

Convolutional neural networks

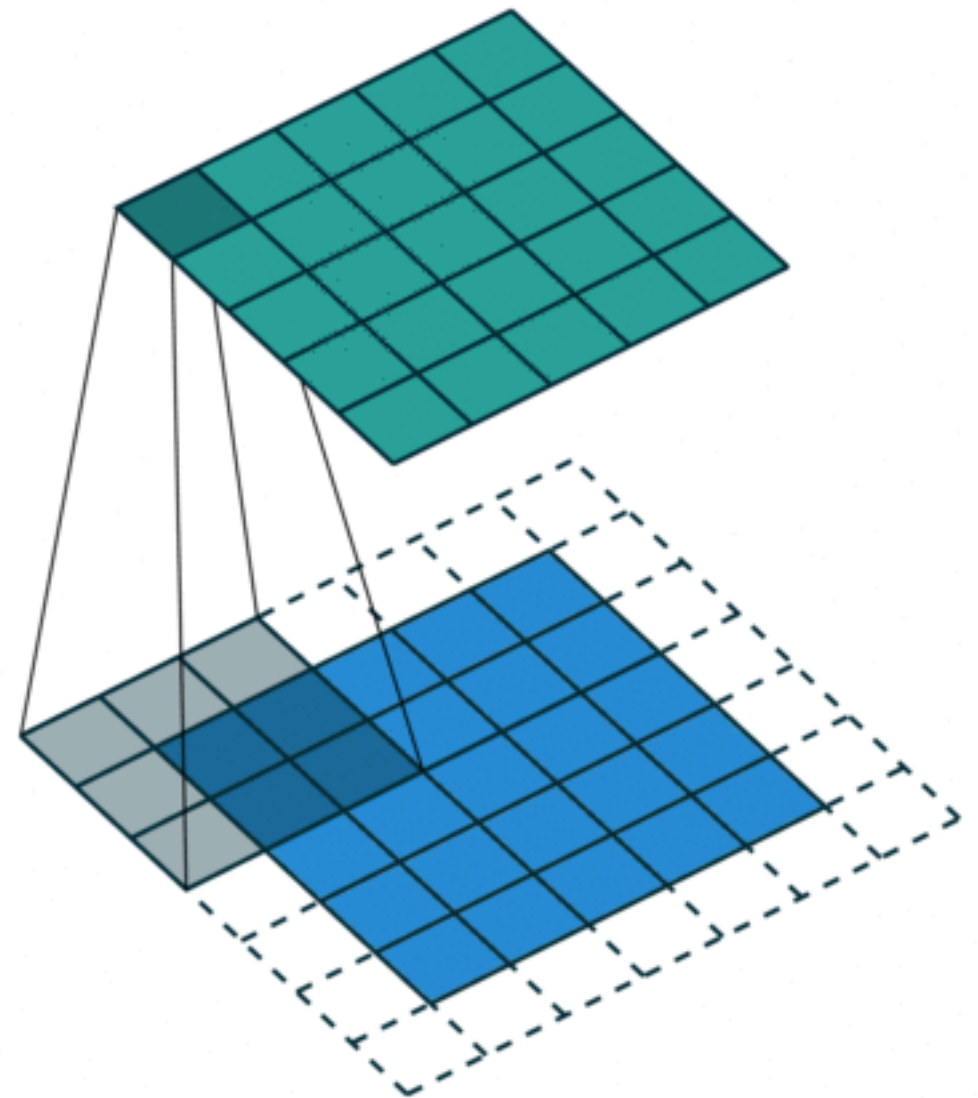
Romain Tavenard (Université de Rennes)

NB: Most figures in these slides are from
Dumoulin & Visin. A guide to convolution arithmetic for deep learning. 2016



The convolution operator

- 2D convolution
 - Blue: input image
 - Gray: convolution kernel
 - Cyan: activation map
- Convolution operation = Dot product between
 - convolution kernel (aka filter)
 - subpart of the input





