



UNIVERSITÀ DEGLI STUDI DI SALERNO



UNIVERSITÀ DEGLI STUDI DI SALERNO
DIPARTIMENTO DI INFORMATICA
DIPARTIMENTO DI ECCELLENZA



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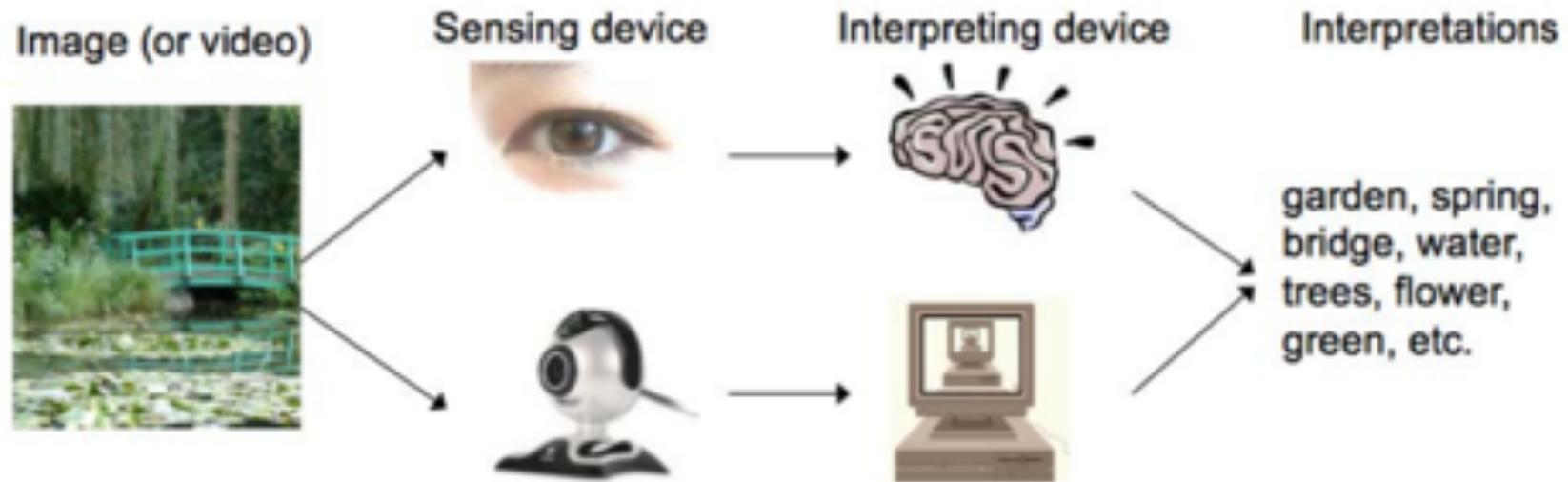
C.A.S.A. Course

CONTEXT AWARE SECURITY ANALYTICS IN COMPUTER VISION
Lesson 1





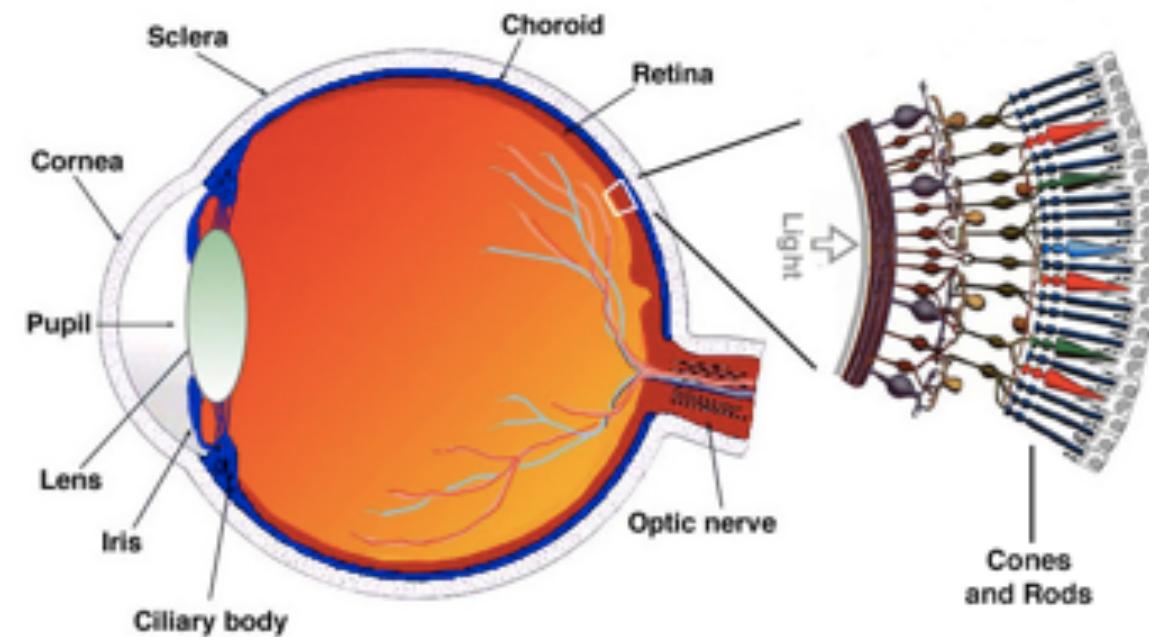
Introduction to Human vs Computer Vision





Introduction to Human vs Computer Vision

Human Eye



There are two types of photoreceptors in the human retina, rods and cones.

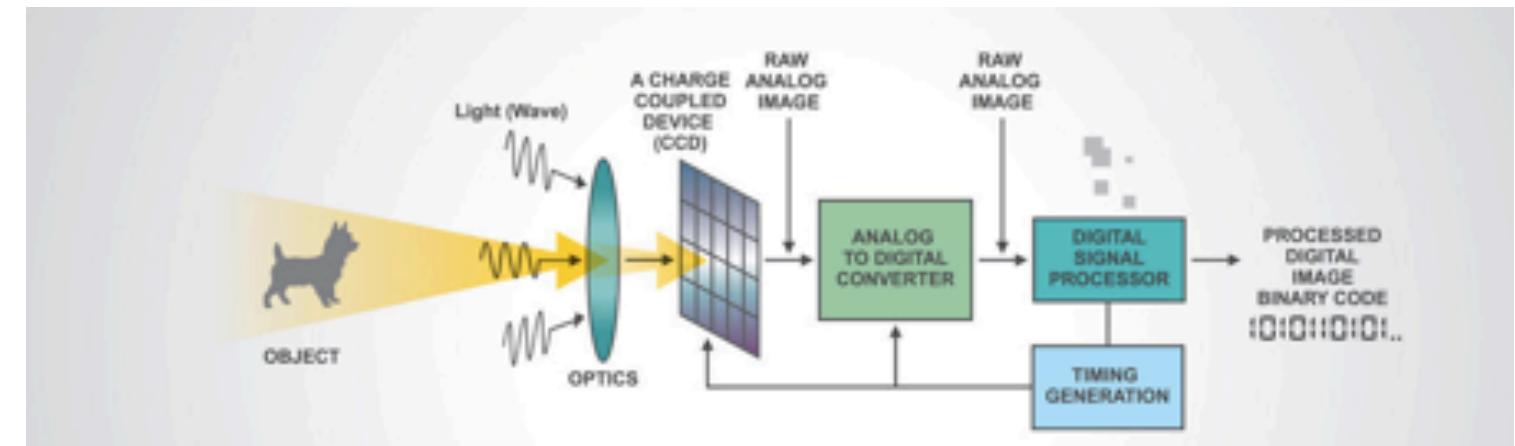
Rods are responsible for vision at low light levels (scotopic vision). They do not mediate color vision, and have a low spatial acuity.

Cones are active at higher light levels (photopic vision), are capable of color vision and are responsible for high spatial acuity.



Introduction to Human vs Computer Vision

Digital Camera



When you press the button to take a photograph with a digital camera, an aperture opens at the front of the camera and light streams in through the lens. There is a piece of electronic equipment that captures the incoming light rays and turns them into electrical signals. This light detector is one of two types, either a charge-coupled device (CCD) or a CMOS image sensor.



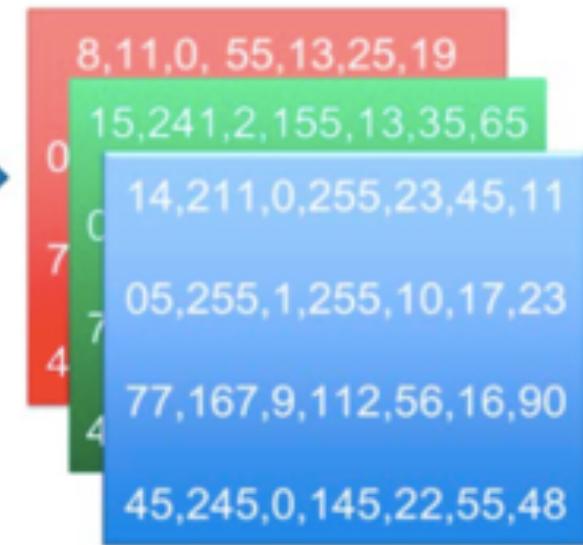
Introduction to Human vs Computer Vision



We see



Computer sees

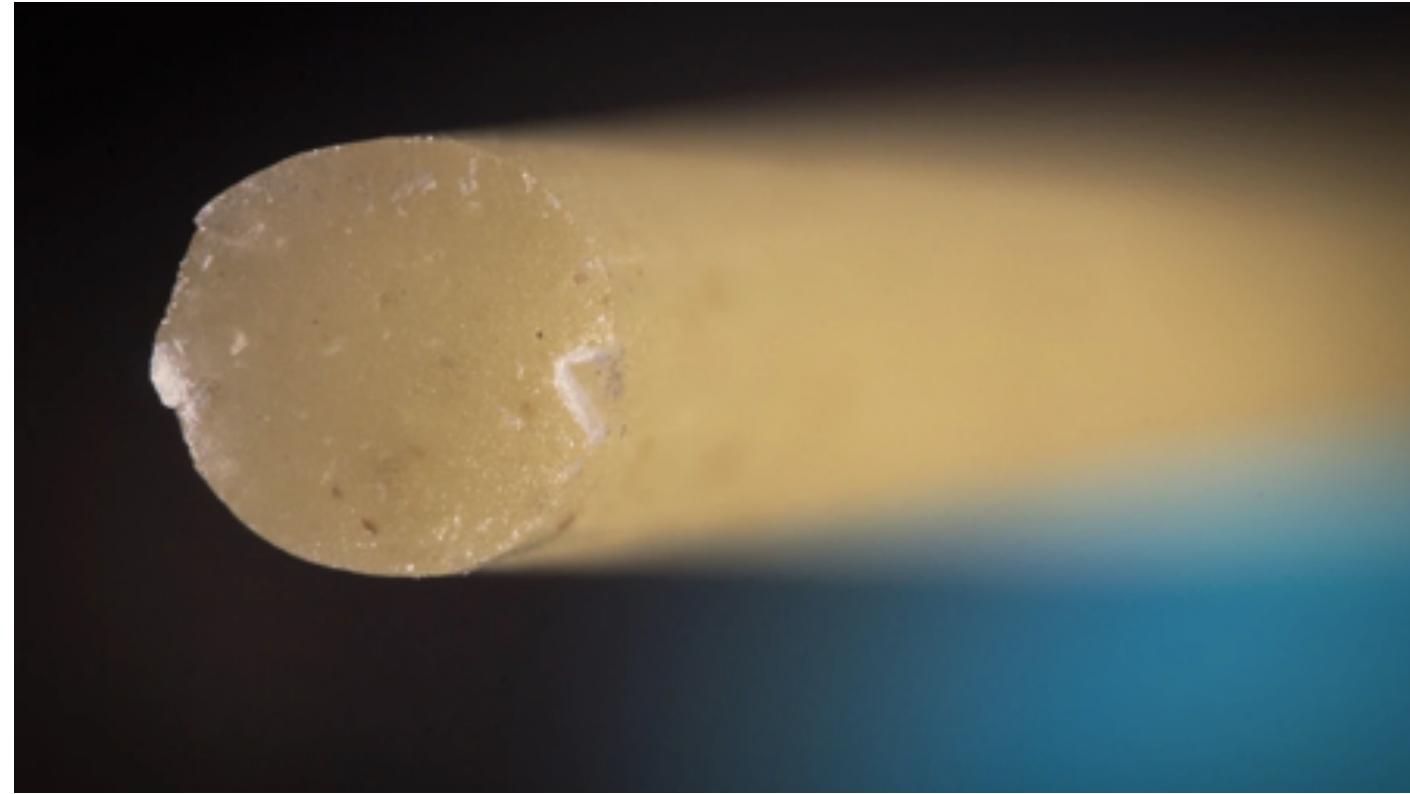




Introduction to Human vs Computer Vision



What is this?





