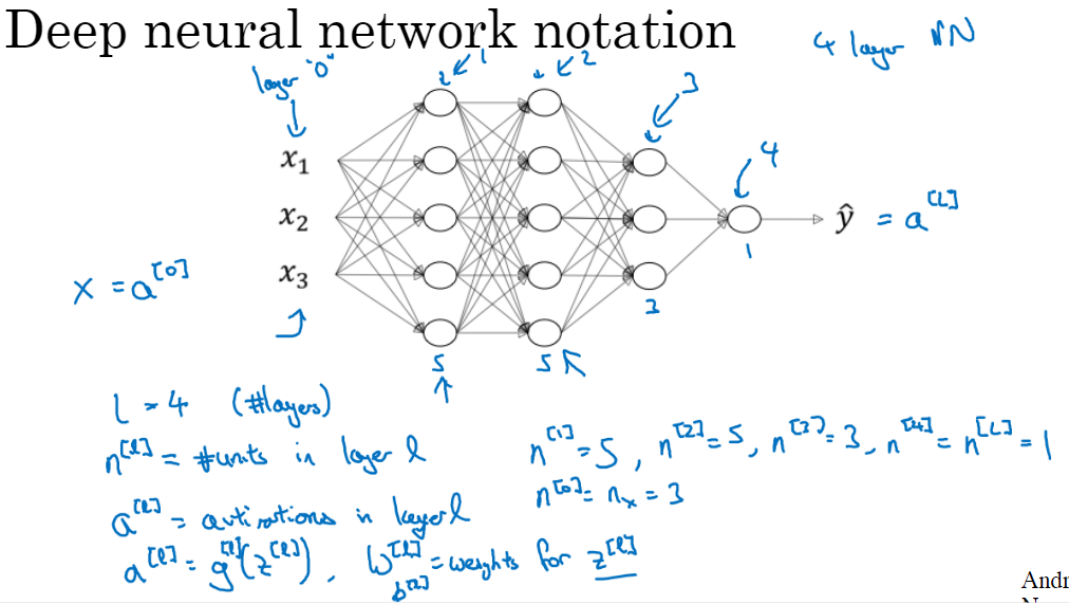
（一）一些新变量的引入

变量名	变量含义
l	layers
$n^{[l]}$	units in layer l



（二）核对矩阵的维数

这个在前面其实已经做过了，这里再总结一下

矩阵符号	矩阵维数
X	$(n^{[0]},m)$
$W^{[l]}$ and $dW^{[l]}$	$(n^{[l]},n^{[l-1]})$
$b^{[l]}$ and $db^{[l]}$	$(n^{[l]},1)$
$Z^{[l]}$ and $dZ^{[l]}$	$(n^{[l]},m)$
$A^{[l]}$ and $dA^{[l]}$	$(n^{[l]},m)$
Y	$(n^{[\text{the last l}]},m)$

