



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Introduction

2025/2026 Computer Vision And Image Processing M — University of Bologna

Corso: Computer Vision and Image Processing M - Image Processing and Computer Vision M | Virtuale)

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University of Bologna, Italy**

Computer Vision vs. Image Processing



Computer Vision deals
with extraction of
information from
images

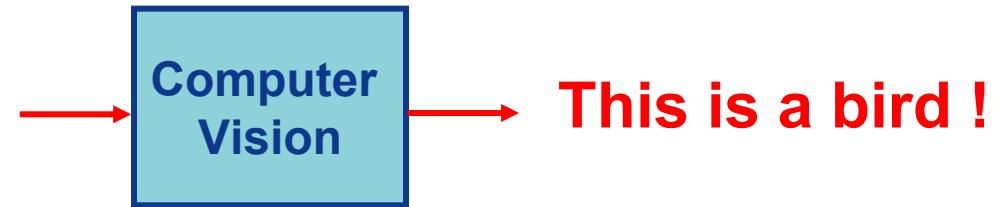
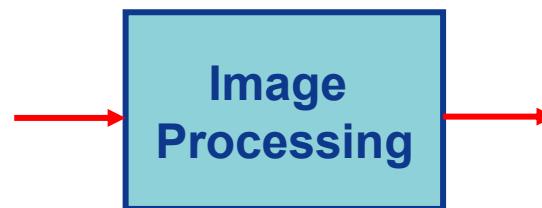


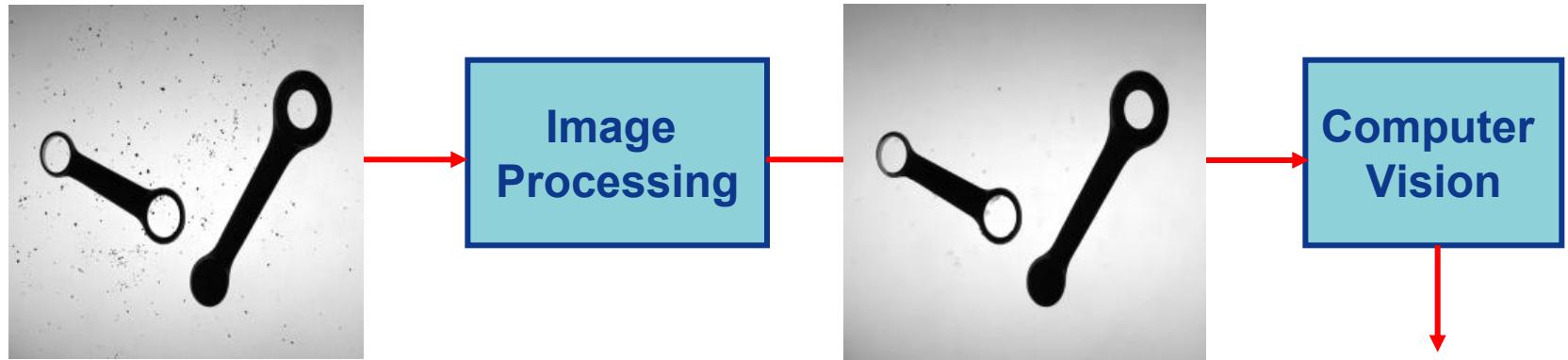
Image Processing
aims at improving
the quality of
images



Computer vision & Image Processing



Quite often Image Processing helps Computer Vision



*Object Classes,
Position and Orientation,
Measurements...*

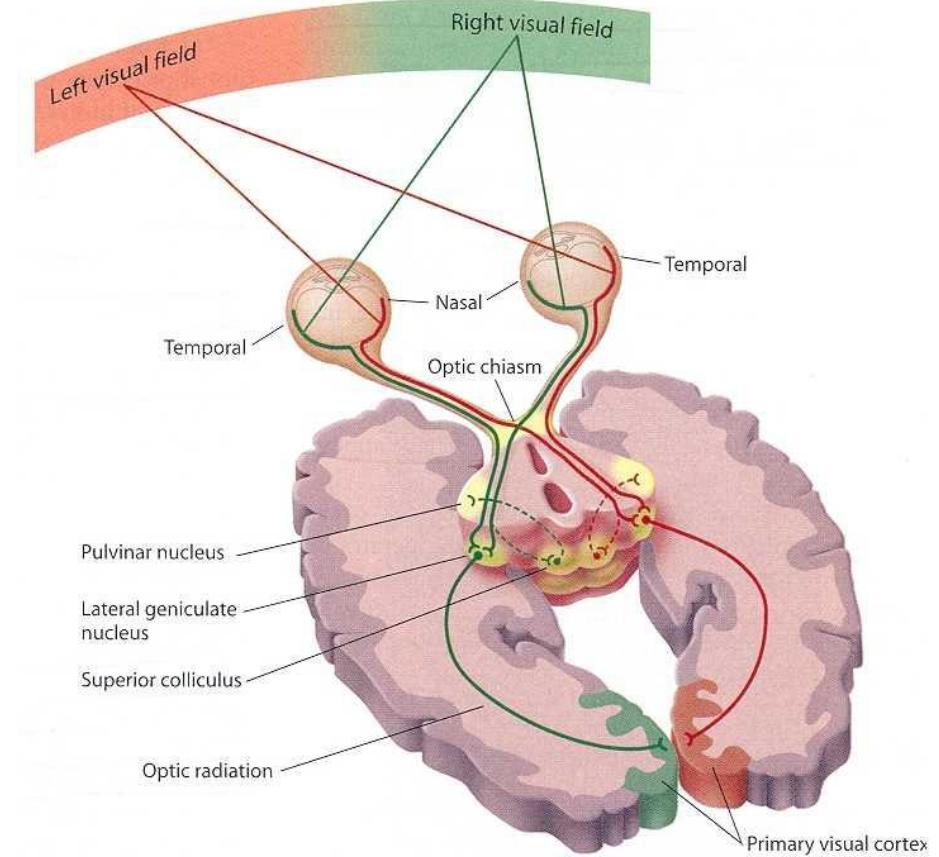
Why studying this stuff ?



Computer
Vision

Countless applications
in many diverse fields !