Introduction to Human vs Computer Vision



Perspective is of great importance in human vision.



Introduction to Human vs Computer Vision

Not only perspective is of great interest in computer vision but also:

Occlusions



Illumination



Deformation



Intraclass variation



Introduction to Human vs Computer Vision

Learning algorithms, as well as human, need to be trained on a large amount of samples per class.

These are
spaghetti...



But these too..





Introduction to Human vs Computer Vision

But when images are complex, what can we use as training data?

What would you use to understand which television broadcast is this?





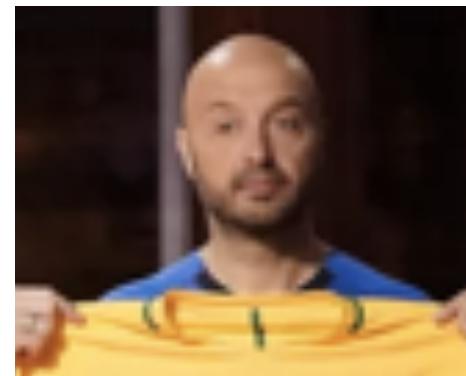
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People?



«Hell's kitchen»



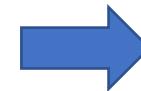
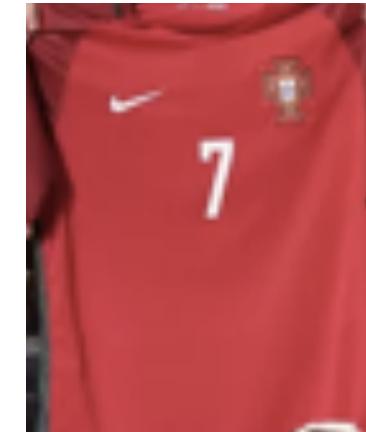
«McDonald's»
spot



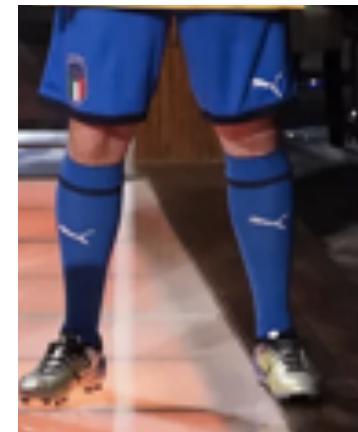
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Clothes?



football match





Introduction to Human vs Computer Vision



Logo!



«Masterchef»



Introduction to Human vs Computer Vision

What band is this?

No logos...

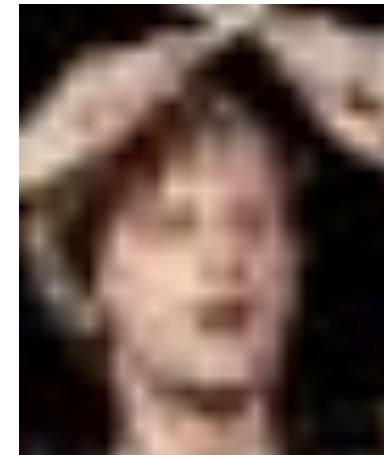




Introduction to Human vs Computer Vision



Face recognition



Dominic Howard
«Muse»





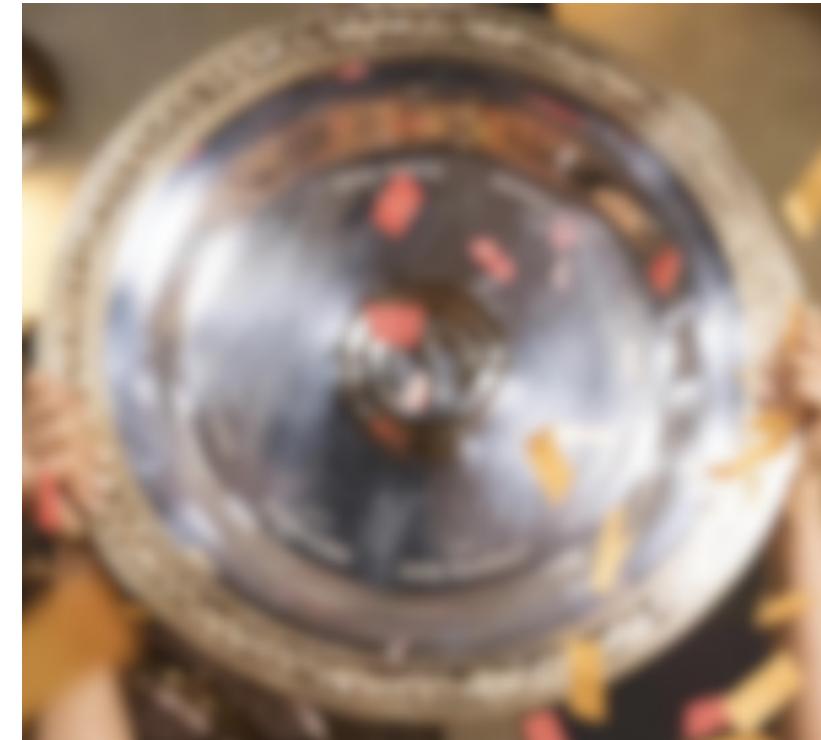
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Because of prize?





Introduction to Human vs Computer Vision



Other «Masterchef» prizes...



Quite different, isn't it?



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A plate in a museum?





Introduction to Human vs Computer Vision



Facial Expression recognition



Smile! Probably she won...



Computer Vision

«Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of a theoretical and algorithmic basis to achieve automatic visual understanding.»

The British Machine Vision Association and Society for Pattern Recognition Retrieved February 20, 2017



