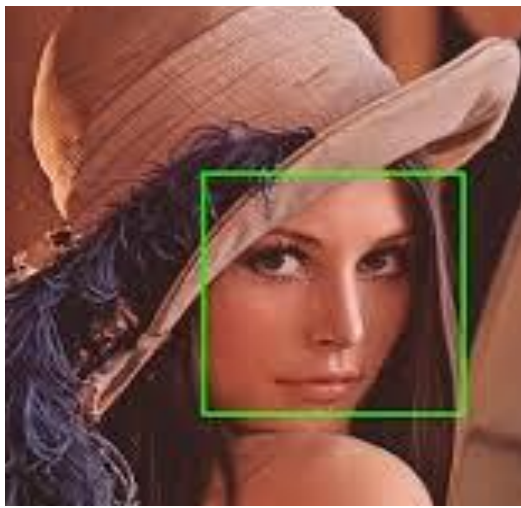
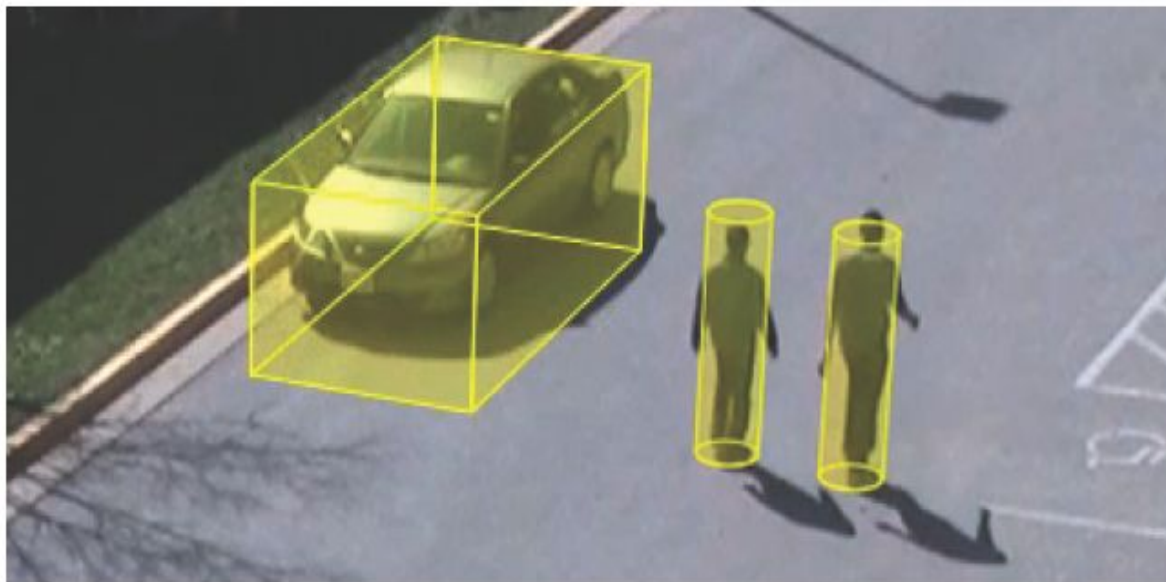




Machine Vision

Iasonas Oikonomidis
Alexandros Makris
Kostas Papoutsakis



Course Info

Class Schedule

- .Friday 4-6: Theory
- .Friday 6-8: Lab

Grading

- .Participation 20%
- .Python programming Assignments 80%.