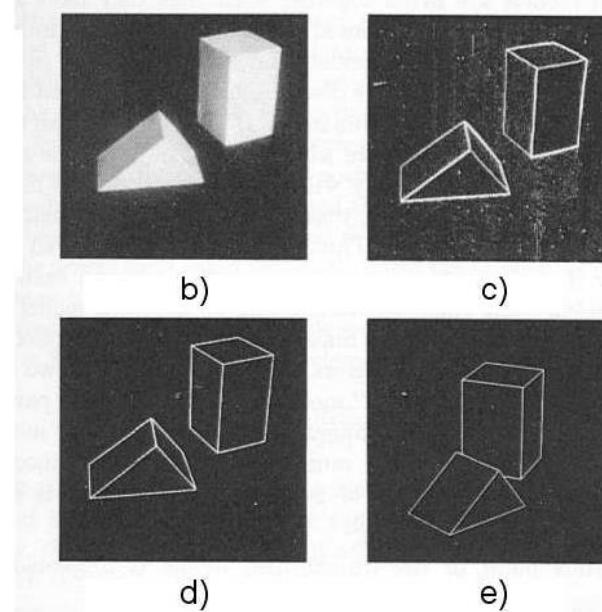
ENG



BIO

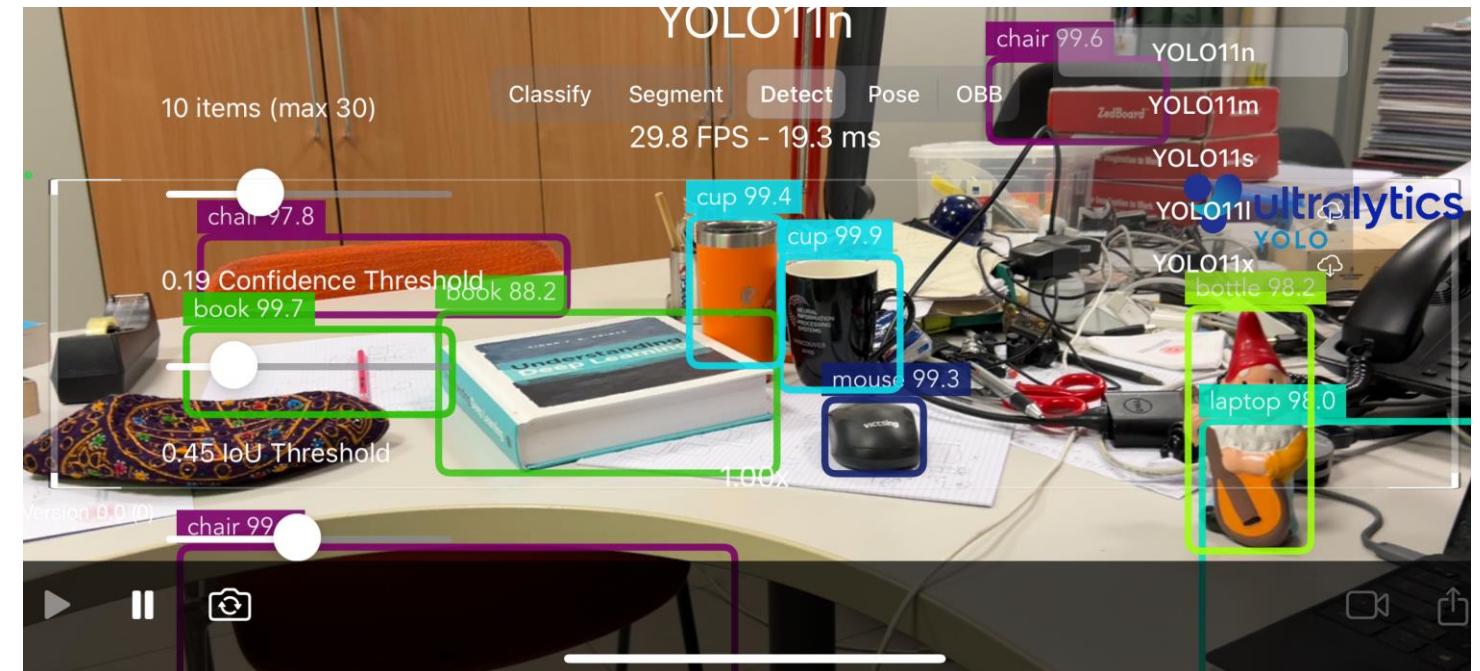
Quite a successful journey !

“the block world”



Larry Roberts, PhD thesis,
Machine perception of three-dimensional solids, MIT, 1963.

“anything anywhere”



Ultralytics Hub - YOLO11 (App Store, Google Play)

Massive and highly influential research



Top publications

Top cited publications over the last five years



Publication	h5-index	h5-median
1. Nature	490	784
2. IEEE/CVF Conference on Computer Vision and Pattern Recognition	450	702
3. The New England Journal of Medicine	441	854
4. Science	415	653
5. Nature Communications	399	509
6. The Lancet	375	712
7. Neural Information Processing Systems	371	637
8. International Conference on Learning Representations	362	652
9. Advanced Materials	330	440
10. Cell	317	528