Computer Vision: Progress in the Hardware



Kinect



Infrared camera

Drones/Mobile cameras

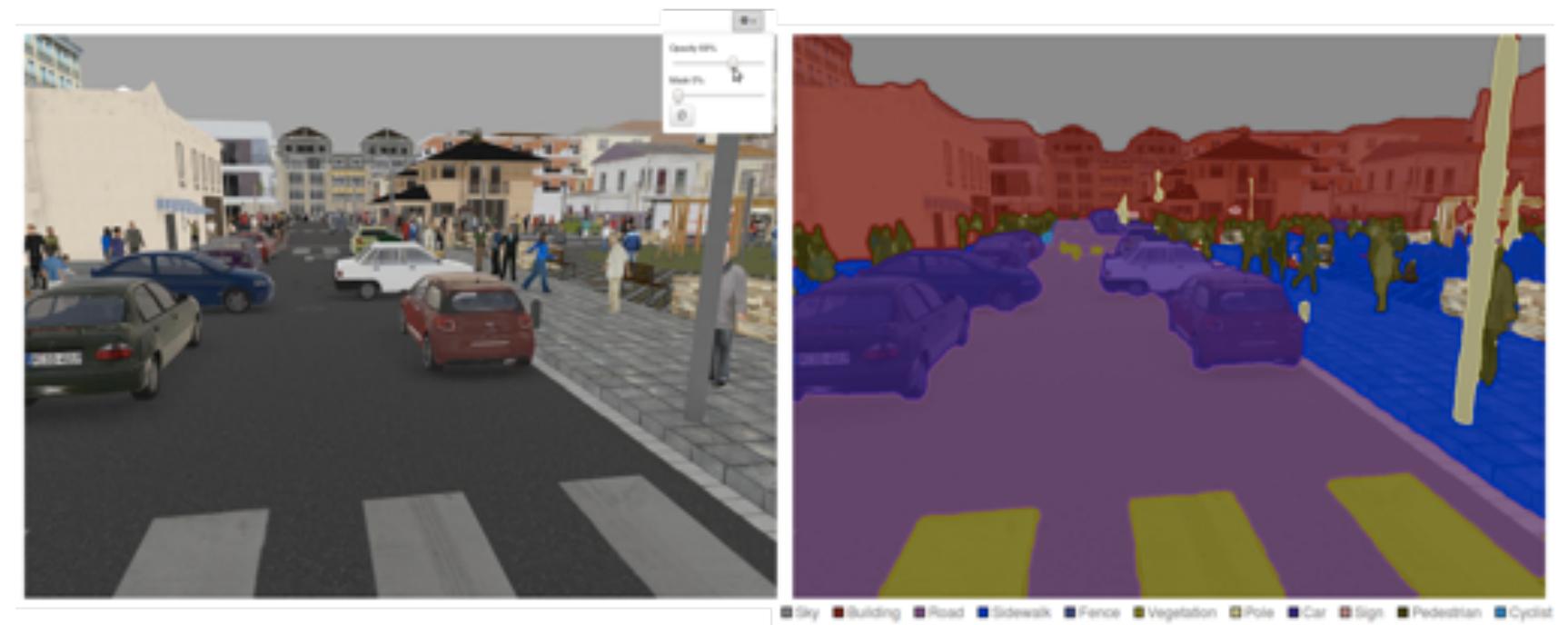




Computer Vision: Progress in algorithms

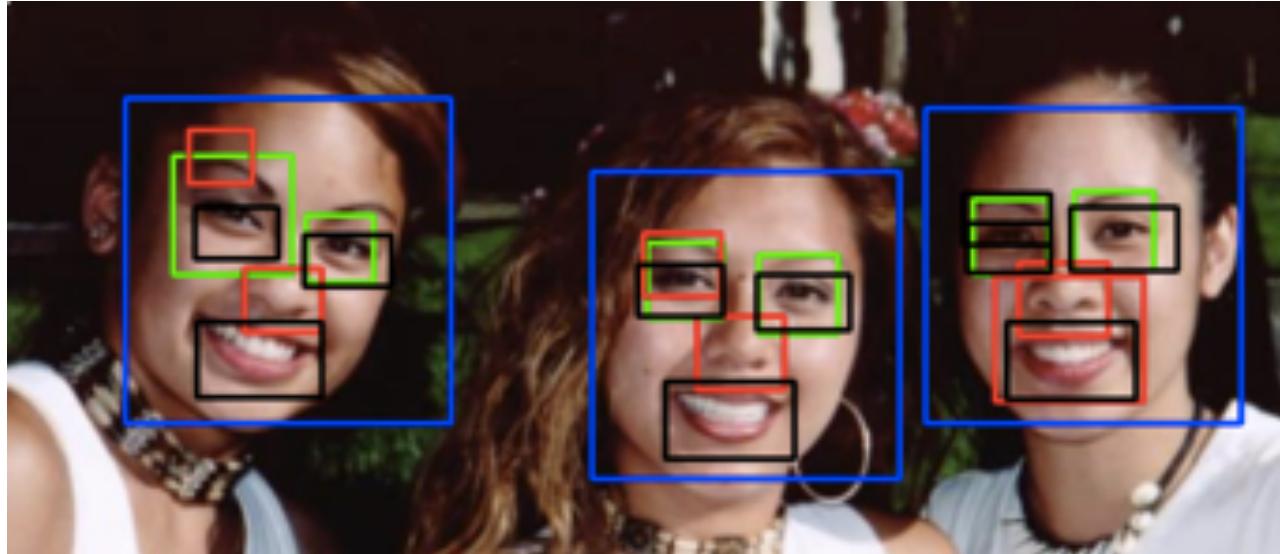


Image
segmentation





Computer Vision: Progress in algorithms



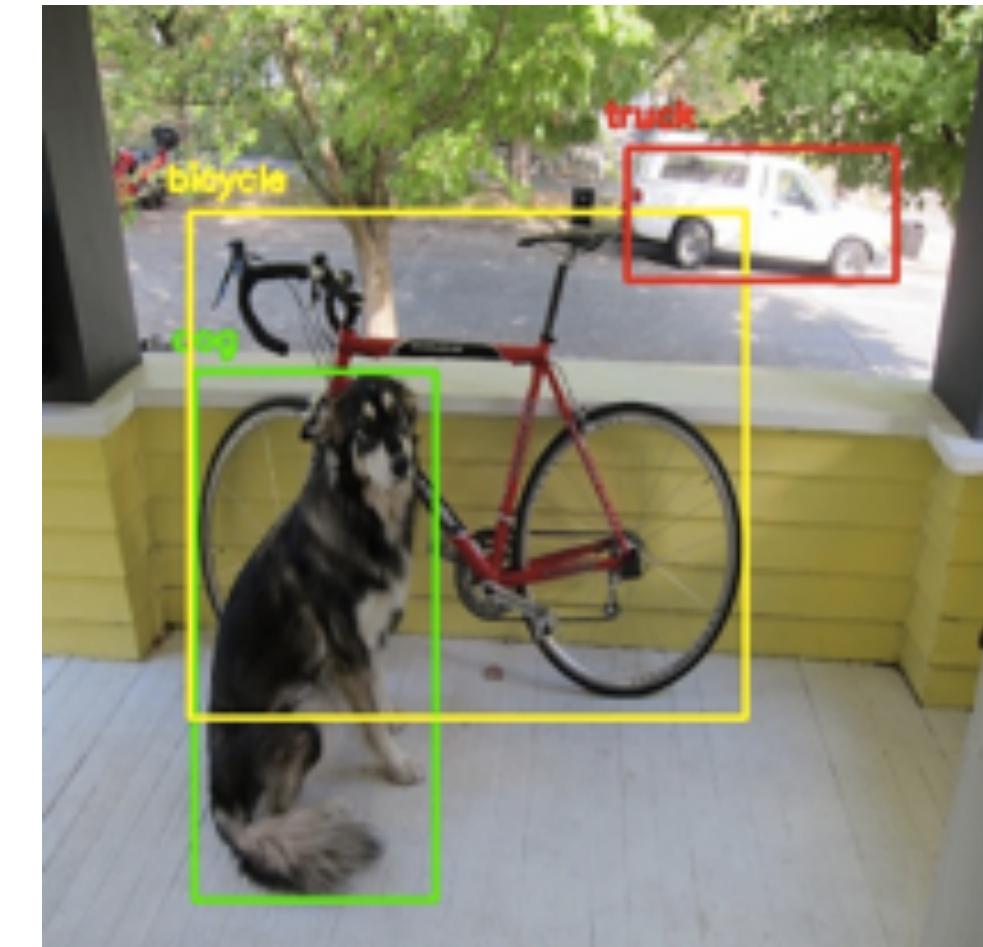
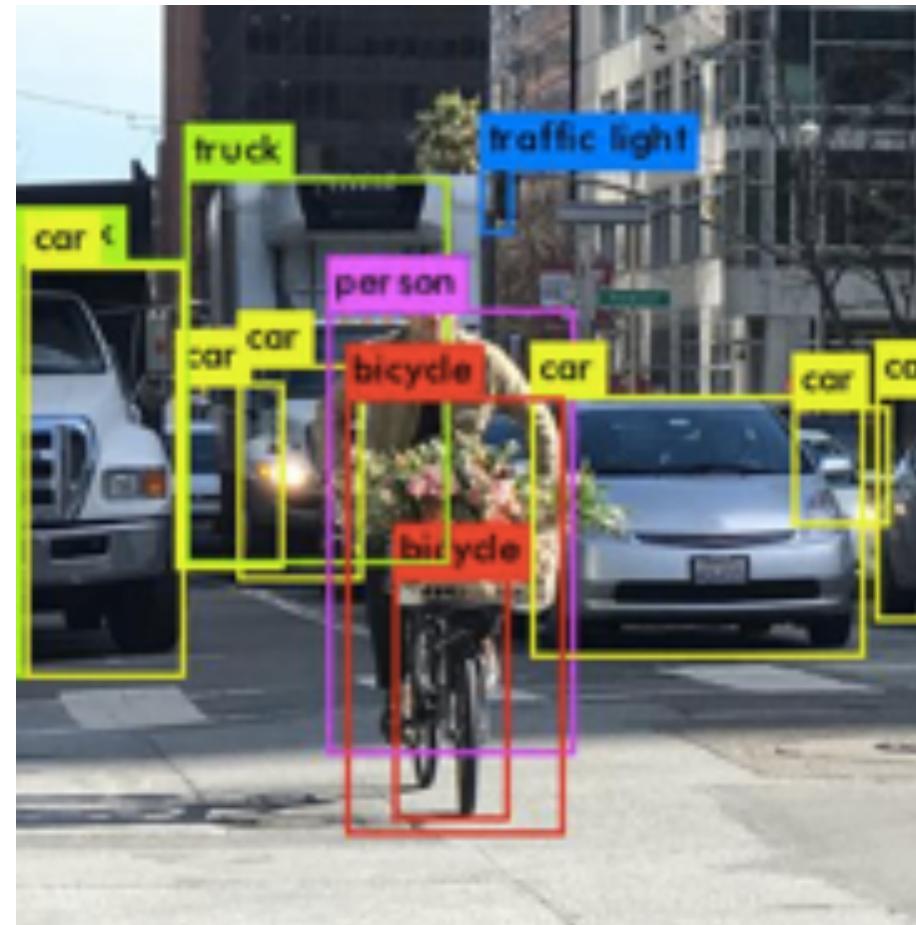
Viola-Jones:
Face detection and part of a
face detection





Computer Vision: Progress in algorithms

Object detection





Computer Vision: Progress in algorithms



People/objects tracking...



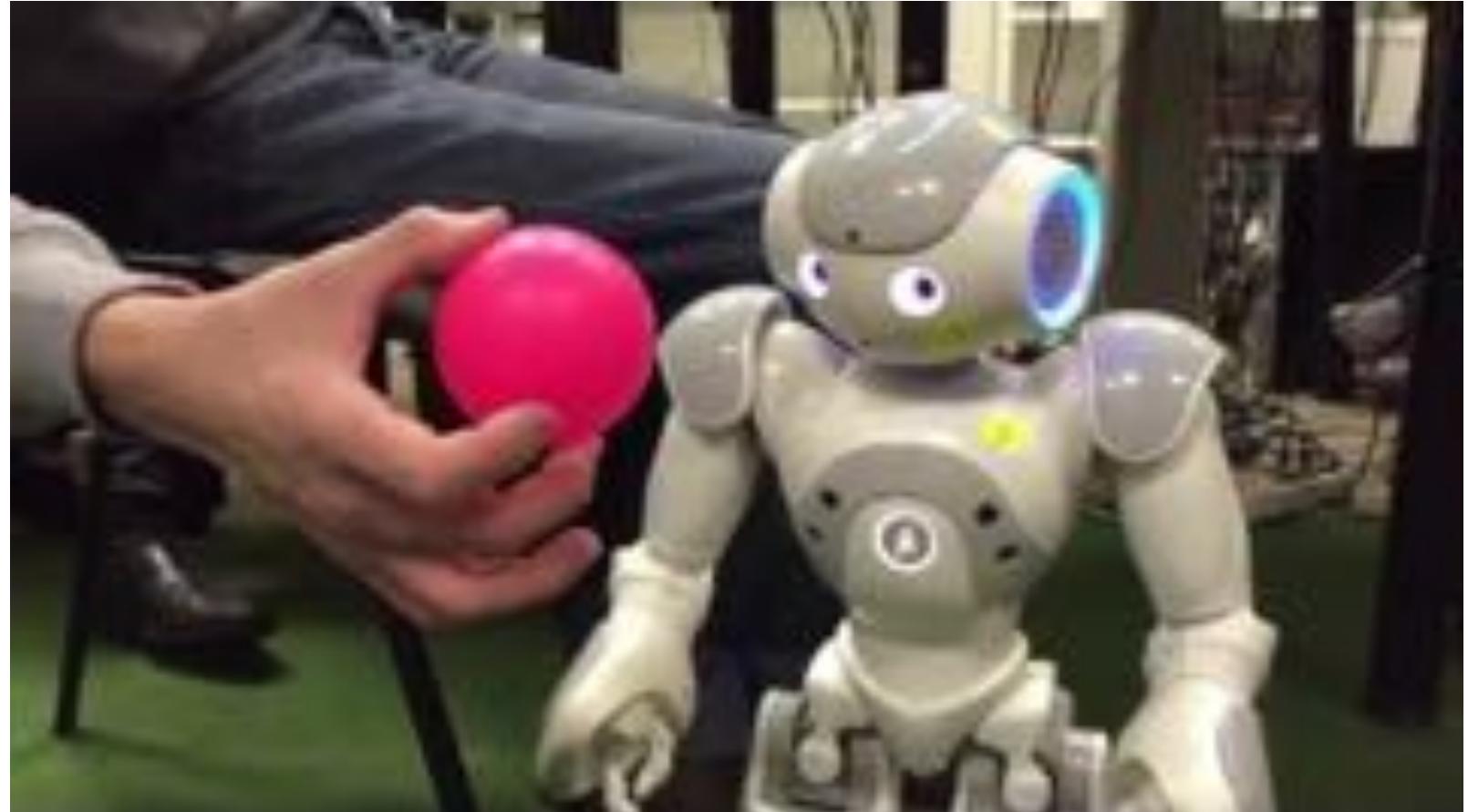
https://www.youtube.com/watch?time_continue=11&v=YhW7YRJvQpg



Computer Vision: Progress in algorithms



...and an example
of application.





Computer Vision: Progress in algorithms

Automatic scene description



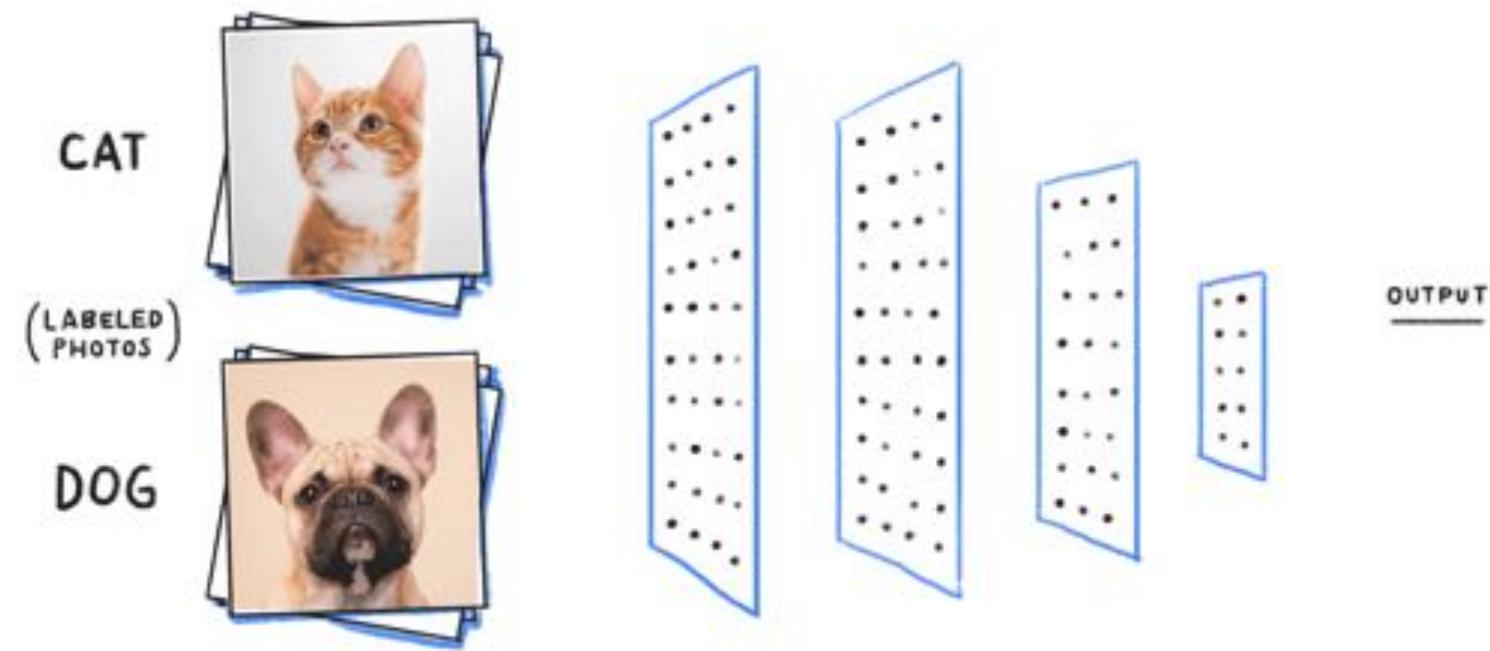
<https://www.youtube.com/watch?v=dKNu9y92iOQ>



Computer Vision: Classification



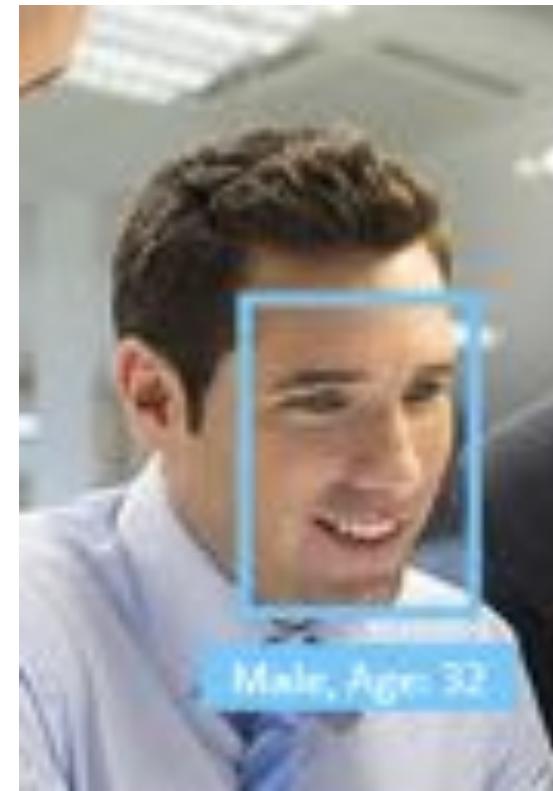
We are interested mainly in classification algorithms...





