CNNS

IMAGES AS FEATURES

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`WiFi : SG-Guest`

Problems with Installation? **ASK!**

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PLAN OF ACTION

TODAY

- Start with project wrap-up
- CNN Basics
- CNN code / experimentation

PLAN OF ACTION

WEDNESDAY

- CNNs on speech data
- Launch into a CNN mini-challenge
  Discuss Final Project ideas
- Value of the feature layer

"HELLO WORLD" → MNIST

- Nice dataset from the late 1980s
- Set of 70,000 28x28 images :
  - Training / Validation / Test = 50k / 10k / 10k
- Now end-of-life as a useful benchmark

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IMAGE CLASSIFICATION

In 2012, Deep Learning started to beat other approaches...

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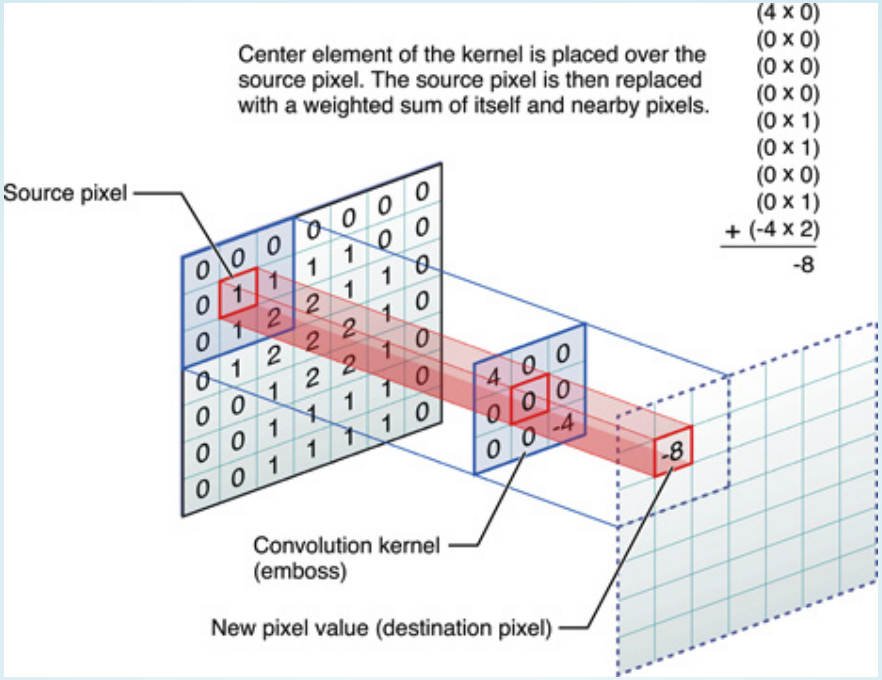
WHAT IS A CNN?

- Pixels in an images are 'organised' :
  - Up/down left/right
  - Translational invariance
- Idea : Use whole image as feature
  - Update parameters of 'Photoshop filters'
- Mathematical term : 'convolution kernel'
  - CNN = Convolutional Neural Network

CNN FILTER



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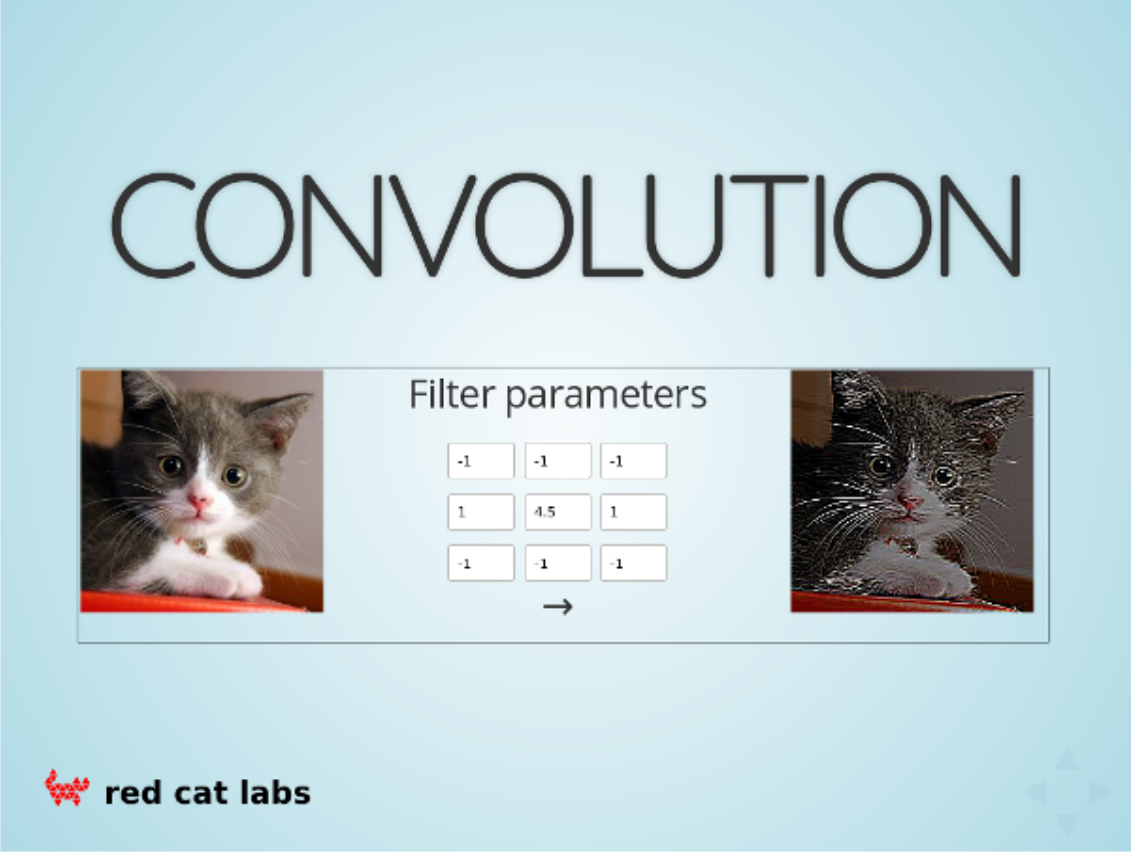
PLAY WITH A FILTER