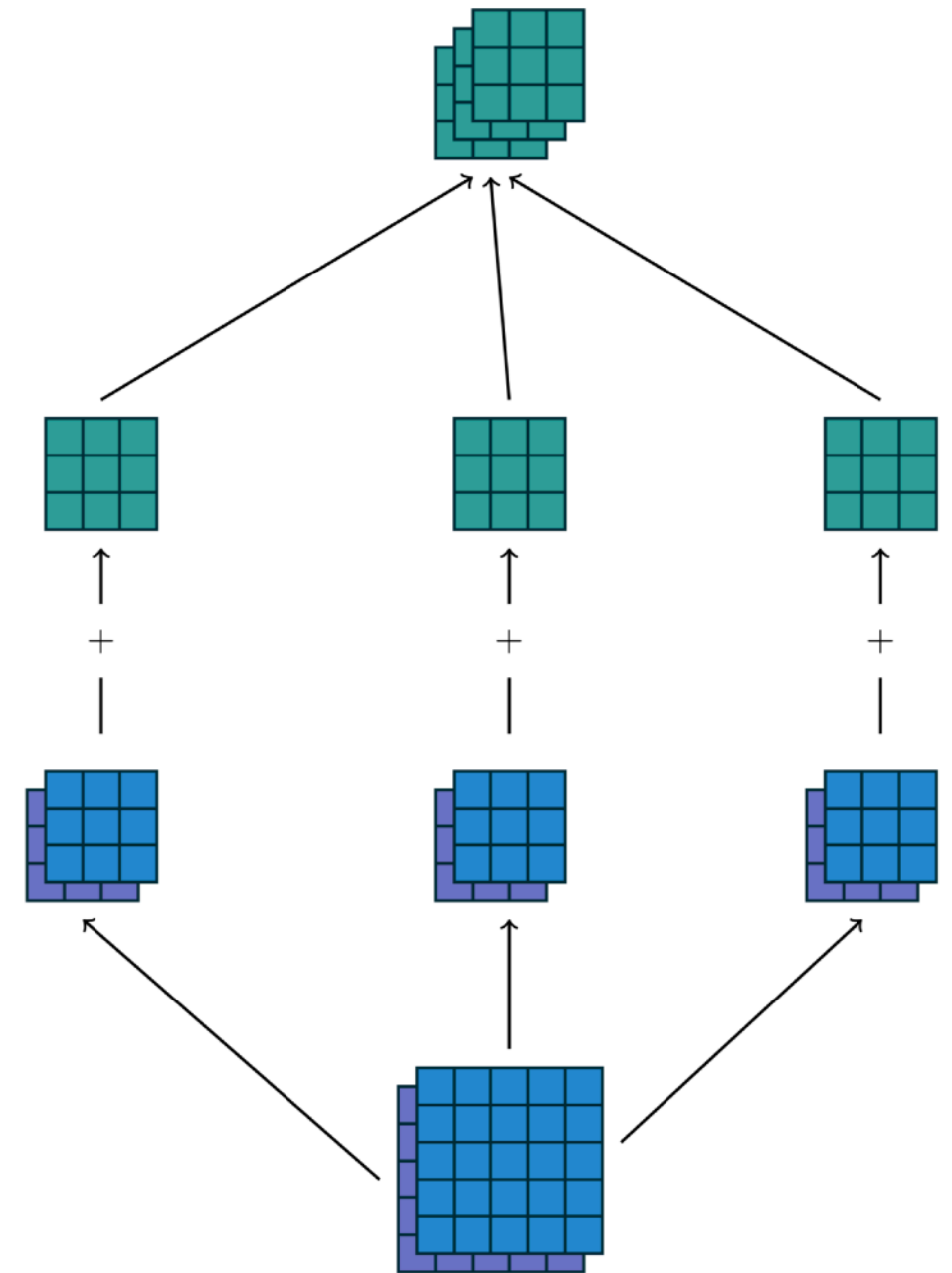
Convolutional layers in NN (1/2)

- A convolution layer is made of
 - convolution kernels
 - biases (1 per kernel)
 - an activation function
- Useful because
 - reduces #parameters
 - encodes translation invariance

Convolutional layers in NN (2/2)



- Multiple input channel case
 - sum the response over all channels
- Multiple kernel case
 - each kernel leads to one output channel