Computer Vision: Classification

...to perform age&gender detection...





Computer Vision: Classification



...emotion classification...



(a) angry



(b) disappointed



(c) laughing



(d) surprised



Computer Vision: Classification



...emotion classification...



(a) angry



(b) disappointed



(c) laughing



(d) surprised



Computer Vision: Classification

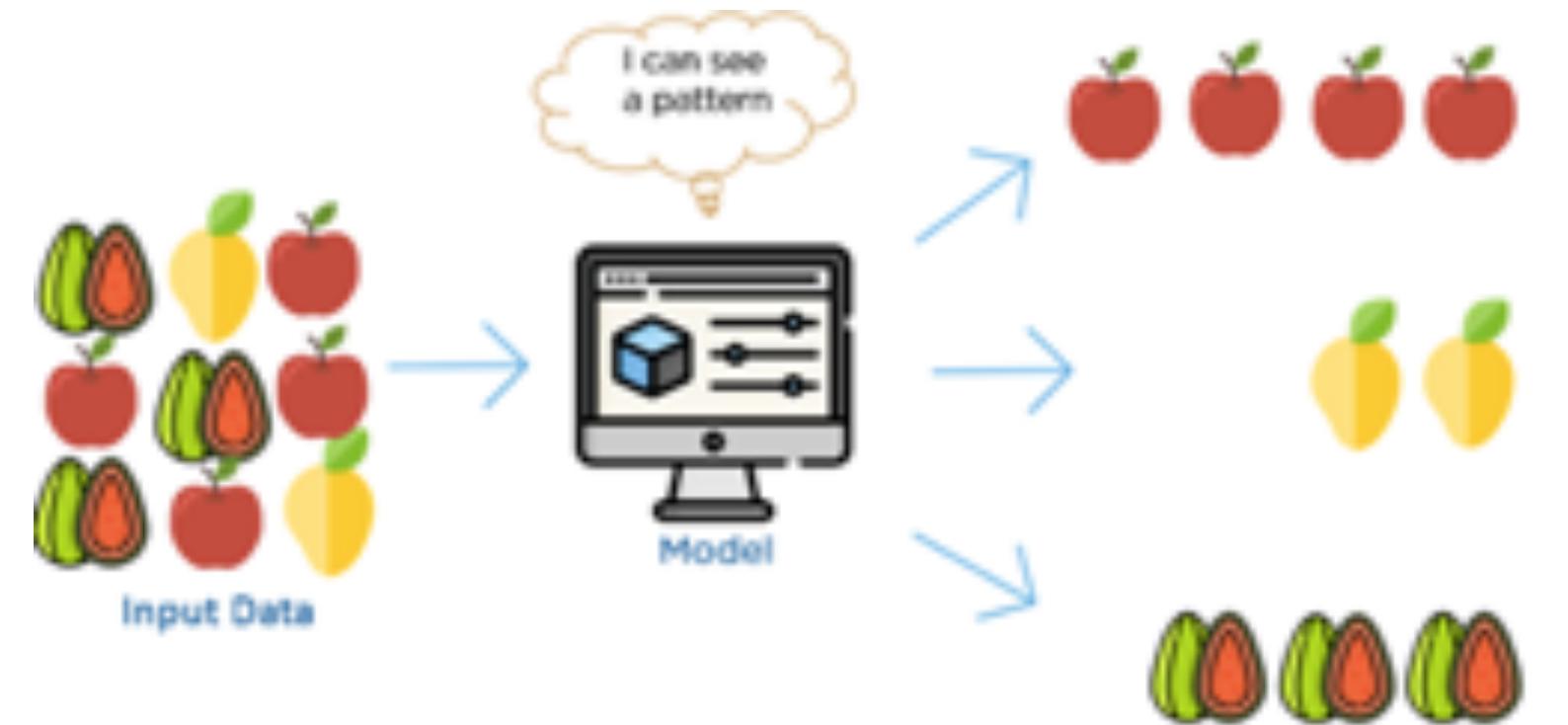
...action recognition
...and so on!





Computer Vision

We are also interested in
clusterization* ...



*usually when we don't know what inputs are.



Computer Vision

...and progressive models.



*usually used in video and time-dependent data

<https://www.youtube.com/watch?v=aryhiDMbhT8>

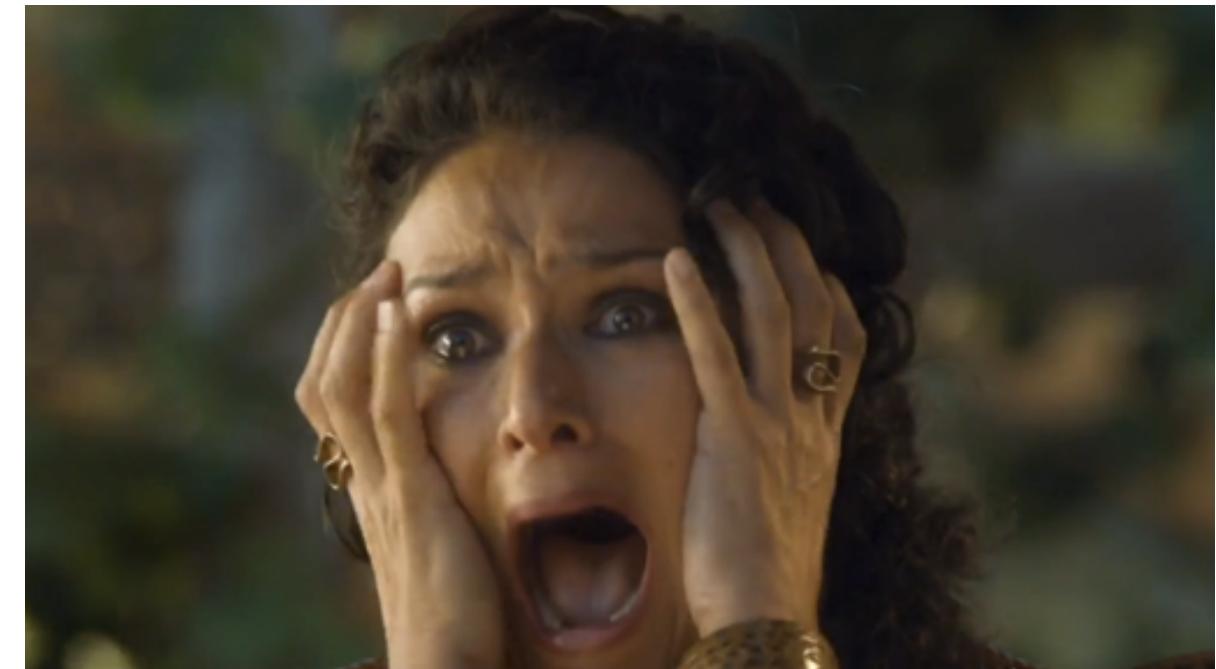


Computer Vision



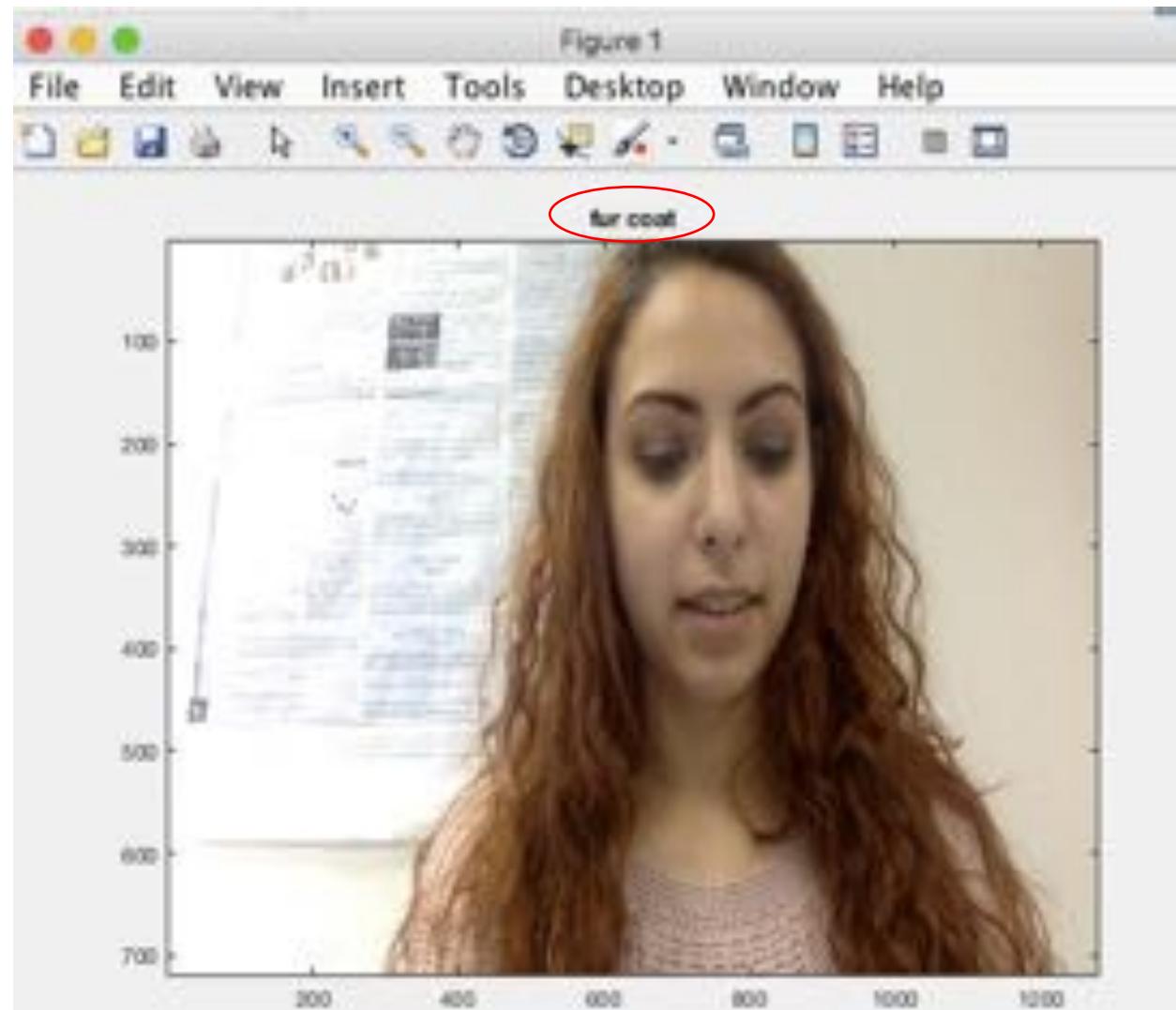
We will perform those tasks with different kind of machine learning algorithms, especially Neural Networks (NN) we will introduce in next lessons.

But, even if we use powerful algorithms as NN, sometimes something goes wrong...





Computer Vision



...I have copper hair...
...but I'm definitely not a fur coat!

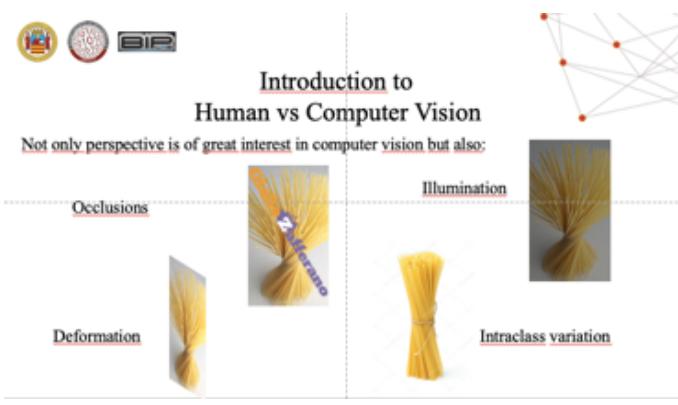




Computer Vision

What would cause problems like this?

Manipulation of images...as we saw in slide 8.