http:// RedCatLabs.com / c

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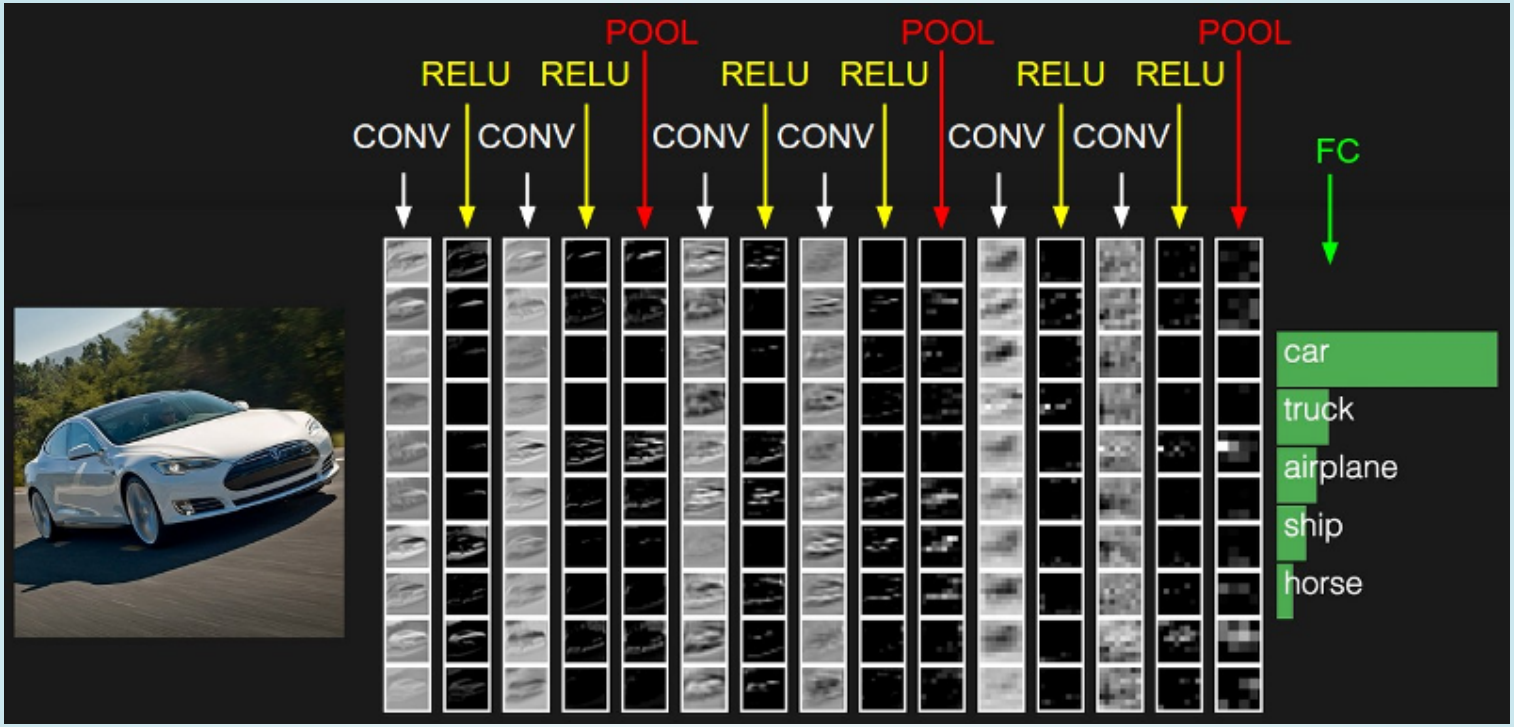
CNN FLOW



