Lecture 09 – Deep Learning and CNNs

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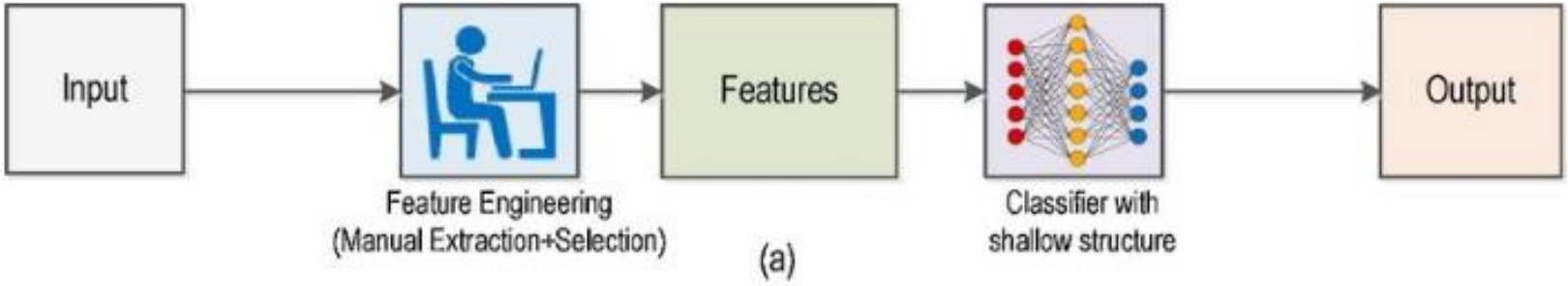
Topics

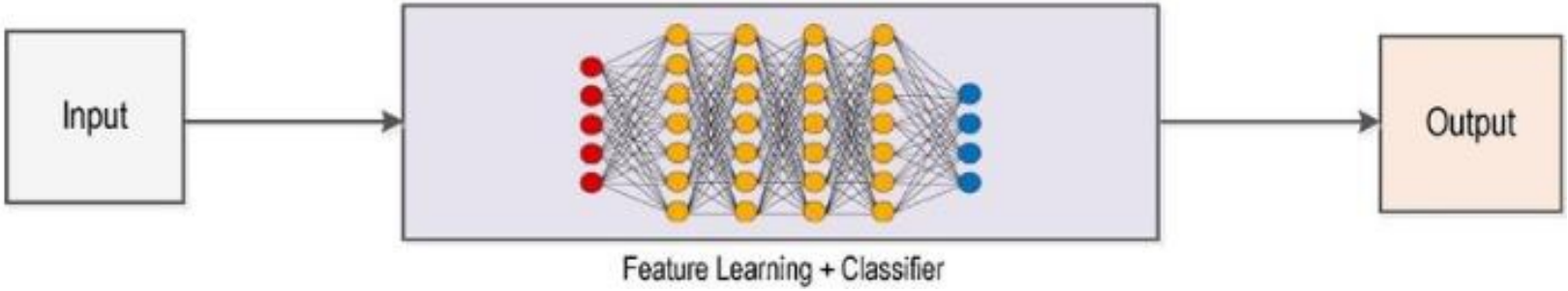
- Discussion of Simpsons Classification
- Deep Learning
- Convolutional Neural Network
  - Lenet
  - Imagenet
  - Deep Networks
- Practice