（三）为什么使用深层表示

观点1

模拟大脑思考过程：由浅到深、由简到繁、层层深入

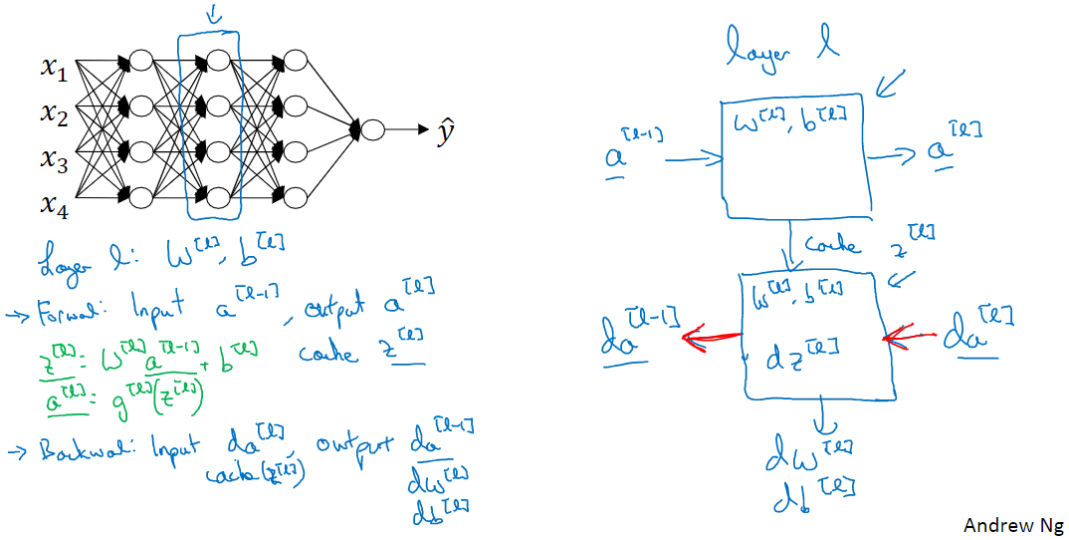
观点2

识别一个n维特征向量，使用单隐层神经网络需要的神经元个数，呈2^n增长。

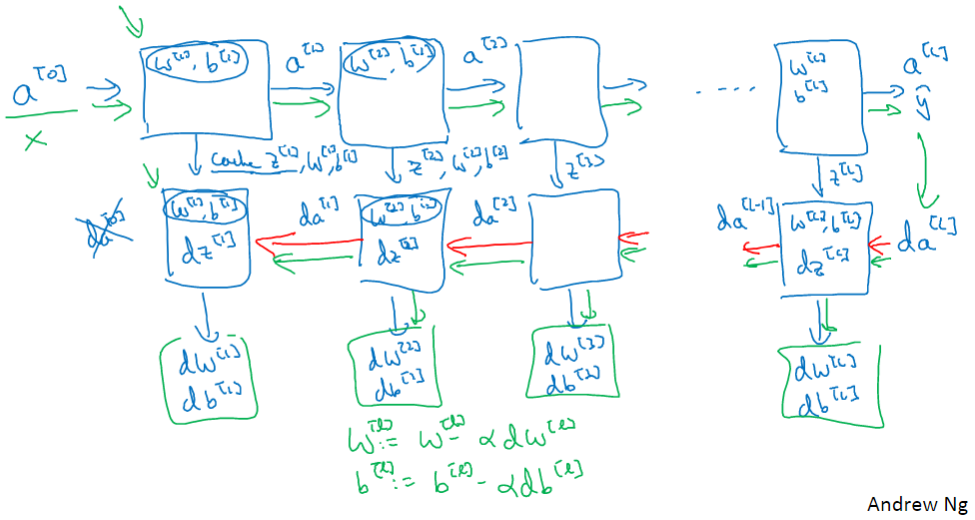
而使用多隐层神经网络所需神经元个数，则呈log n增长

（四）搭建深层神经网络块

Forward and backward functions



Forward and backward functions



（五）前向和反向传播的实现

$$##Forward\ Propagation##Z^{[l]} = W^{[1]}A^{[l-1]} + b^{[l]}A^{[l]} = g^{[l]}(Z^{[l]})##Backward\ Propagation##dZ^{[l]} = dA^{[l]} * g^{[l]'}(Z^{[l]})dW^{[l]} = \frac{1}{m}dZ^{[l]}A$$

Forward and backward propagation

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$$\begin{aligned}
&Z^{[1]} = W^{[1]}X + b^{[1]}\\
&A^{[1]} = g^{[1]}(Z^{[1]})\\
&Z^{[2]} = W^{[2]}A^{[1]} + b^{[2]}\\
&A^{[2]} = g^{[2]}(Z^{[2]})\\
&\vdots\\
&A^{[L]} = g^{[L]}(Z^{[L]}) = \hat{Y}
\end{aligned}$$

$$\begin{aligned}
&dZ^{[L]} = A^{[L]} - Y\\
&dW^{[L]} = \frac{1}{m}dZ^{[L]}A^{[L]^T}\\
&db^{[L]} = \frac{1}{m}np.\mathrm{sum}(\mathrm{d}Z^{[L]}, axis = 1, keepdims = True)\\
&dZ^{[L-1]} = dW^{[L]^T}dZ^{[L]}g'^{[L]}(Z^{[L-1]})\\
&\vdots\\
&dZ^{[1]} = dW^{[L]^T}dZ^{[2]}g'^{[1]}(Z^{[1]})\\
&dW^{[1]} = \frac{1}{m}dZ^{[1]}A^{[1]^T}\\
&db^{[1]} = \frac{1}{m}np.\mathrm{sum}(\mathrm{d}Z^{[1]}, axis = 1, keepdims = True)
\end{aligned}$$