.Prerequisites

- .Linear algebra
- .Probabilities
- .Programming

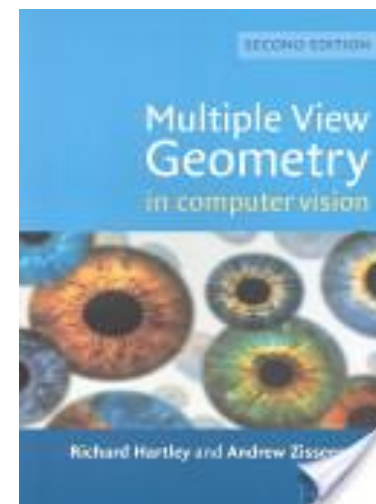
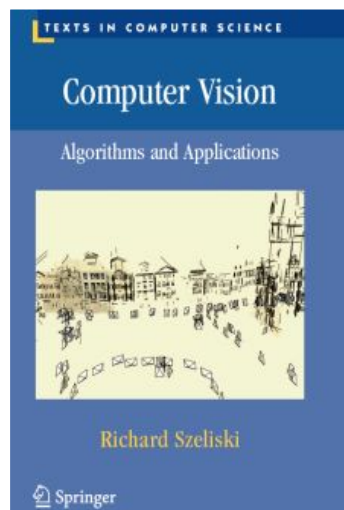
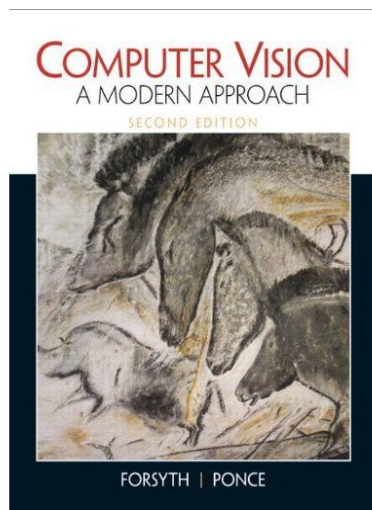
Course Info

Site: <https://eclass.hmu.gr/courses/TM152/>

(pwd:cv2019)

Textbooks:

- Forsyth & Ponce, *Computer Vision: A Modern Approach*
- Szeliski, *Computer Vision: Algorithms and Applications*.
- Hartley, Zisserman, *Multiple View Geometry in Computer Vision*.



The goal of Computer Vision

Make computers understand images.

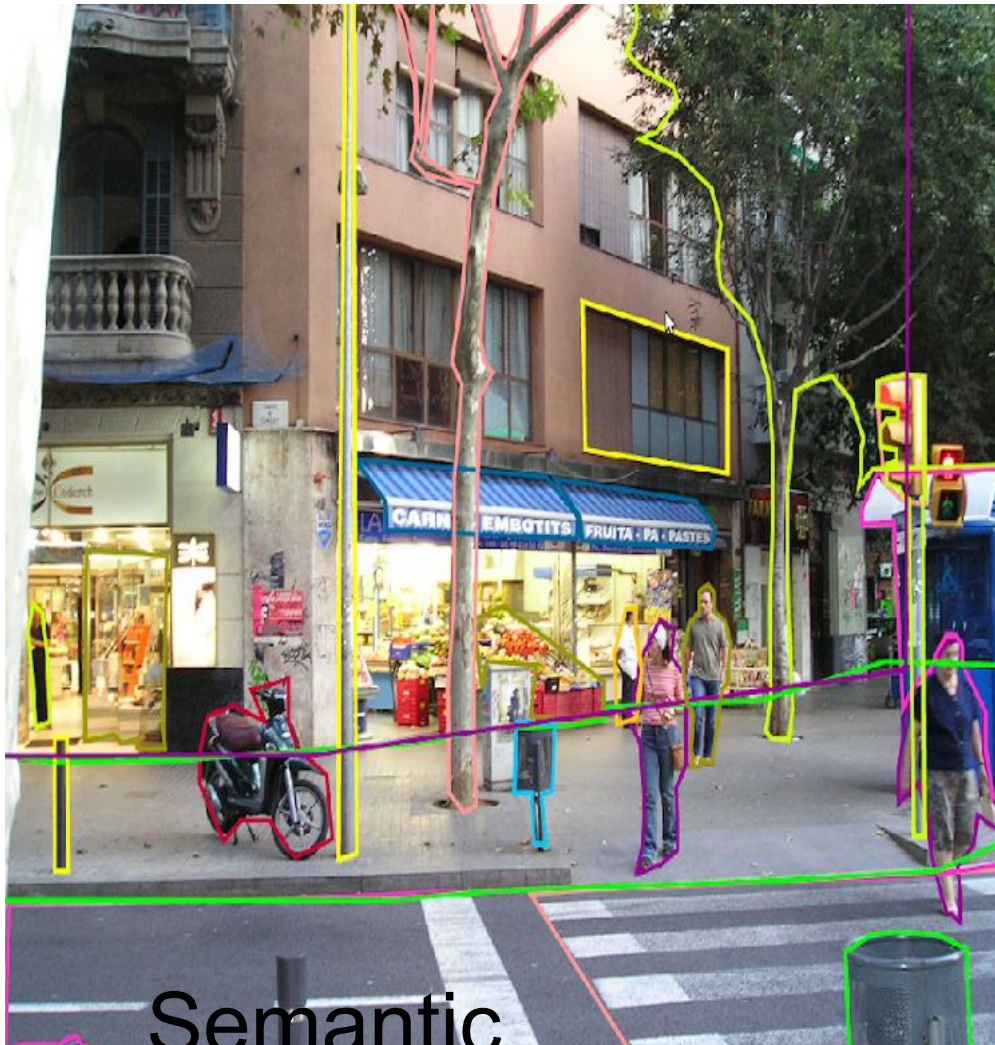
(e.g. photos, videos, medical images)