Traditional and Deep Learning

- Traditional

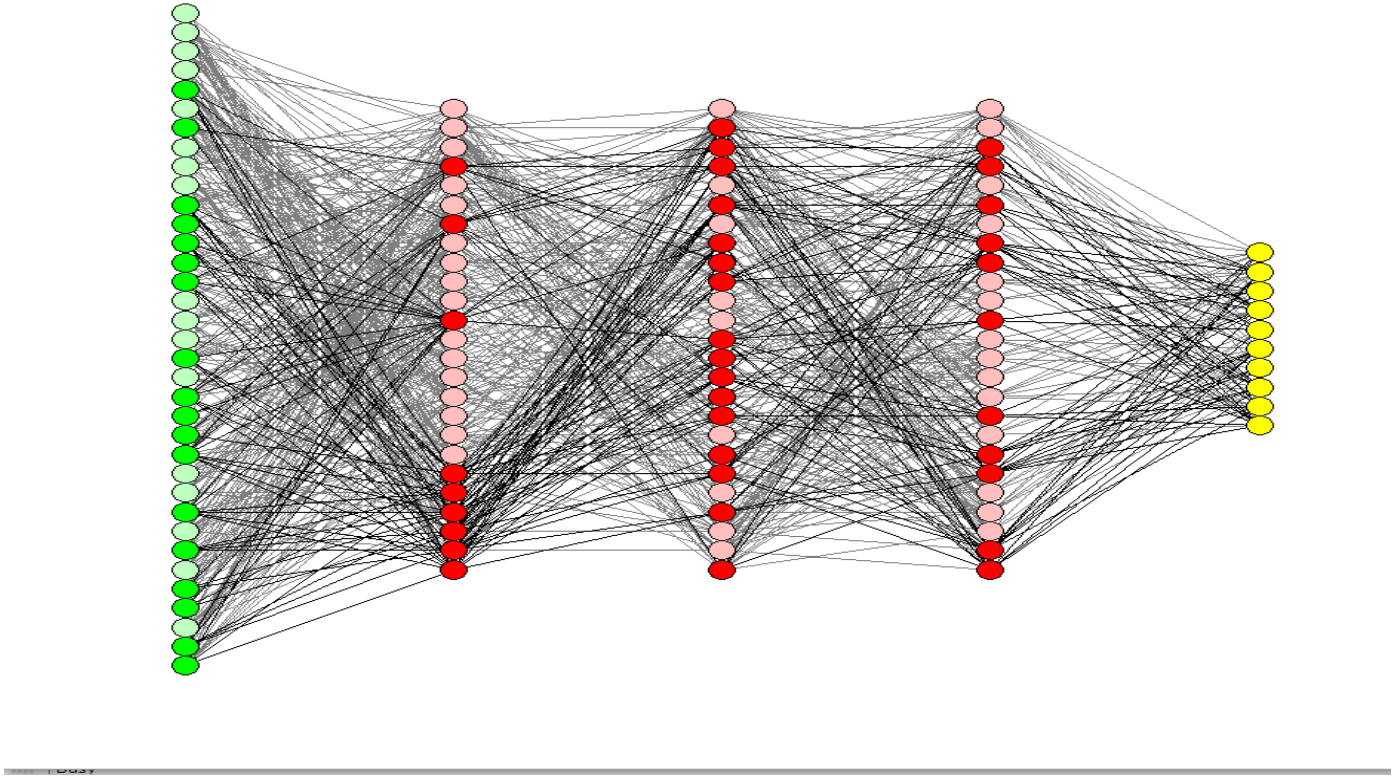


- Deep



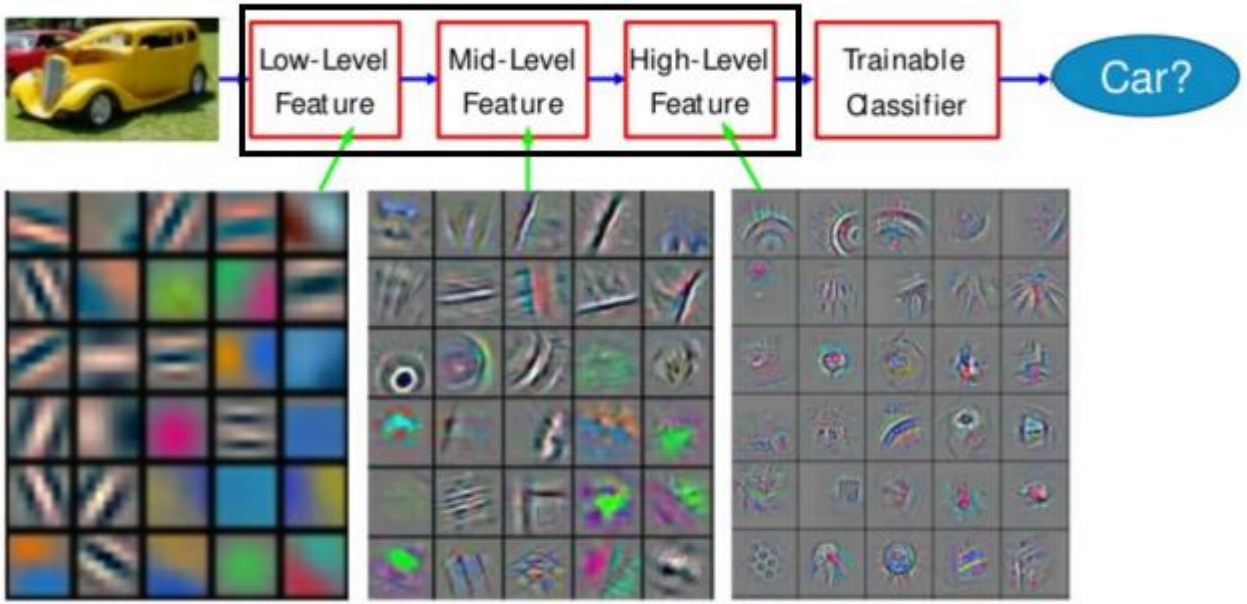
Deep Learning

- Dense Multi-Layer Architectures



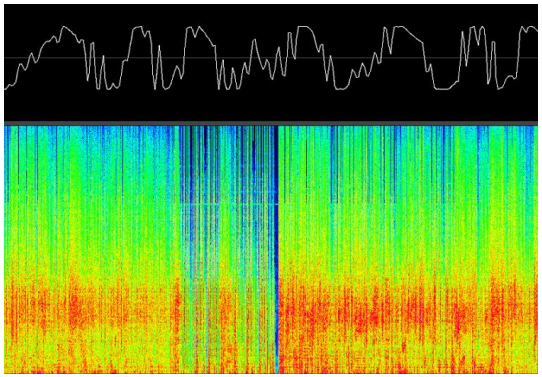
Deep Learning

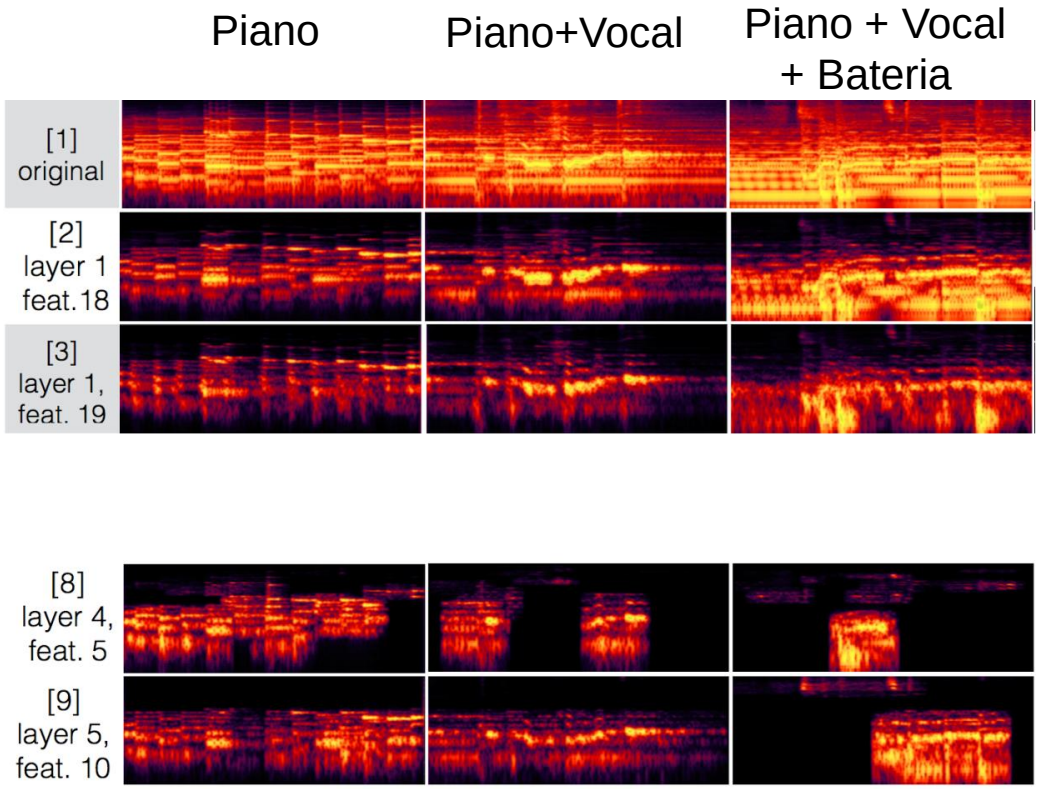
- Implicit feature extraction
- Learnable Filters
- Deep Abstraction



