



Lecture 1: Introduction

Welcome to CS231n



Top row, left to right:

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Middle row, left to right

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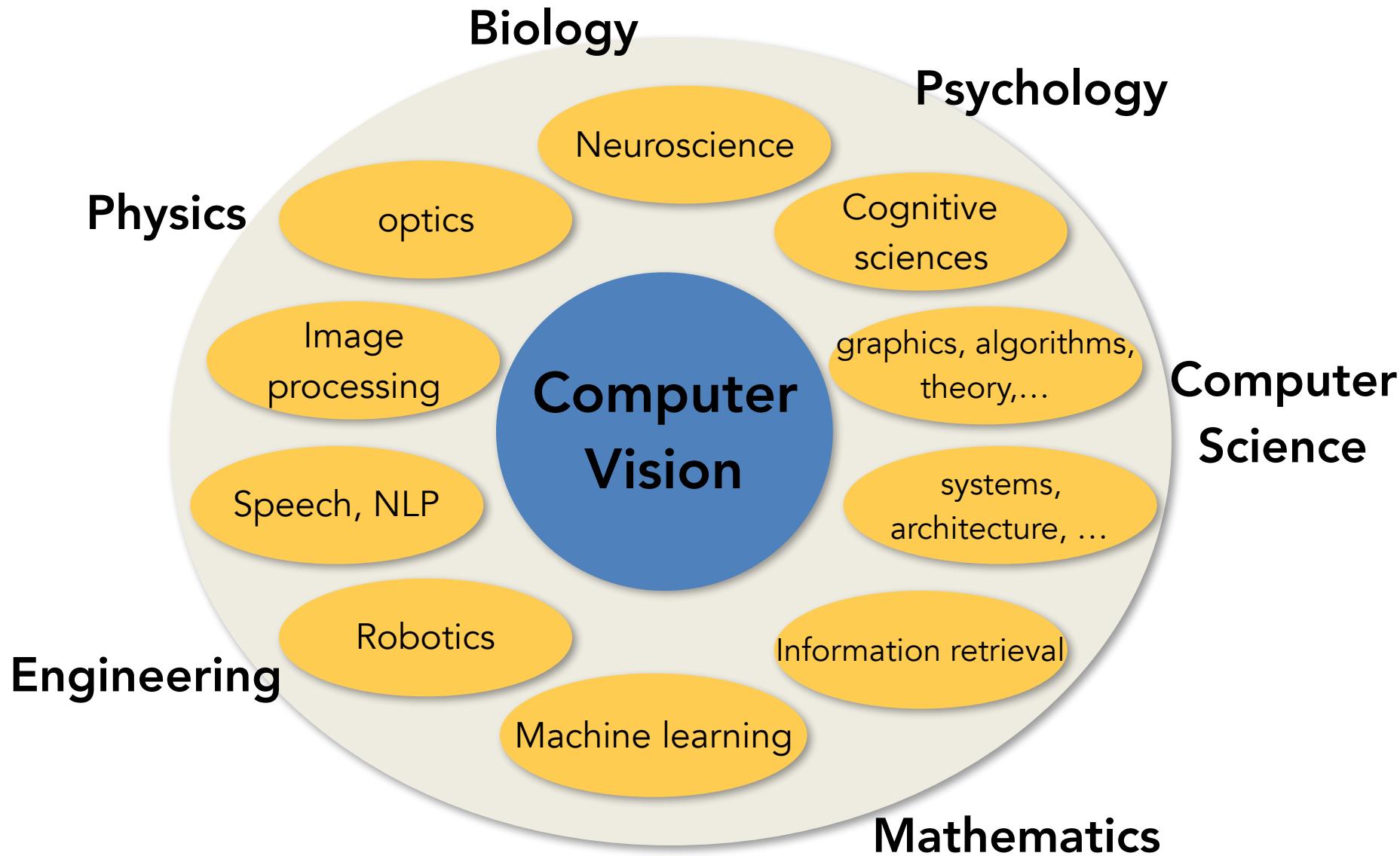
Bottom row, left to right