Key Process Technology in all Industries



**Cognex DataMan
(1982)**

Inspection, Gauging,
Guidance, *Tracing*,
Compliance, Monitoring

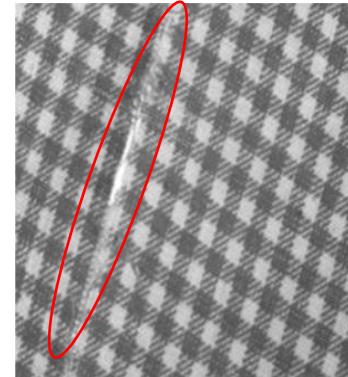


Process Optimization

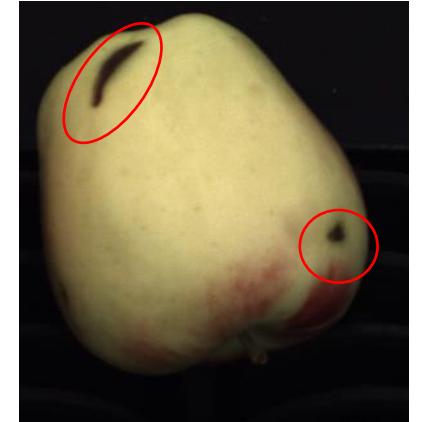
Automotive



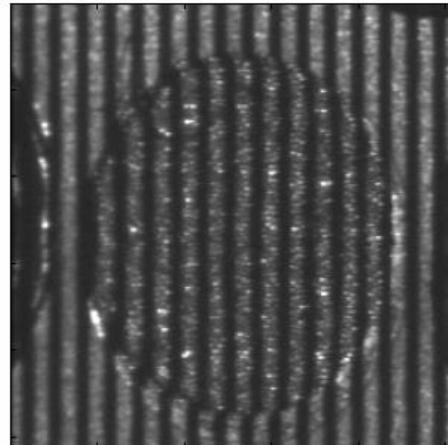
Textile



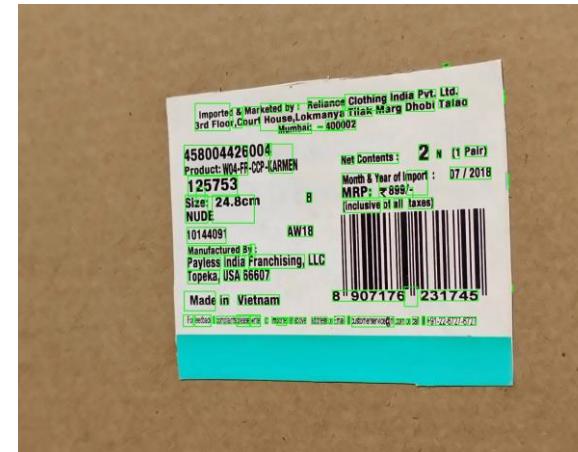
Food&Beverage



Electronics

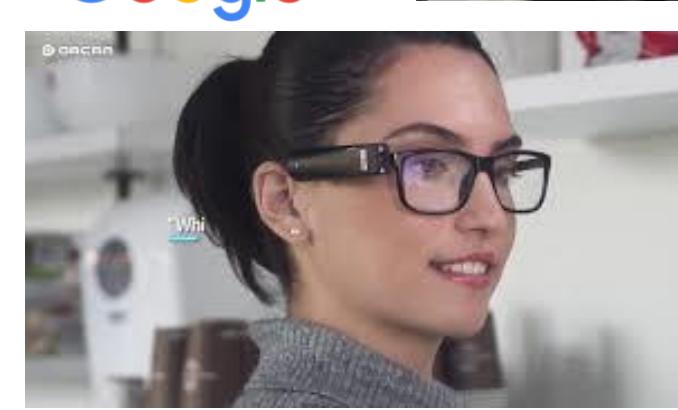
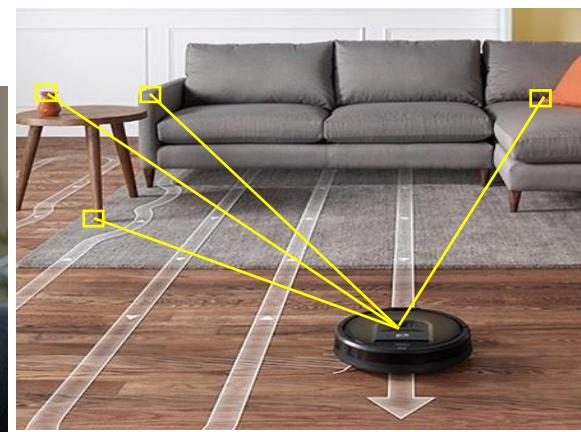
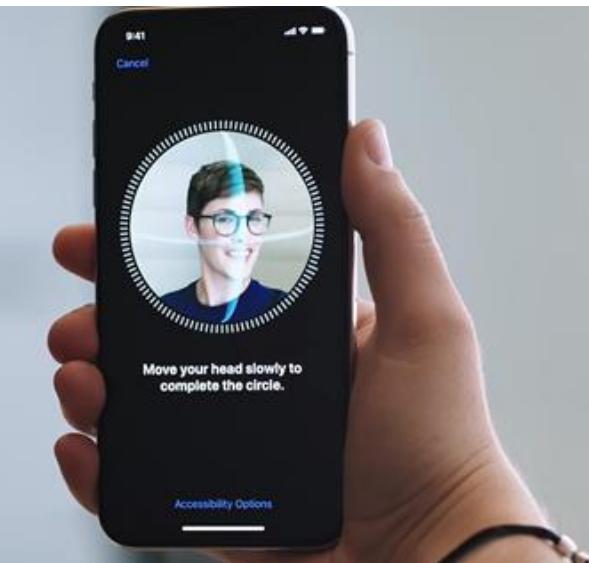
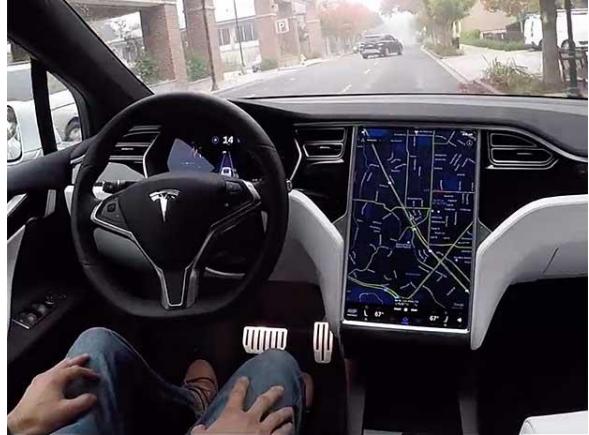