Deep Learning

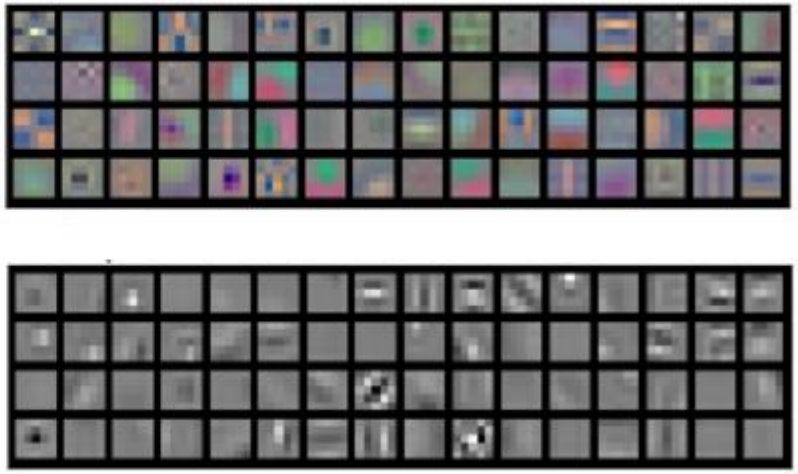
- Wide applied in the Computer Vision area (audio, images, video processing, etc.).





Deep Learning

- Tissue Classification
- Medical Images



Deep Learning

- Face

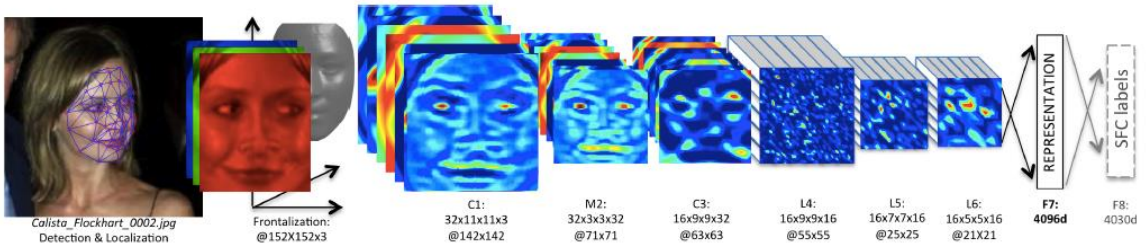
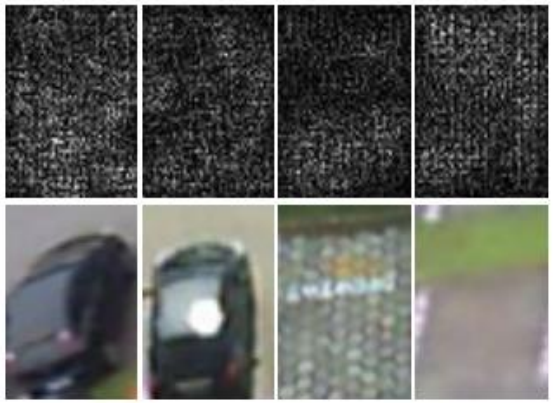


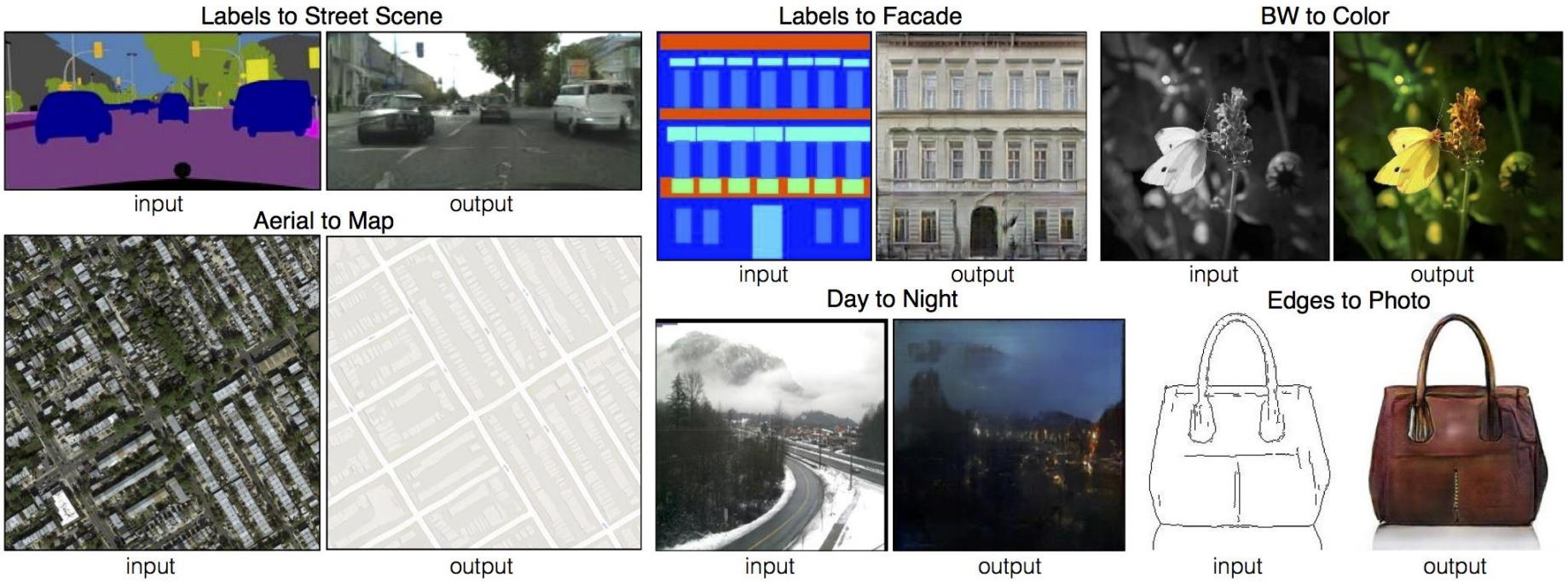
Figure 2. **Outline of the *DeepFace* architecture**. A front-end of a single convolution-pooling-convolution filtering on the rectified input, followed by three locally-connected layers and two fully-connected layers. Colors illustrate outputs for each layer. The net includes more than 120 million parameters, where more than 95% come from the local and fully connected layers.

