Class 6

Deep Learning: a glimpse of what is really happening

Overview

- **Deep** Convolutional Neural Networks
- The Deep Learning Zoo
- Generative Models
- Concluding Remarks

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Deep Convolutional NN

- MNIST: 10 classes, 28x28 pixels
- ImageNet: 21841 classes, 256x256 pixels
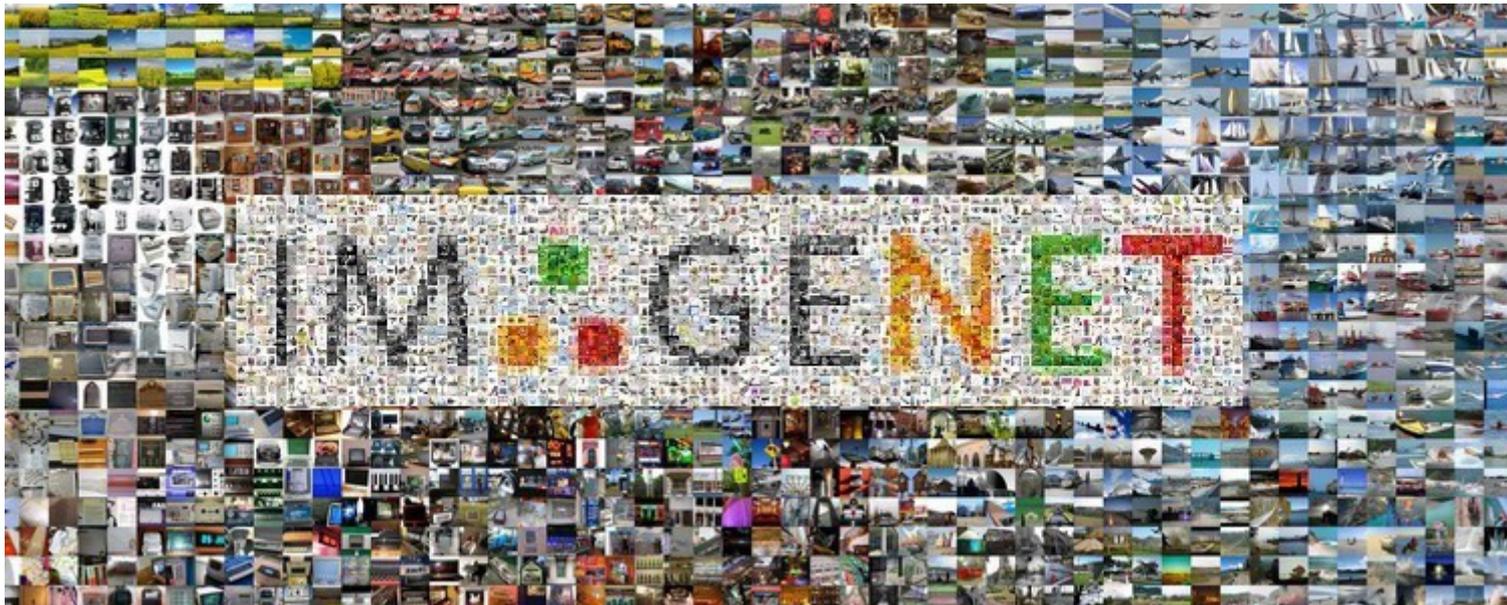
Toilet paper, yacht, cup, cameleon…

LeNet Architecture
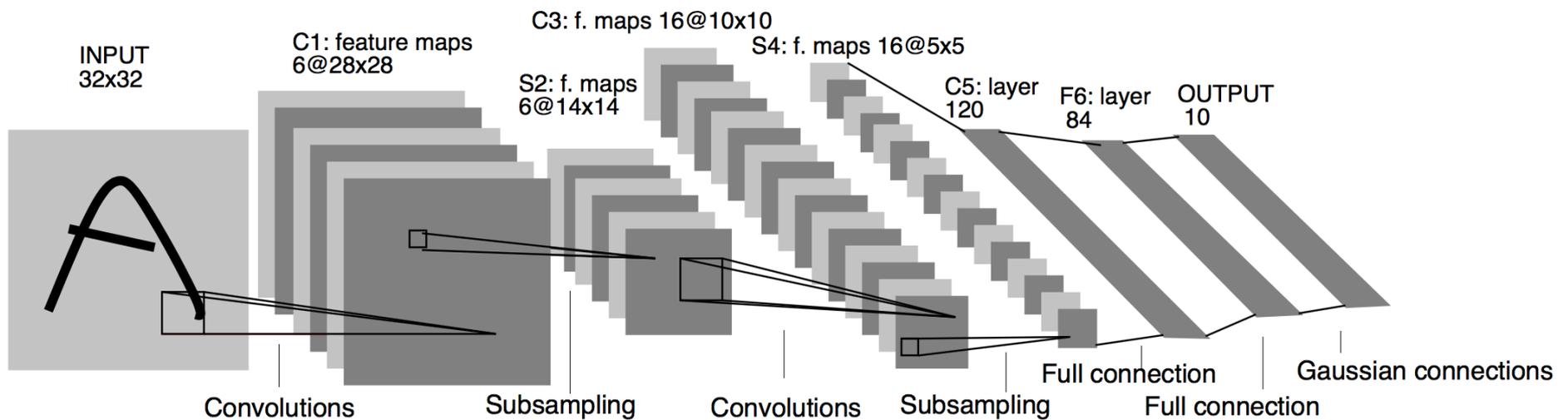
~60k parameters, 5 layers

DCNN Architectures

- AlexNet (2012)
  ~60M parameters, 8 layers
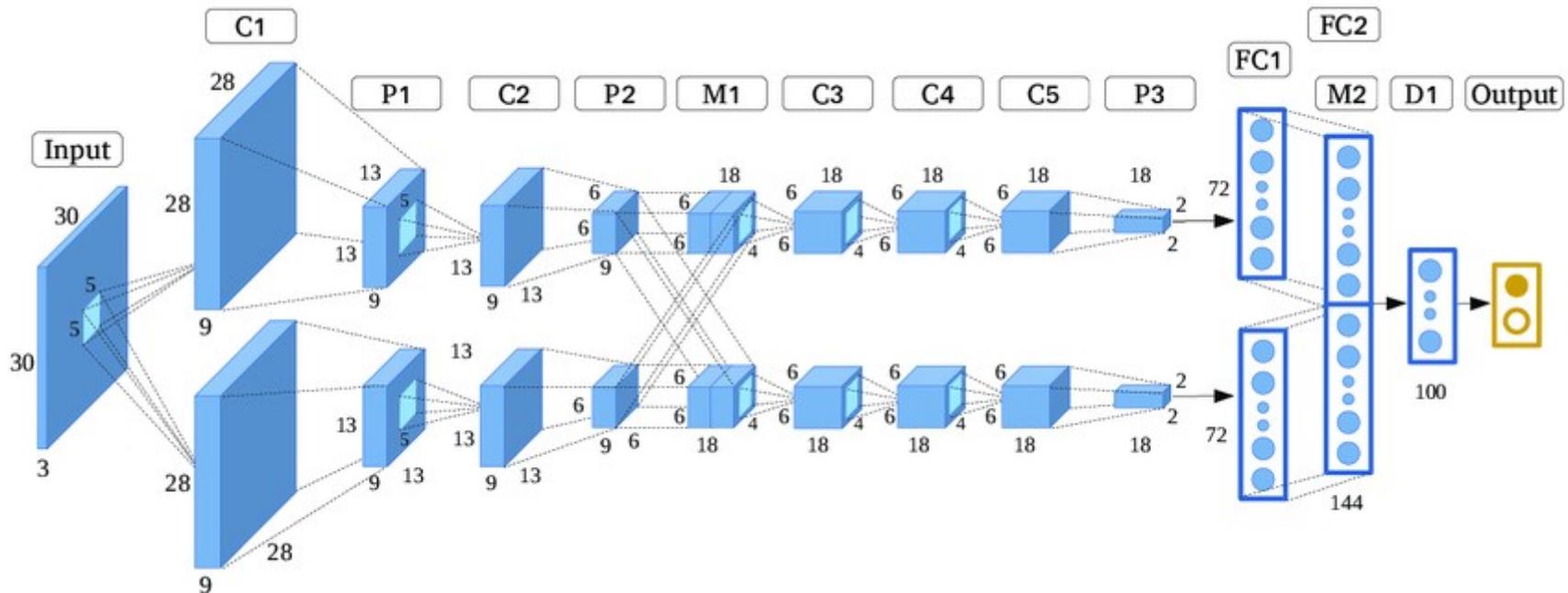
DCNN Architectures