Transportation & Logistics



Pharma & Tobacco

Mass-Market Consumer Products



Google

Key Process Technology in all Industries

Inspection, Gauging,
Guidance, *Tracing*,
Compliance, Monitoring



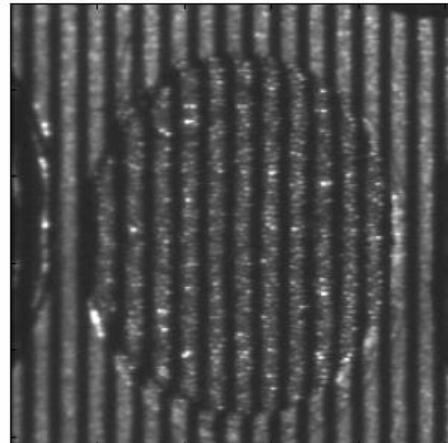
Process Optimization

Automotive

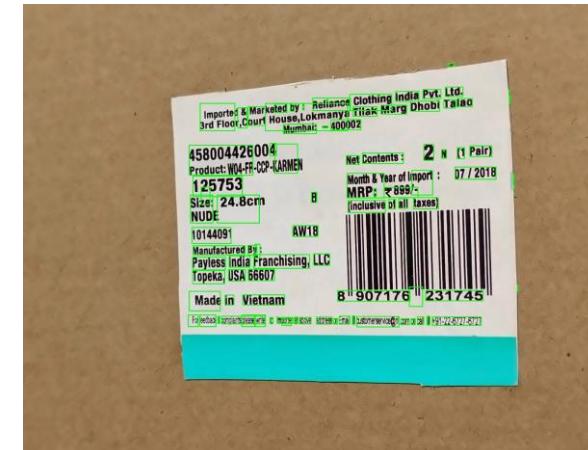


**Cognex DataMan
(1982)**

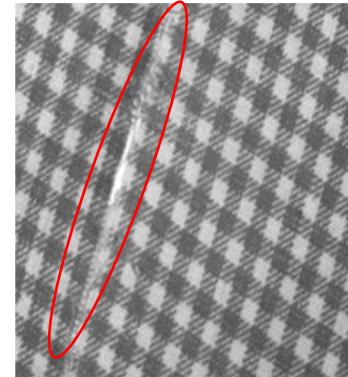
Electronics



Transportation & Logistics



Textile

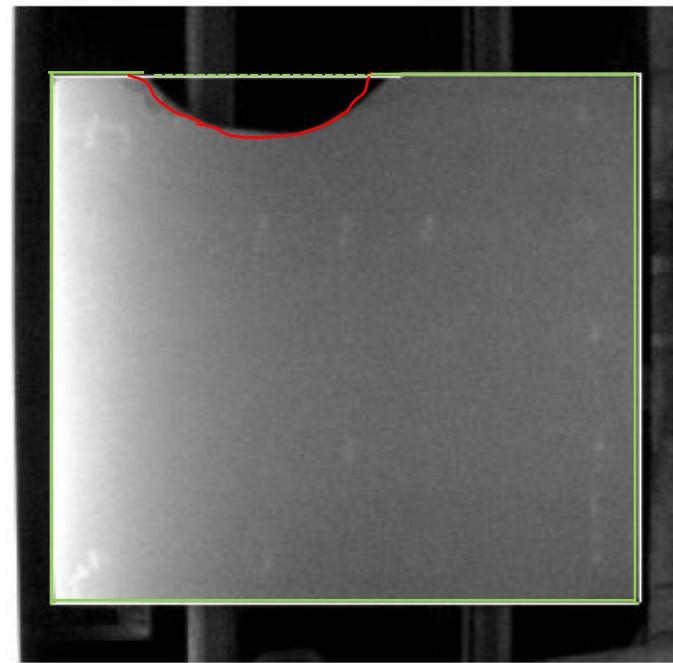