- PKLot



Deep Learning

- Image Translation



Deep Learning

- Deep Fakes

https://www.youtube.com/watch?v=mUfJOQKdtAk

Deep Learning

Pros

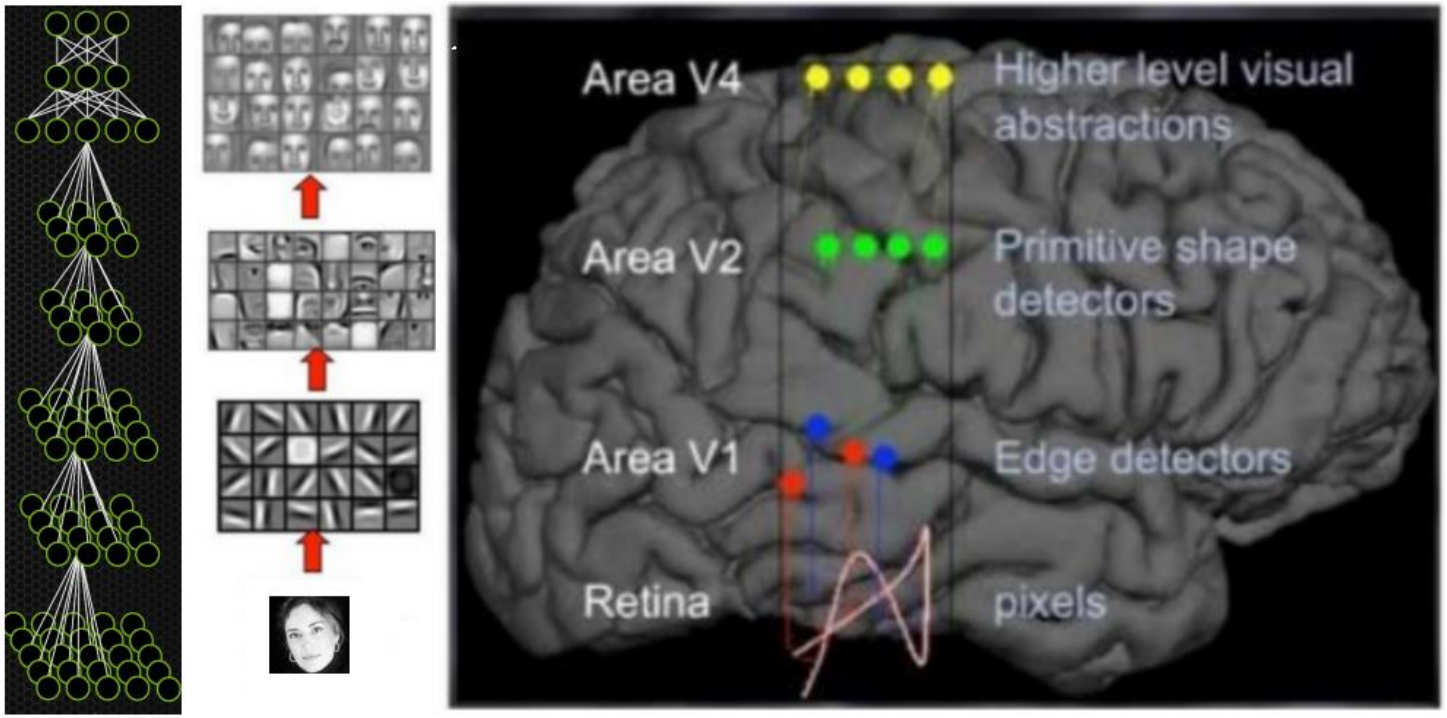
- Enables learning of features rather than hand tuning
- Impressive performance gains on
  - Computer vision
  - Speech recognition
  - Some text analysis
- Potential for much more impact

Cons

- Computationally really expensive
- Requires a lot of data for high accuracy
- Extremely hard to tune
  - Choice of architecture
  - Parameter types
  - Hyperparameters
  - Learning algorithm
  - …
- Computational + so many choices = incredibly hard to tune