- VGG (2014)
  - ~138M parameters, up to 19 layers
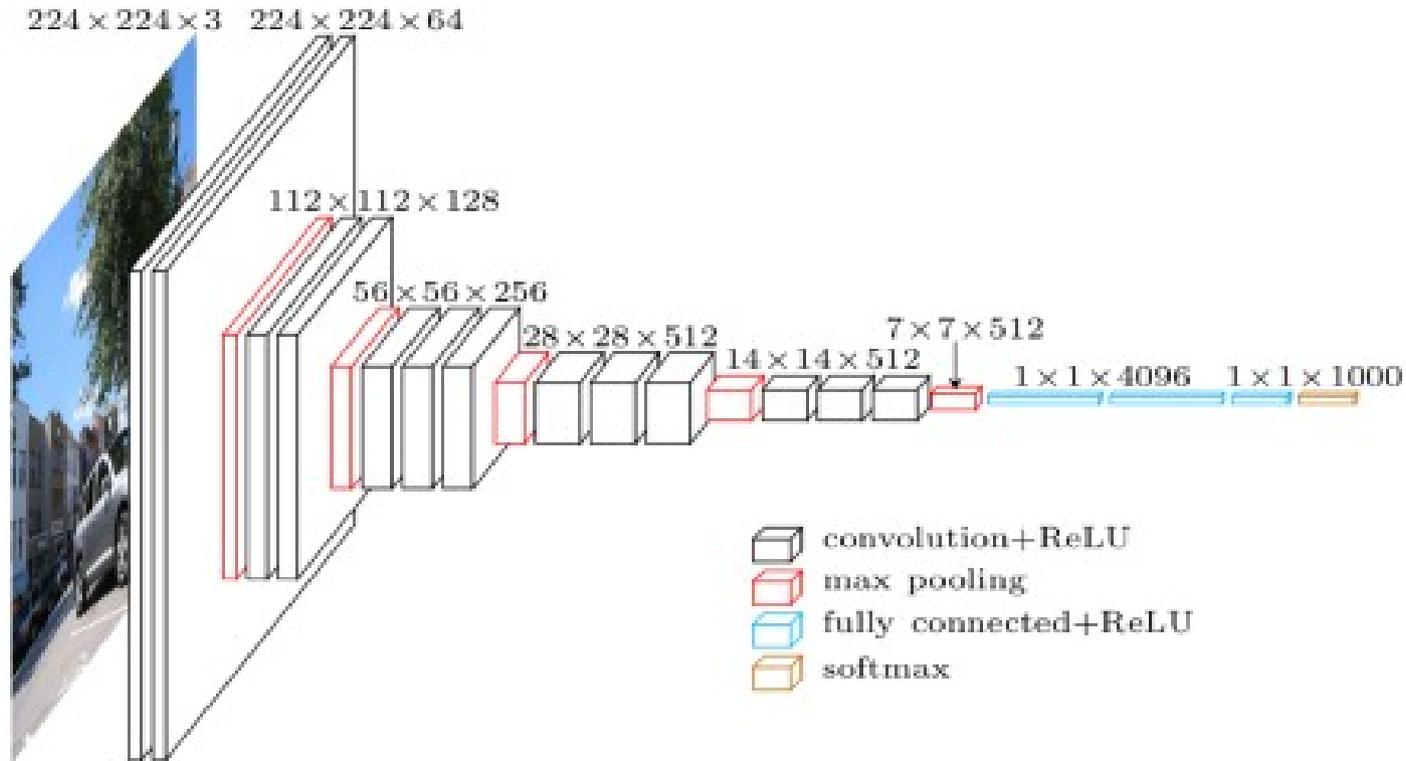
DCNN Architectures

- Inception (2014)
  ~7M parameters, 22 layers

Input: 299x299x3, Output:8x8x2048

Convolution
AvgPool
MaxPool
Concat
Dropout
Fully connected
Softmax

Input:
299x299x3

Output:
8x8x2048

Final part:8x8x2048 -> 1001
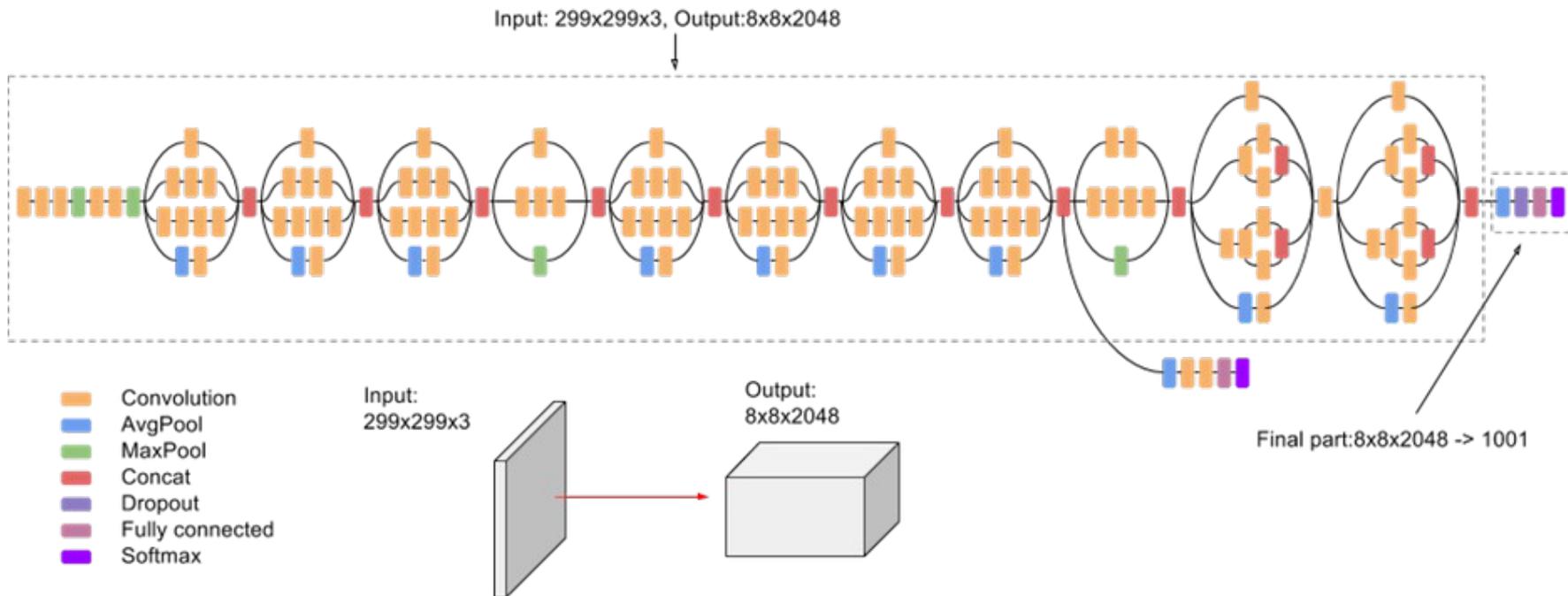
DCNN Architectures