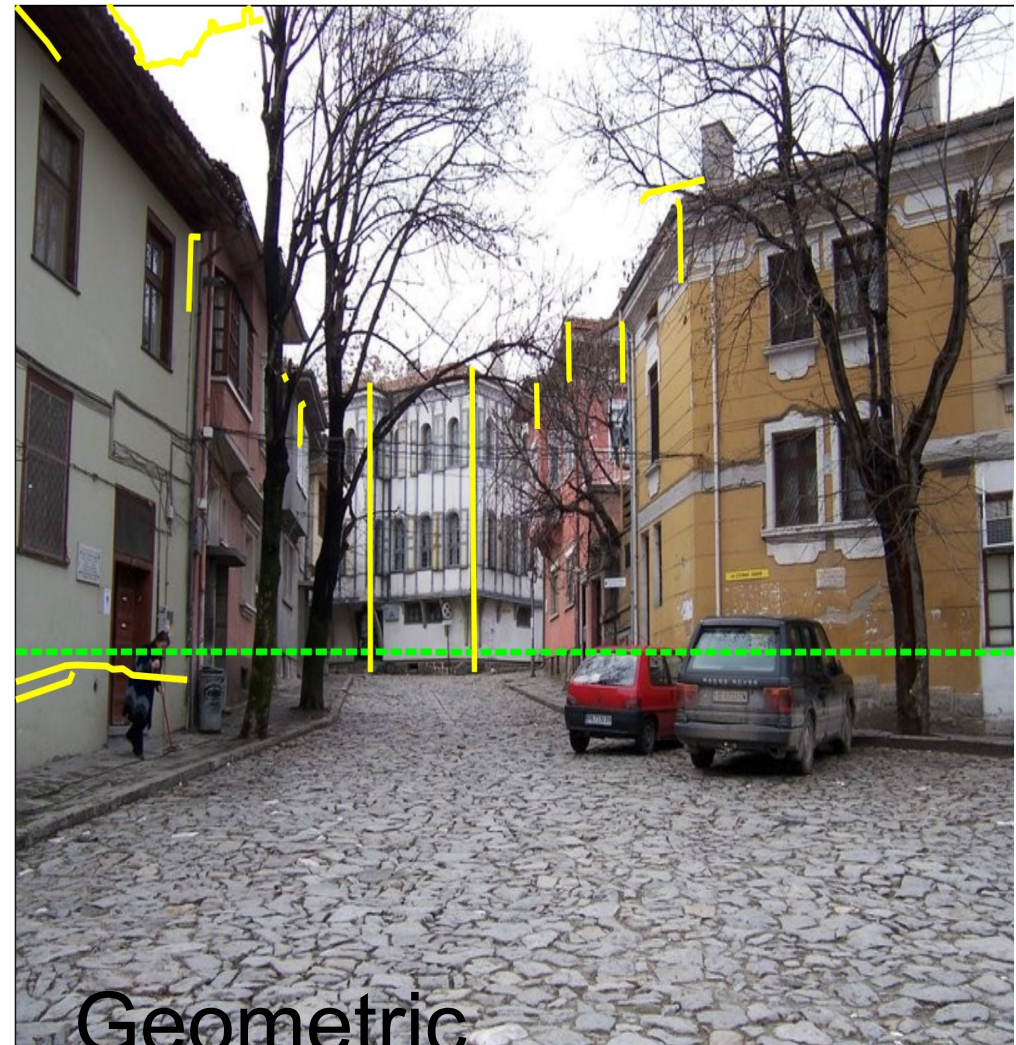
0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0



What Kind of information?