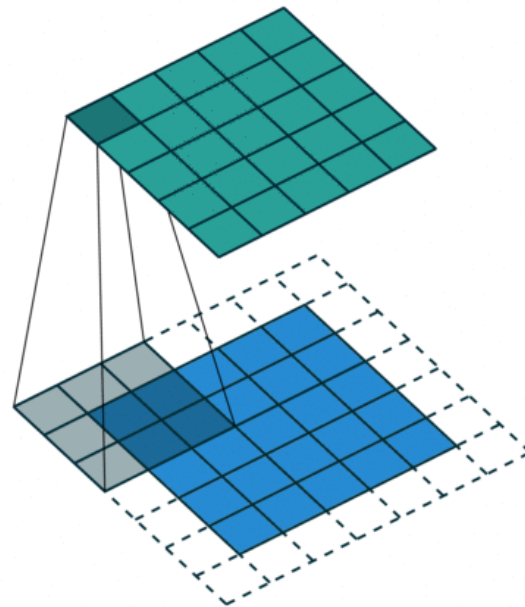


2 input channels, 3 kernels

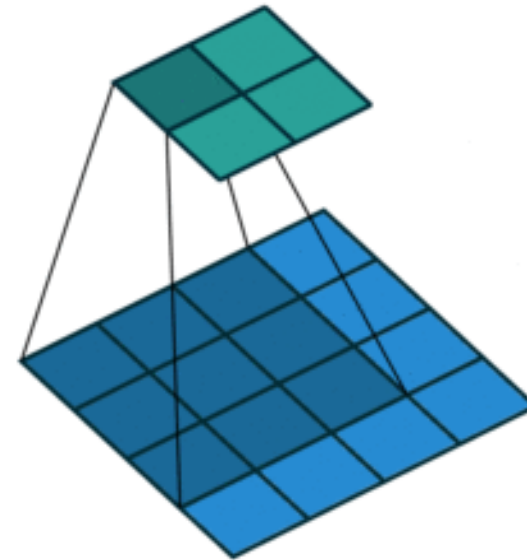
Convolutional layers in NN: hyper parameters



- Padding

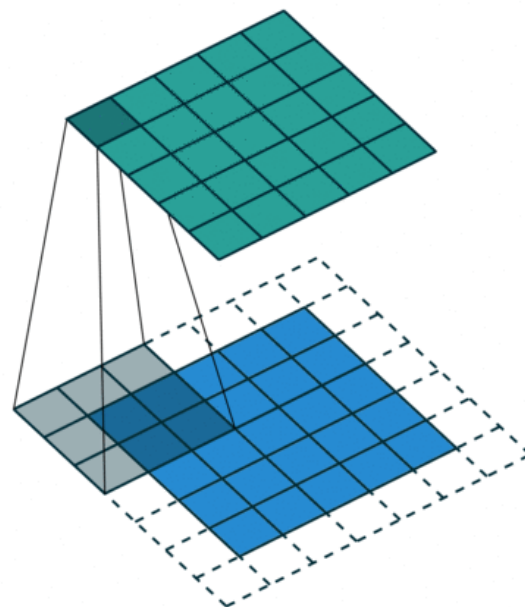


padding="same"

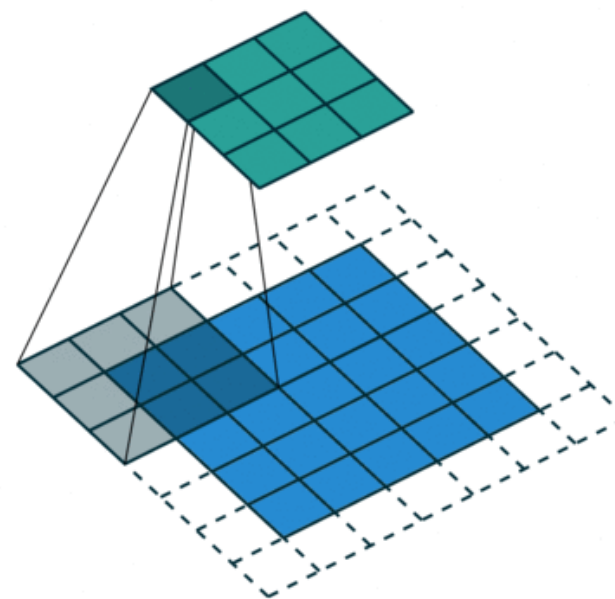


padding="valid"

- Strides



strides=1



strides=2



Pooling (aka subsampling) layers in NN

- Max pooling / Average pooling
- Hyper-parameters
 - pool size
 - strides (use None in keras)
 - padding (use "valid" in keras)