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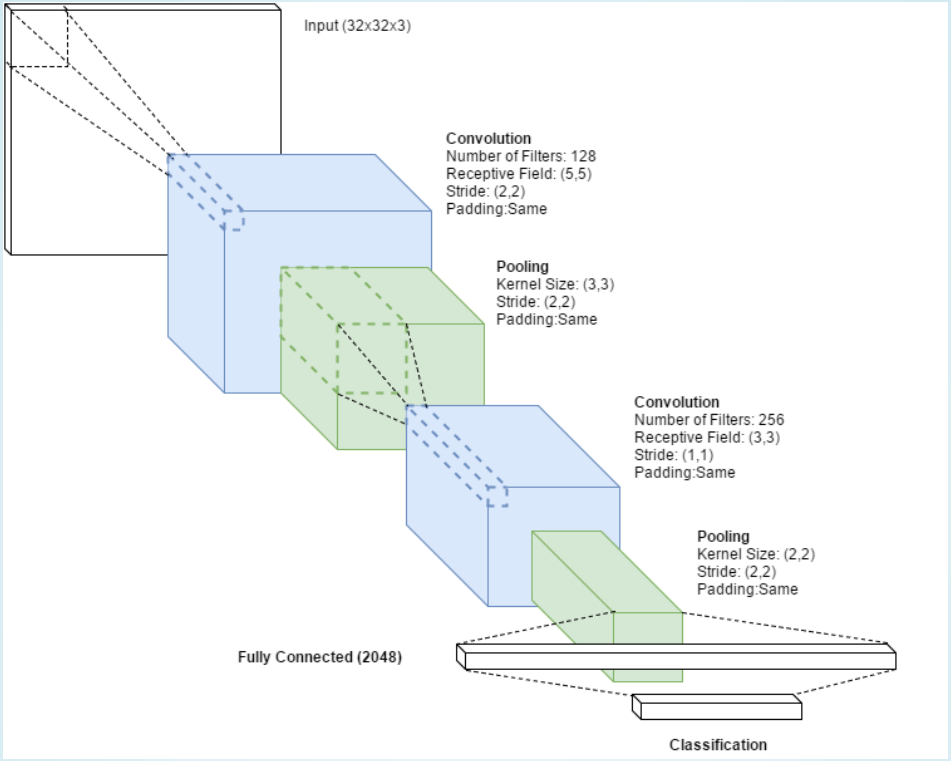
CNN DETAILS

- Some more jargon :
  - Kernel shapes, strides, padding
  - Pooling
  - Receptive field
  - With/without Dense layer

CNN PARAMS




```
hidden1 = Conv2D(128, 5, strides=(2, 2), padding='same')( input )
```

See also this notebook

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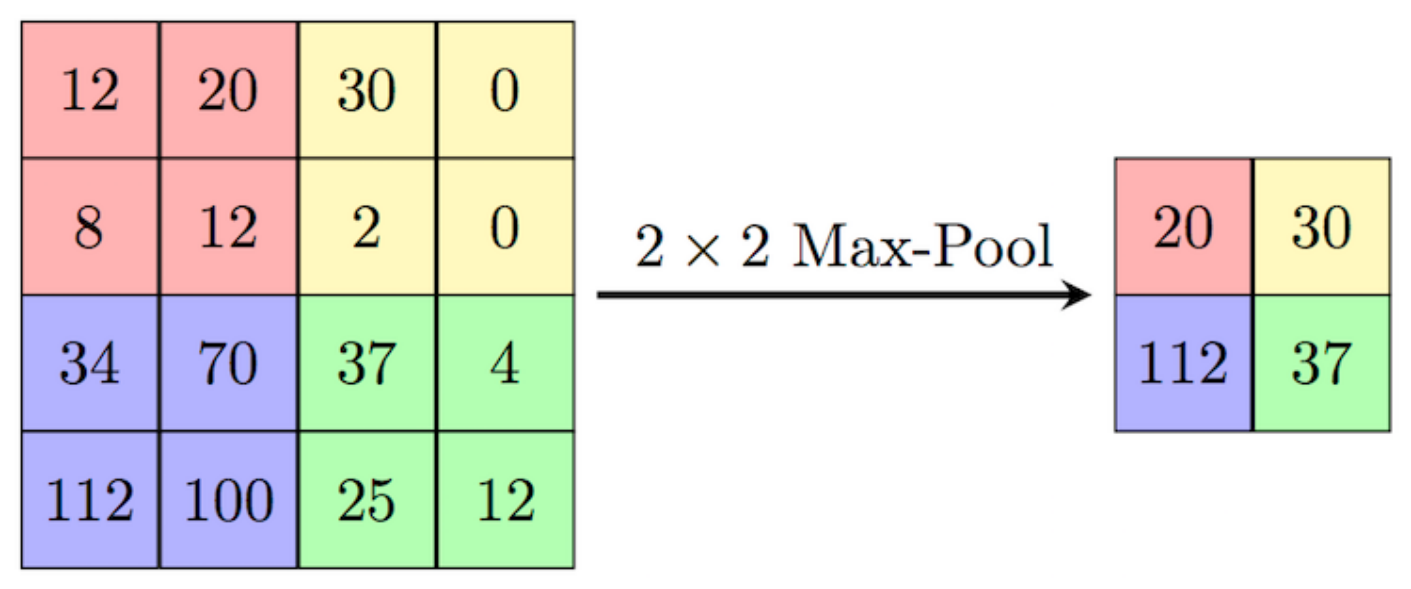
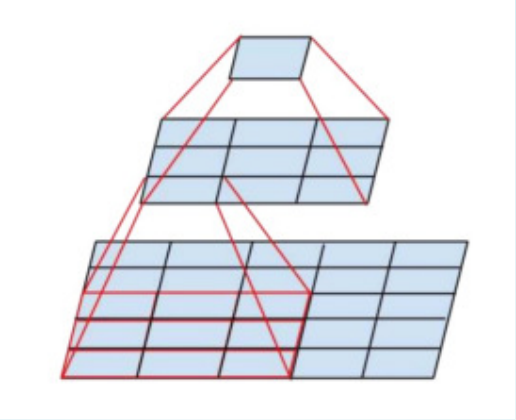
POOLING