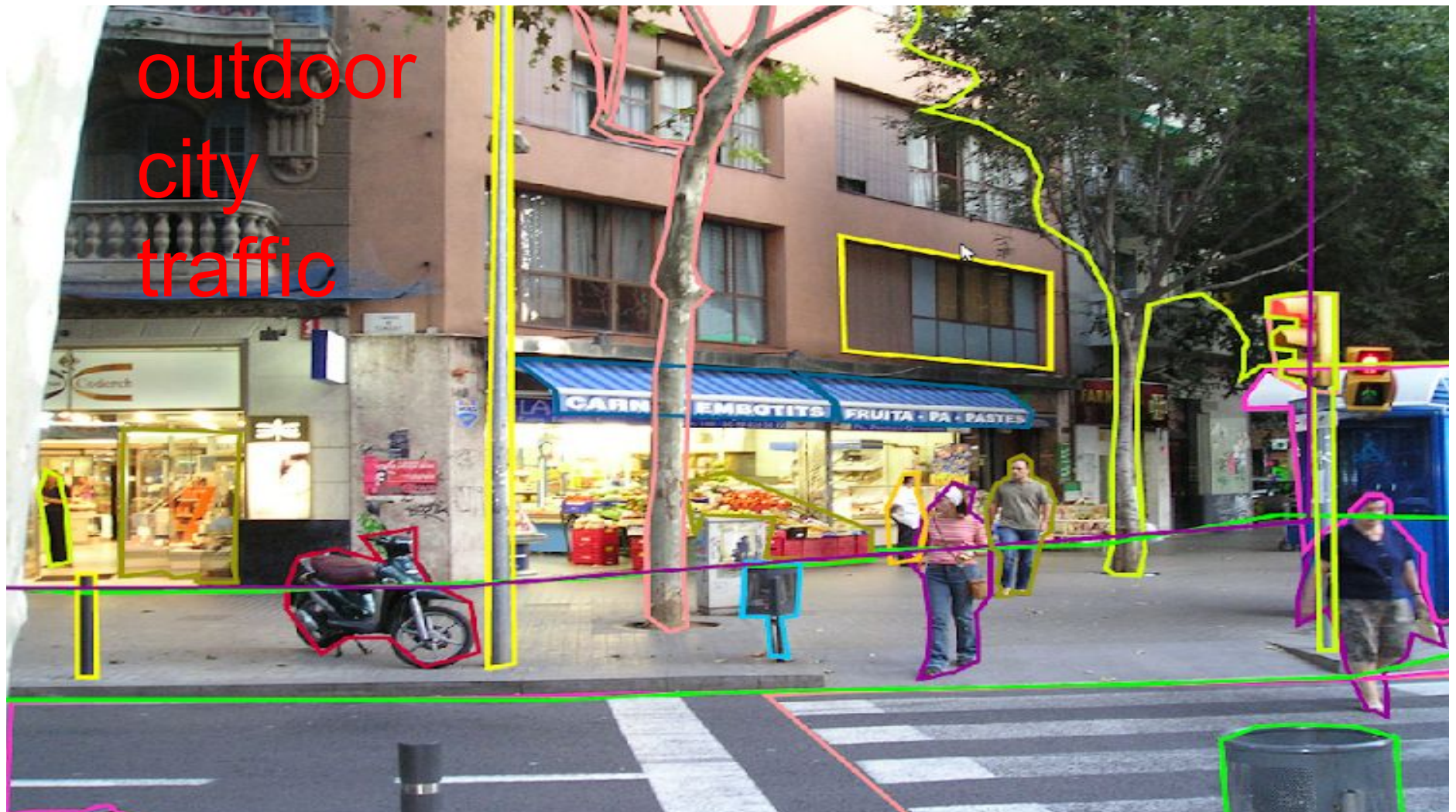


Semantic
Information

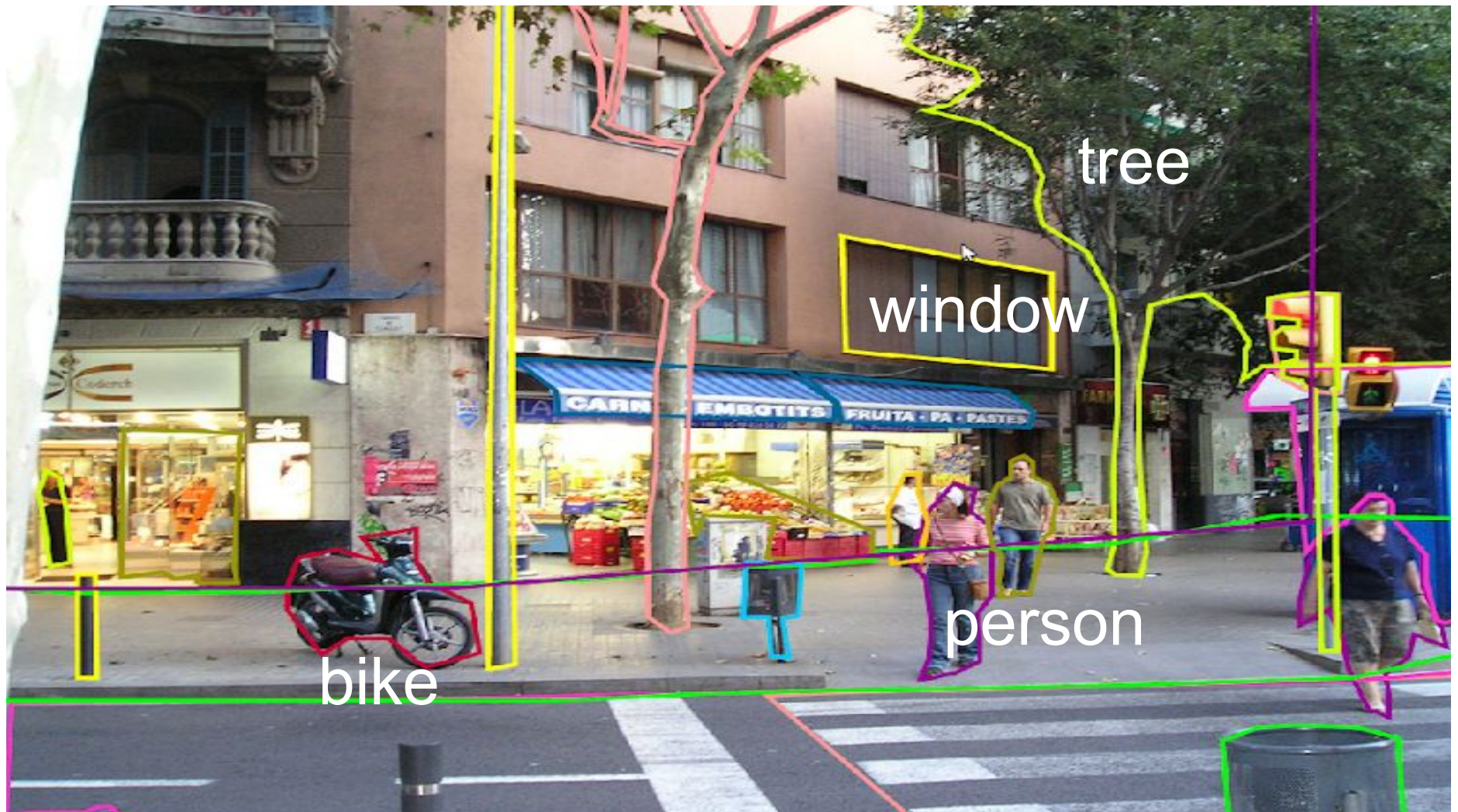


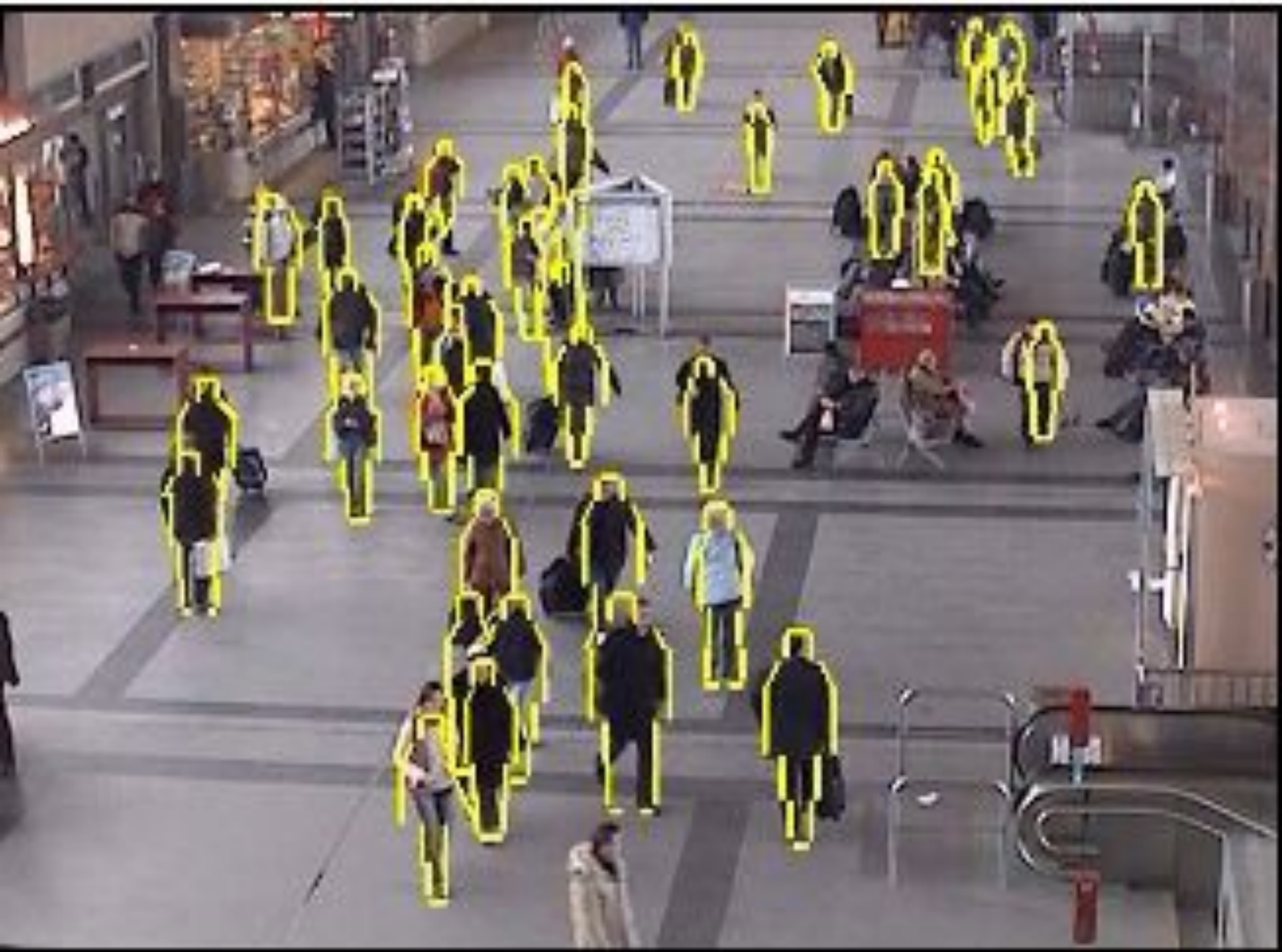
