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Case Studies

Why look at
case studies?

Outline

Classic networks:

- LeNet-5 ←
- AlexNet ←
- VGG ←

ResNet (152)

Inception

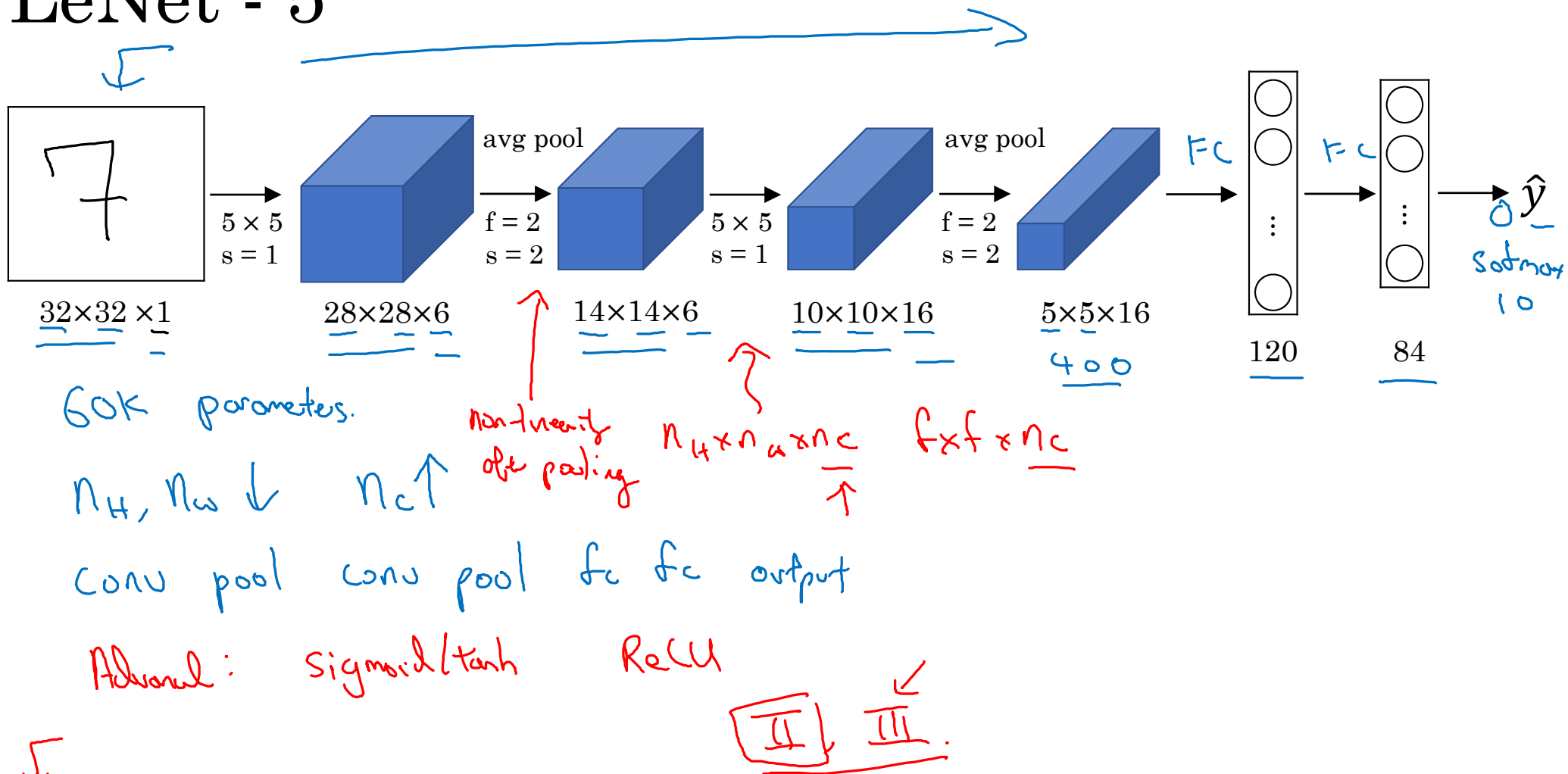


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Case Studies

Classic networks

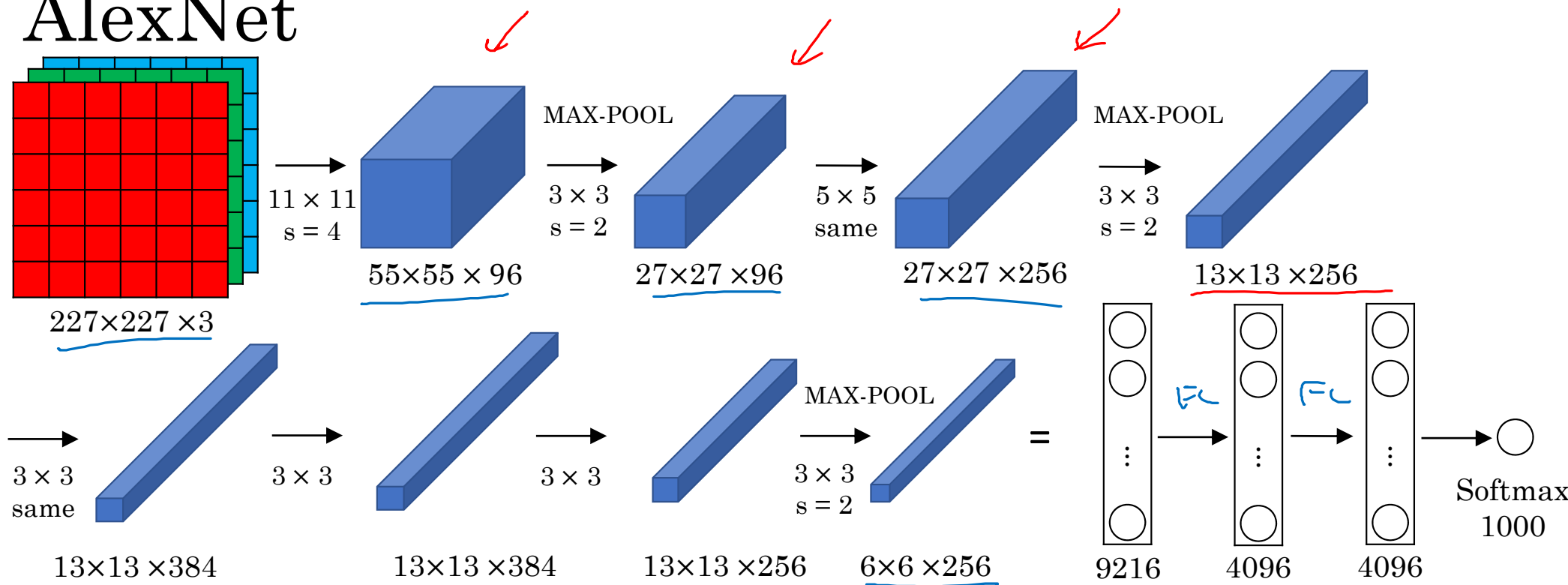
LeNet - 5



[LeCun et al., 1998. Gradient-based learning applied to document recognition]

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AlexNet