"panda"

Adversarial Noise



+

=



"gibbon"



"vulture"

Adversarial Rotation



+

=



"orangutan"



"not hotdog"

Adversarial Photographer



+

=

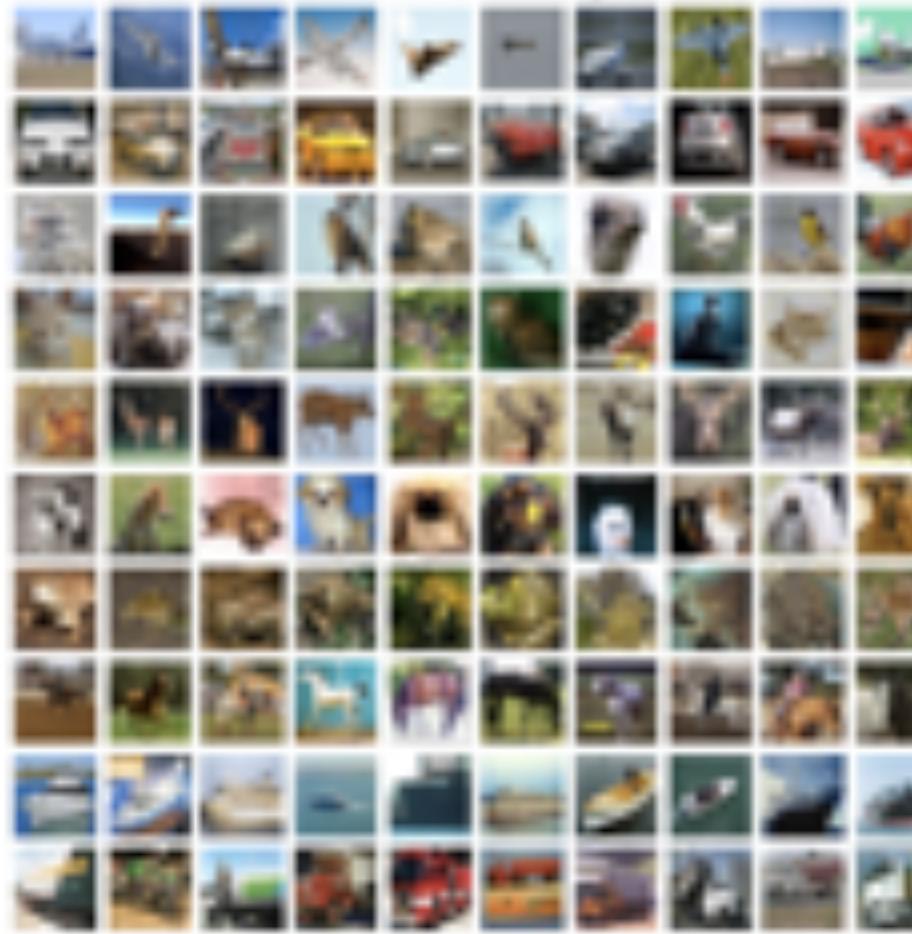


"hotdog"



Computer Vision

airplane
automobile
bird
boat
car
deer
dog
dove
motorcycle
sofa
train
tvmonitor



It's good to have a lot of classes.
(GoogleNet has 1000 classes)

In this way we can classify a lot
of things...





Computer Vision



...but it is vitally important collecting a lot of sample per class in order to ensure the proper functioning of the neural network!

Interclass variations are essential.



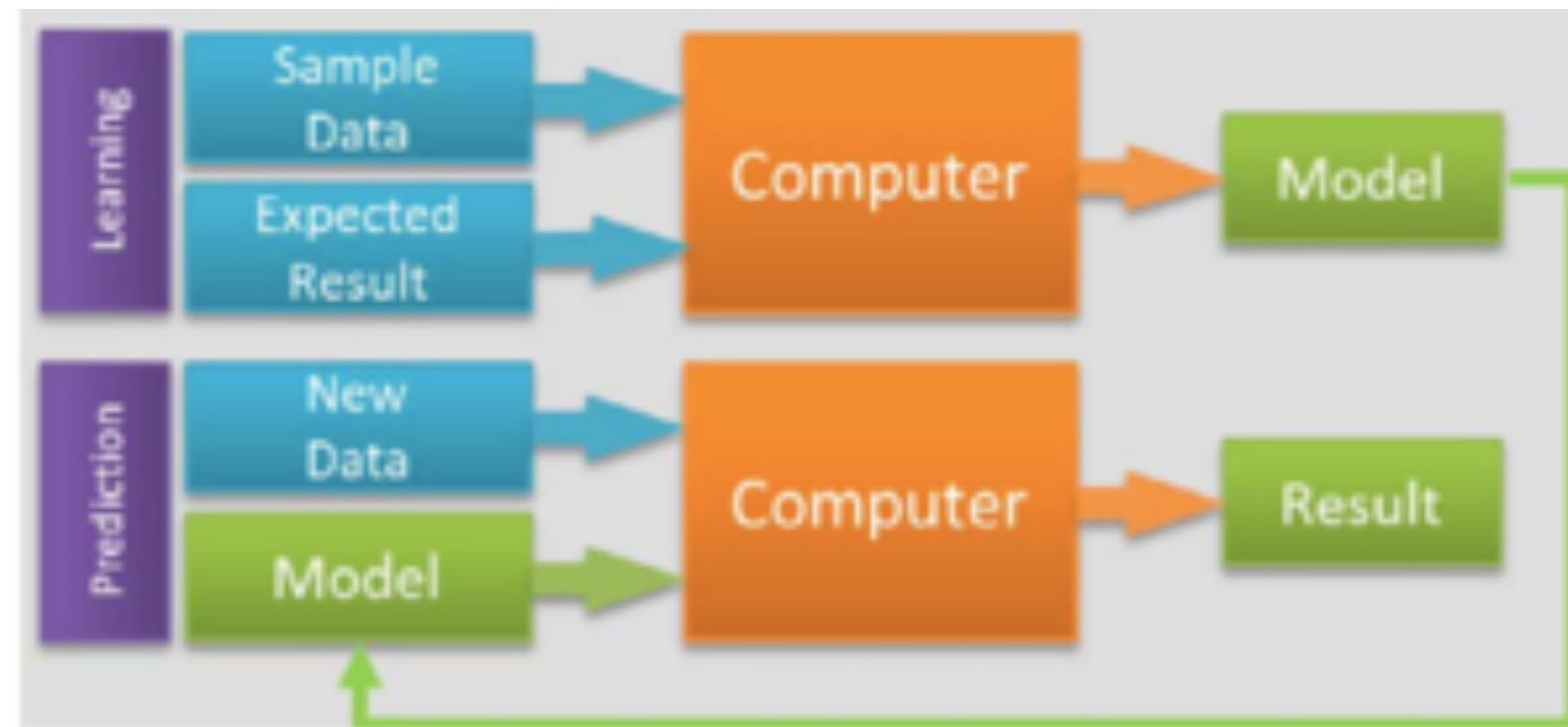


Computer Vision: Traditional models





Computer Vision: Deep Learning





Computer Vision: Machine Learning vs Deep Learning

Machine Learning

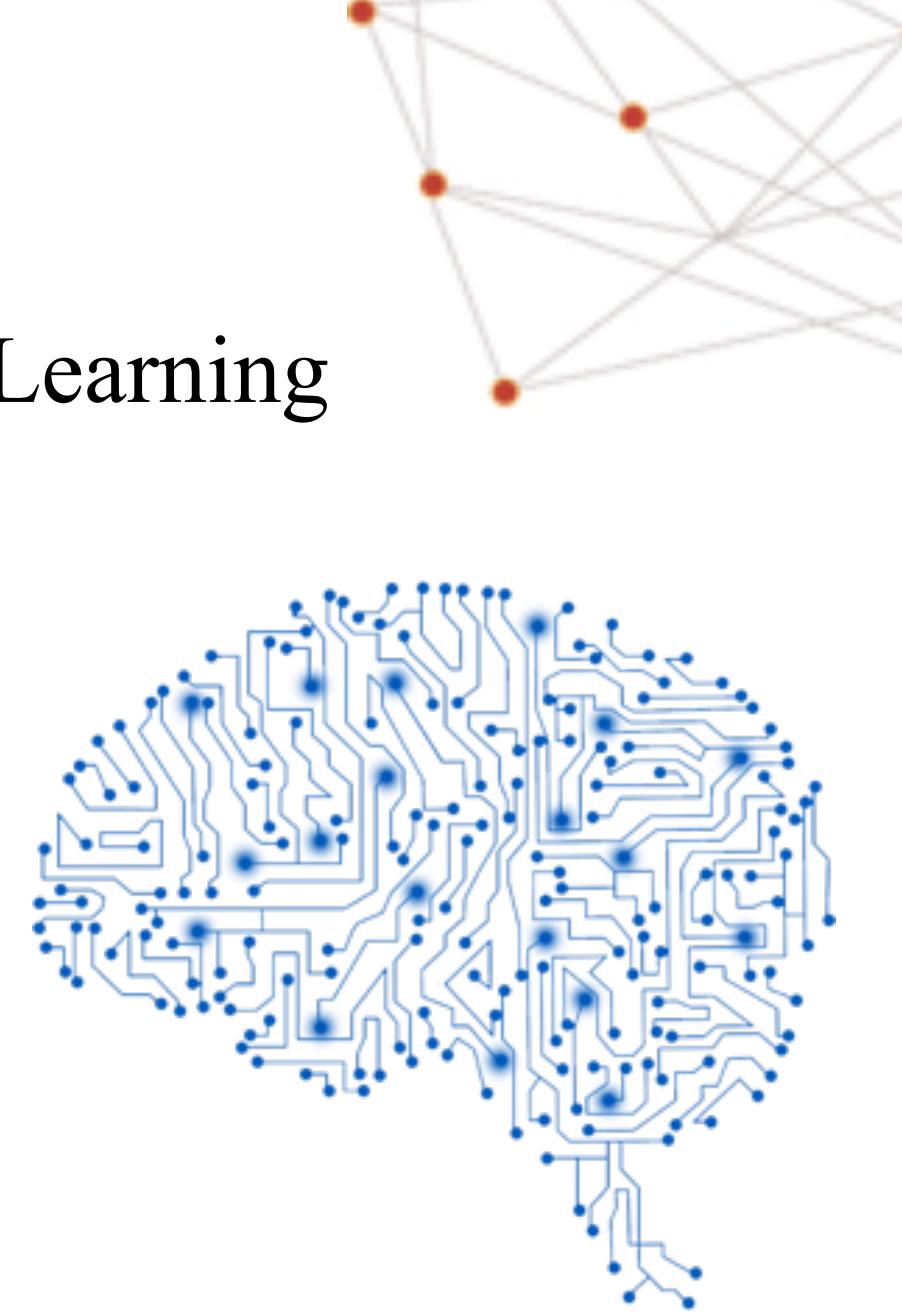
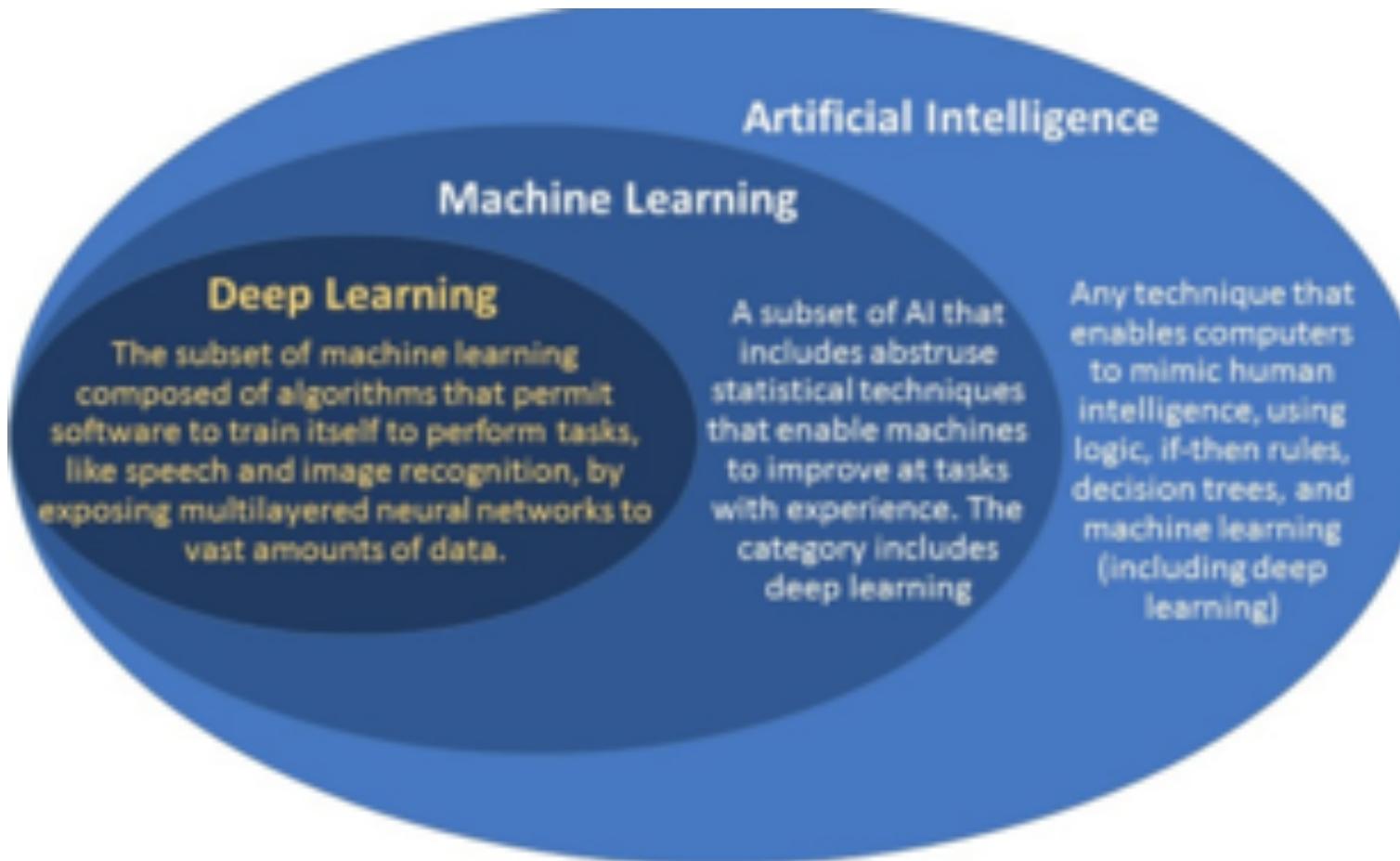