Geometric
Information

Semantic Information: Scene and Context

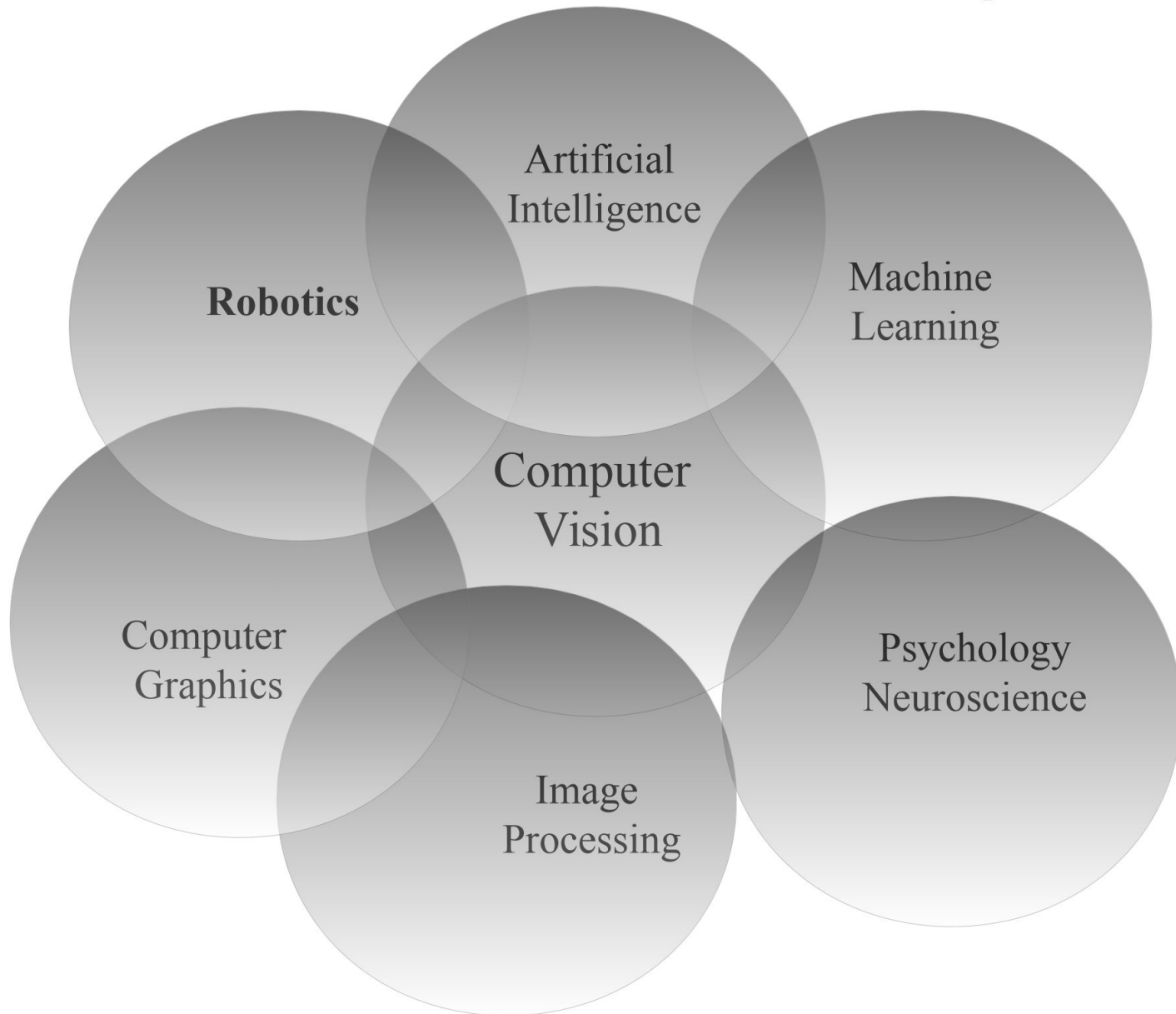


Semantic Information: Object Recognition