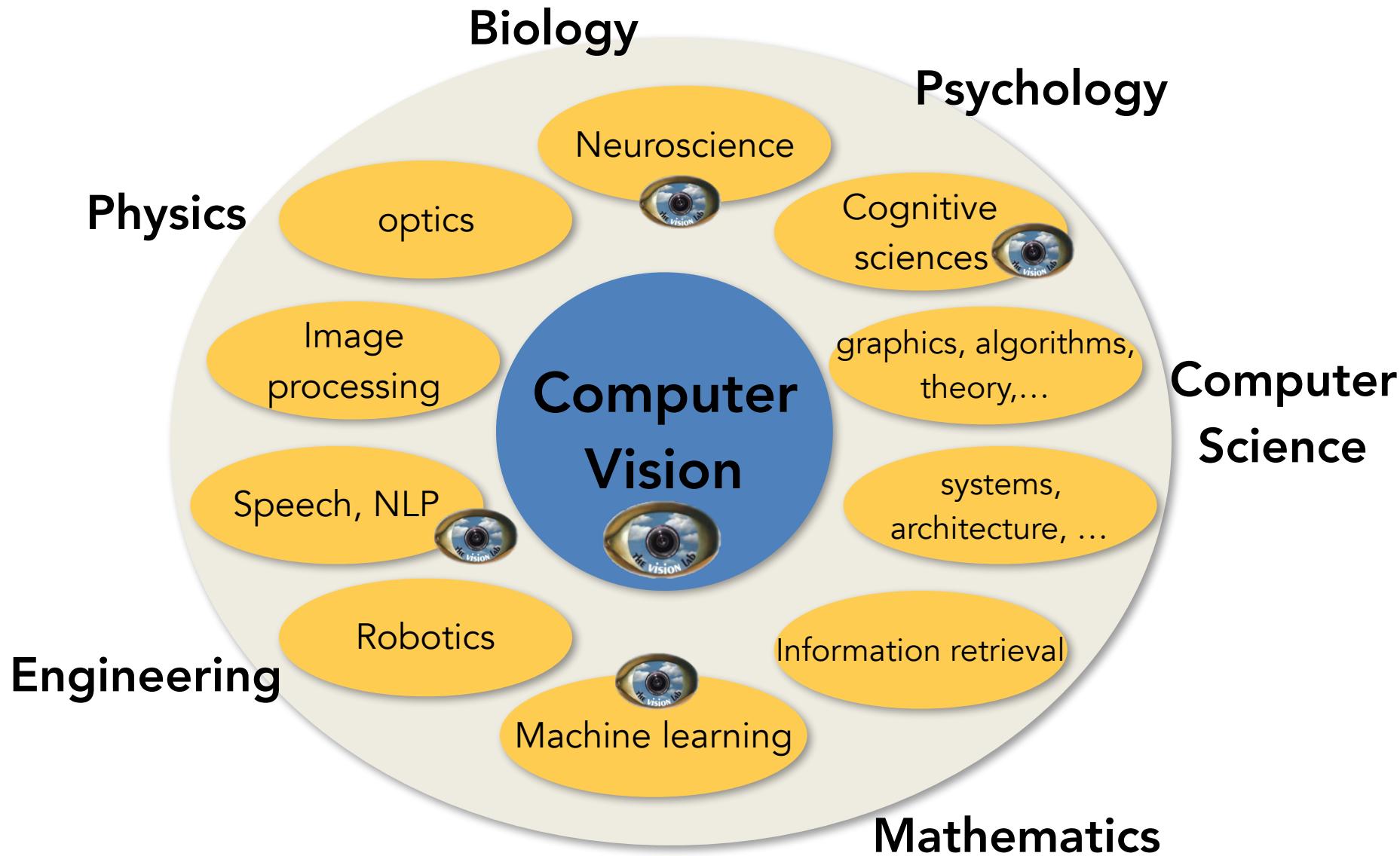
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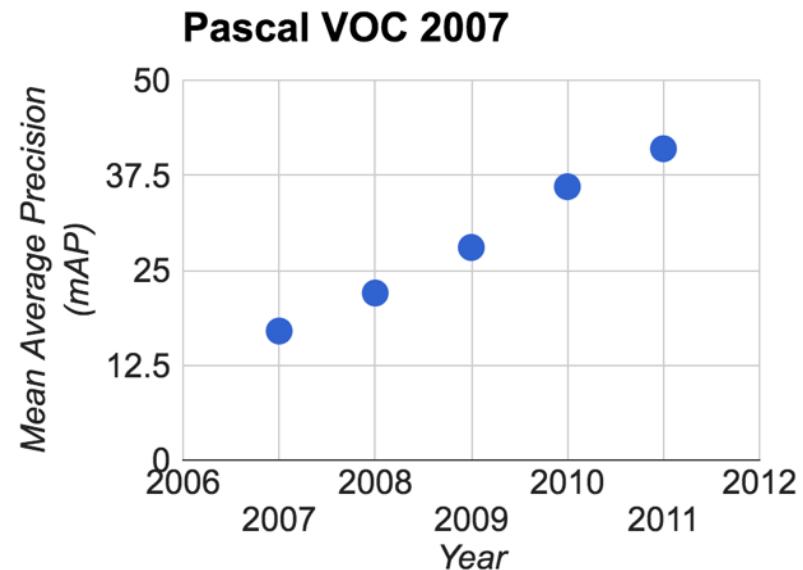
Related Courses @ Stanford