- ResNet (2015)
     up to 1000 layers !
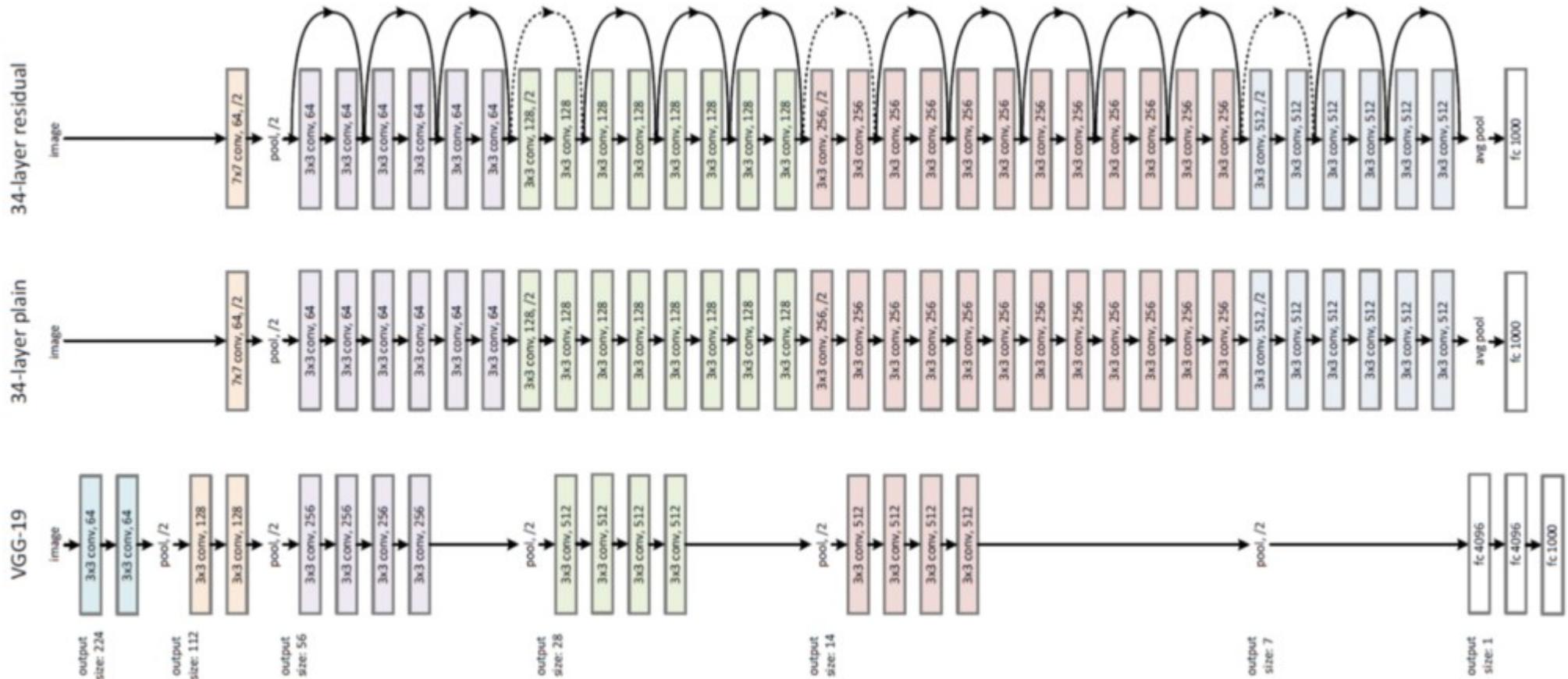
A summary
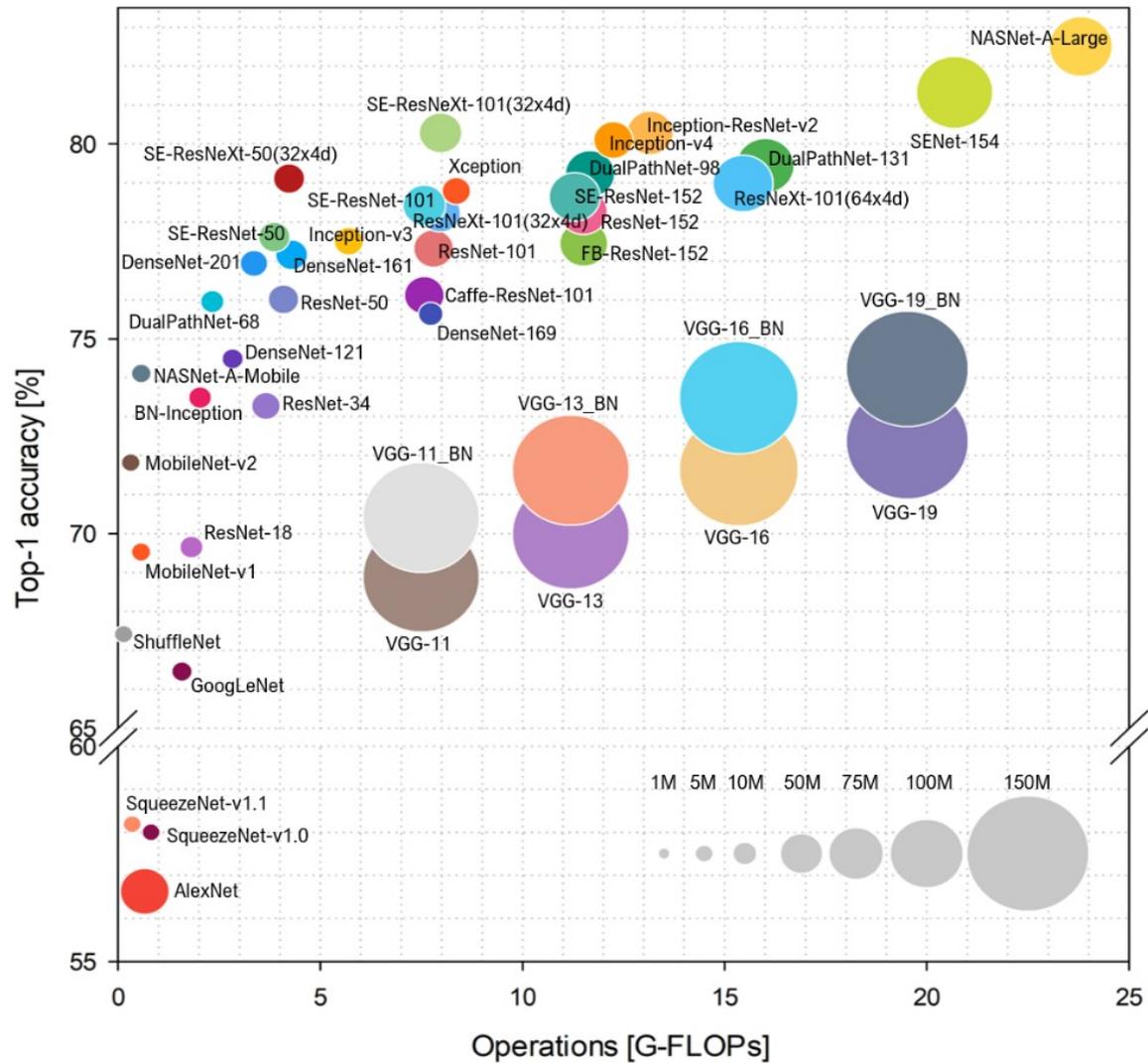
DCNN - Model complexity
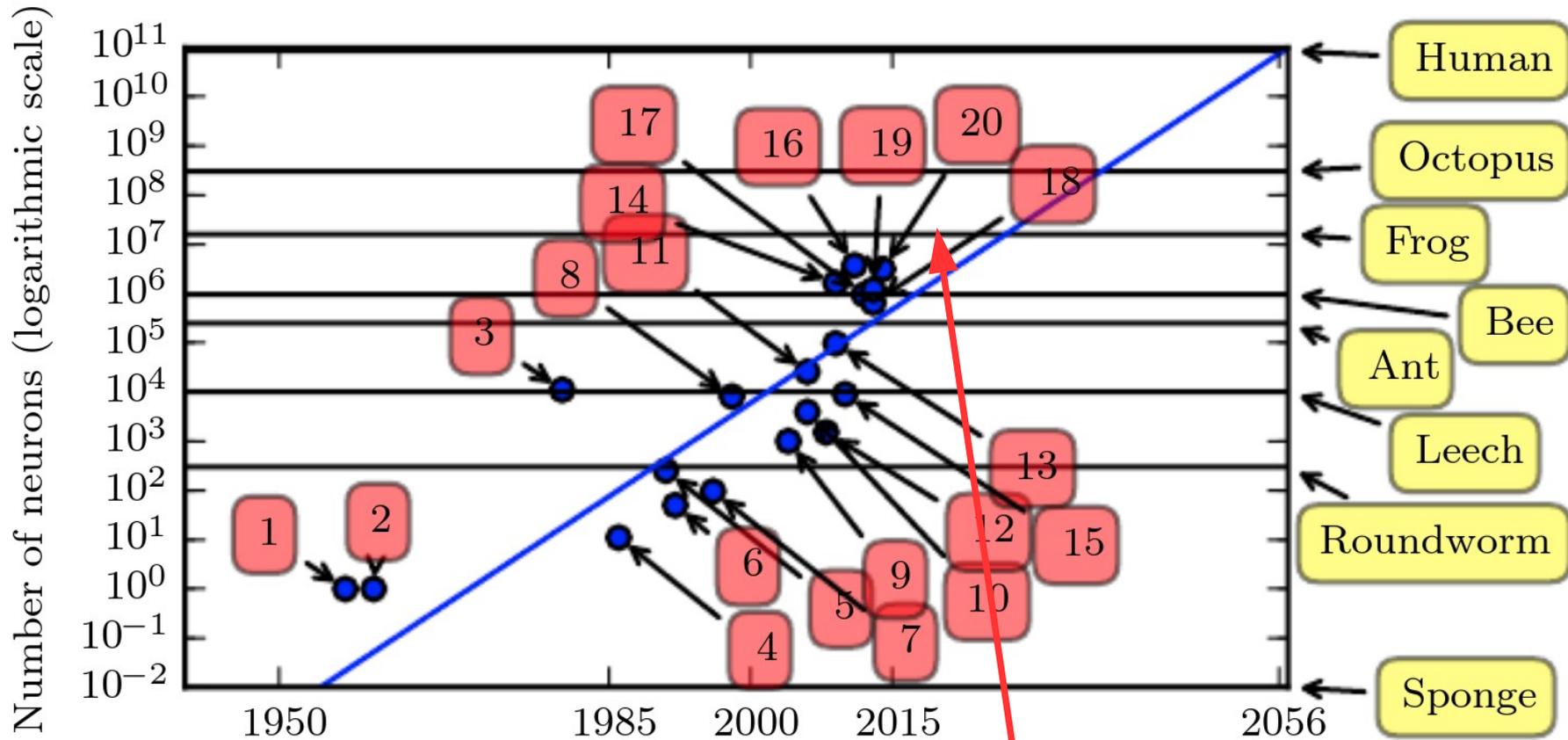
Inception v3 (25M