Connections to other disciplines



Computer Vision vs Graphics

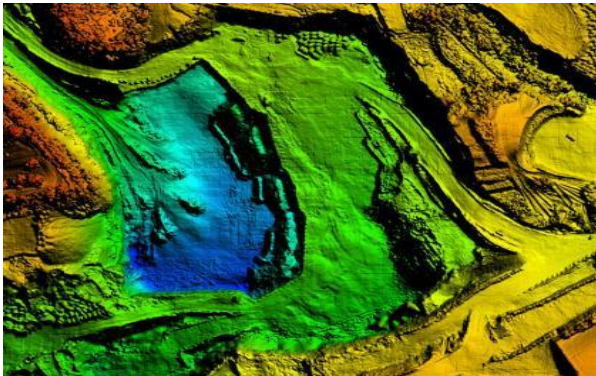
$$I = f(C_{amera}, L_{ight}, M_{aterial}, S_{tructure})$$

Computer Graphics: Knowing C, L, M, S, construct I.

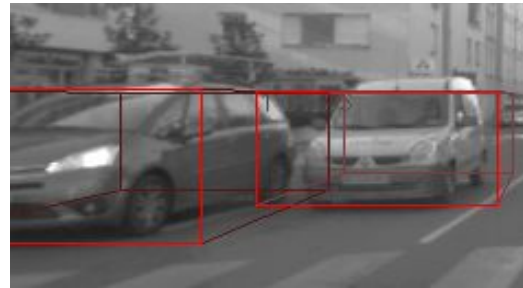
Computer Vision: Knowing I, extract C, L, M, S.