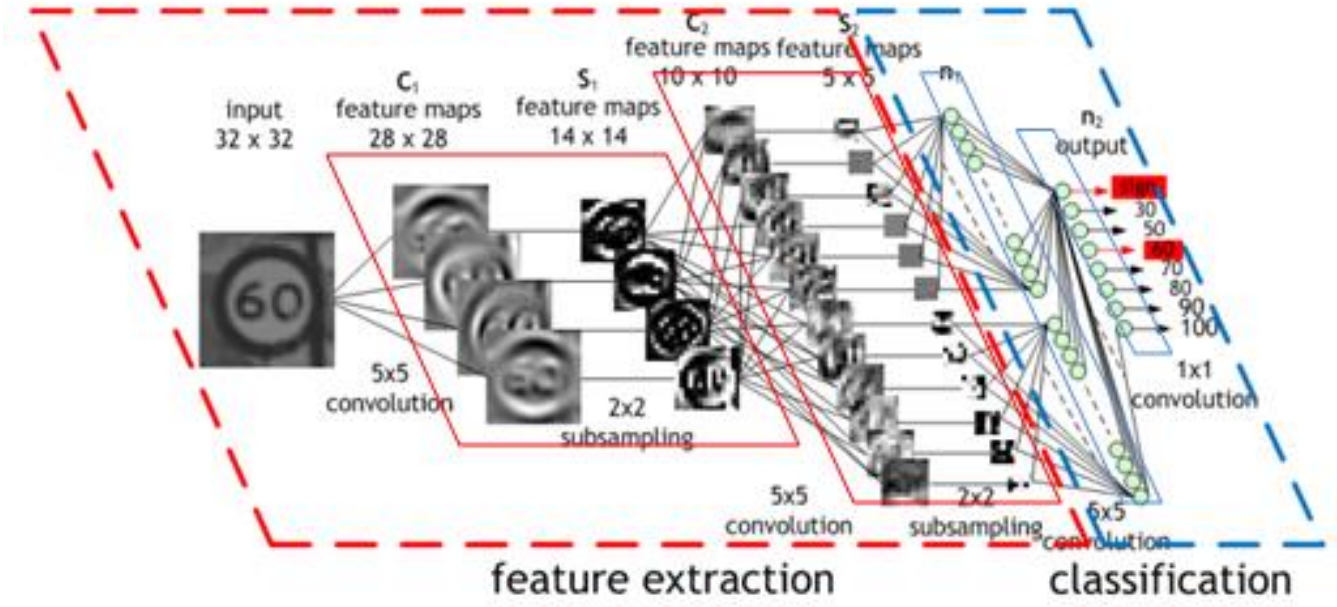
Convolutional Neural Networks

- Lecun 90´s



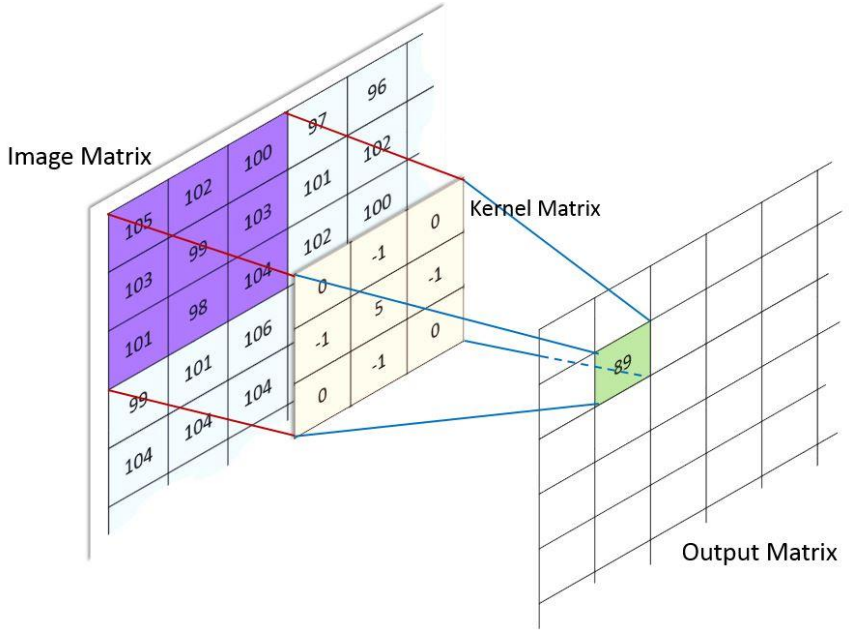
Convolutional Neural Networks

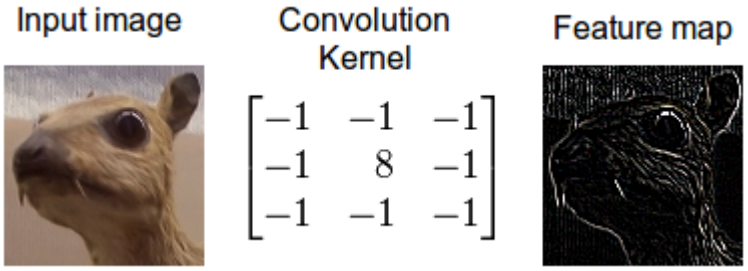
- Feature Extraction
  - Learnable Filters
- Classification
  - Fully-Connected
  - SVM
  - ....