Object detection challenge

Object Detection, LSVRC Competition

Source: image-net.org
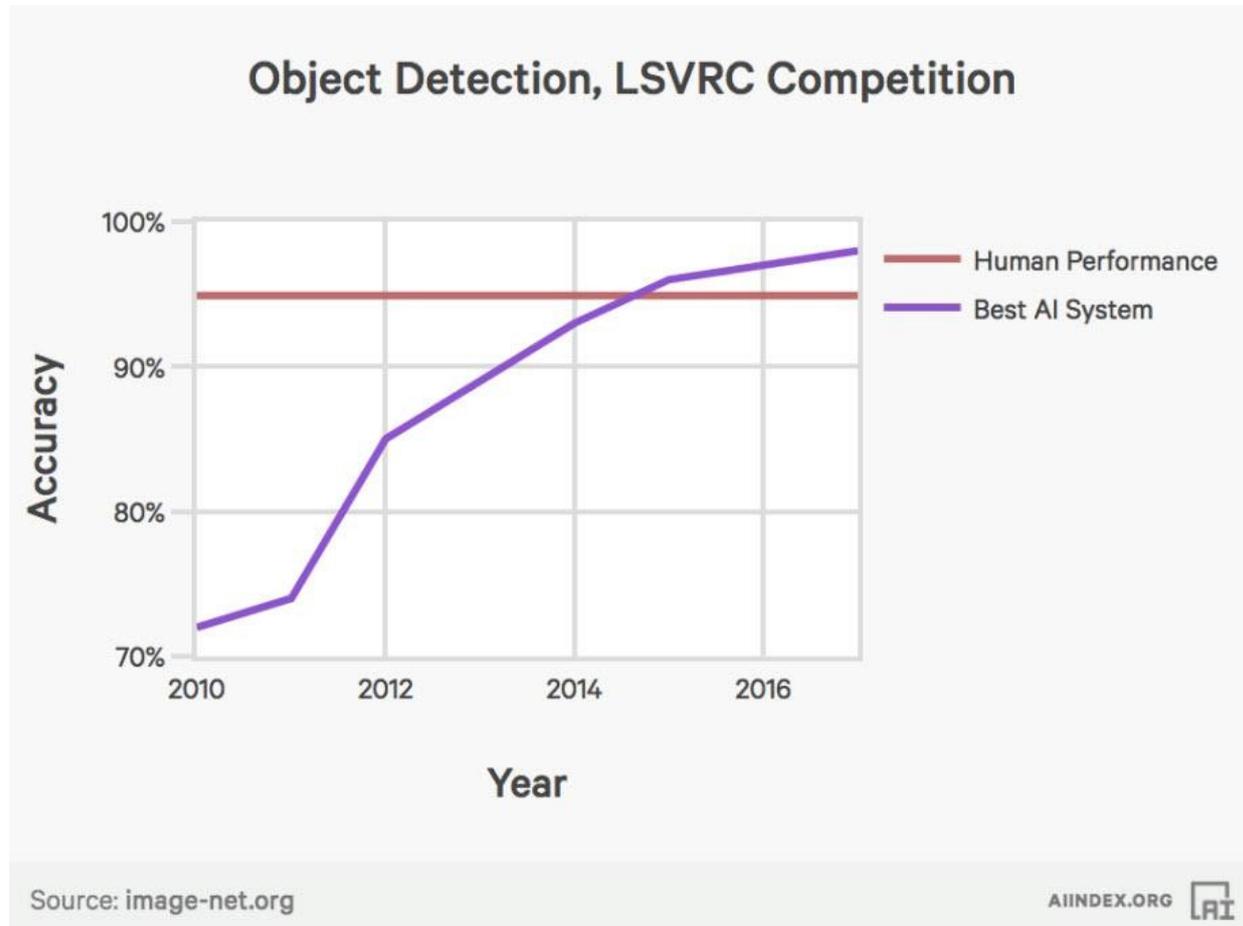
Object detection - results
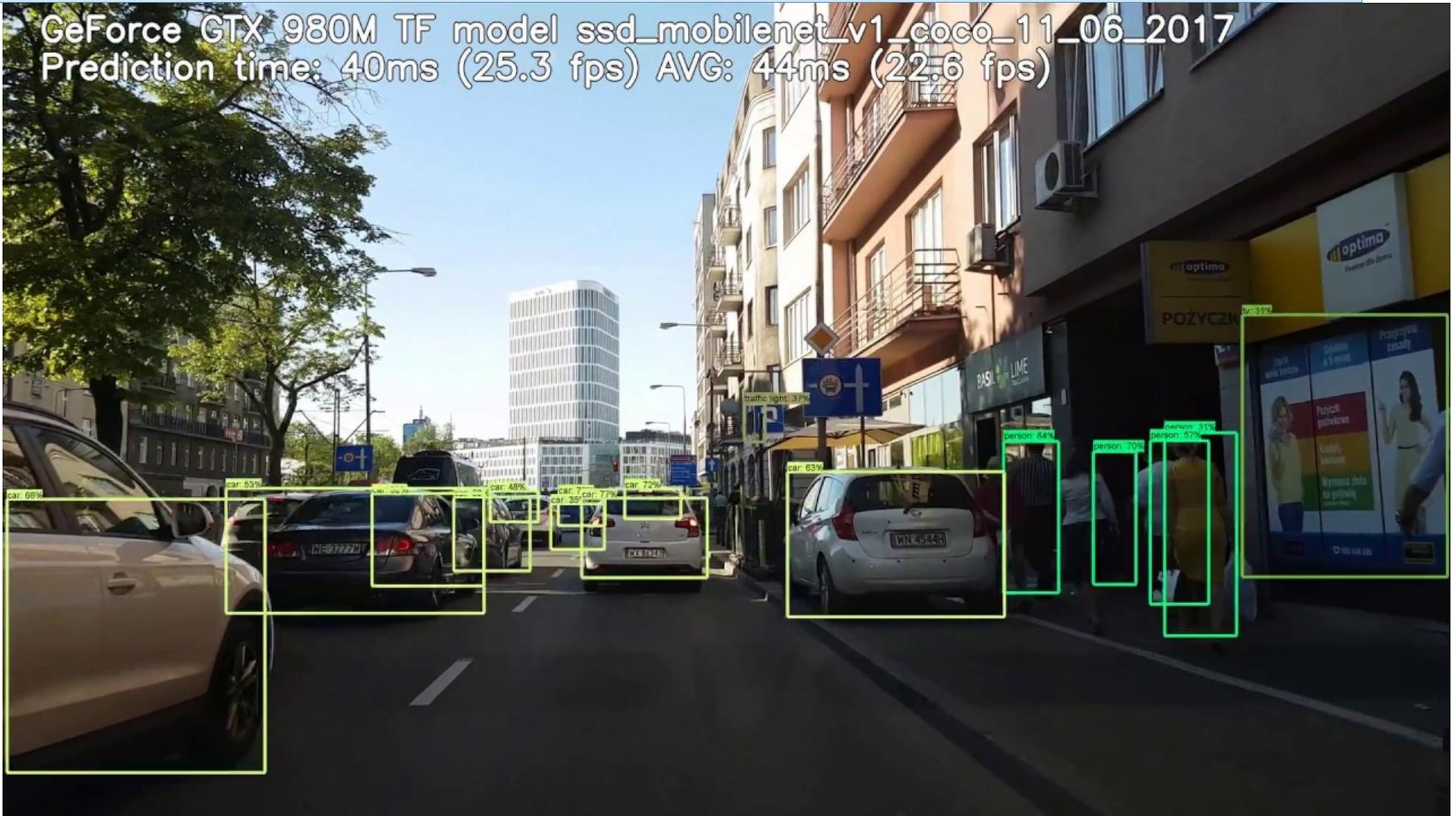
Image Segmentation