Deep Learning



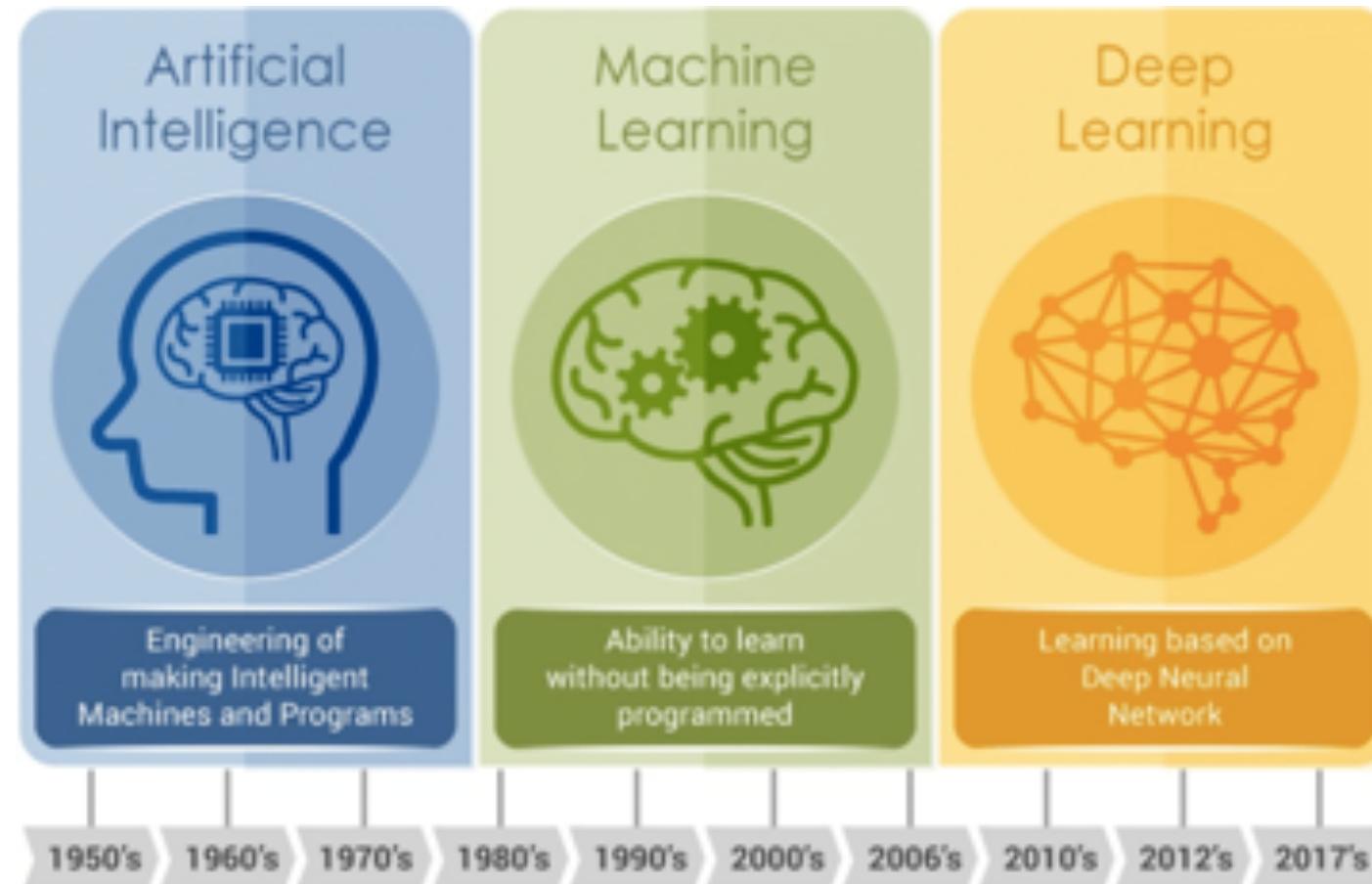


Computer Vision: AI, Machine Learning, Deep Learning





Computer Vision: AI, Machine Learning, Deep Learning

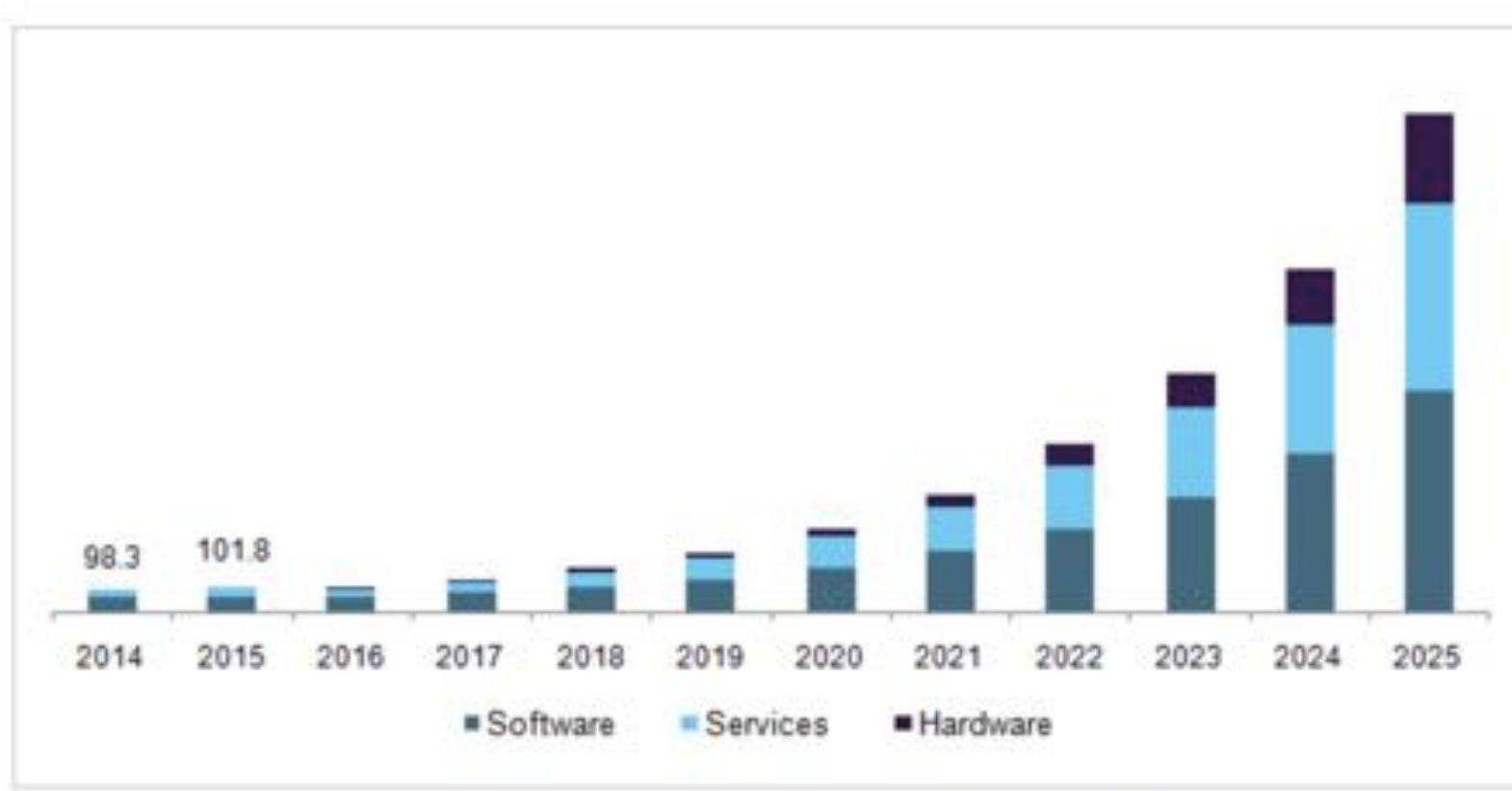




Computer Vision: AI, Machine Learning, Deep Learning

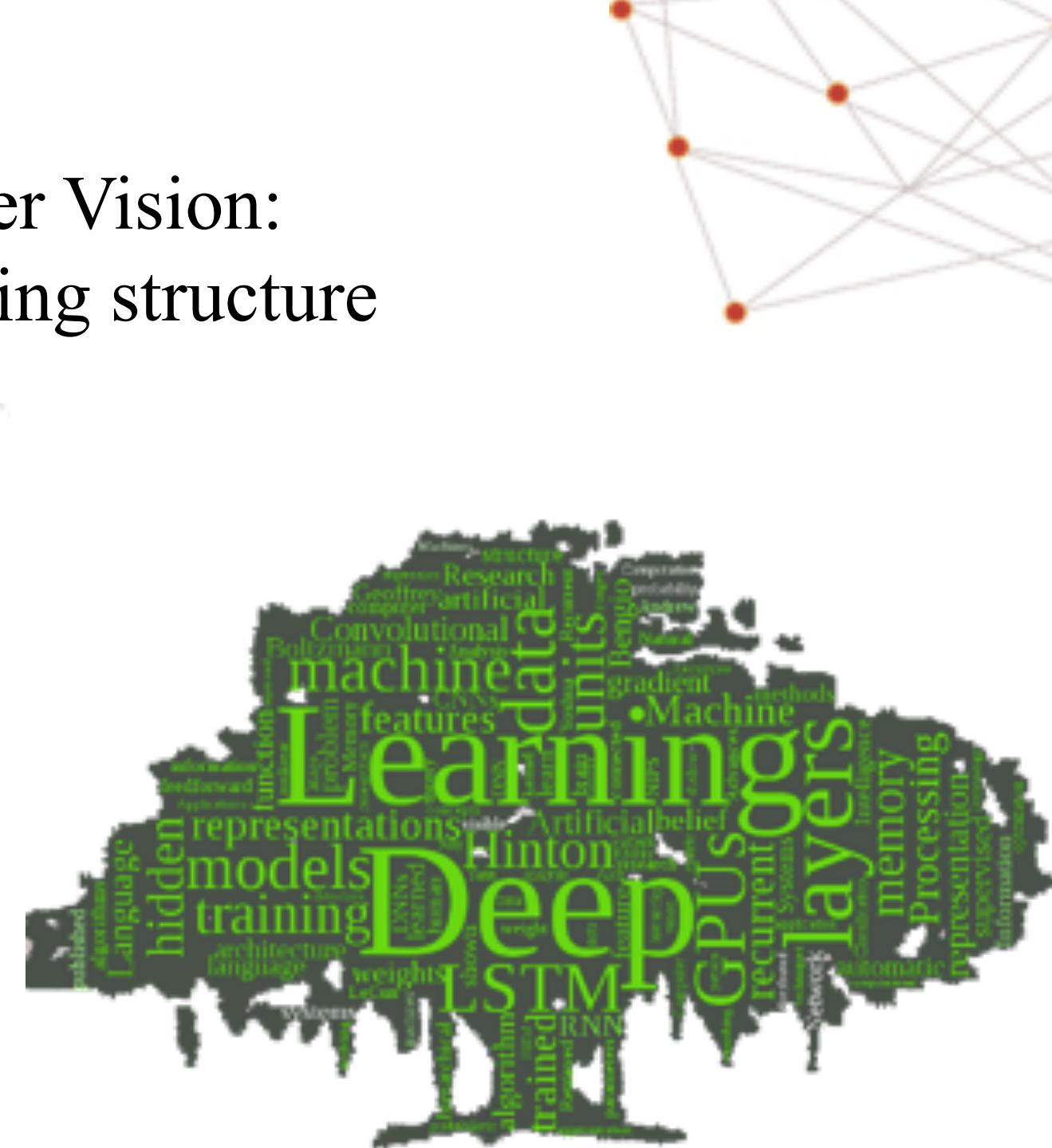


U.S. deep learning market, by solution, 2014 - 2025 (USD Million)