Convolutional Neural Networks

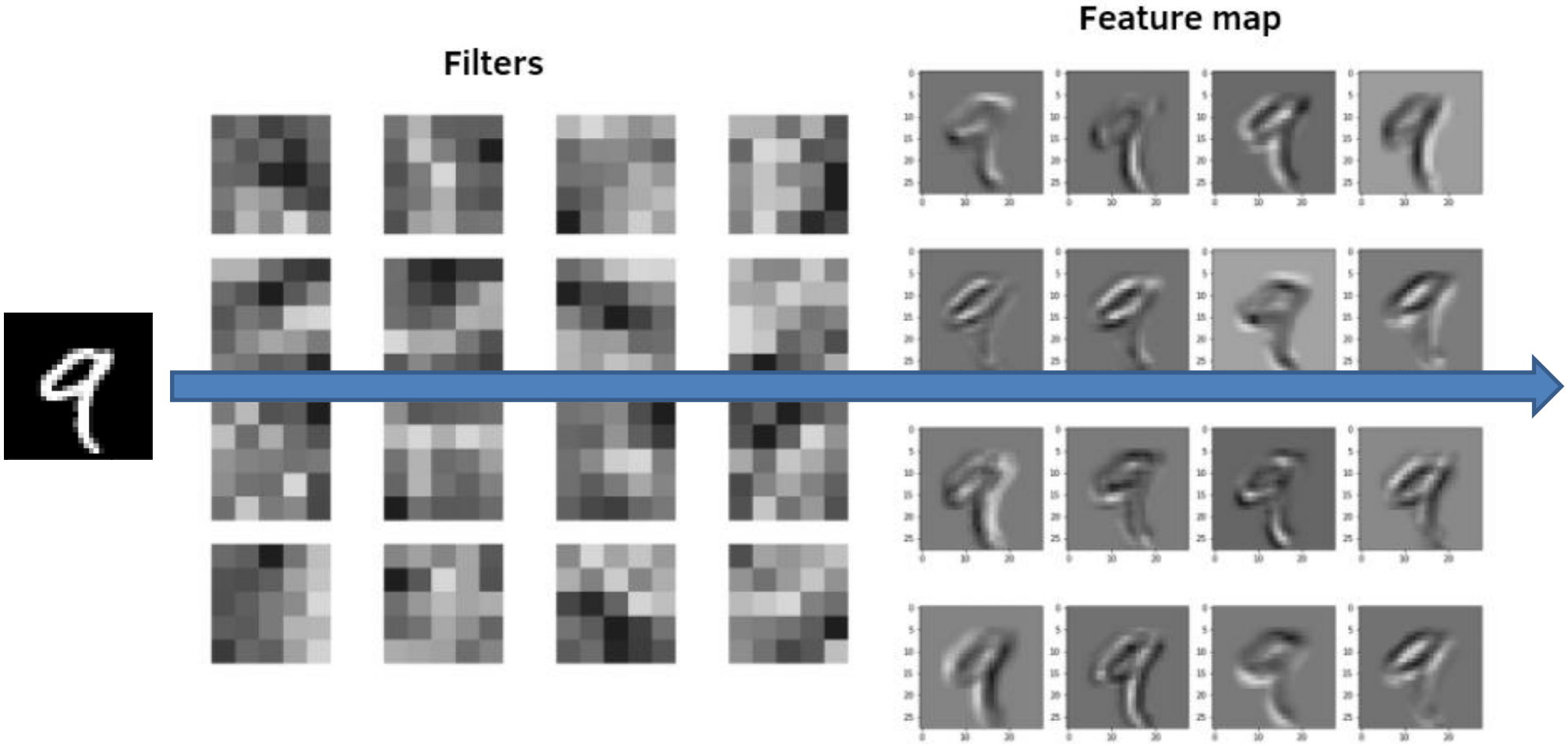
- Image Convolution





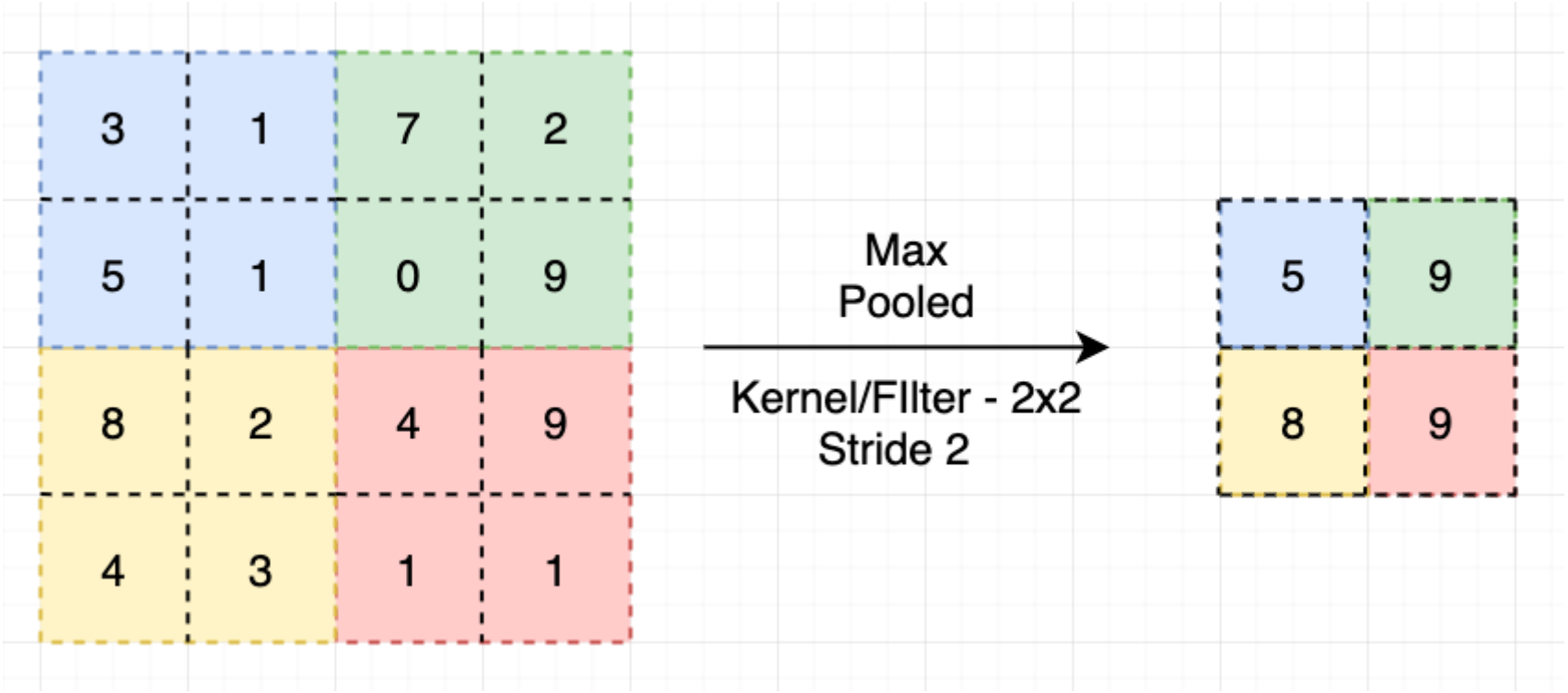
Convolutional Neural Networks

- Learned Filters and Resulting Feature Map



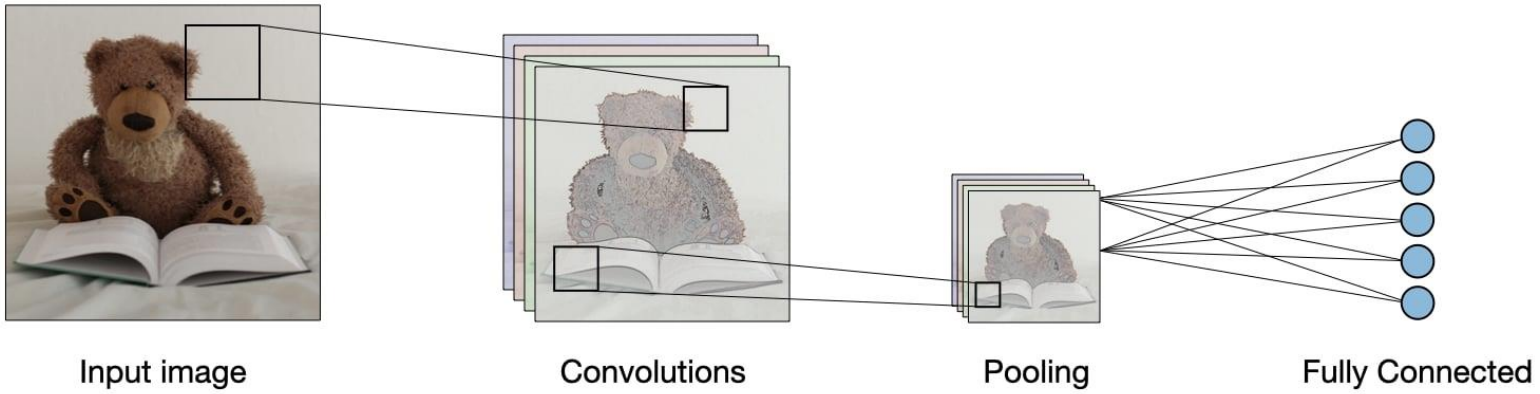
Convolutional Neural Networks