Food&Beverage

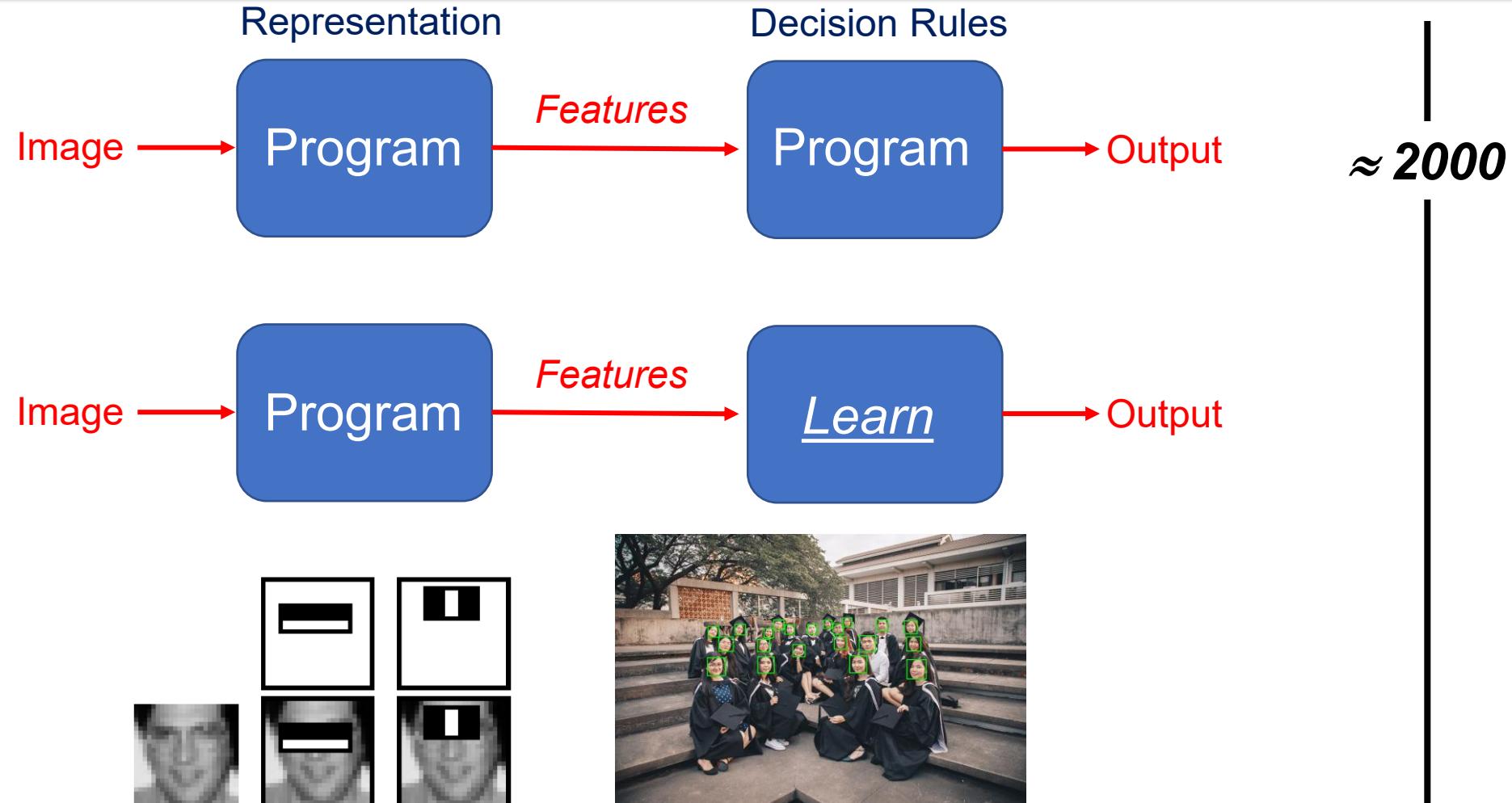


Pharma & Tobacco

Paradigms and Timeline



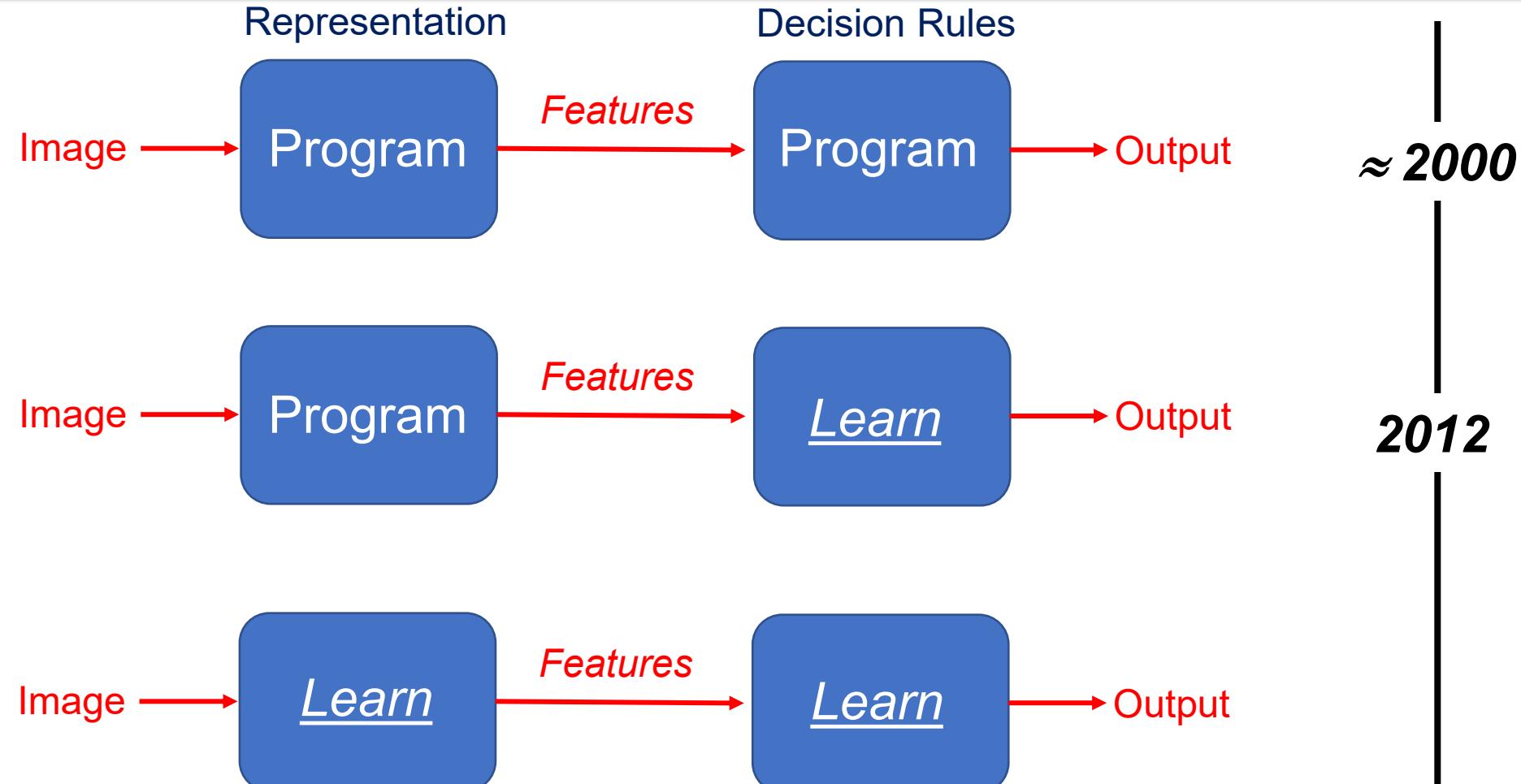
Paradigms and Timeline



Viola&Jones, Haar Features + Boosting, 2001

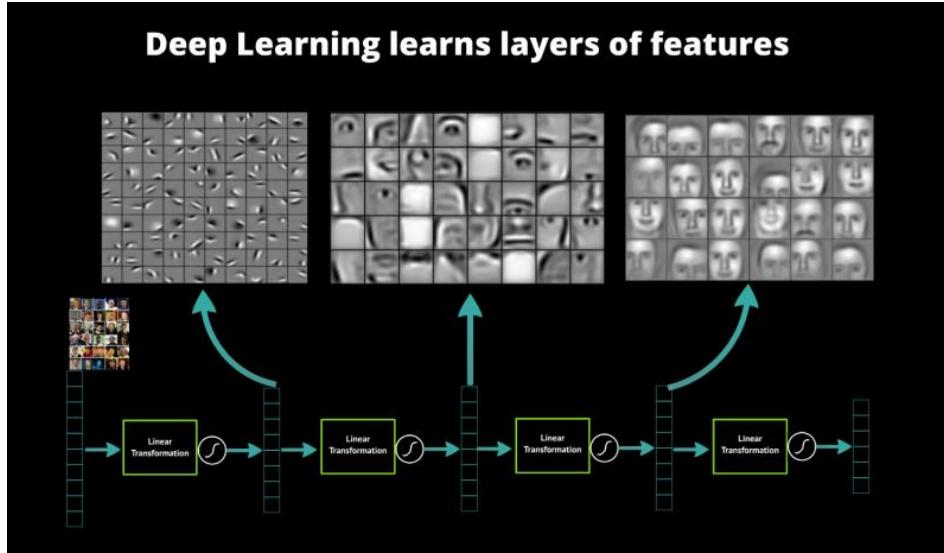
<https://towardsdatascience.com/understanding-face-detection-with-the-viola-jones-object-detection-framework-c55cc2a9da14>

Paradigms and Timeline



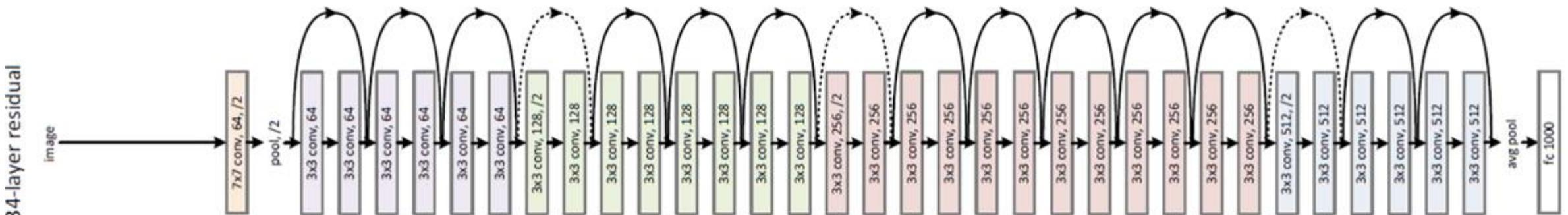
Deep Learning i.e. Representation Learning