Computer Vision: Deep Learning structure



Fundamentals:

Brands of ML

Evaluation

Data processing

Overfitting & underfitting

DL in practice:

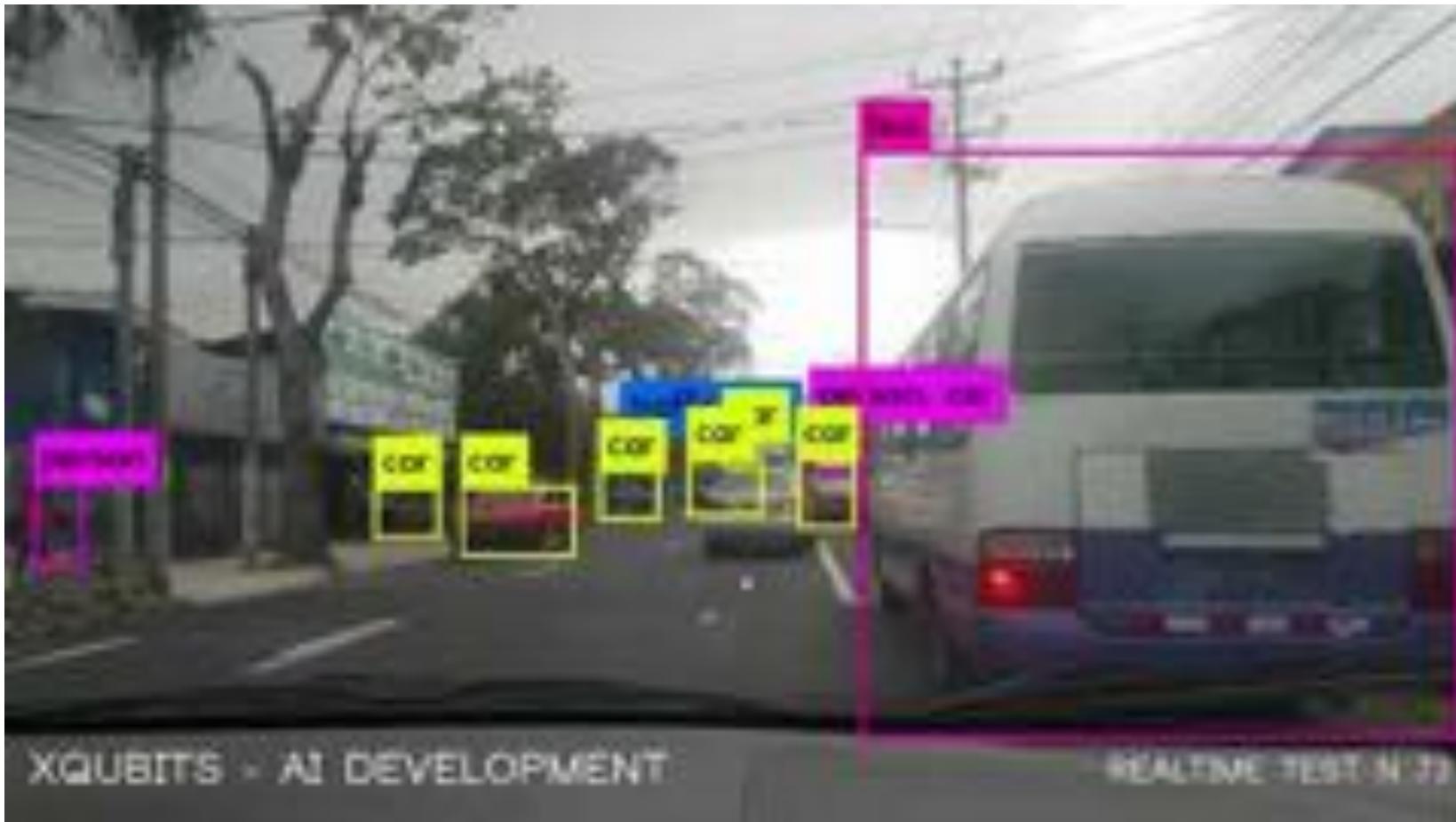
CNN

RNN

Generative models

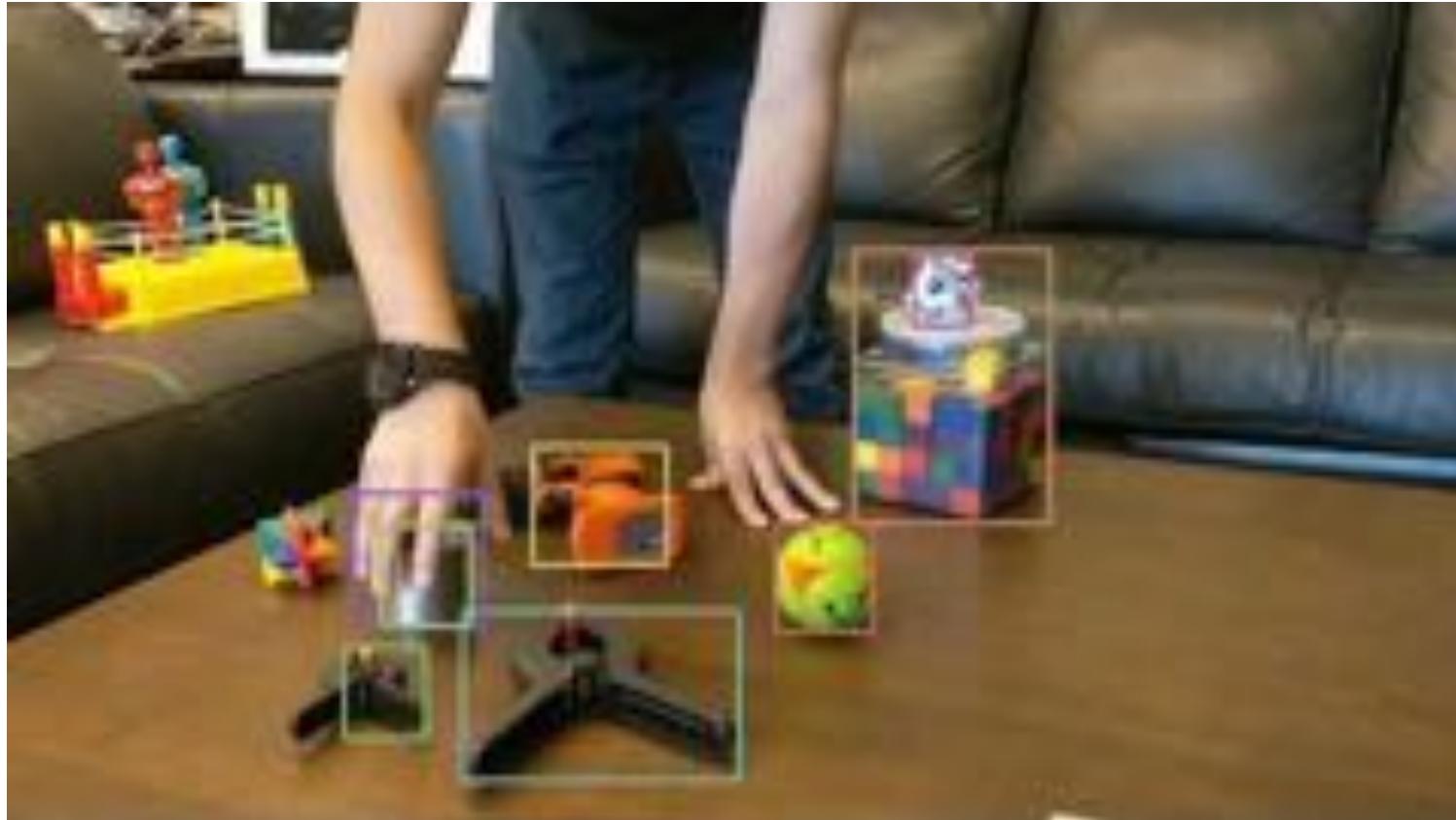


Where are we now? Real-time CNN





Where are we now? Real-time RNN



<https://www.youtube.com/watch?v=RByCiOLlxug>



Where are we now? Real-time GAN



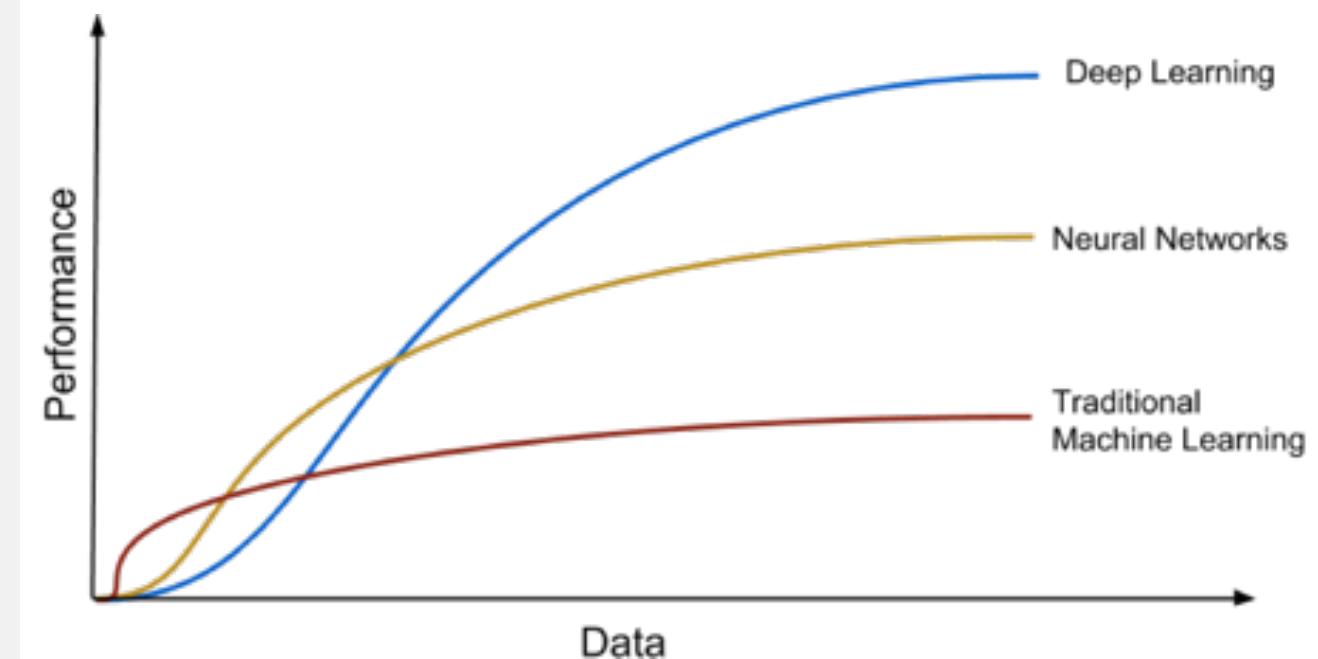
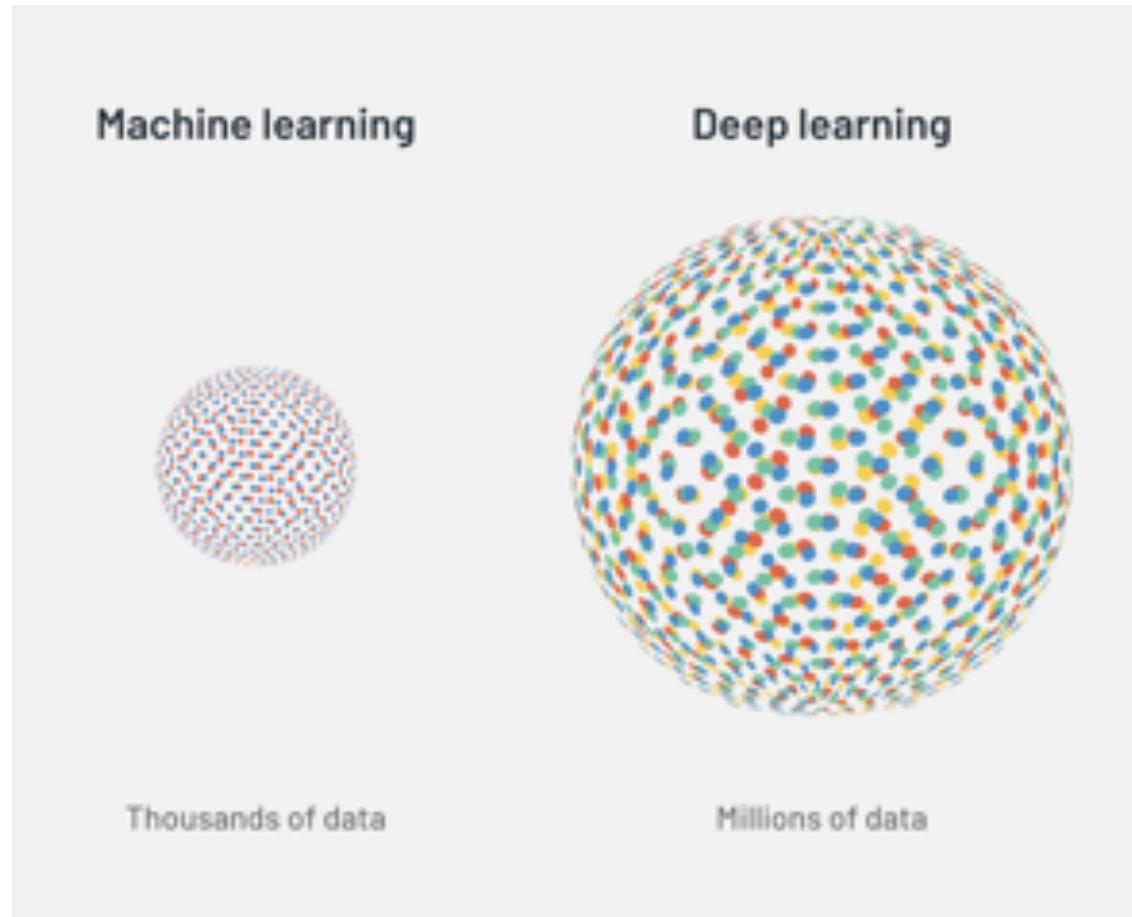
<https://www.youtube.com/watch?v=JzgOfISLNjk>