DCNN Architecture for Segmentation

- U-Net

Fusion
Convolution
Deconvolution
Softmax
Feature Map
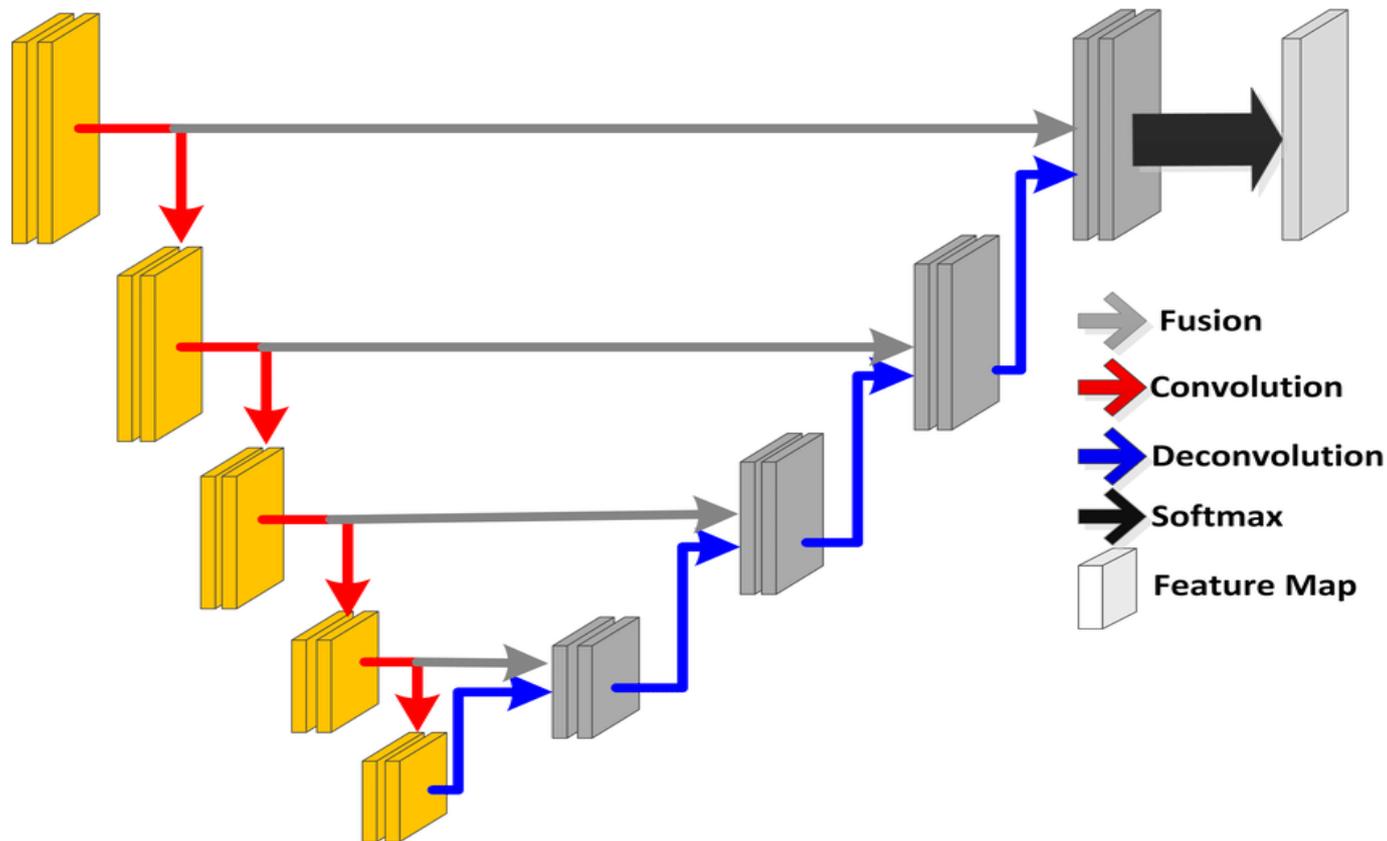
DCNN Architecture for Segmentation
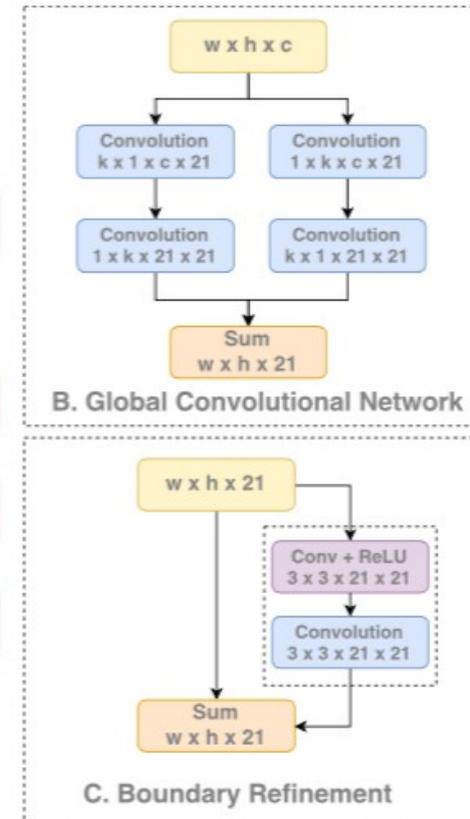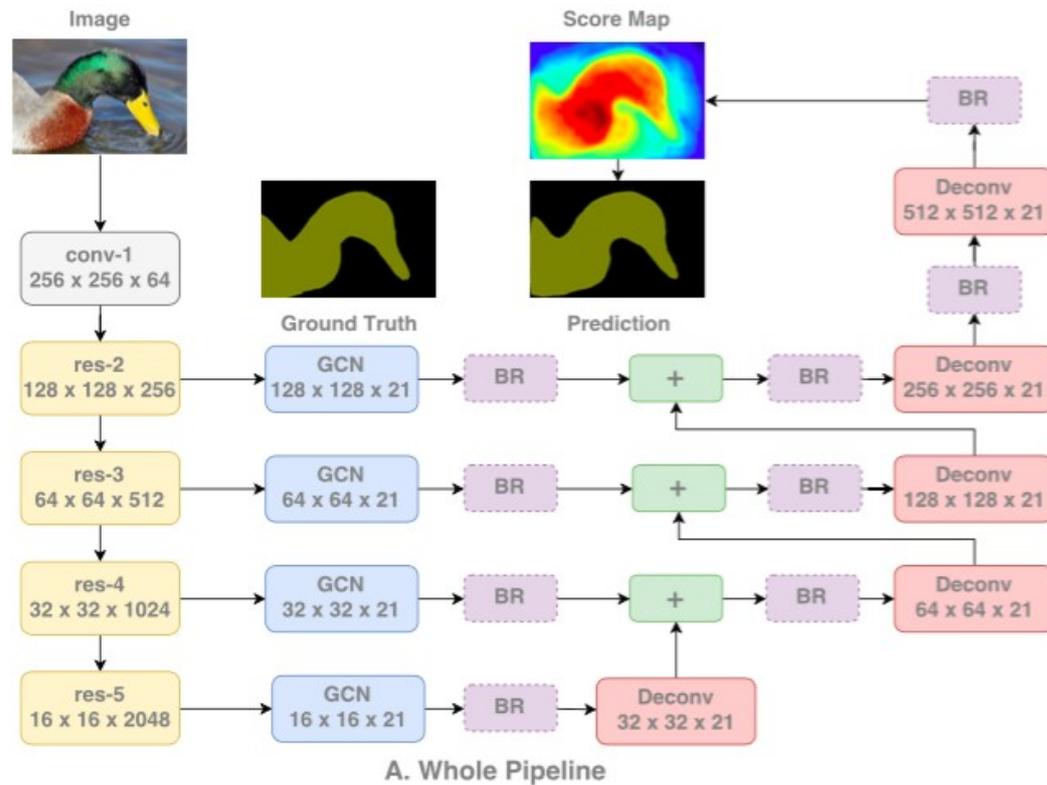
New problems in Computer Vision

- Human Parsing

- Image Captioning
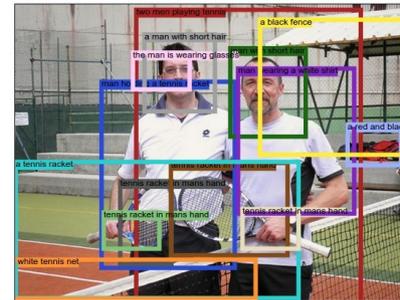
- 3D reconstruction from a single image

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The Deep Learning Zoo
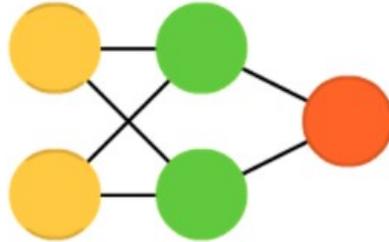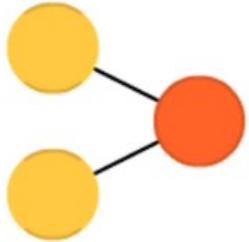
A mostly complete chart of **Neural Networks**
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http://www.asimovinstitute.org

Perceptron, FFNN

Backfed Input Cell
Input Cell
Noisy Input Cell
Hidden Cell
Probablistic Hidden Cell
Spiking Hidden Cell
Output Cell
Match Input Output Cell
Recurrent Cell
Memory Cell
Different Memory Cell
Kernel
Convolution or Pool

Auto-encoders

Backfed Input Cell

Input Cell

Noisy Input Cell

Hidden Cell

Probablistic Hidden Cell

Spiking Hidden Cell

Output Cell

Match Input Output Cell

Recurrent Cell

Memory Cell

Different Memory Cell

Kernel

Convolution or Pool

Auto-encoders

Original Input — Latent Representation — Reconstructed Output

Encoder → h → Decoder

x → r
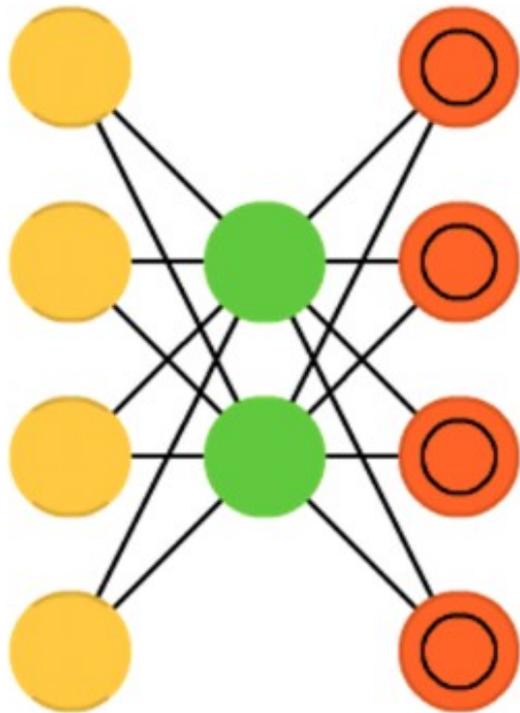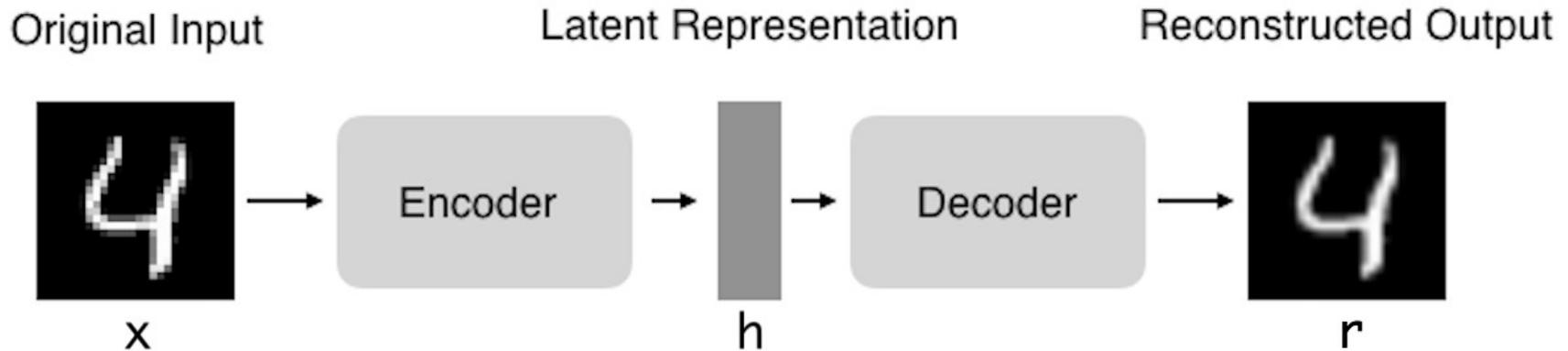
- Applications
  - Denoising
  - Dimension Reduction
  - Indexation