Deep Convolutional Neural Networks...and beyond



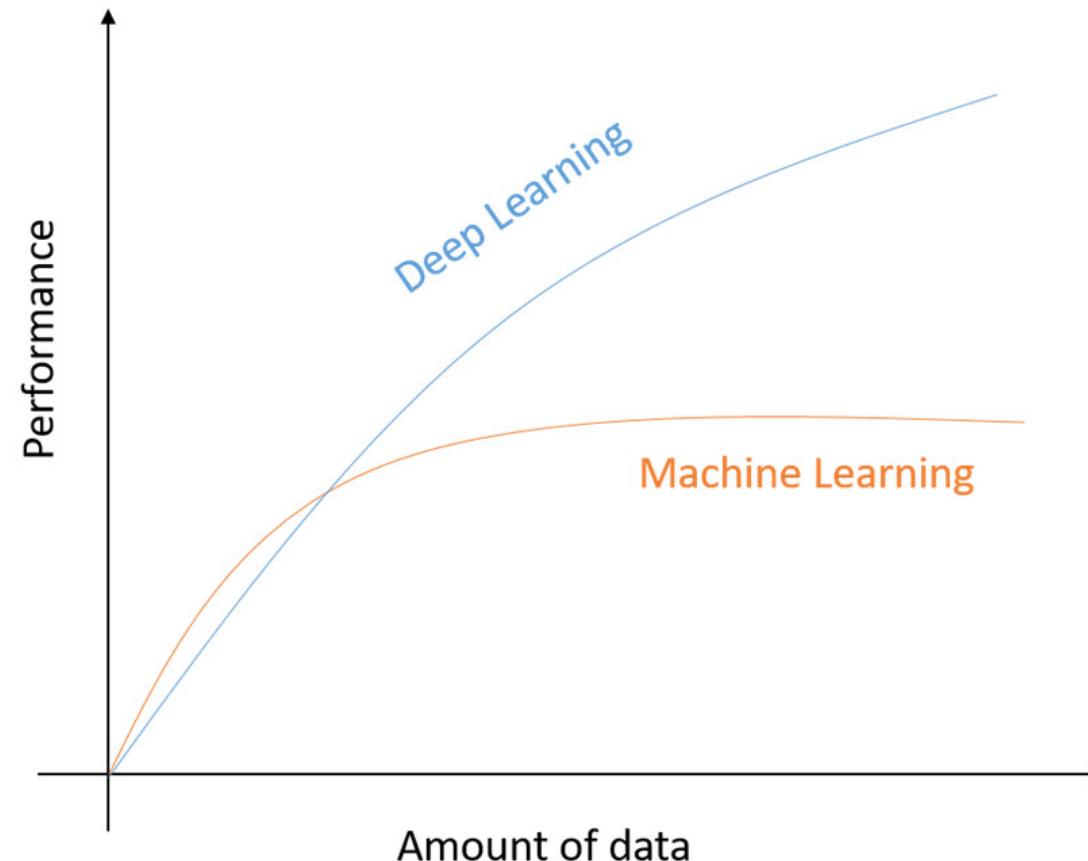
Credits: <https://www.datasciencecentral.com/a-primer-on-deep-learning/>

- Deep CNNs learn hierarchies of features and deploy *inductive biases* dealing with the structure of images.
- Large capacity (i.e. powerful) models requiring vast amounts of training data to prevent overfitting.



Since 2012: AI ≈ Deep (Machine) Learning

Deep&Machine Learning vs. Data



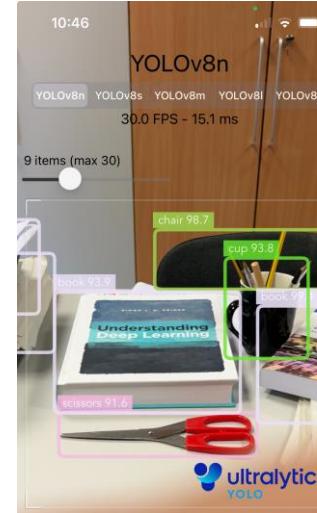
Deep Learning for Computer Vision



Image Classification



Lane Detection



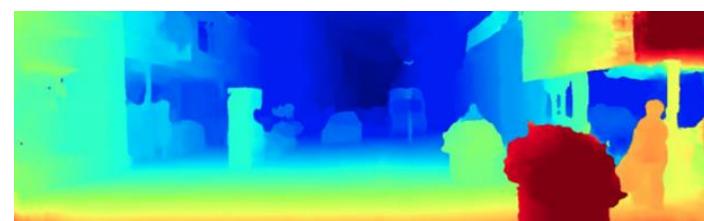
Object Detection and Instance-Part Segmentation



Semantic Segmentation



Depth Estimation (Stereo, Monocular)



Deep Learning (AI) ?



Cognex DataMan
(1982)