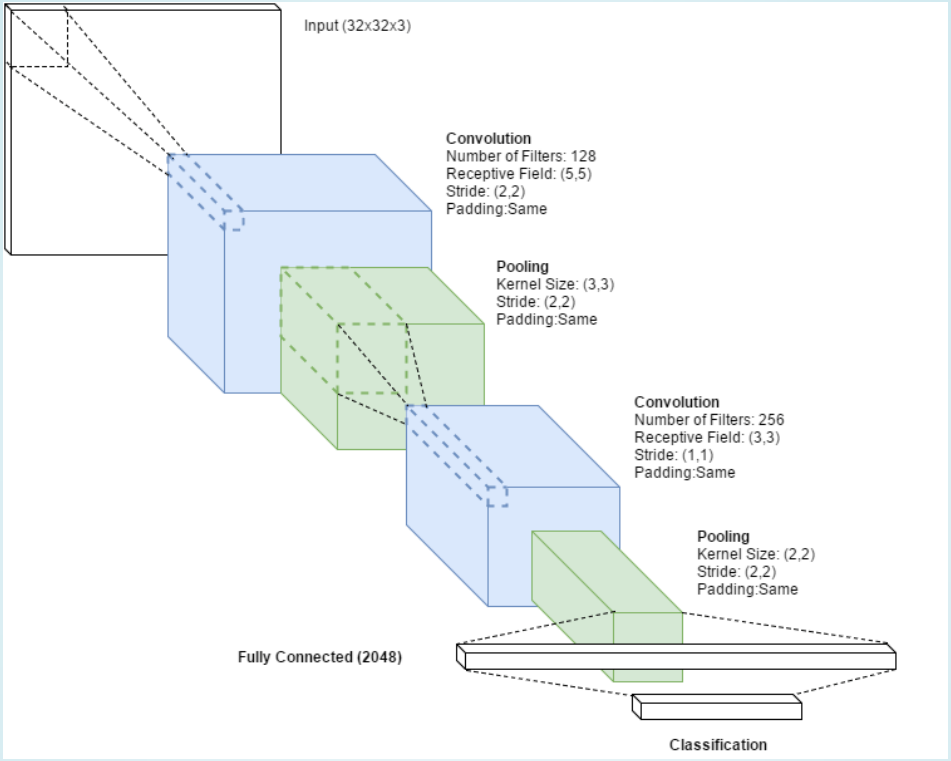

```
hidden2 = MaxPooling2D( pool_size=(2, 2) )( hidden1 )
```

RECEPTIVE FIELD



2 x (3x3) < (5x5)

DENSE & SOFTMAX




```
output = Softmax()(Dense(1000)(Dense(2048, activation='relu')( hidden6 )))
```

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FOCUS ON CHANNELS

- Each layer has channels
  - eg: First image layer = 3 channels (R, G and B)
- Each channel depends on all channels in previous layer