Recurrent Neural Networks
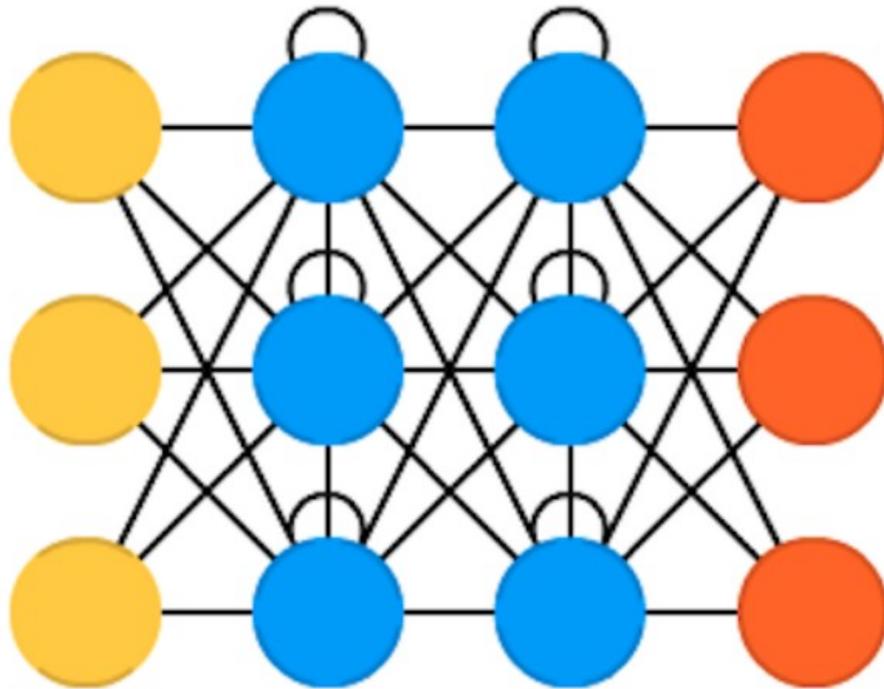
Long Short-Term Memory (LSTM)
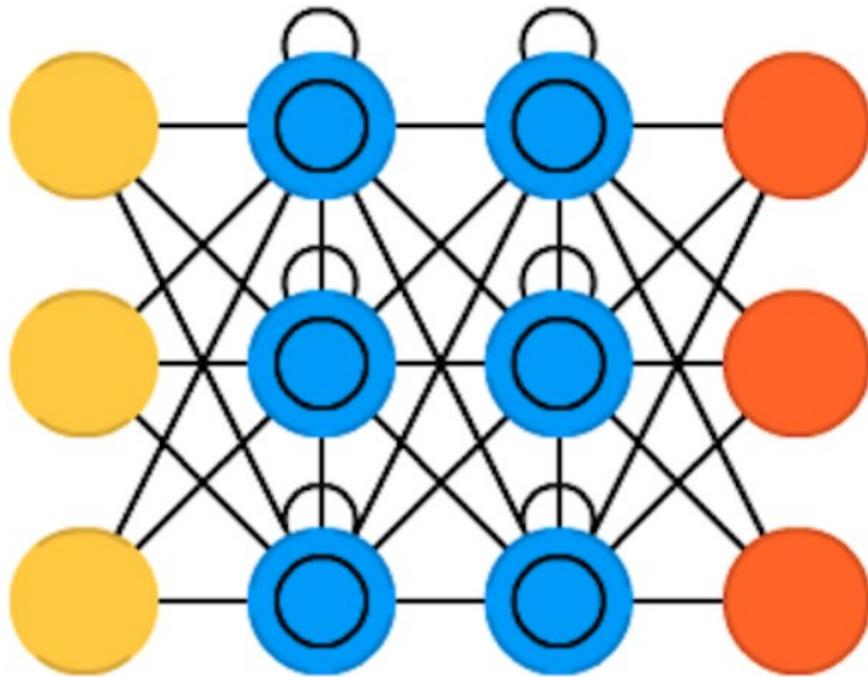
Deep Residual Networks

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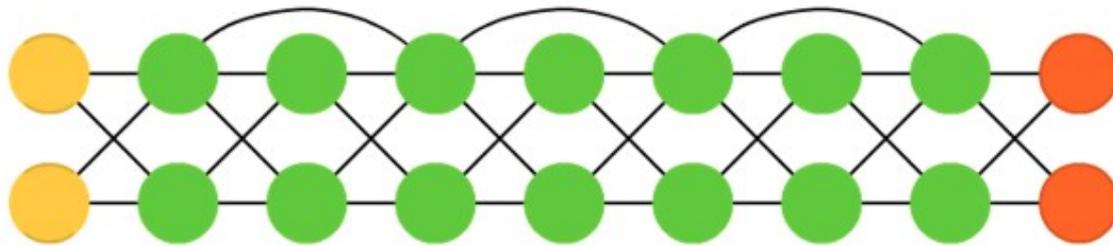
- Concluding Remarks

Generative Adversarial Networks
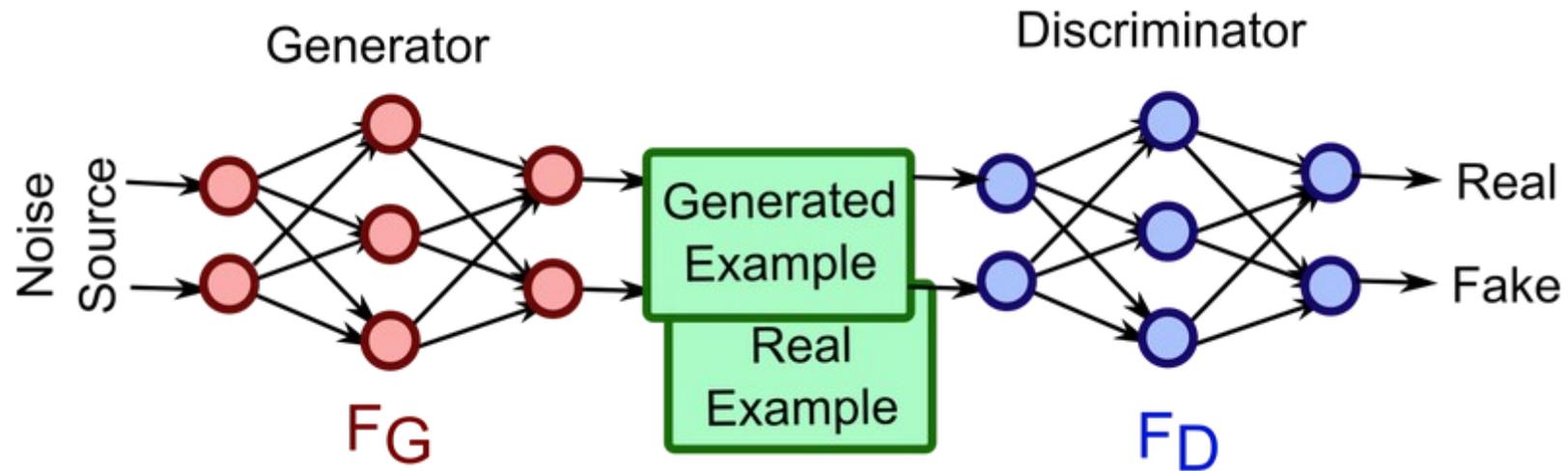
Game theory
Nash equilibrium

Generative Adversarial Networks

- Difficult to train...

- But useful in many applications

Formant analysis network   Articulation network   Output network

Audio window

Emotional state

Vertex positions
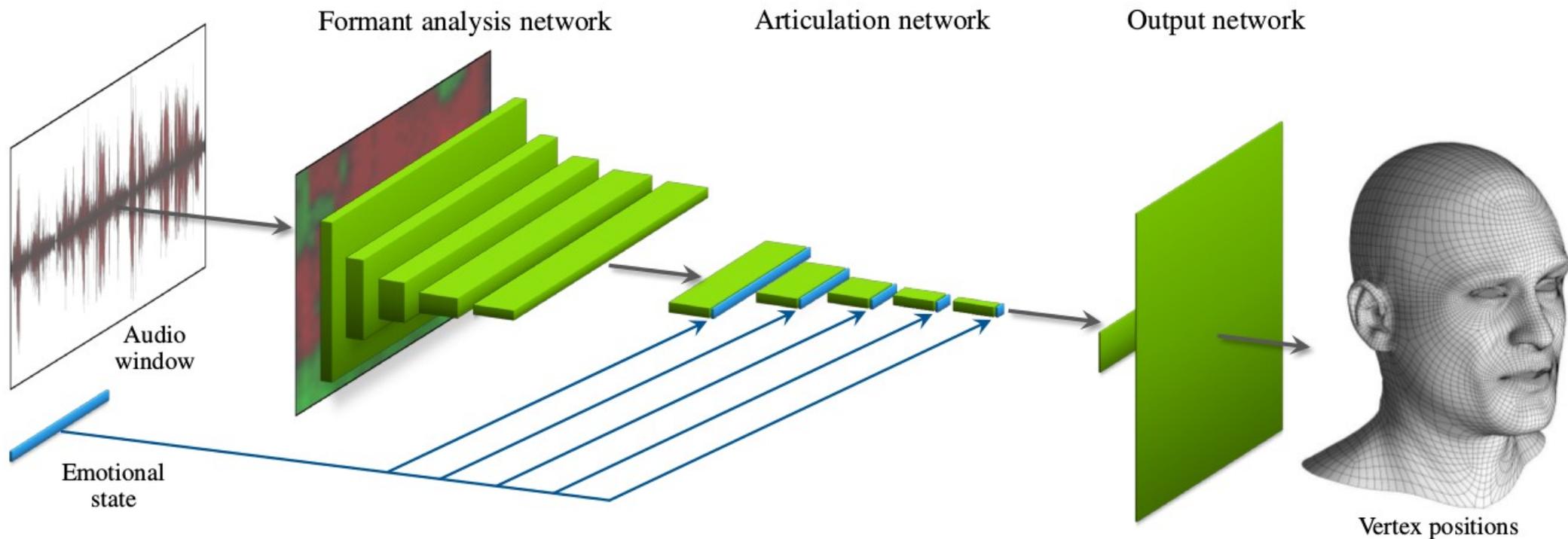
Generative Adversarial Networks