- CS131 (Fall 2016, Profs. Fei-Fei Li & Juan Carlos Niebles):
 - Undergraduate introductory class
- CS 224n (Winter 2017, Prof. Chris Manning and Richard Socher)
- CS231a (Spring 2017, Prof. Silvio Savarese)
 - Core computer vision class for seniors, masters, and PhDs
 - Topics include image processing, cameras, 3D reconstruction, segmentation, object recognition, scene understanding
- **CS231n (this term, Prof. Fei-Fei Li & Justin Johnson & Serena Yeung)**
 - **Neural network (aka “deep learning”) class on image classification**
- And an assortment of CS331 and CS431 for advanced topics in computer vision

PASCAL Visual Object Challenge (20 object categories)

[Everingham et al. 2006-2012]

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www.image-net.org

22K categories and **14M** images

- Animals
 - Plants
 - Structures
 - Person
- Bird
- Fish
- Mammal
- Invertebrate
- Tree
- Flower
- Food
- Materials
- Artifact
- Tools
- Appliances
- Structures
- Scenes
- Indoor
- Geological Formations
- Sport Activities

Deng, Dong, Socher, Li, Li, & Fei-Fei, 2009

IMAGENET Large Scale Visual Recognition Challenge

Steel drum

The Image Classification Challenge:

1,000 object classes

1,431,167 images



Output:
Scale
T-shirt
Steel drum
Drumstick
Mud turtle



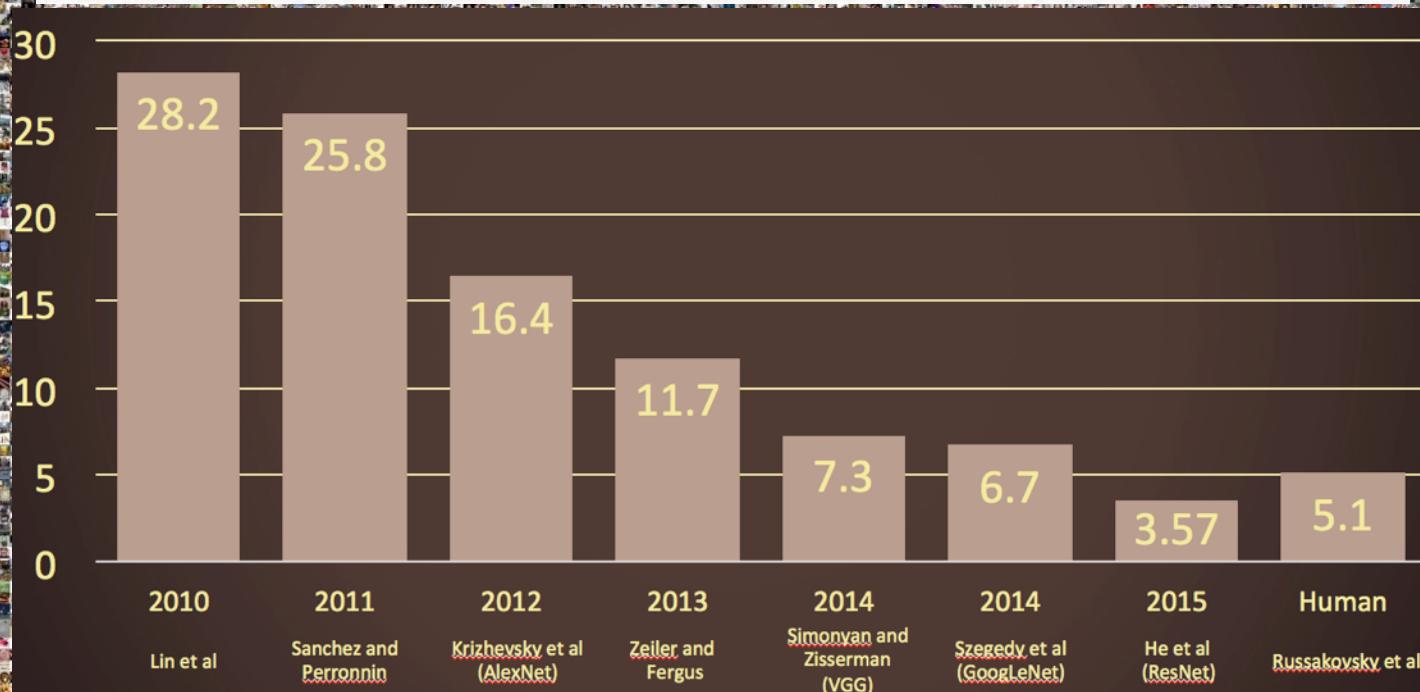
Output:
Scale
T-shirt
Giant panda
Drumstick
Mud turtle



Russakovsky et al. arXiv, 2014

IMAGENET Large Scale Visual Recognition Challenge

The Image Classification Challenge:
1,000 object classes
1,431,167 images



Russakovsky et al. arXiv, 2014

Today's agenda

- A brief history of computer vision
- CS231n overview

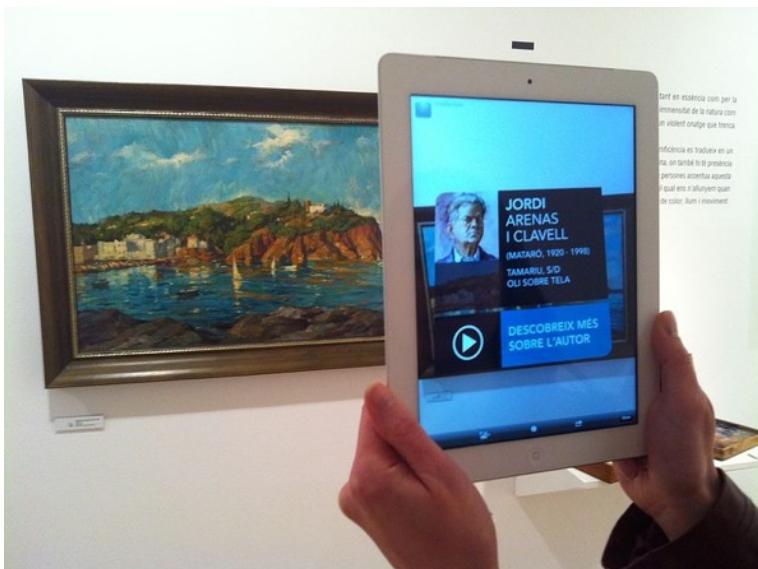
CS231n focuses on one of the most important
problems of visual recognition –
image classification