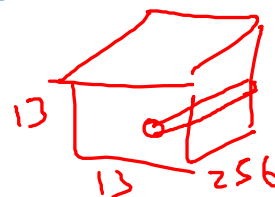


- Similar to LeNet, but much bigger.

- ReLU

- Multiple GPUs.

- Local Response Normalization (LRN)



~60M parameters

[Krizhevsky et al., 2012. ImageNet classification with deep convolutional neural networks]

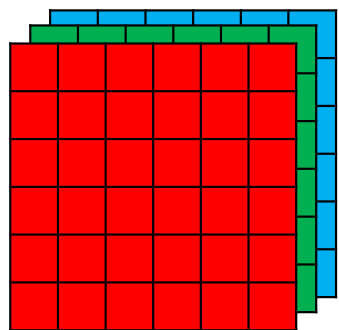
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VGG - 16

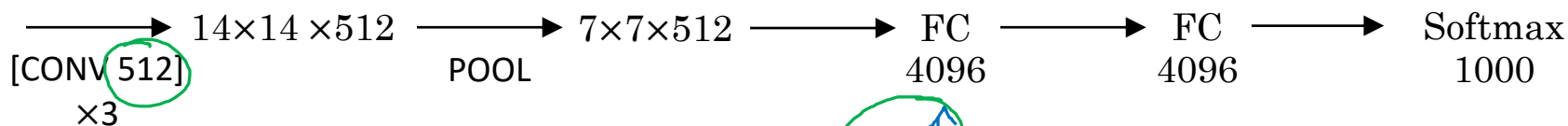
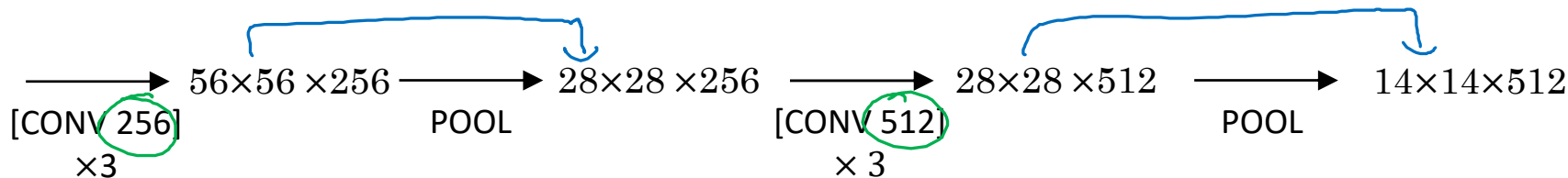
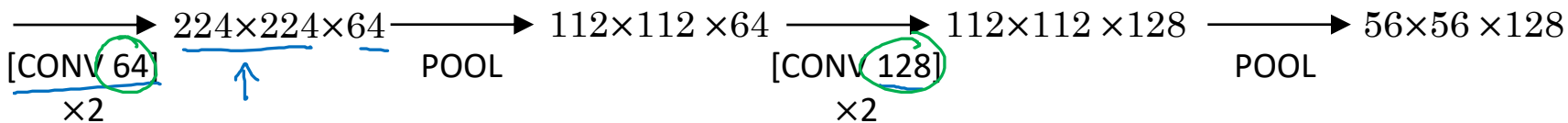
VGG-19