3	3	2	1	0
0	0	1	3	1
3	1	2	2	3
2	0	0	2	2
2	0	0	0	1

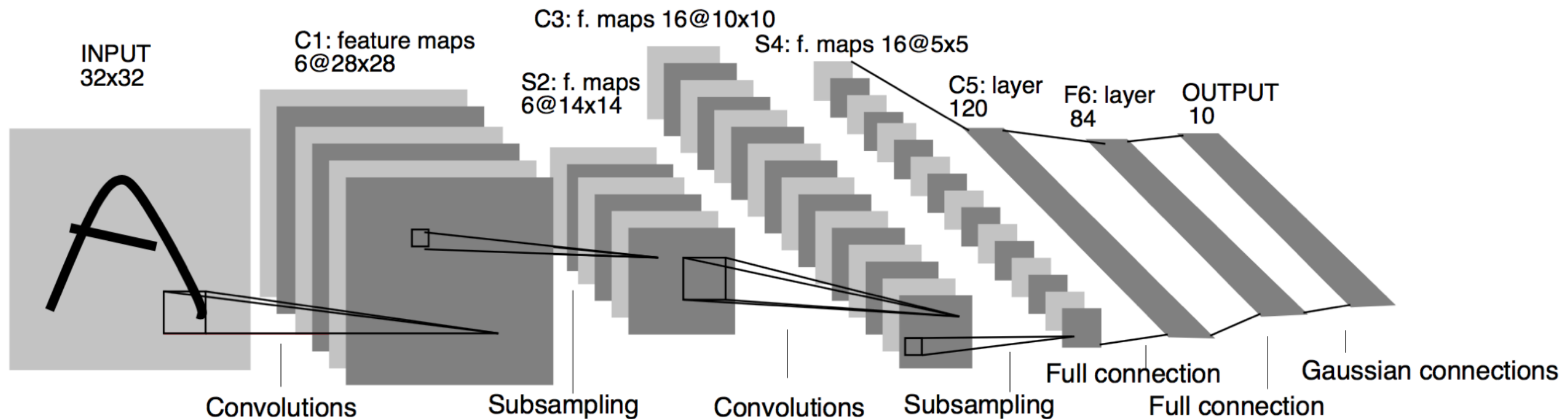
3.0	3.0	3.0
3.0	3.0	3.0
3.0	2.0	3.0

pool_size=3, strides=1
(not recommended)