<https://www.youtube.com/watch?v=mAz3op4T5eA>



Computer Vision: Deep Learning data

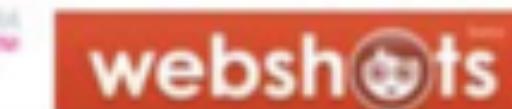




Computer Vision: Deep Learning data



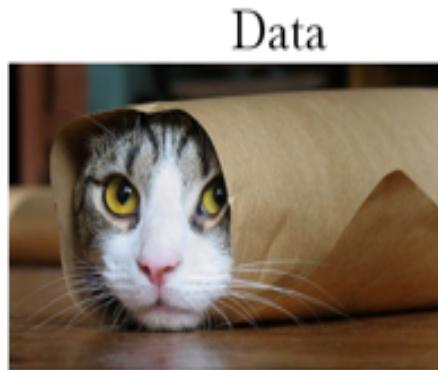
Fortunately, data are everywhere!





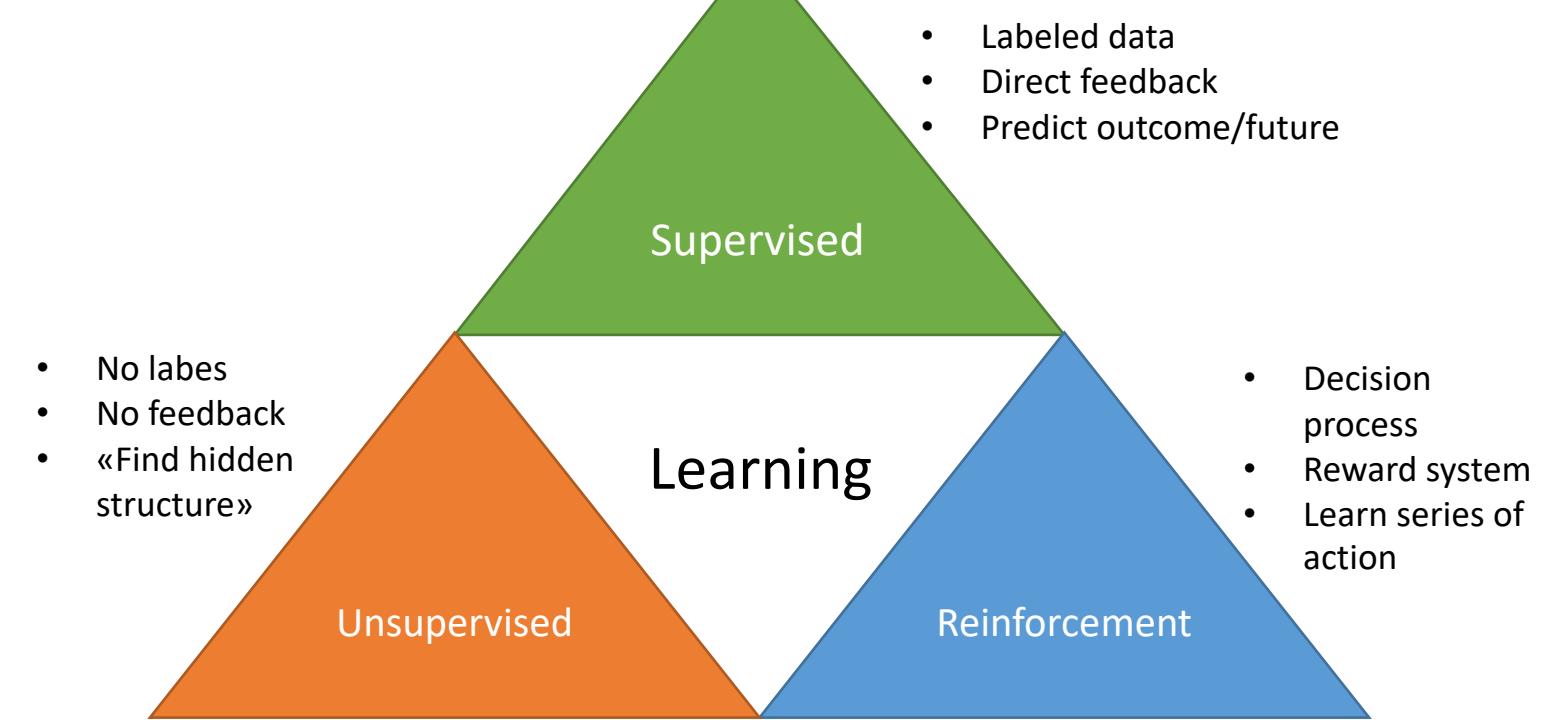
Computer Vision: Deep Learning data

But it's less easy to find labeled data!



Label

Cat



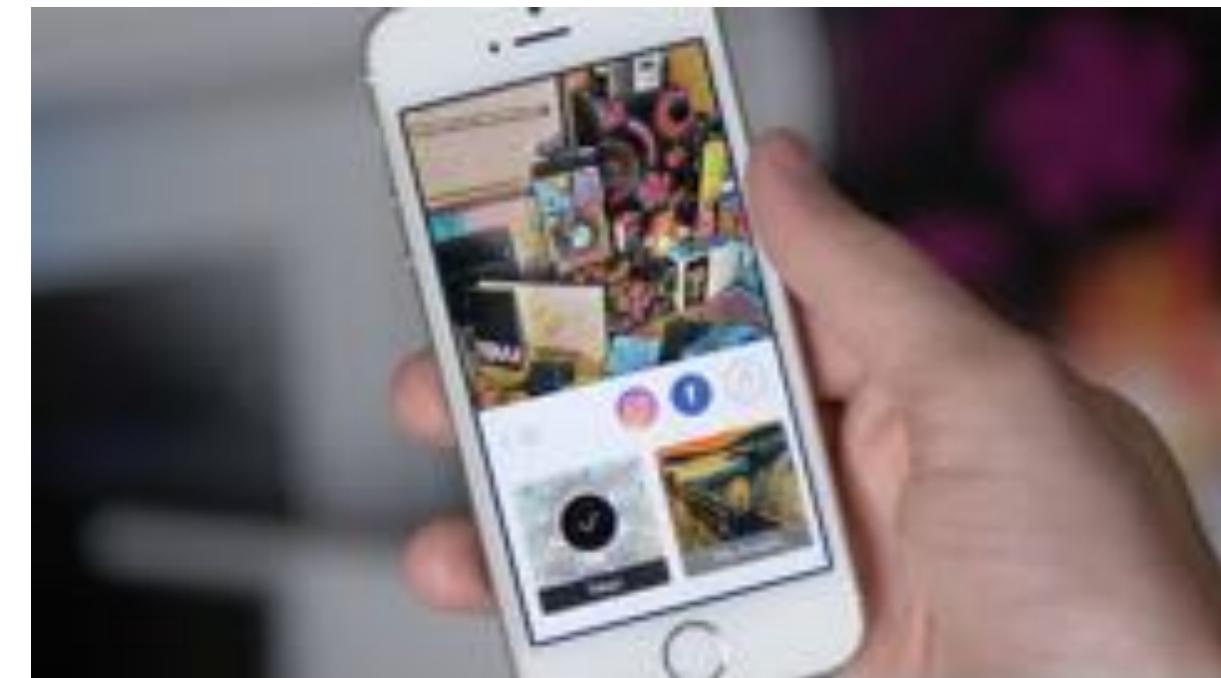


Computer Vision: Combining Deep Learning systems





Computer Vision: Deep Learning Apps

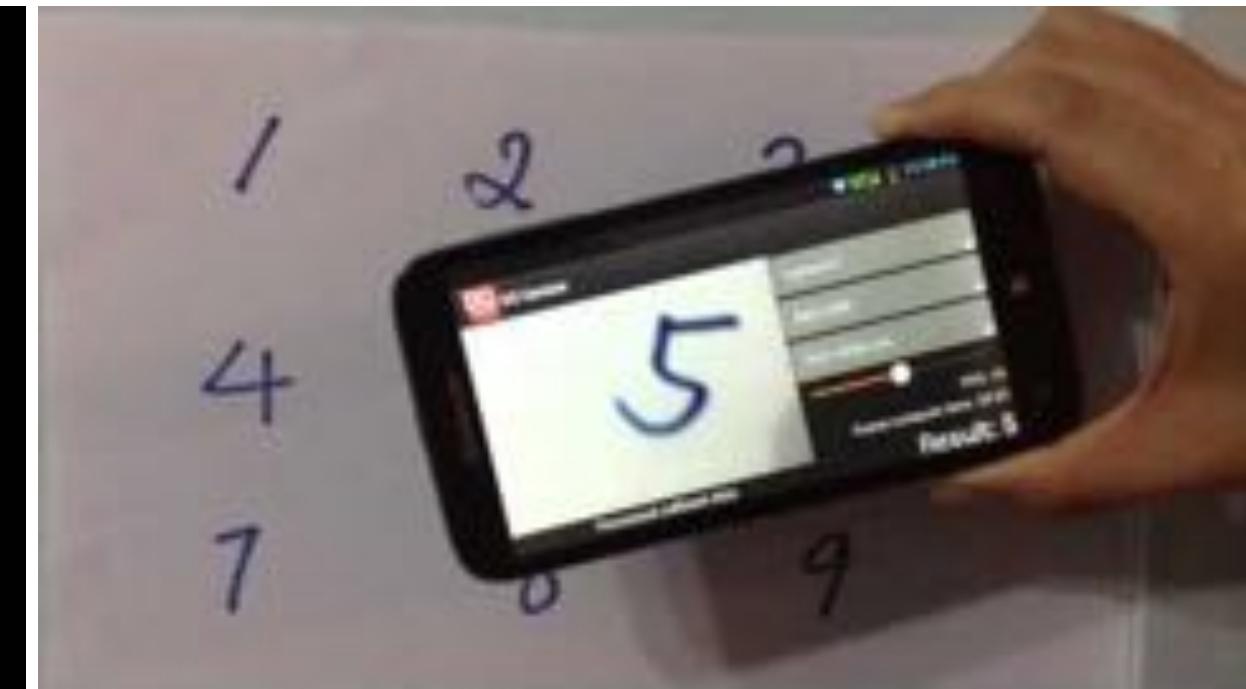


<https://www.youtube.com/watch?v=5a0NBoYRDhM>

<https://www.youtube.com/watch?v=Ey1IkwYGSC0>



Computer Vision: Deep Learning Apps



<https://www.youtube.com/watch?v=2Db6t0mmSZQ>

<https://www.youtube.com/watch?v=lkuucfUW36k>