CONV = 3x3 filter, s = 1, same

MAX-POOL = 2x2, s = 2



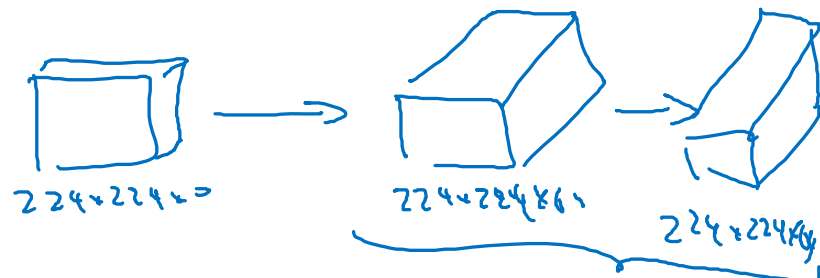
224x224x3



$n_H, n_W \downarrow$

$n_C \uparrow$

$\sim 138M$



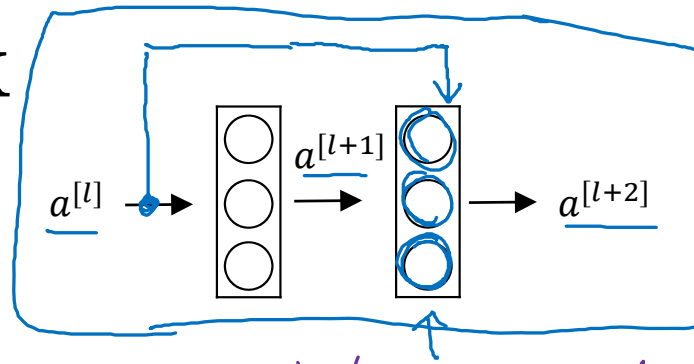


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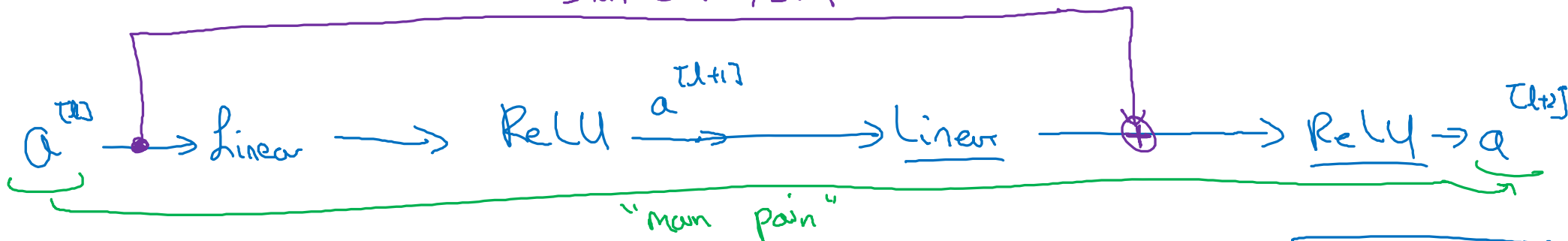
Case Studies

Residual Networks (ResNets)

