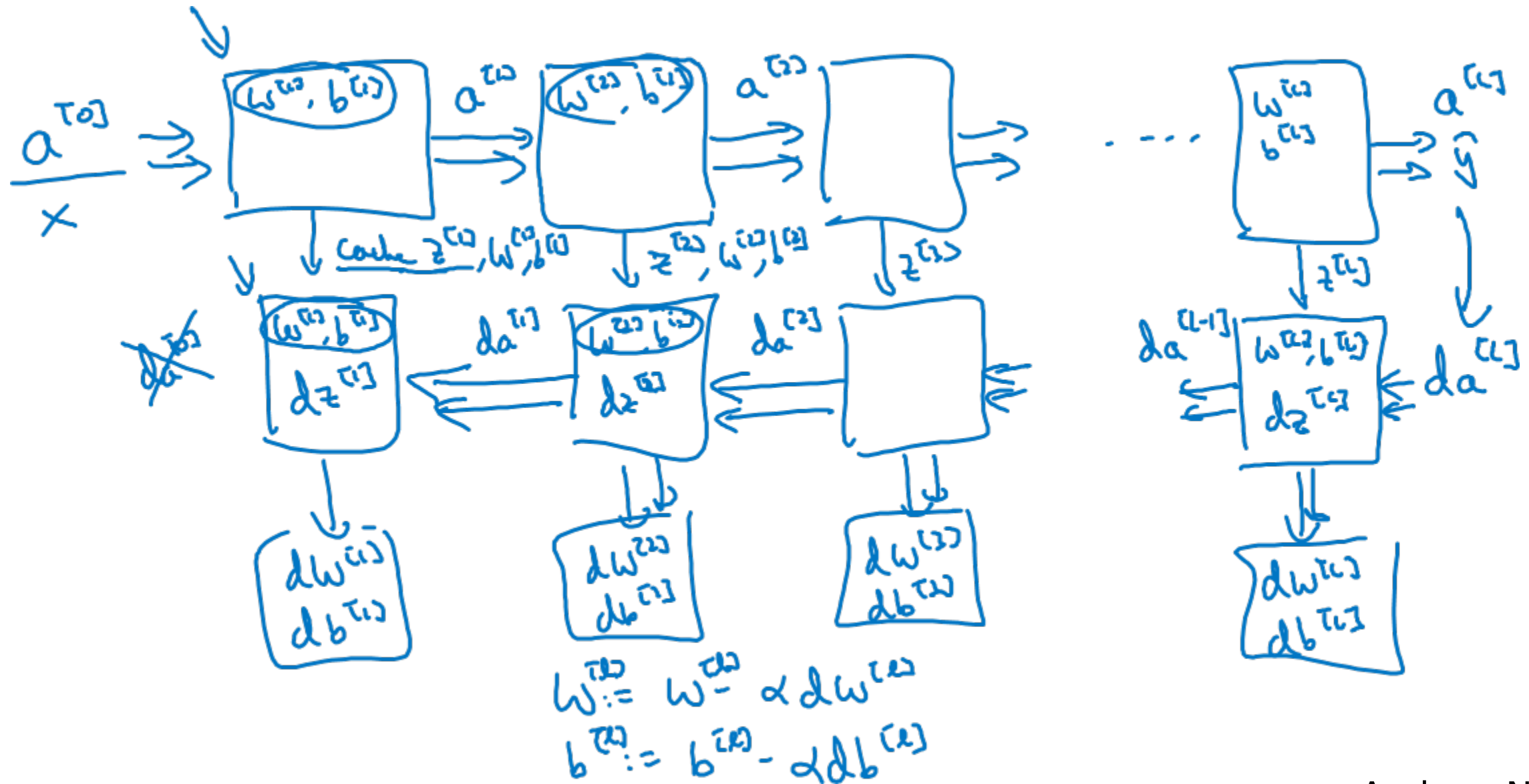
$$z^{[l]} = W^{[l]} a^{[l-1]} + b^{[l]} \quad \text{cache } z^{[l]}$$

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

→ Backward: Input $da^{[l]}$, output $da^{[l-1]}$
 cache $z^{[l]}$
 $\frac{dW^{[l]}}{db^{[l]}}$



Forward and backward functions





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Deep Neural Networks

Forward and backward
propagation

Forward propagation for layer l

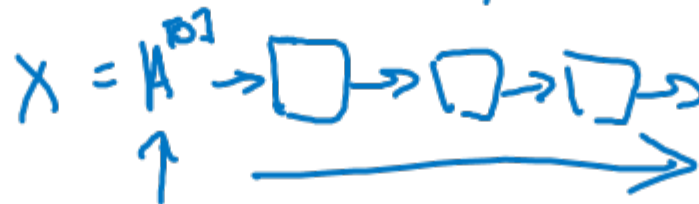
→ Input $a^{[l-1]}$ ←

→ Output $a^{[l]}$ ← $W^{[l]}, b^{[l]}$

$$z^{[l]} = W^{[l]} \cdot a^{[l-1]} + b^{[l]}$$

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

$a^{[0]}$
 $A^{[0]}$



Verzweig:

$$z^{[l]} = W^{[l]} \cdot A^{[l-1]} + b^{[l]}$$

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

Backward propagation for layer l

→ Input $a^{[l]}$

→ Output $da^{[l]}$, $dW^{[l]}$, $db^{[l]}$

$$\begin{aligned}
 dz^{[l]} &= da^{[l]} * g^{[l]'}(z^{[l]}) \\
 dw^{[l]} &= dz^{[l]} \cdot \underline{a^{[l-1]}} \\
 db^{[l]} &= dz^{[l]} \\
 \underline{da^{[l-1]}} &= W^{[l]T} \cdot dz^{[l]} \\
 \underline{dz^{[l]}} &= W^{[l+1]T} dz^{[l+1]} * g^{[l+1]'}(z^{[l+1]})
 \end{aligned}$$

$$\begin{aligned}
 dz^{[l]} &= \underline{dA^{[l]}} * g^{[l]'}(z^{[l]}) \\
 dw^{[l]} &= \frac{1}{n} dz^{[l]} \cdot A^{[l-1]T} \\
 db^{[l]} &= \frac{1}{n} np.sum(dz^{[l]}, axis=1, keepdims=True) \\
 \underline{dA^{[l-1]}} &= W^{[l]T} \cdot dz^{[l]}
 \end{aligned}$$

Summary