- Pooling Layer



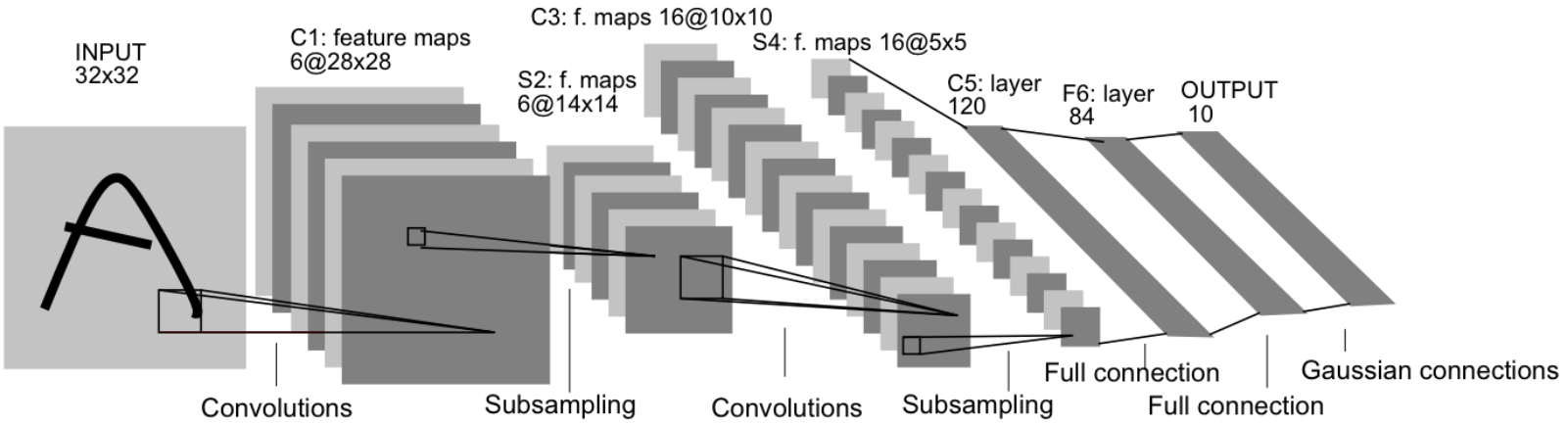
Convolutional Neural Networks

- All Together



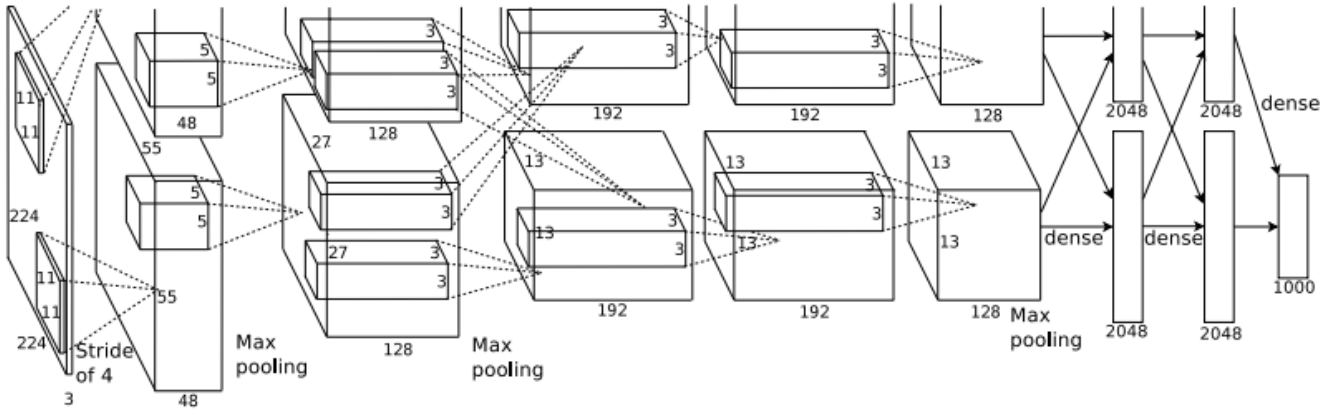
Convolutional Neural Networks

- Lenet
  - Yan Lecun – 90´s (IBM / FACEBOOK)
  - Handwritten Digits
  - ~60 K Parameters
  - ~345 K Connections