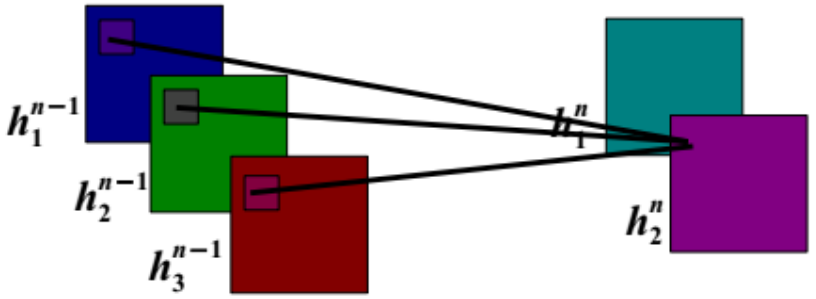
CNN EQUATIONS

$$h_j^n = max\left(0, \sum_{k=1}^{K} h_k^{n-1} * w_{kj}^n\right)$$

output feature map

input feature map

kernel



CNN DIAGRAM

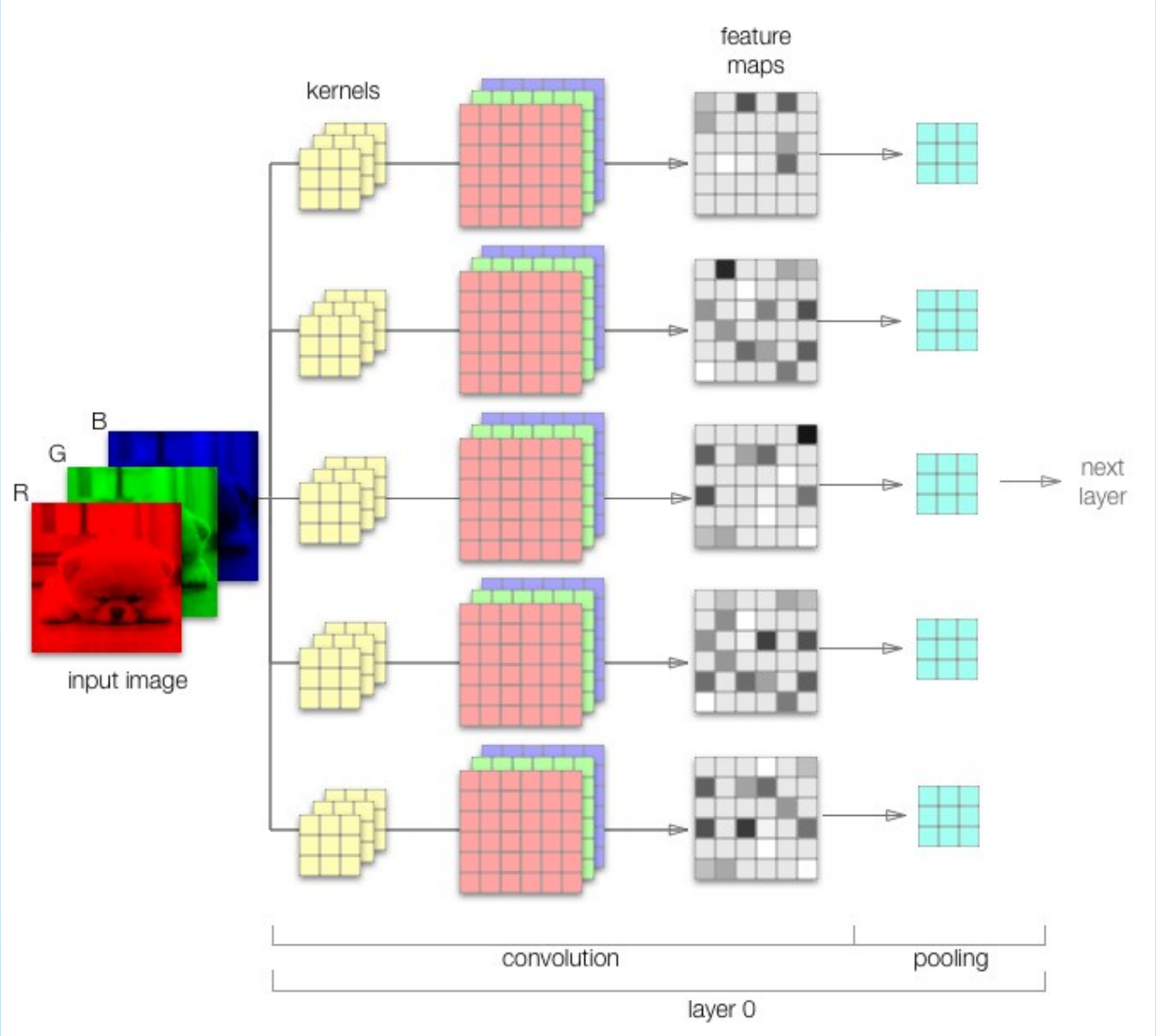


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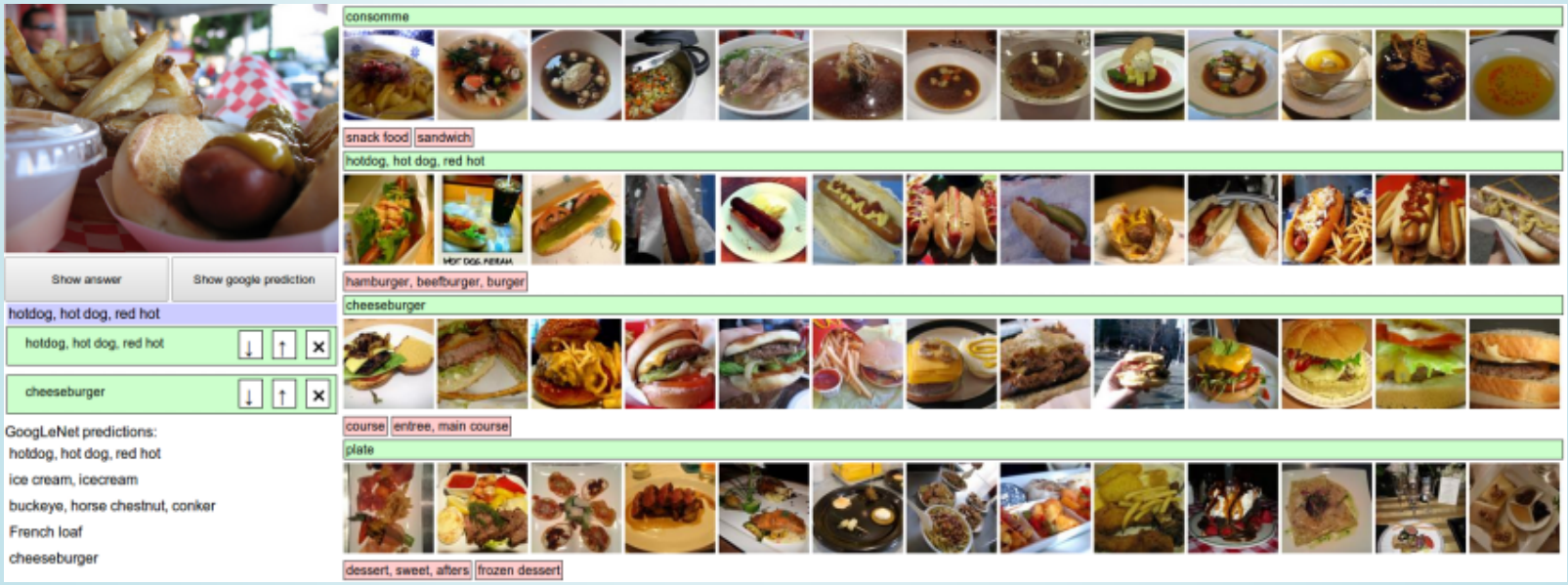