- Example Video

Generative Adversarial Networks

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About AI, Deep Learning...
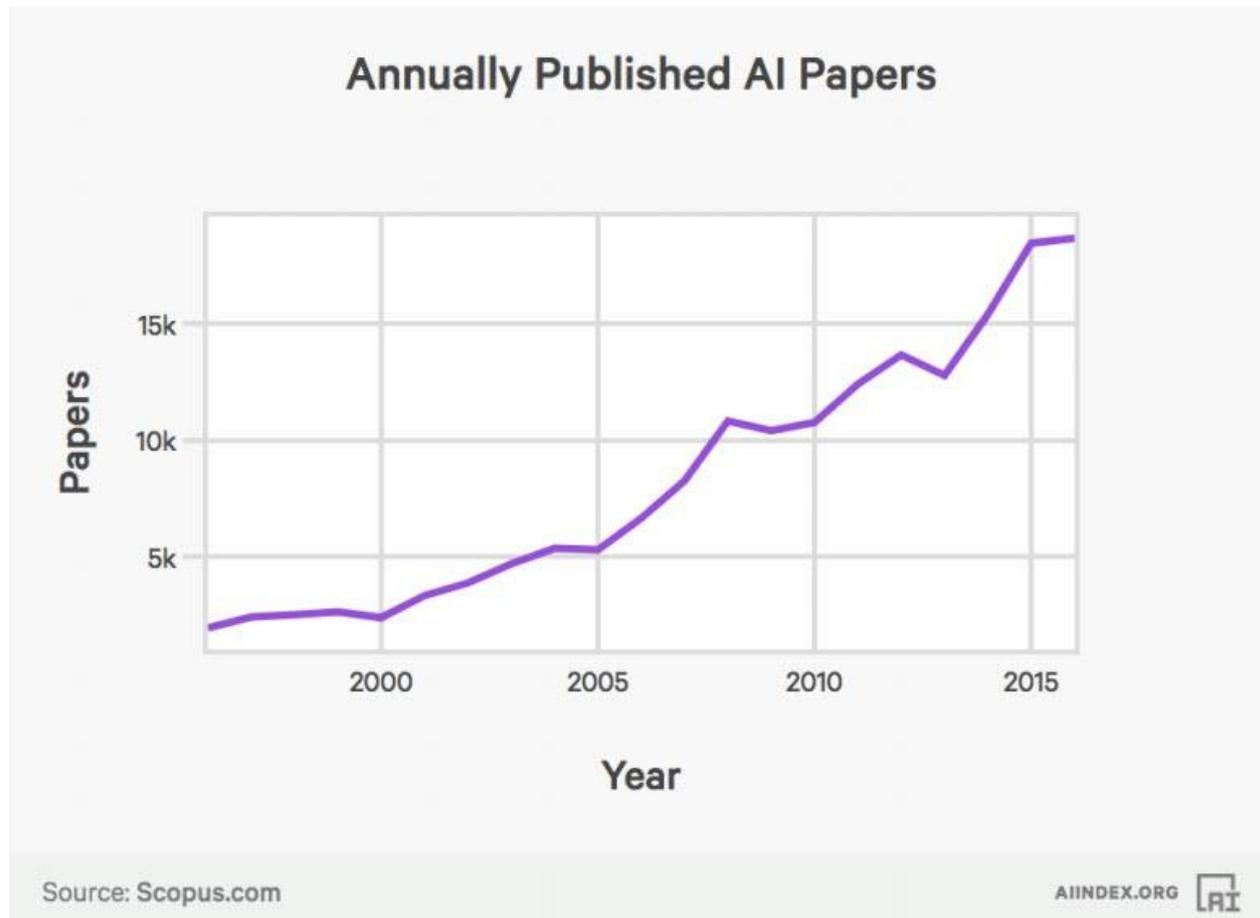
Annually Published AI Papers
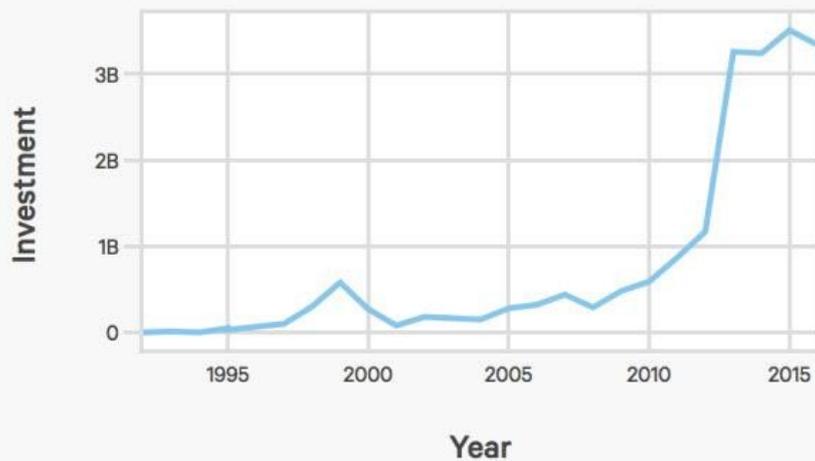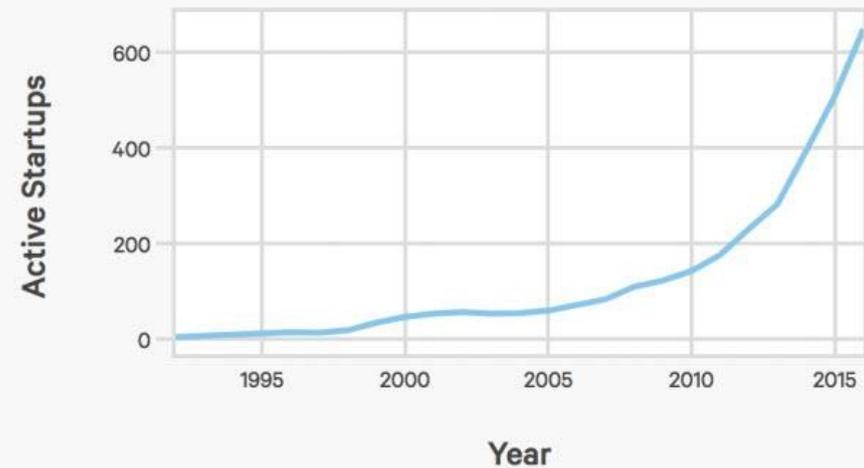
Source: Scopus.com   AIINDEX.ORG

About AI, Deep Learning...

About AI, Deep Learning...

Job Openings, Skills Breakdown (Monster.com)

Source: Monster.com   AIINDEX.ORG
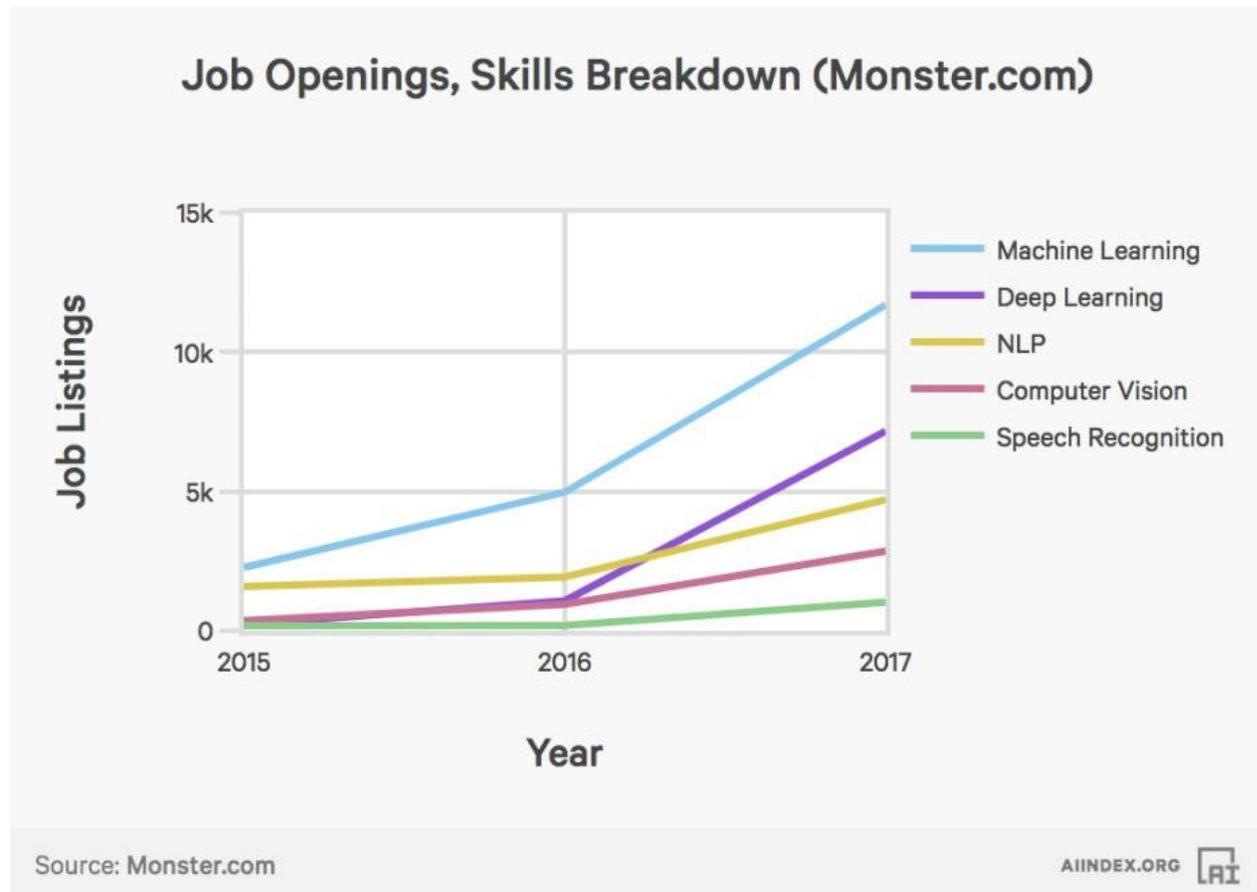
Challenges - Supervision