Residual block



"short cut" / skip connection



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

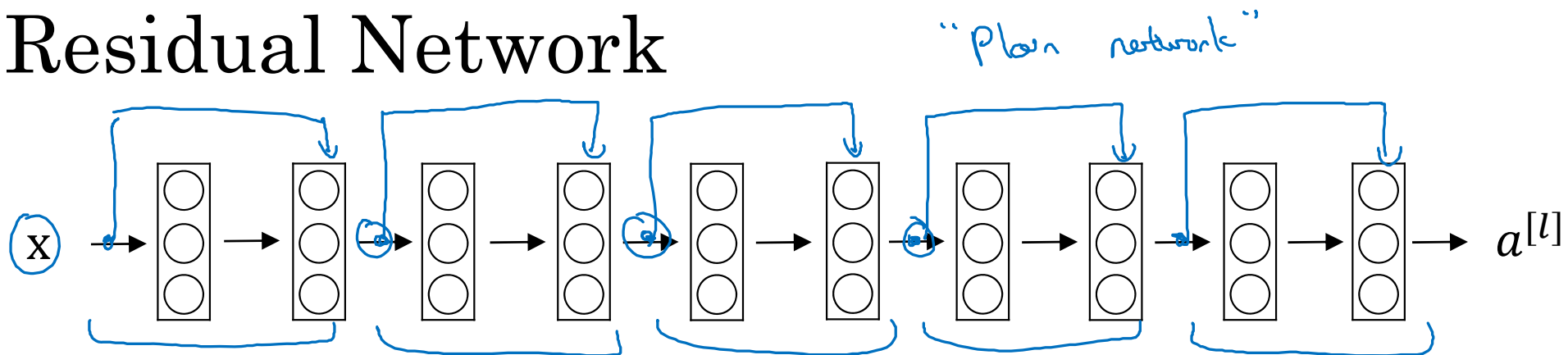
$$a^{[l+1]} = g(z^{[l+1]})$$

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

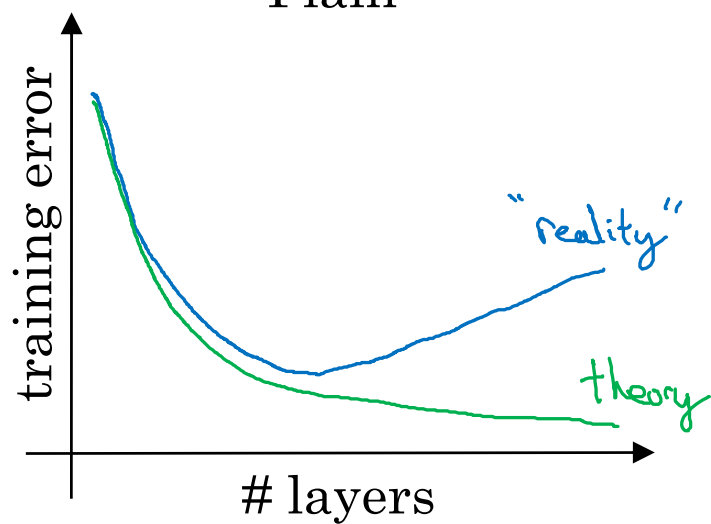
~~$$a^{[l+2]} = g(z^{[l+2]})$$~~

$$a^{[l+2]} = g(z^{[l+2]} + \underbrace{a^{[l]}}_{\text{skip connection}})$$

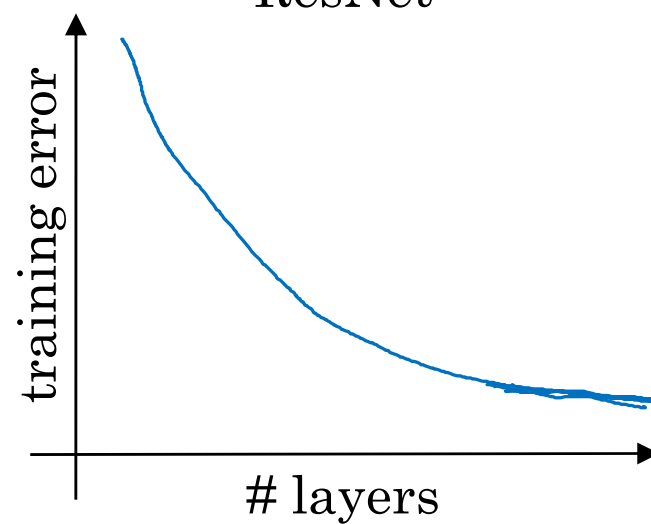
Residual Network



Plain



ResNet





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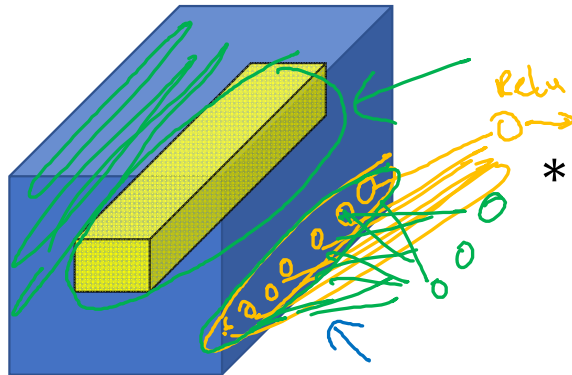
Case Studies

Network in Network and 1×1 convolutions

Why does a 1×1 convolution do?