Convolutional model zoo

1. LeNet [LeCun *et al.*, 1989]

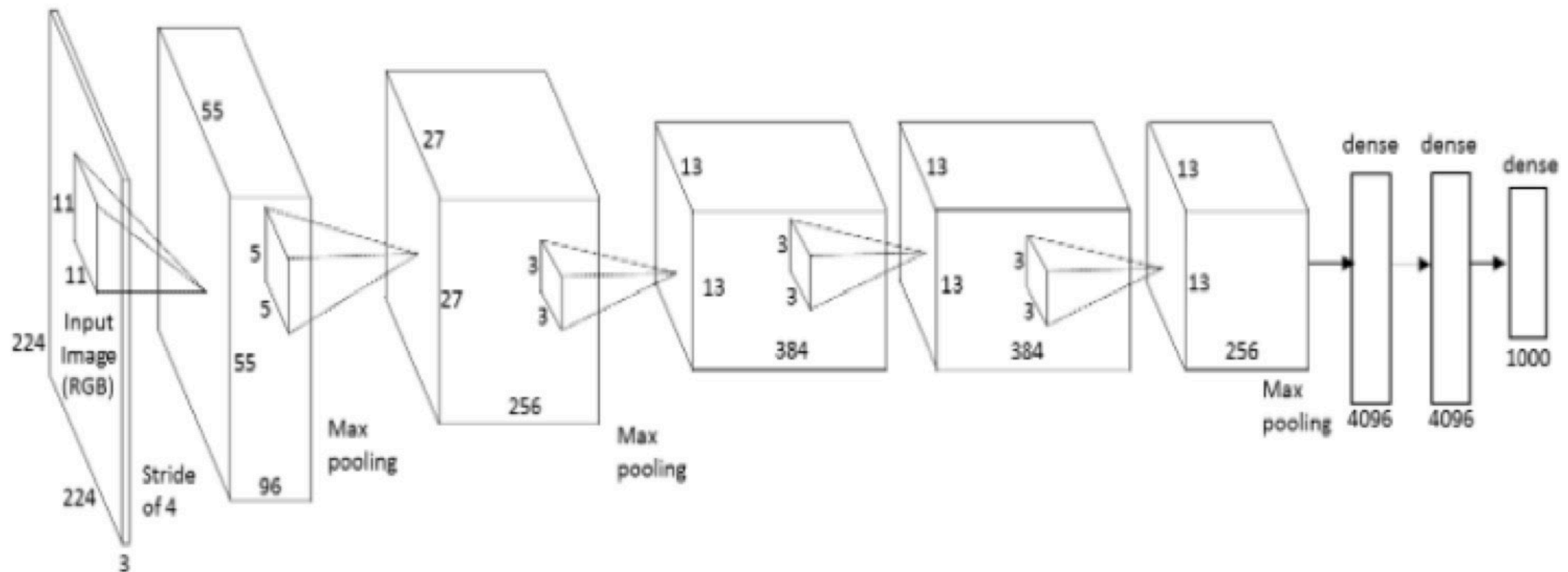
- 60k parameters



Convolutional model zoo

2. AlexNet [Krizhevsky *et al.*, 2012]

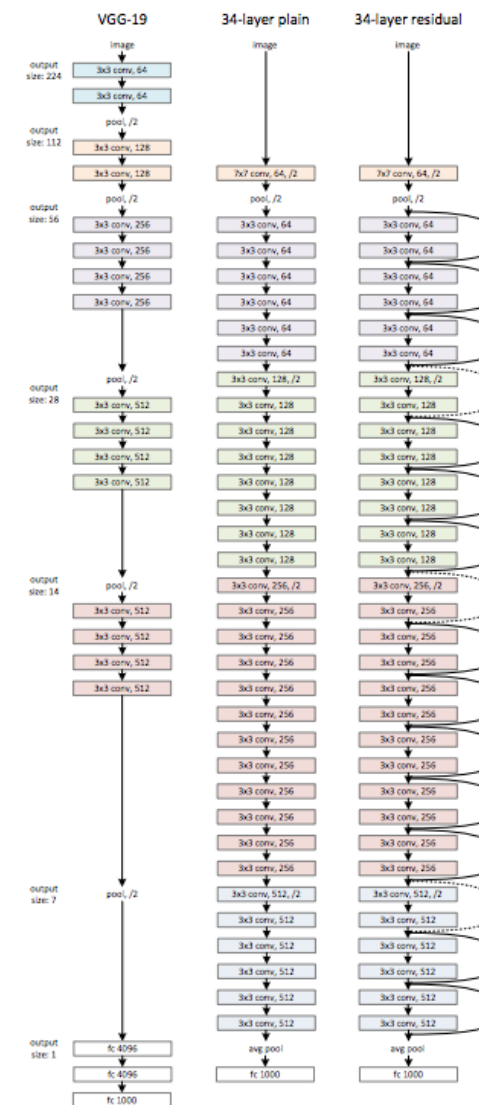
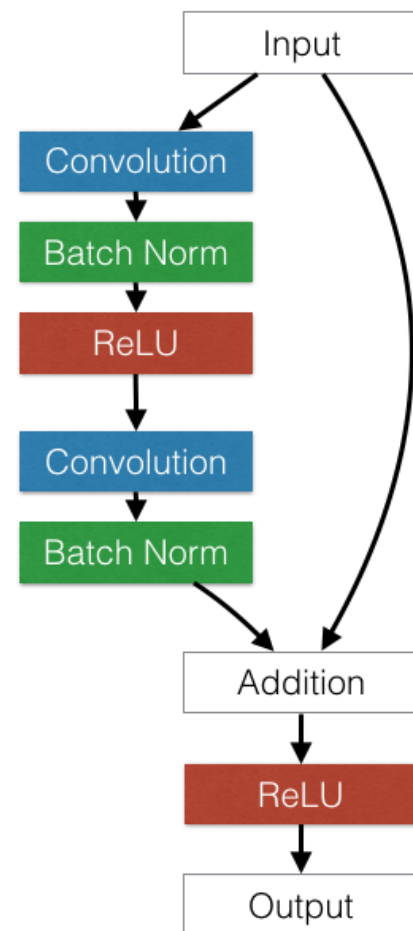
- 60M parameters



Convolutional model zoo

3. Residual Networks [He *et al.*, 2016]

- Aims at facing the *vanishing gradient* effect
- ResNet-110: ~2M parameters



Q: How do I know what architecture to use?

A: don't be a hero.

1. Take whatever works best on ILSVRC (latest ResNet)
2. Download a pretrained model
3. Potentially add/delete some parts of it
4. Finetune it on your application.



Andrej Karpathy,
Deep Learning Summer School,
2016