IMAGE COMPETITION

- ImageNet aka ILSVRC
- over 15 million labeled high-resolution images...

  ... in over 22,000 categories



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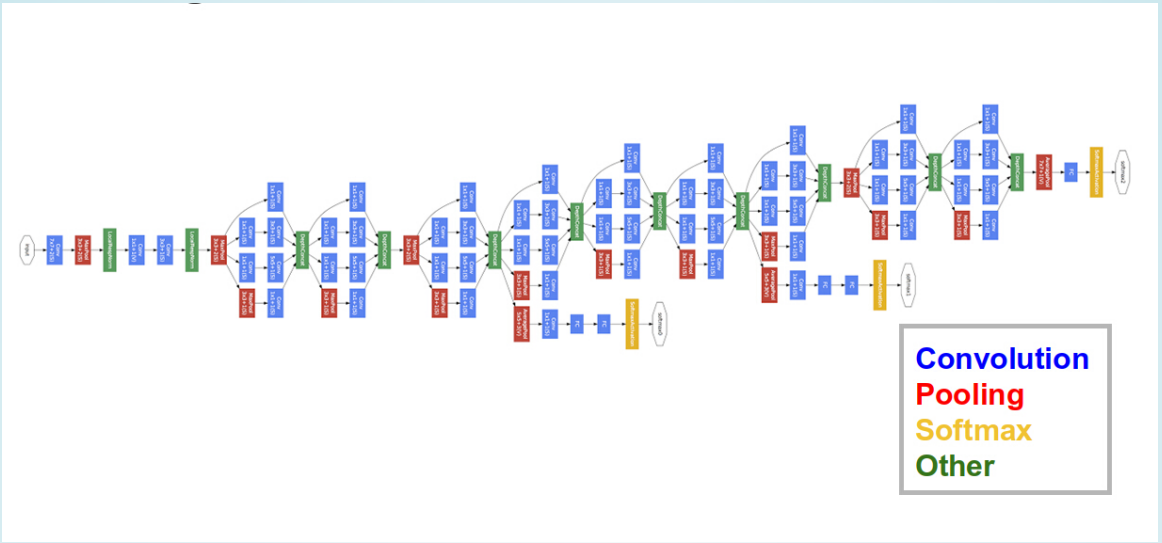
MORE COMPLEX NETWORKS