1	2	3	6	5	8
3	5	5	1	3	4
2	1	3	4	9	3
4	7	8	5	7	9
1	5	3	7	4	8
5	4	9	8	3	5

$6 \times 6 \times 1$



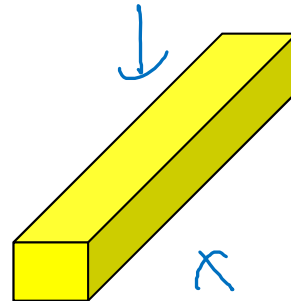
$6 \times 6 \times 32$

*

2

=

32 \rightarrow # filters.
 $n_c^{[L+1]}$



$1 \times 1 \times 32$

=

ReLU

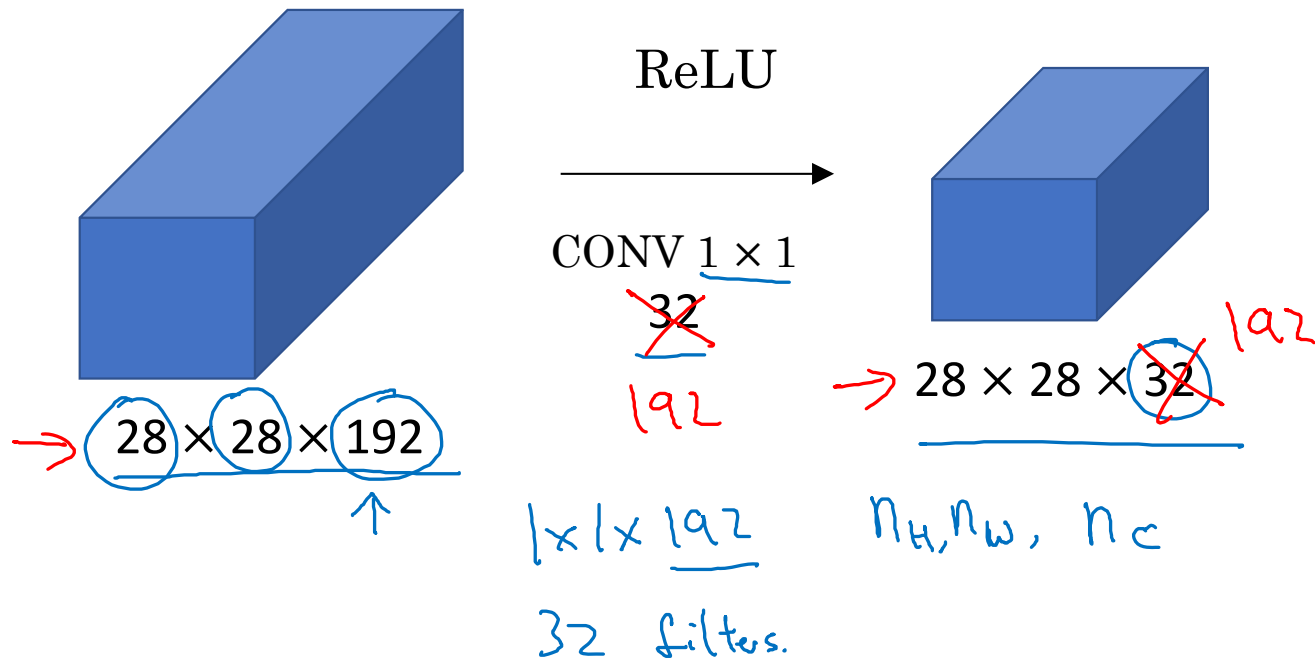
Network in
Network

2	4	6	...		

$6 \times 6 \times \text{\# filters}$

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Using 1×1 convolutions



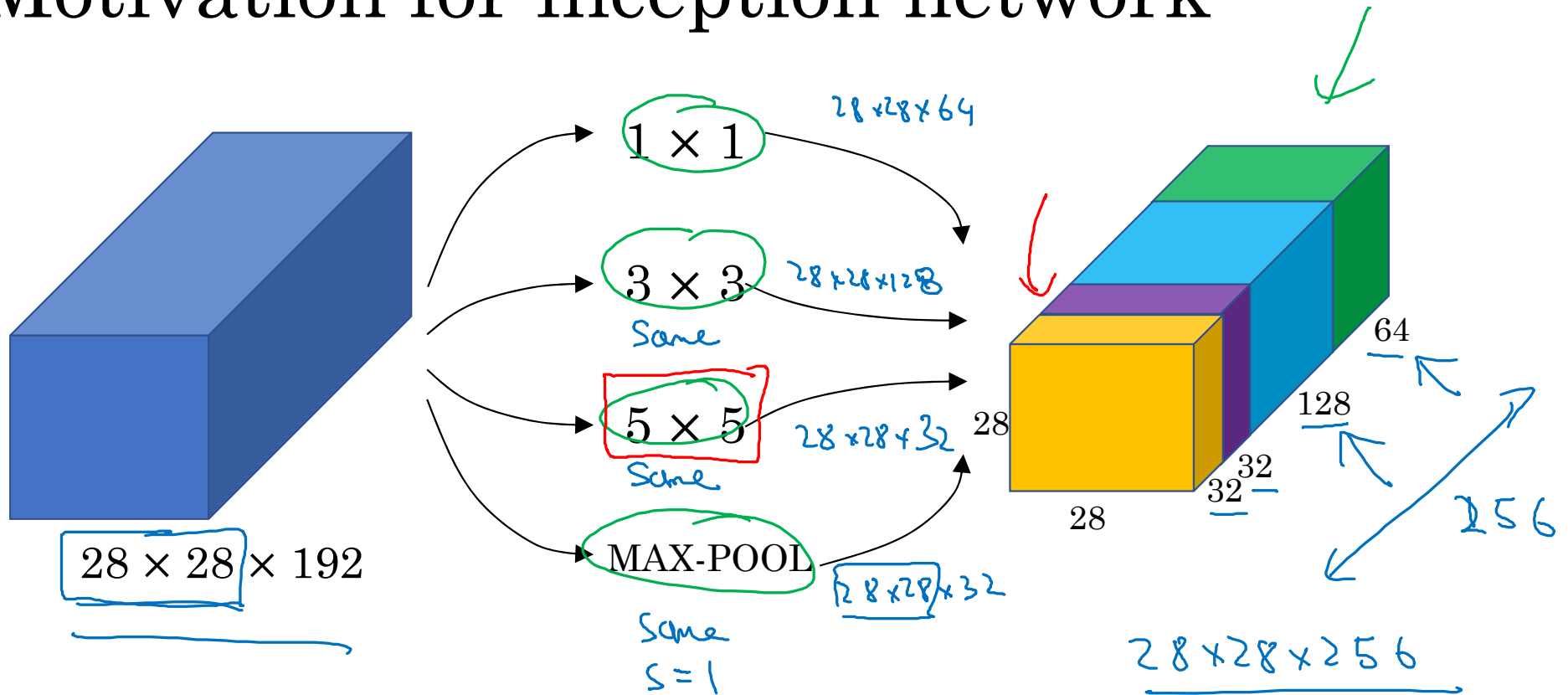


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Inception network motivation

