

Image Processing and Computer Vision Notes

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1. Introduction

Computer vision deals with extraction of information from images. On the other hand, image processing does not return information but another image (e.g. given an image, it returns the same image with increased contrast or details).

Often, computer vision and image processing work together in order to extract information from raw images.

Computer vision was biologically inspired, and was based on human's primary visual cortex; nowadays, it has countless applications in many diverse fields.

Brief history:

- In the 60's, first CV program; developed in MIT, it was able to recognize simple shapes.
- In the 80's, first industrial system.
- In the present, it has several applications, like automotive, metal and packaging.
- Lately, it is used even in mass-market consumer products, which introduces some issues:
 - developing a sophisticated technology like computer vision is much easier in a factory than in the everyday world;
 - factories provide a controlled environment (e.g. optimal light conditions), whereas the outside world does not.

Due to these reasons, computer vision applications developed for the outside world do not guarantee 100% affidability, but provide a decent level of accuracy.

Features and Depth Sensing:

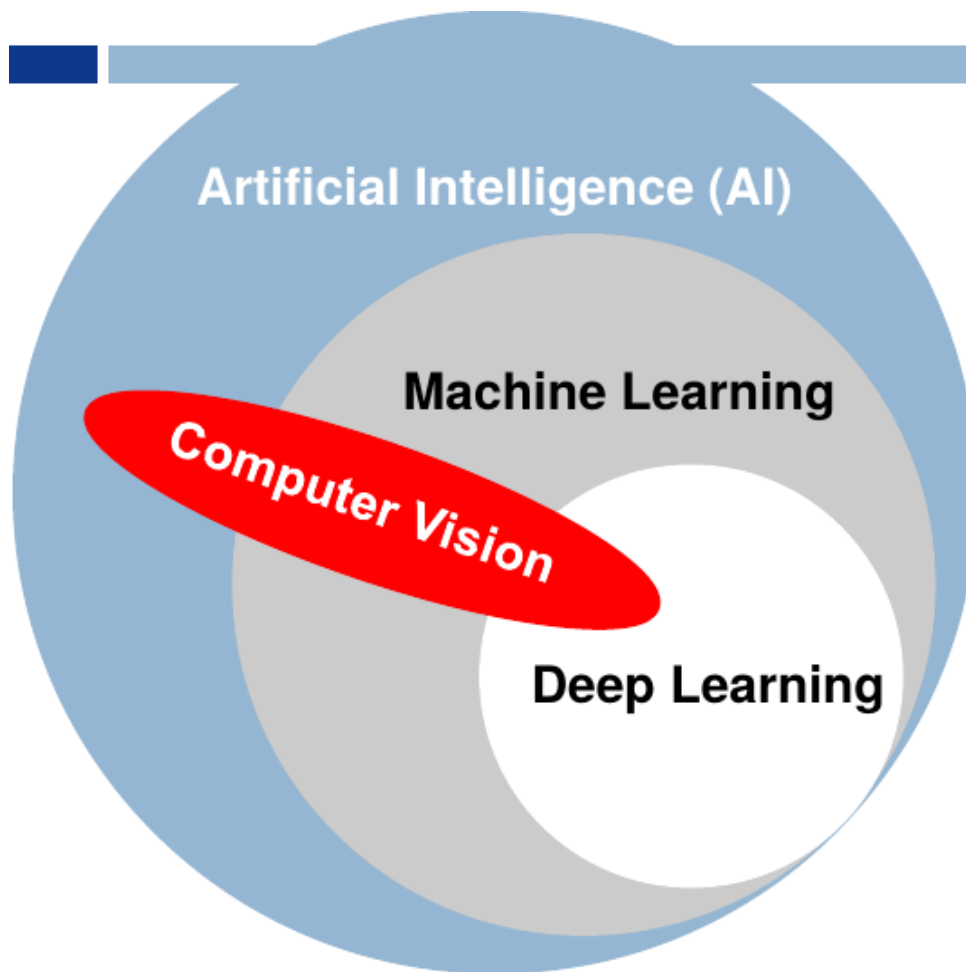
- Local invariant features \Rightarrow the detector/descriptor paradigm allows finding and matching salient regions across images invariantly to viewpoint changes.
- Affordable depth cameras \Rightarrow key to controlling machines by gestures and/or body movements.