GoogLeNet (2014)

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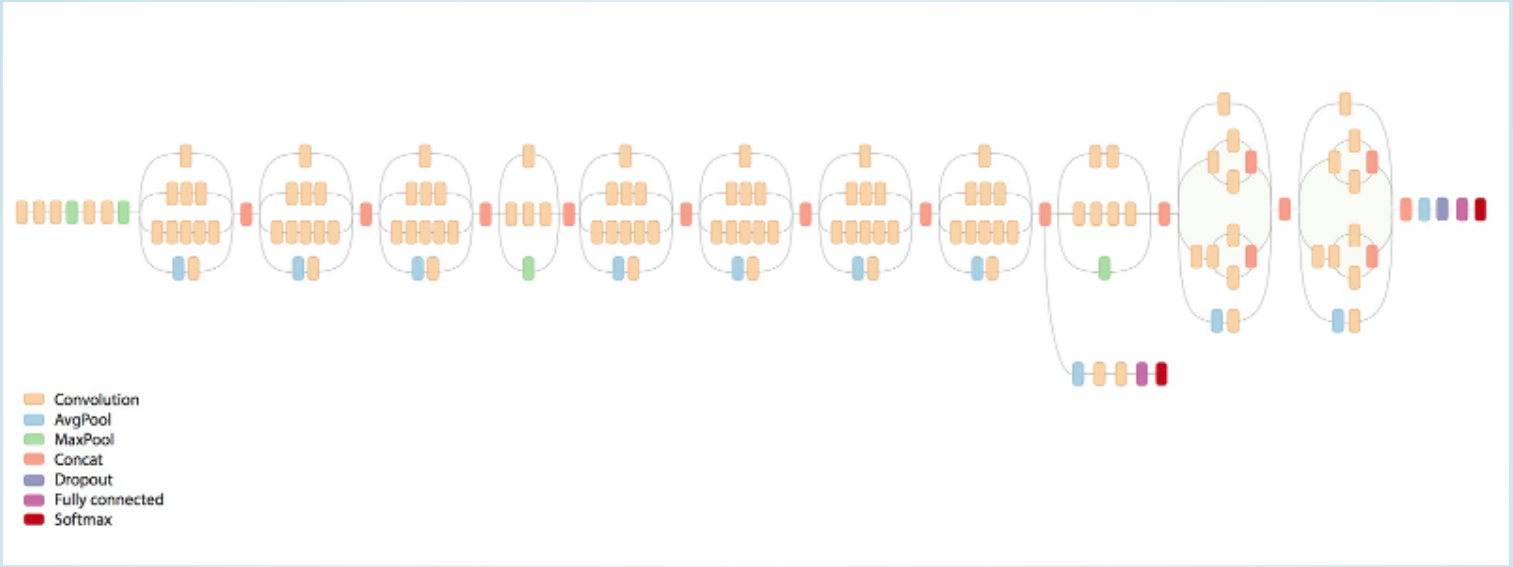
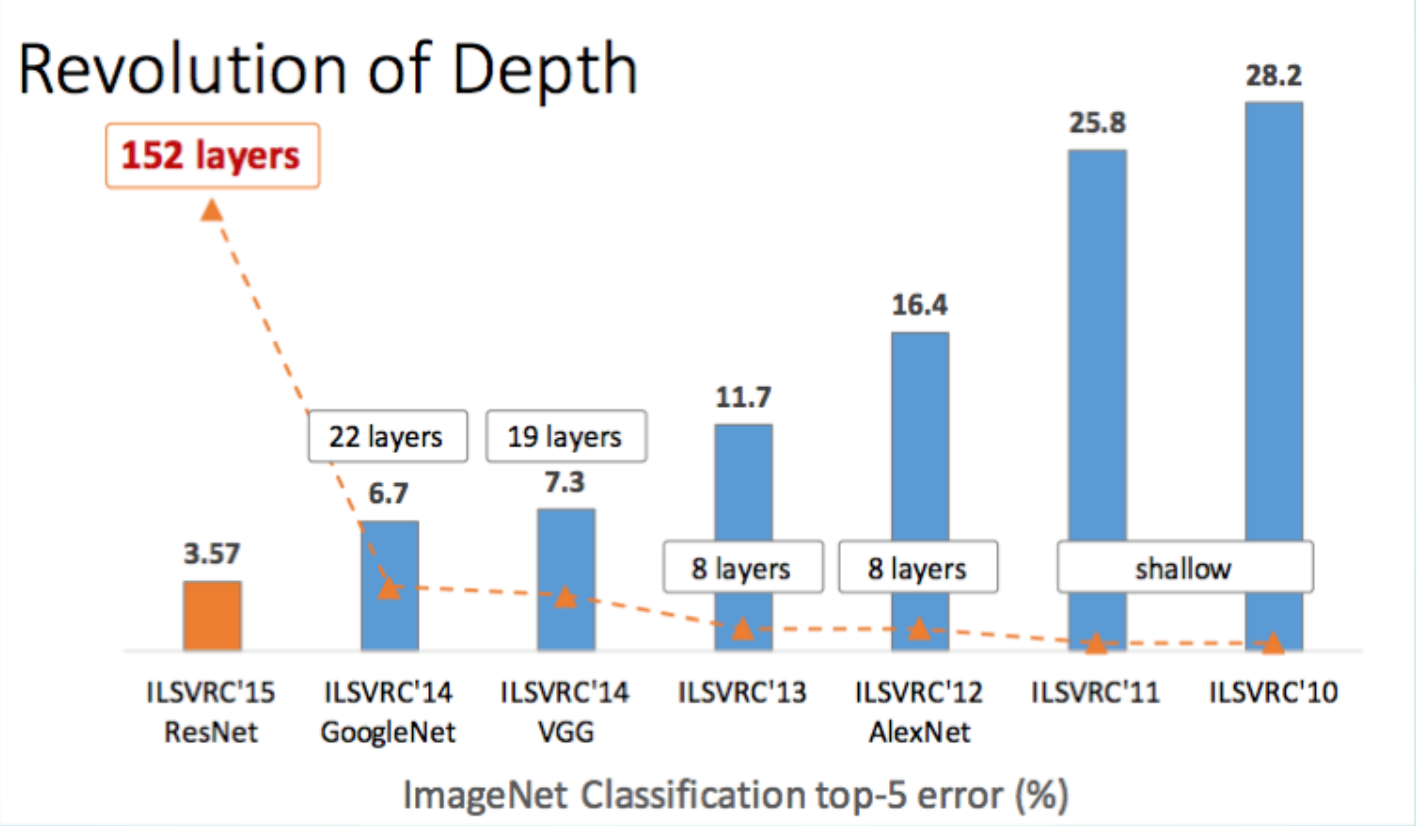
... AND DEEPER