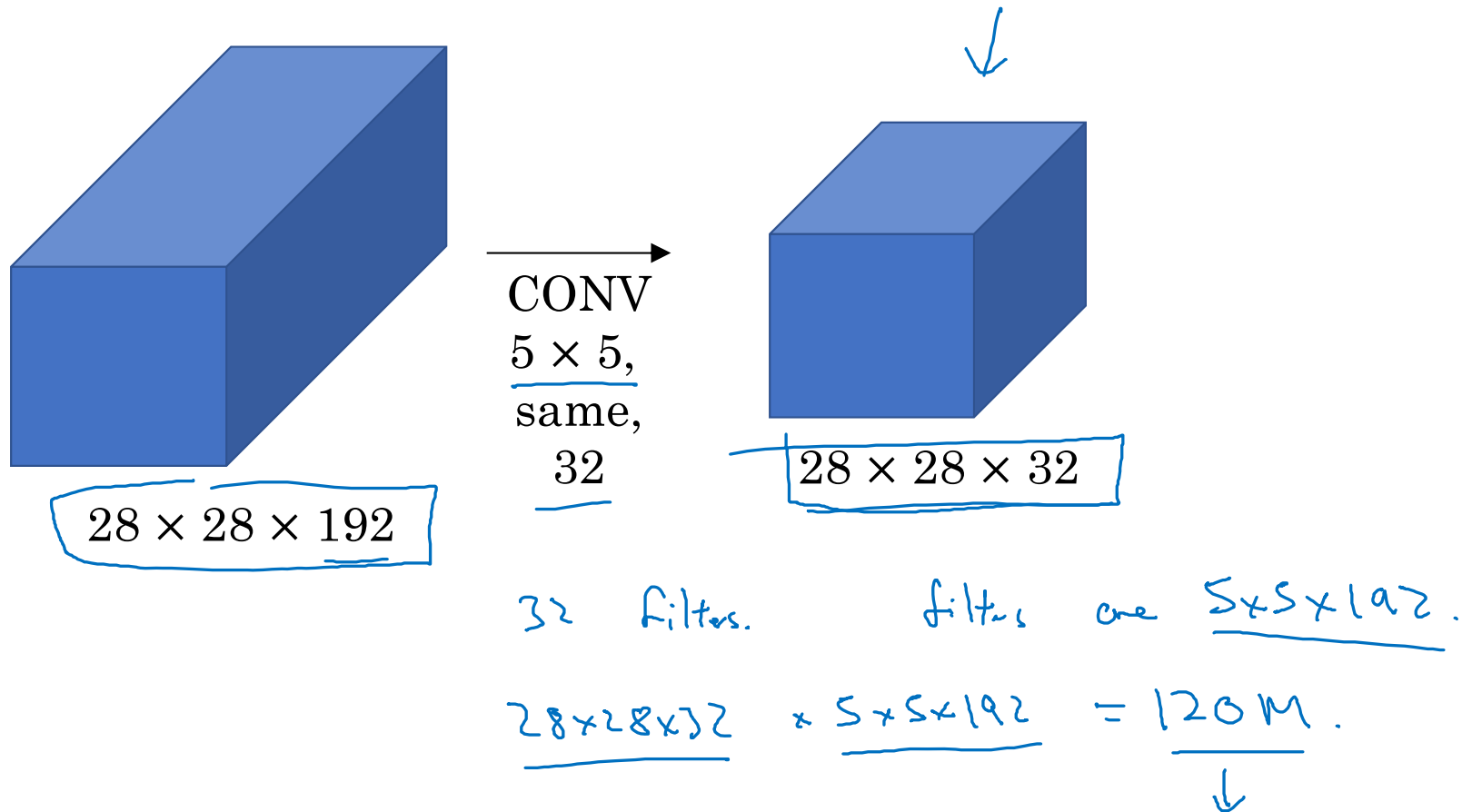
Motivation for inception network



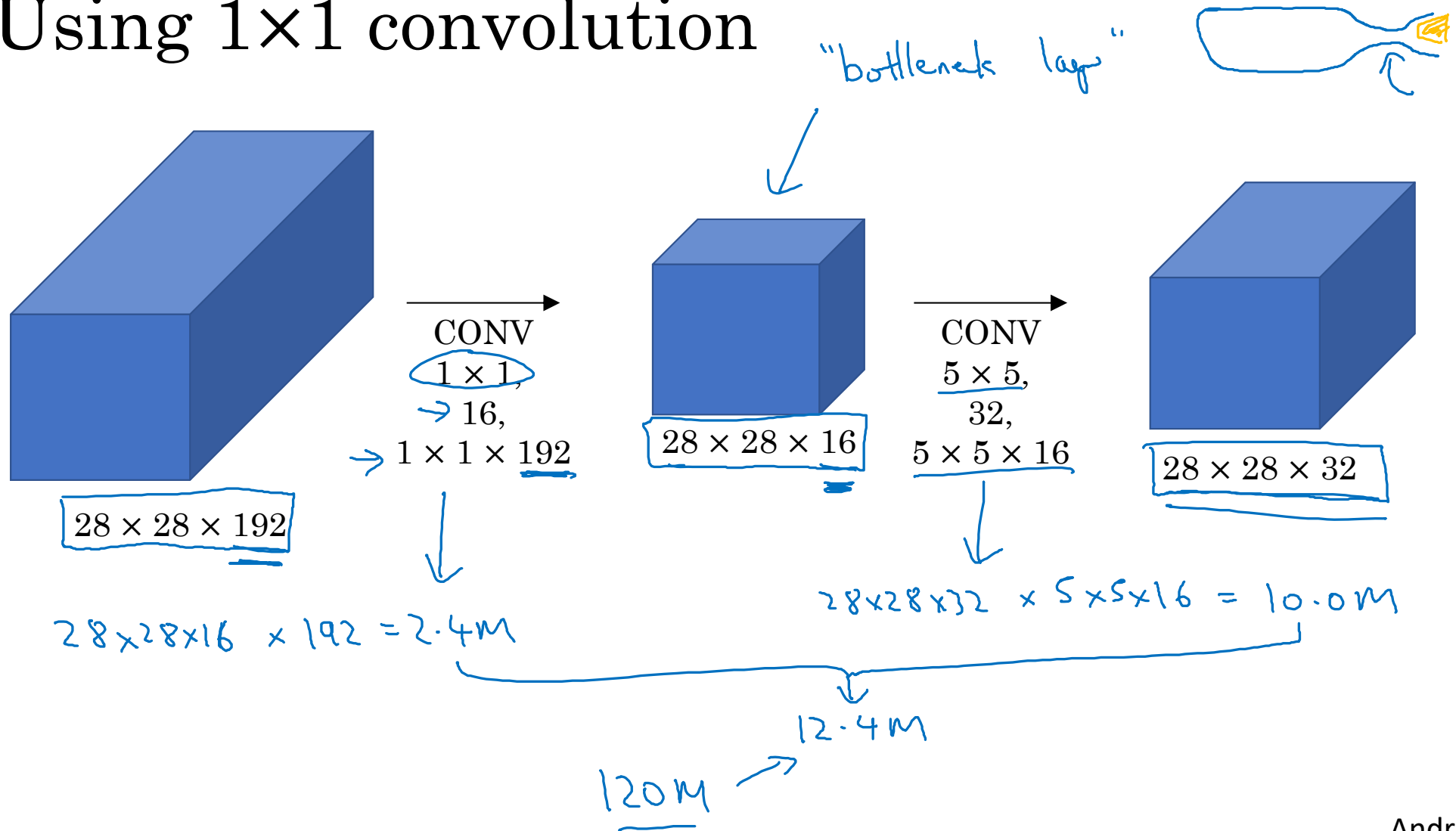
[Szegedy et al. 2014. Going deeper with convolutions]

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The problem of computational cost