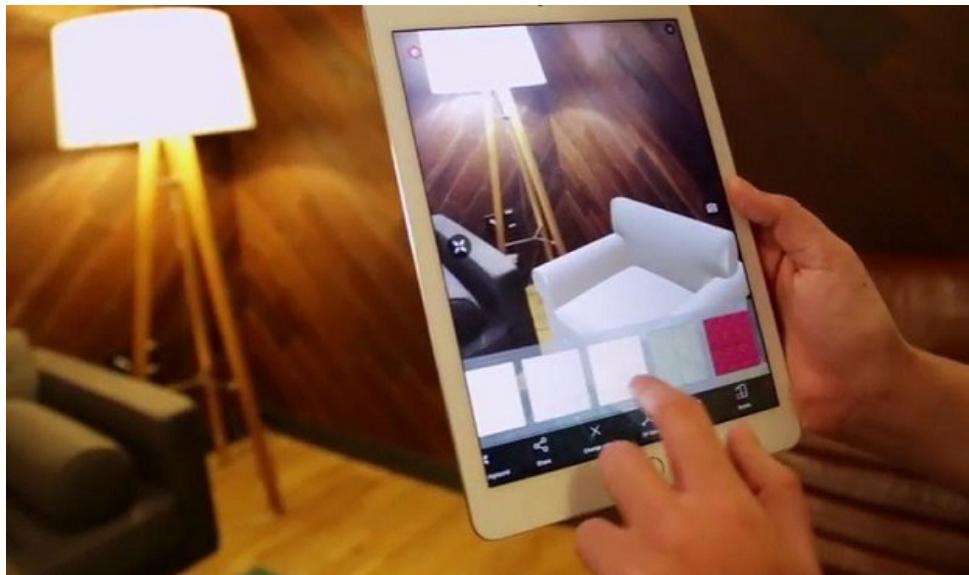
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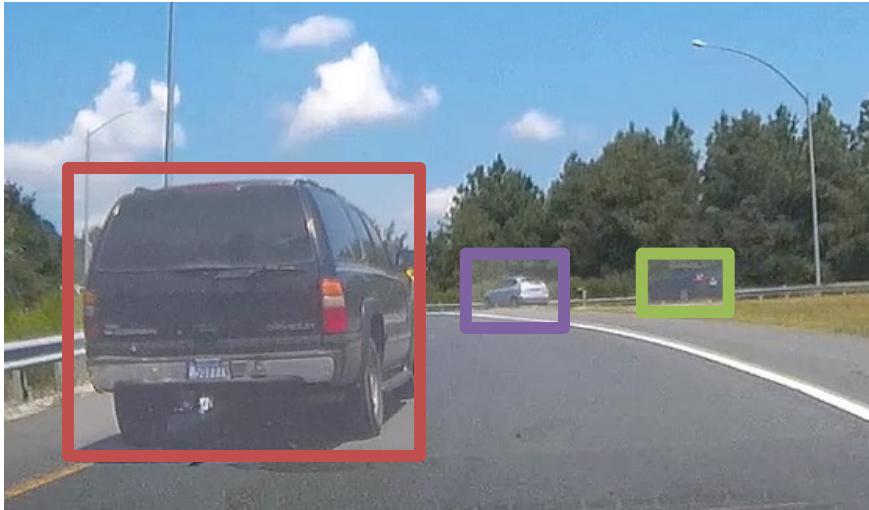


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There is a number of visual recognition problems that are related to image classification, such as object detection, image captioning



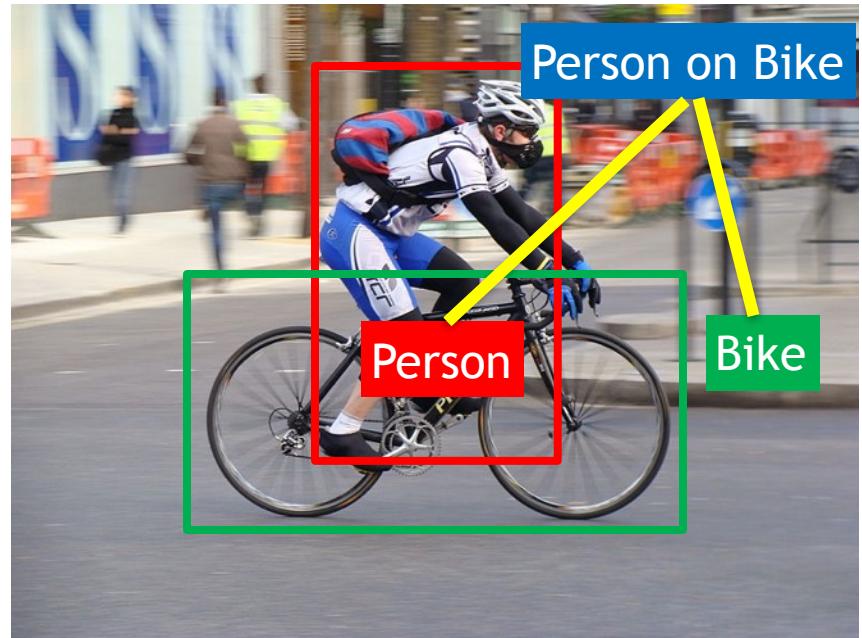
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Person
Hammer