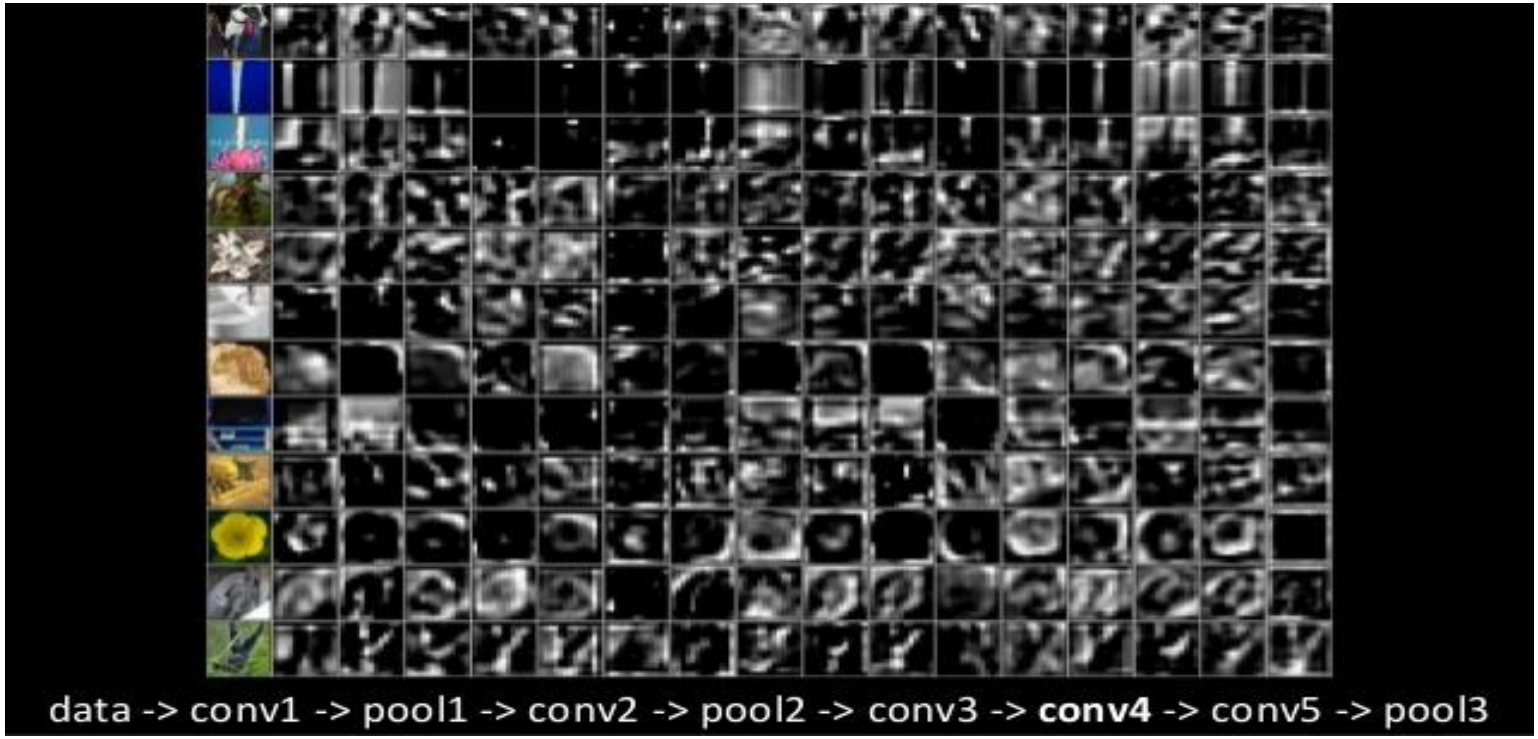
Convolutional Neural Networks

- AlexNet
  - Alex Krizhevsky – 2012 (Krizhevsky Net)
  - Imagenet 2012 Challenge (1000 classes)
    → 1.2 M Train, 50K Val, 150K Test
  - 2012 Winner (15.3% Error - Top 5)
    → 2° SIFT Based (26.2%)



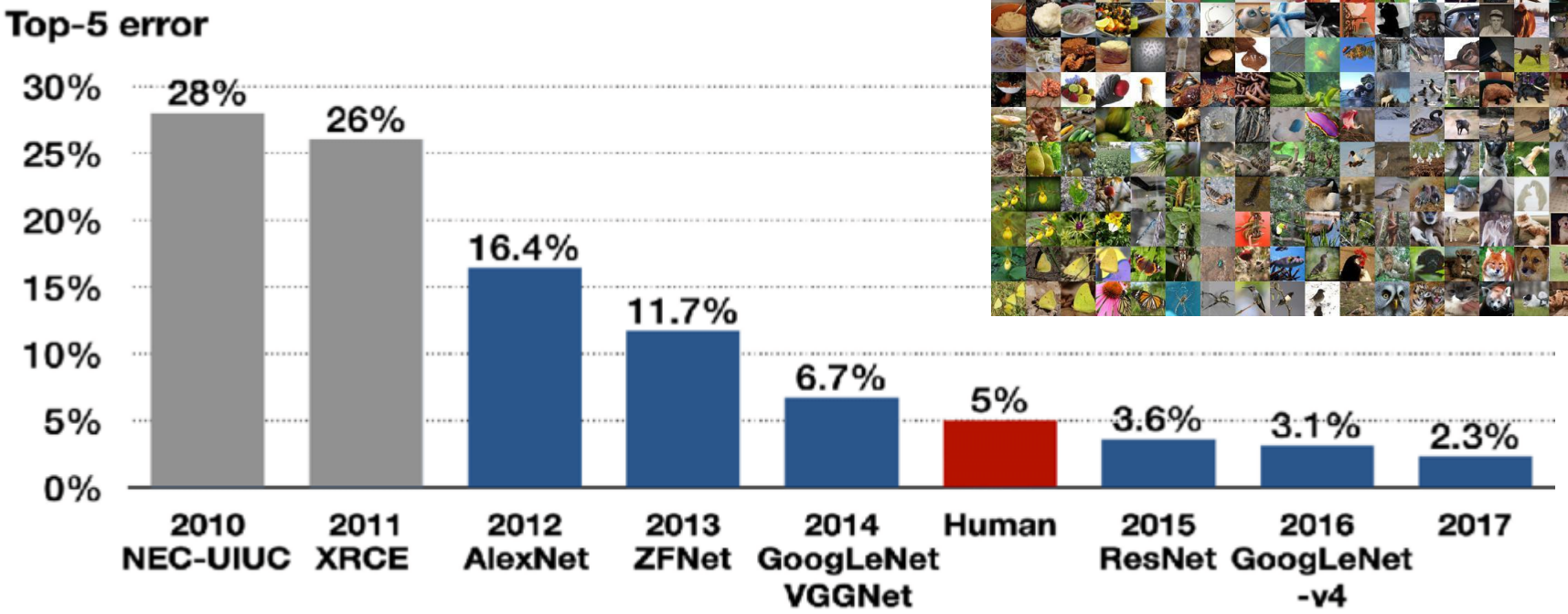
Convolutional Neural Networks

- Alexnet



Imagenet Challenge

- Imagenet 2012 Challenge
  - 1000 classes
  - 1.2 M Train
  - 50K Val
  - 150K Test
  - [LINK TO ACCs]



Let's Code

- [LINK]