Inspection, Gauging,
Guidance, Tracing,
Compliance, Monitoring

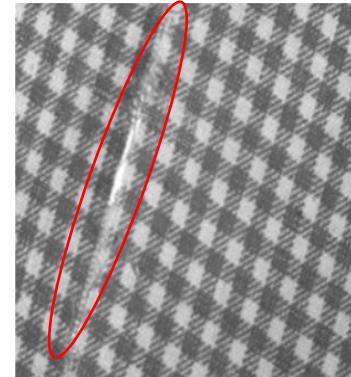


Process Optimization

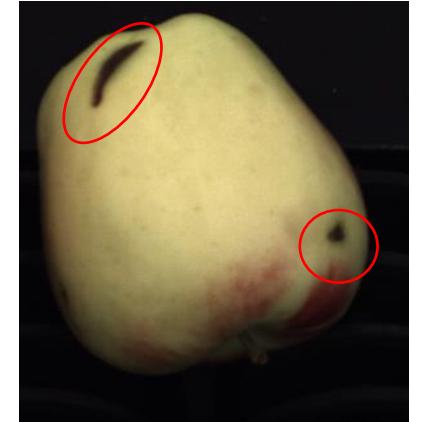
Automotive



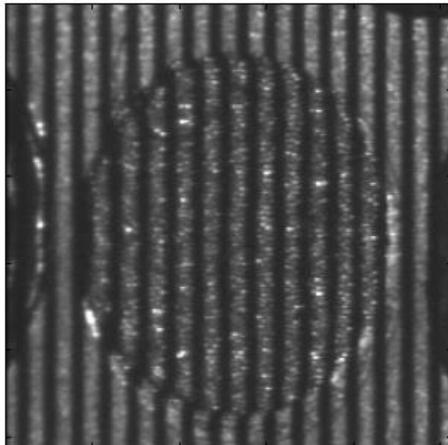
Textile



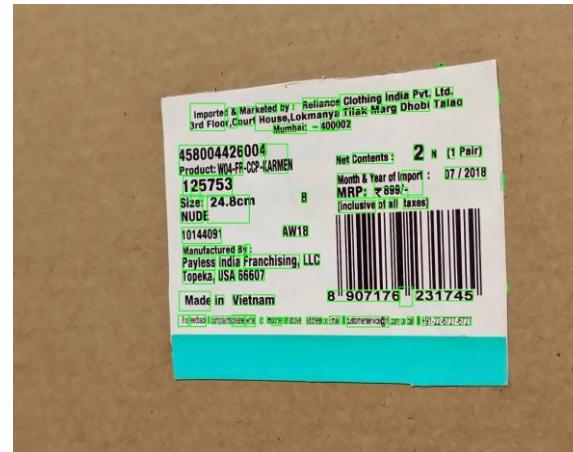
Food & Beverage



Electronics

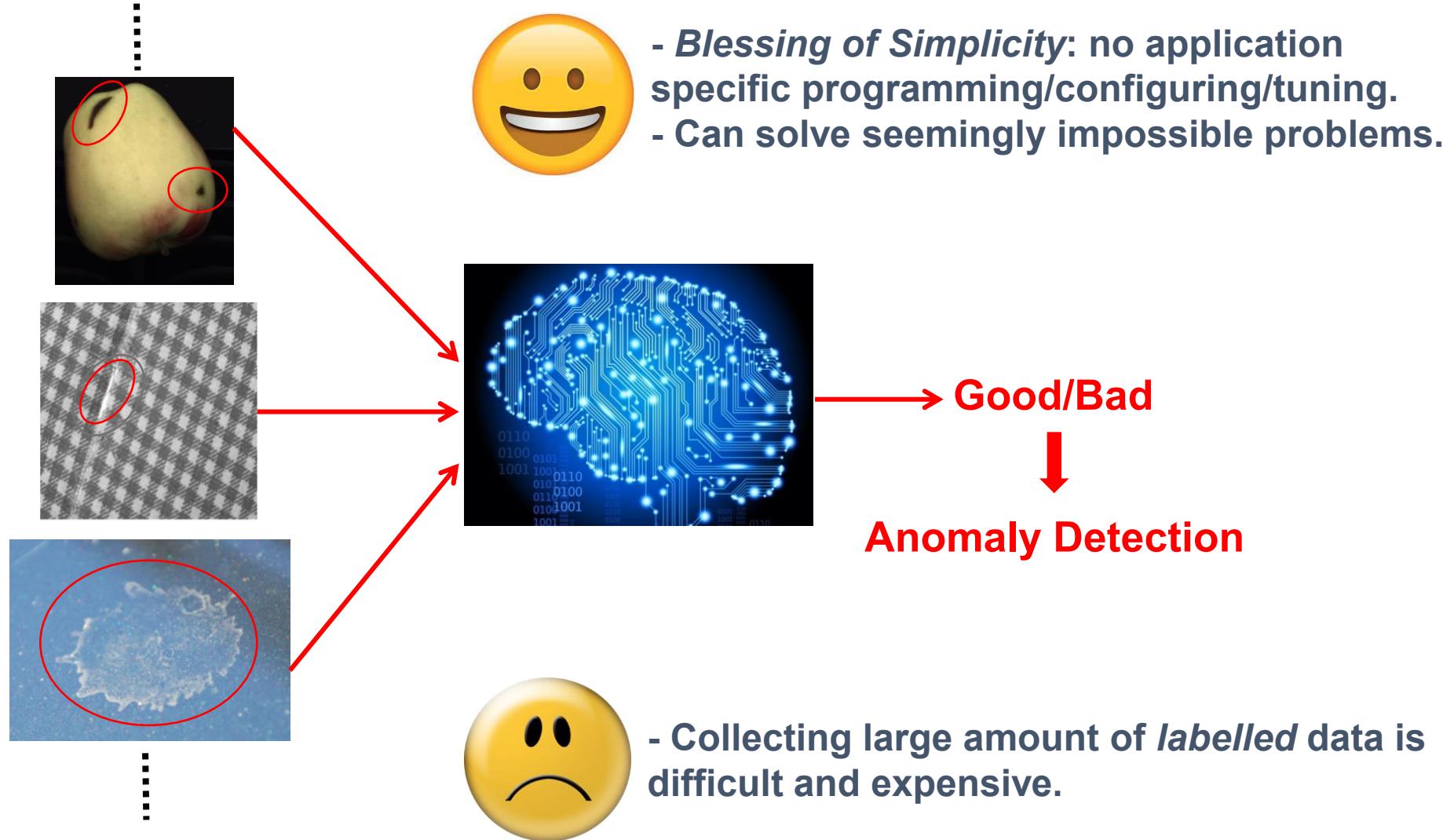


Transportation & Logistics



Pharma & Tobacco

It's happening



New Generative Tasks



DALL-E 3 (Bing)

DDPM aka Diffusion
Models, 2020
Latent Diffusion Models,
2022 (Stable Diffusion)

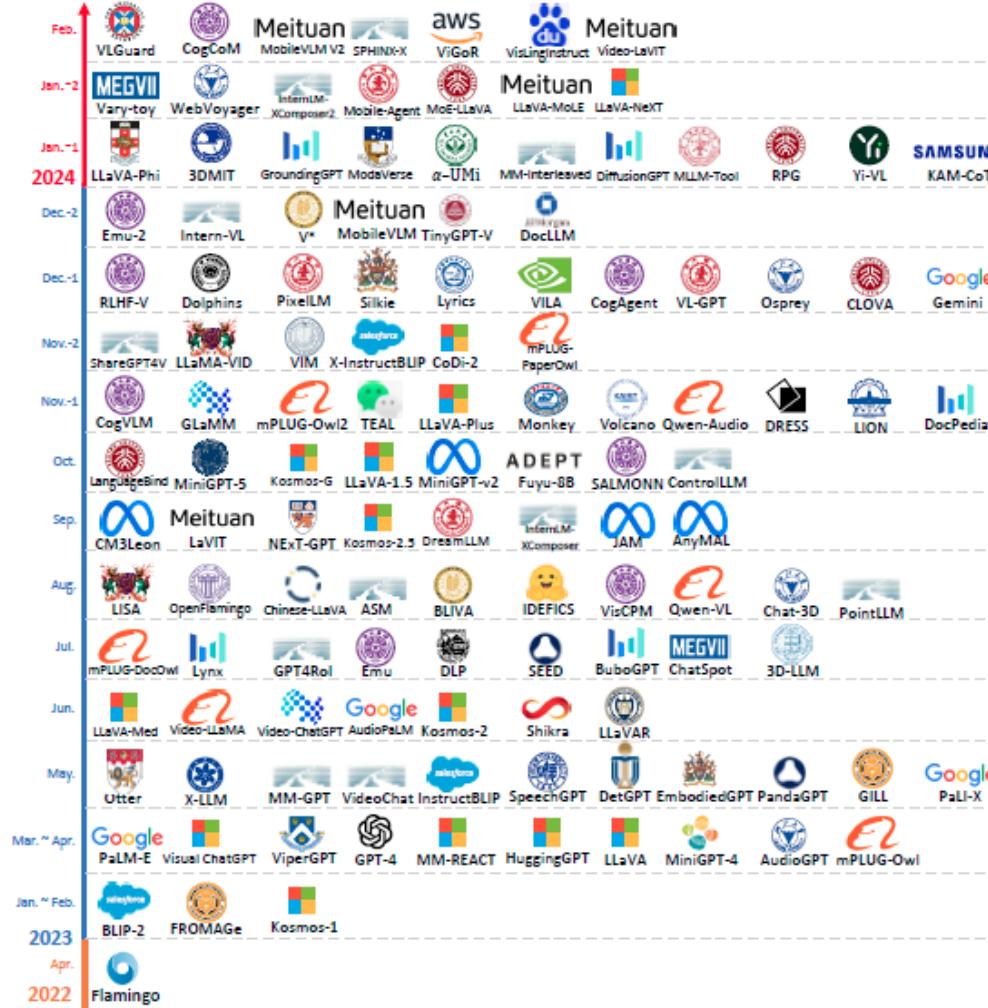


A photorealistic image of a
panda wearing the jersey
of Bologna FC and teaching
to a group of very
interested frogs



A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about. **SORA – OpenAI**

MLMs (Multimodal Large Language Models)



(<https://arxiv.org/pdf/2401.13601>)

Visual input example, Extreme Ironing:



LLaVA: Large Language and Vision Assistant

Source: <https://www.barnorama.com/wp-content/uploads/2016/12/03-Confusing-Pictures.jpg>

What is unusual about this image?