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- Object detection
- Action classification
- Image captioning
- ...



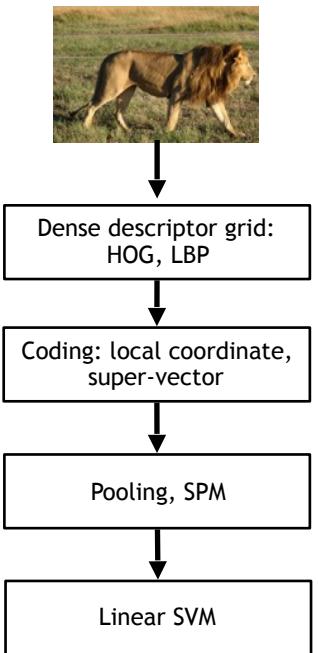
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Convolutional Neural Networks (CNN) have become an important tool for object recognition

IMAGENET Large Scale Visual Recognition Challenge

Year 2010

NEC-UIUC

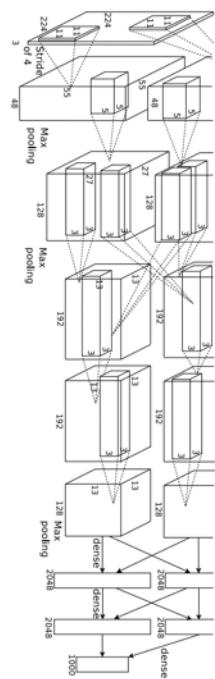


[Lin CVPR 2011]

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Year 2012

SuperVision



[Krizhevsky NIPS 2012]

Figure copyright Alex Krizhevsky, Ilya Sutskever, and Geoffrey Hinton, 2012. Reproduced with permission.

Year 2014

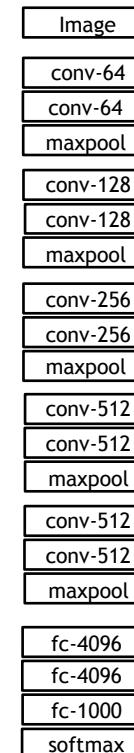
GoogLeNet

- Pooling
- Convolution
- Softmax
- Other



[Szegedy arxiv 2014]

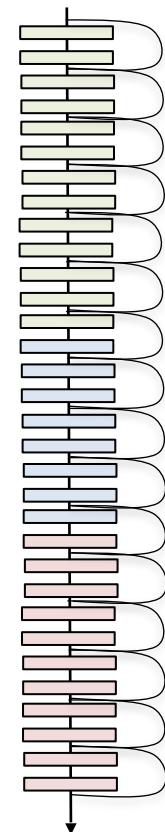
VGG



[Simonyan arxiv 2014]