« She had your dark suit in greasy wash water all year »
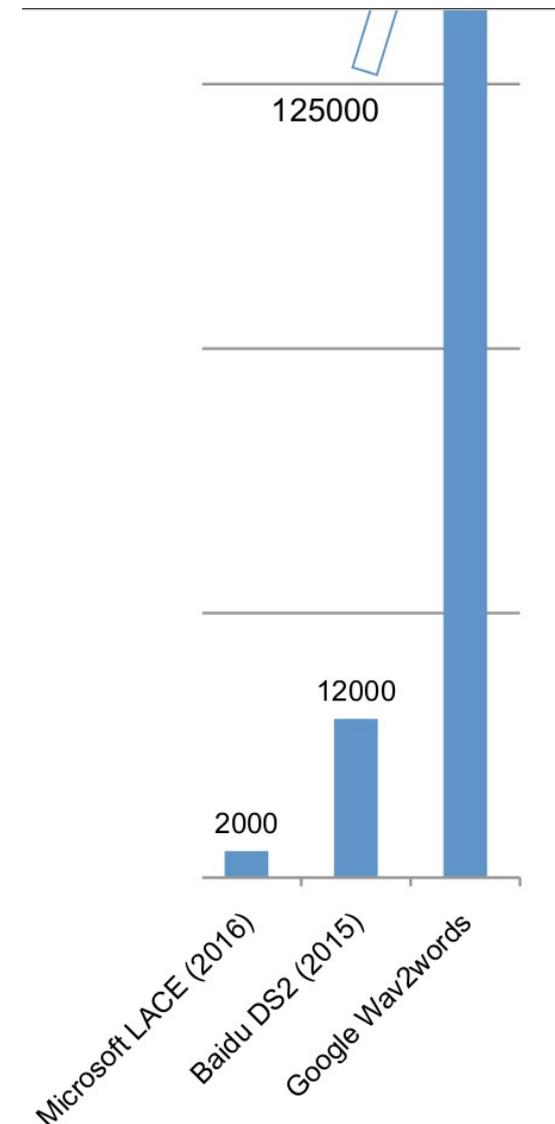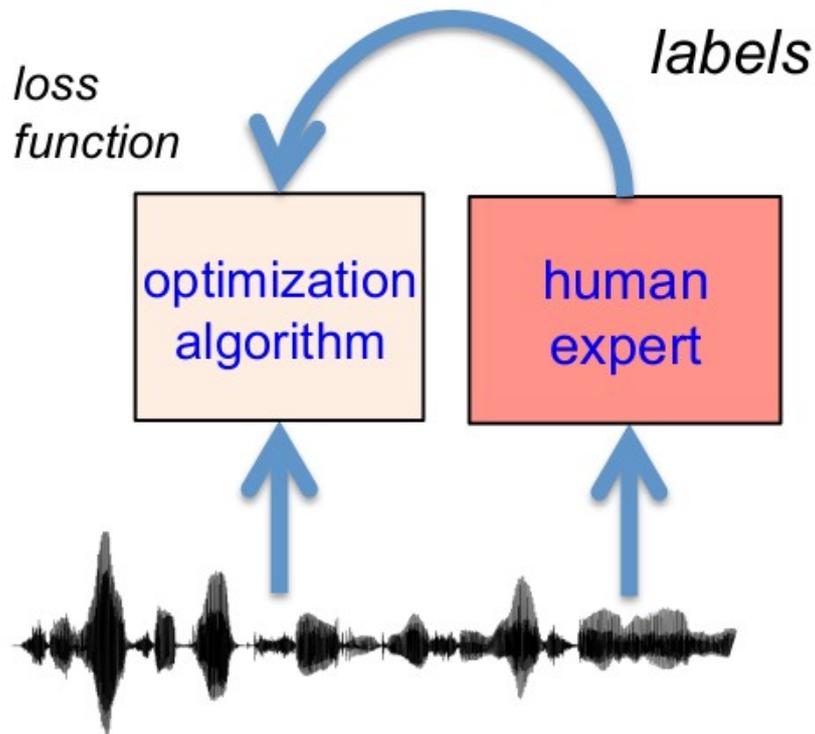
loss function

labels

optimization algorithm

human expert

125000

12000

2000

Microsoft LACE (2016)

Baidu DS2 (2015)

Google Wav2words

Challenges - Supervision

How do infants do?

Cristia et al, 2017

Supervised (orthographically transcribed)

Heures de parole

Tsimane: 264
Mozambique: 720
USA (low SES): 1248
USA (high SES): 4800
Microsoft LACE (2016): 2000
Baidu DS2 (2015): 12000
Google Wav2words: 125000

4 year olds
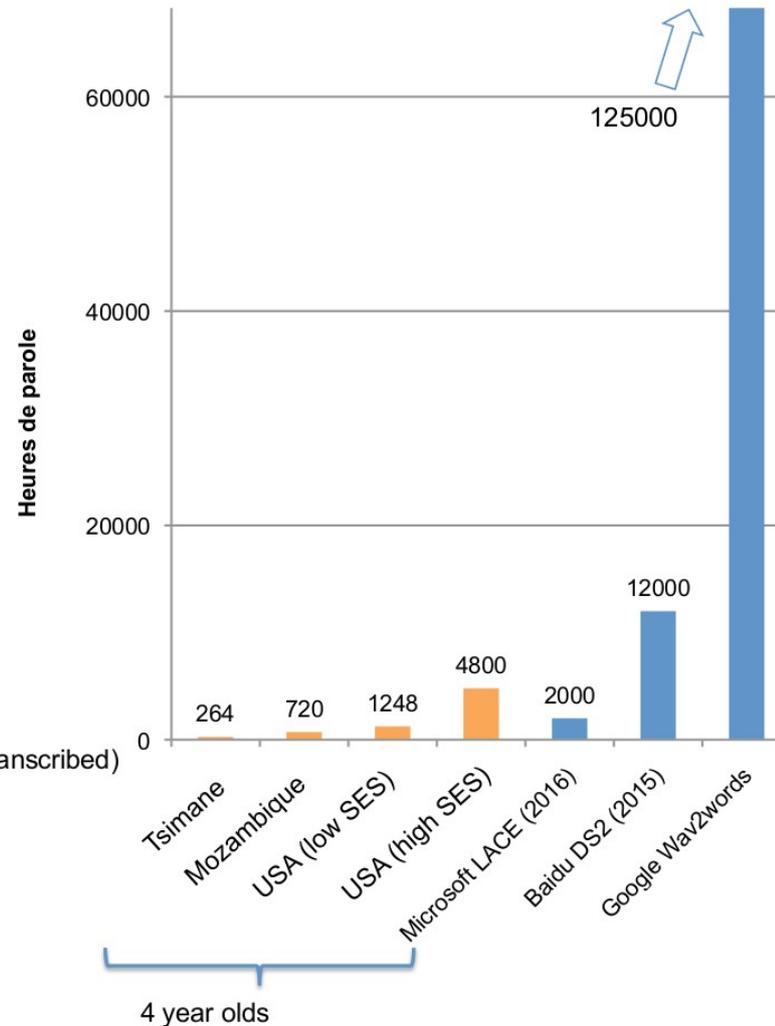
Challenges - Supervision

How do infants learn language?

Heures de parole

+ 1000000000 words of text

+0 words of text!

+multimodal input
+some parental feedback

Supervised (orthographically transcribed)

Unsupervised (sensory data only)

60000
40000
20000
0

125000
12000
4800
2000
1248
720
264

Tsimane
Mozambique
USA (low SES)
USA (high SES)
Microsoft LACE (2016)
Baidu DS2 (2015)
Google Wav2words

4 year olds

Cristia et al, 2017

INP ENSEEIHT

Challenges - Domain Adaptation

Challenges - Domain Adaptation

Challenges - Domain Adaptation

Challenges - Domain Adaptation

Challenges - Domain Adaptation

Ganin et al., 2015; 2016

Multiple Task Learning

What is Intelligence?

- Curiosity
- Adaptation to new situations
- Knowledge transfert
- ...