The unusual aspect of this image is a man ironing clothes on the back of a minivan or van. This is not a typical place to perform this activity, as one would usually iron clothes in a more stationary and safe location, such as a home, using a regular ironing board. The scene depicted in the image is peculiar as it involves a makeshift ironing setup on a vehicle, which can be both unsafe and unconventional. Additionally, it is not clear how the man is able to maintain balance and stability while ironing clothes in such an unstable environment.

[Start a new conversation, and clear the history]

What's happening in the scene?

The image depicts a man standing on top of a yellow SUV in a busy city street. He is holding a portable ladder, seemingly ironing clothes while standing on the vehicle. Around the scene, there are other cars, a traffic light, and a fire hydrant. Additionally, there are two other people in the vicinity, one close to the man on the car and another further away. The man on the ladder appears to be attracting attention due to his unconventional choice of ironing his clothes on top of a moving car. The city street around him is bustling with activity, adding to the unique nature of the scene.

User GPT-4 [32]

What is unusual about this image?

The unusual thing about this image is that a man is ironing clothes on an ironing board attached to the roof of a moving taxi.

User BLIP-2

Can you explain this meme in detail?
a man is sitting on the back of a yellow cab

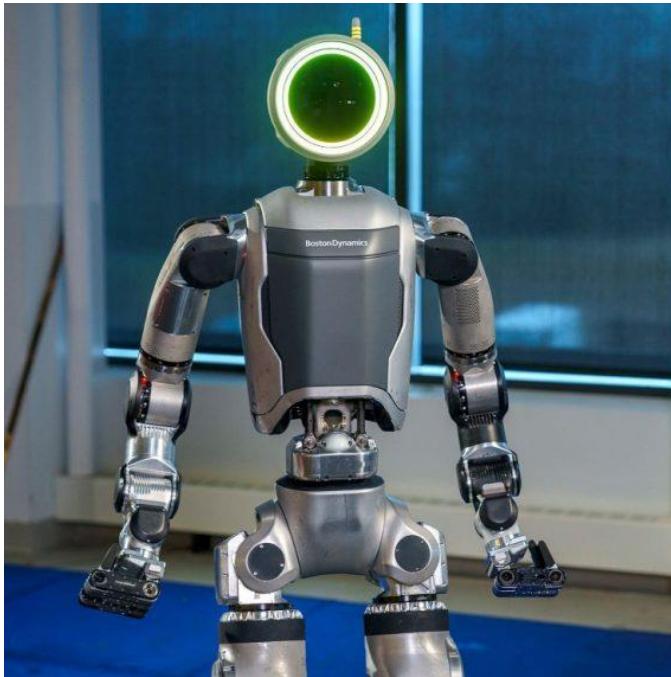
User OpenFlamingo

Can you explain this meme in detail?
The man is drying his clothes on the hood of his car.

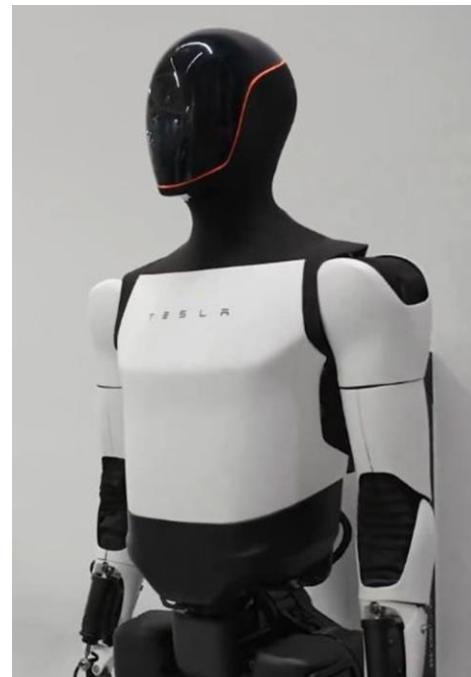
Embodied Intelligence



Computer Vision + LLMs +Humanoid Robotics



Electric Atlas
Boston Dynamics



Optimus Gen 2
Tesla

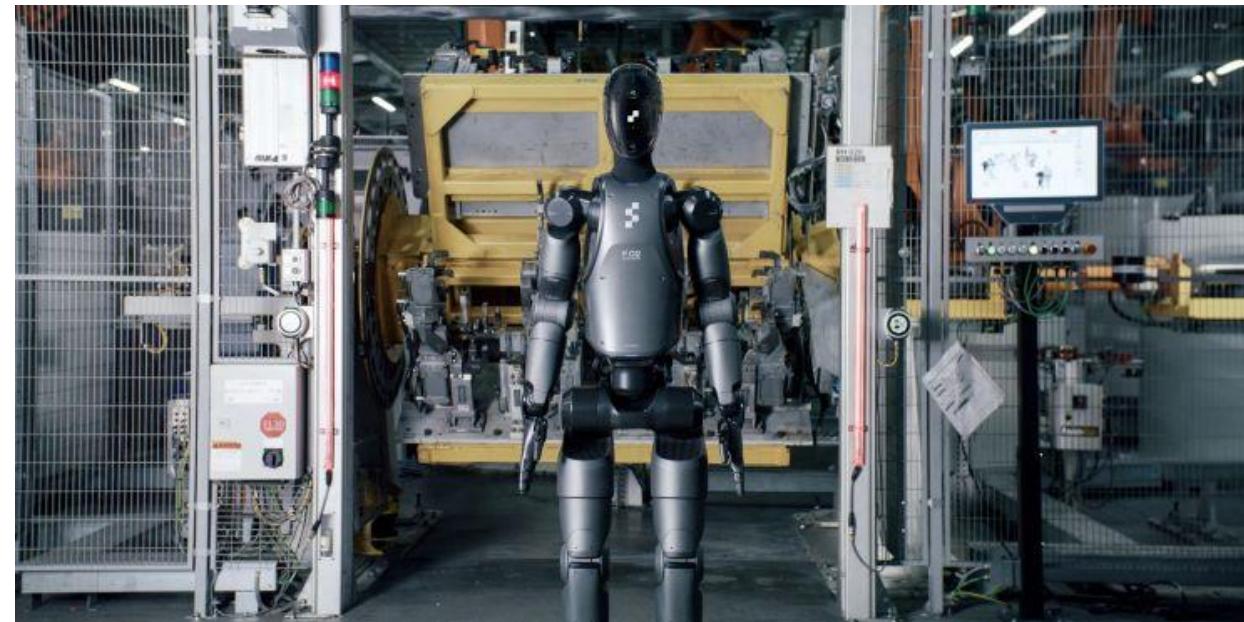


Figure 02 – Figure AI
<https://www.figure.ai>

[Top 12 Humanoid Robots of 2025 - Humanoid Robotics Technology](#)