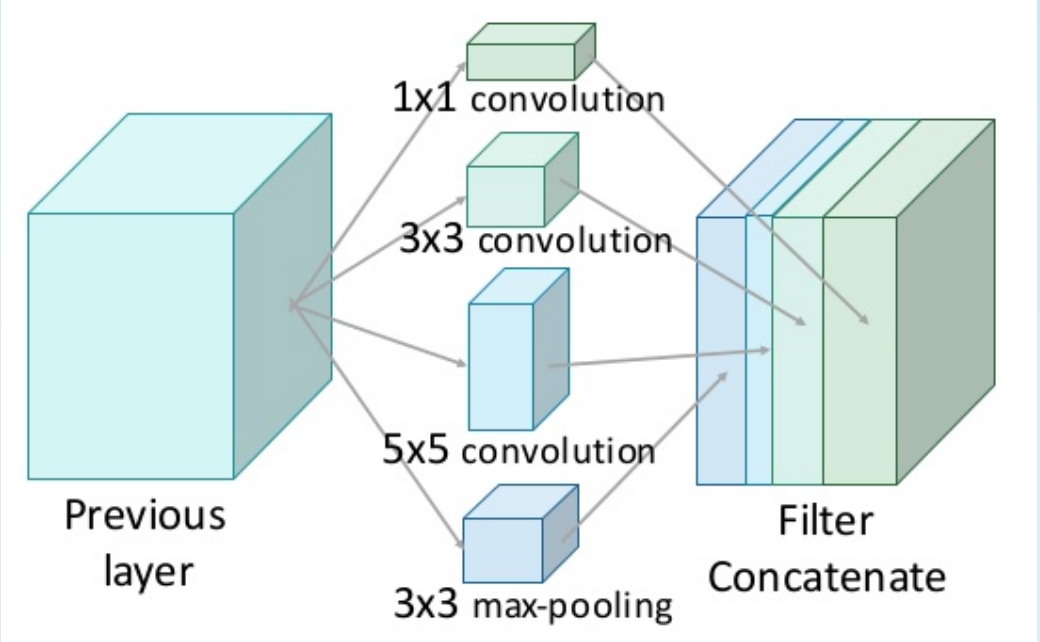
Google Inception-v3 (2015)

DEPTH / TIME / RESULTS



Microsoft ResNet (2015)

INCEPTION MODULE



... just the beginning of variations

- QUESTIONS -

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My blog : http://mdda.net/

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