1.1. Computer Vision and Artificial Intelligence

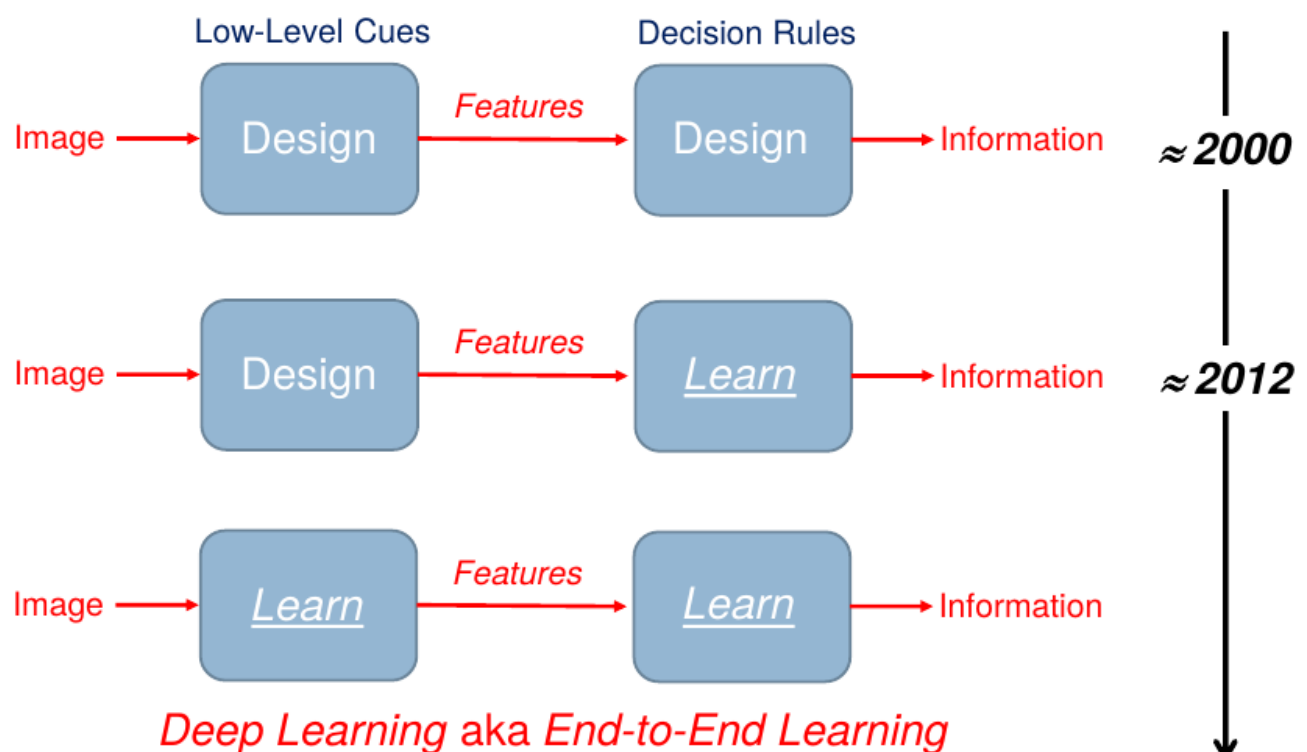
- Artificial Intelligence (AI) \Rightarrow any technique that enables computers to mimic human intelligence.
- Machine Learning (ML) \Rightarrow computers learn from examples rather than being explicitly programmed.

- Deep Learning (DL) \Rightarrow Machine Learning realized through Deep Neural Networks.

Computer Vision is trasversal, and it can be implemented with mathematical models (simple AIs) or it can be based on ML/DL.



1.2. Computational Workflow



- *Data-centric* paradigm:
 - big data;
 - value shifts from domain knowledge to data.