Year 2015

MSRA

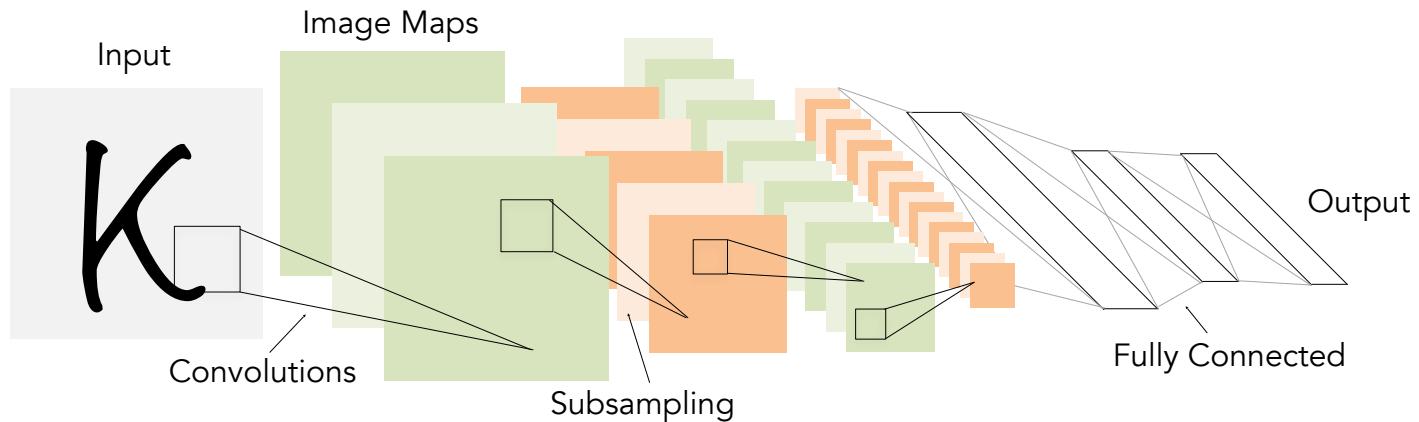


[He ICCV 2015]

Convolutional Neural Networks (CNN)
were not invented overnight

1998

LeCun et al.



of transistors



10^6

pentium® II

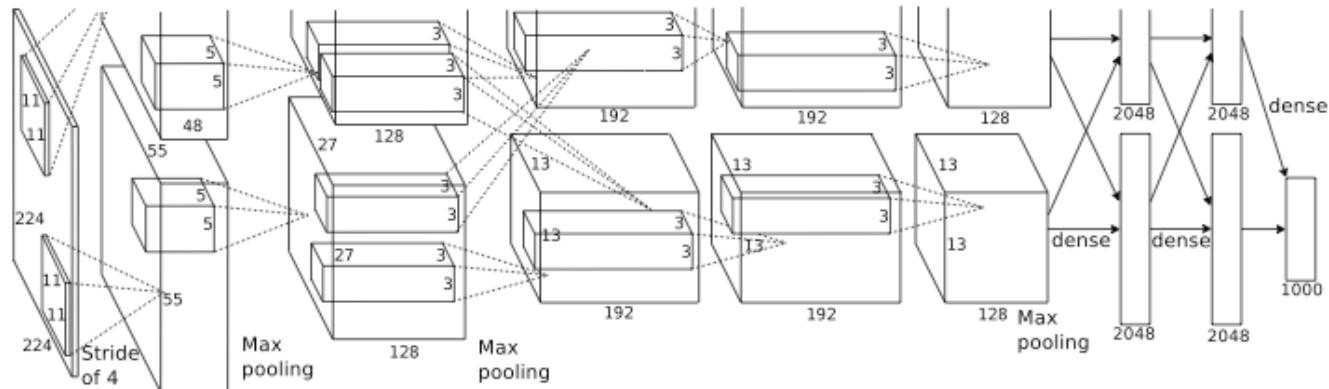
of pixels used in training

10^7



2012

Krizhevsky et al.



of transistors



10^9

GPUs



of pixels used in training

10^{14}



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Who we are

Instructors



Fei-Fei Li



Justin Johnson



Serena Yeung

Emeritus



Andrej Karpathy

Teaching Assistants



Albert Haque



Rishi Bedi



Shyamal Buch



Zhao (Joe) Chen



Timnit Gebru



Agrim Gupta



De-An Huang



Russell Kaplan



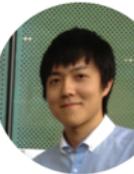
Leo Keselman



Nishith
Khandwala



Shayne Longpre



Zelun Luo



Lane McIntosh



Oliver Moindrot



Amani Peddada



Emma Peng



Ben Poole



Luda Zhao