Using 1×1 convolution



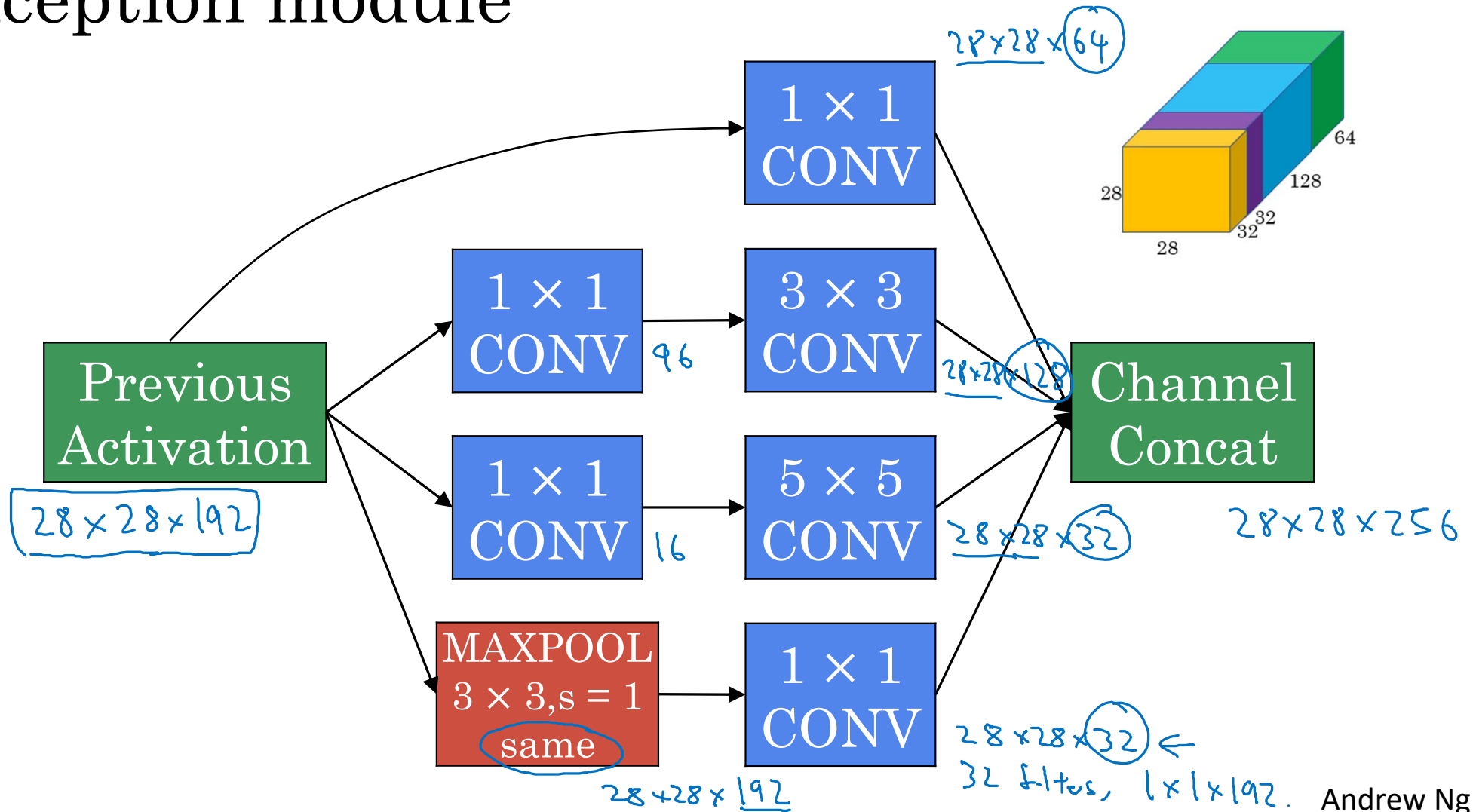


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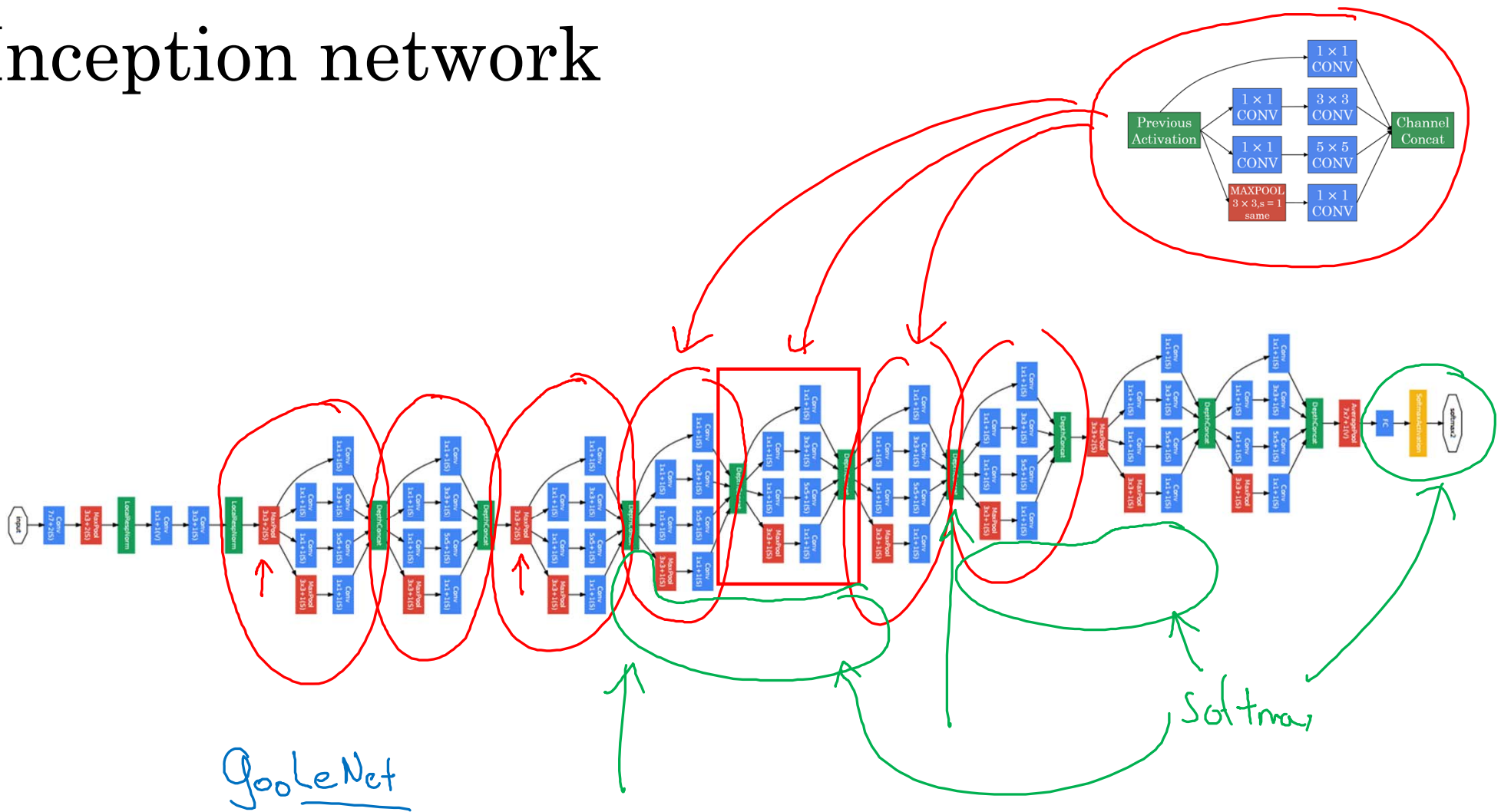
Case Studies

Inception network

Inception module



Inception network



[Szegedy et al., 2014, Going Deeper with Convolutions]

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<http://knowyourmeme.com/memes/we-need-to-go-deeper> 

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