Computer Vision Applications

Cartography



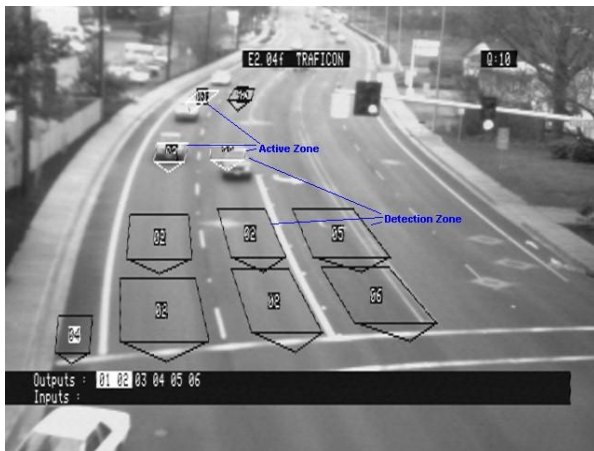
Intelligent Vehicles



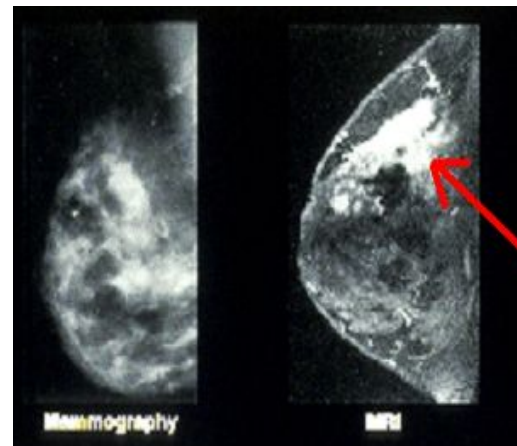
Robotics



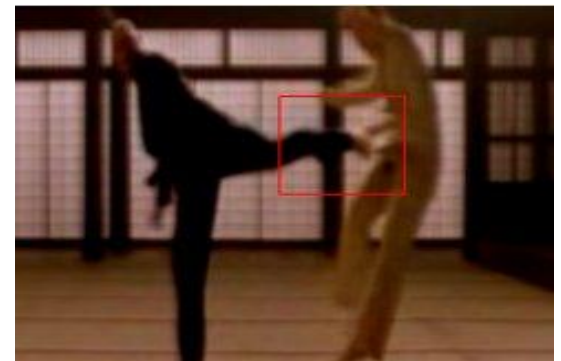
Security



Medical



Multimedia Databases



Computer Vision Examples

Optical Character Recognition (OCR)

- Convert scanned documents to text.
- License plate readers.
- Automatic check processing.

4YCH428

4YCH428

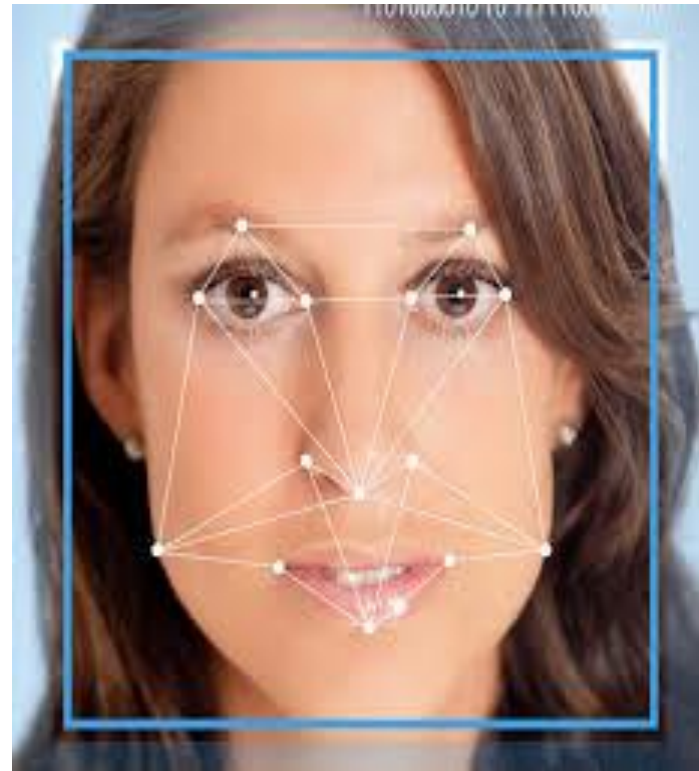
4YCH428

The screenshot displays a software window titled "Check Entry" with a "Front" tab. It shows a scanned check from "DataTrade Demo" for \$653.10, dated Feb 18, 2006. The check is payable to "DataTrade" and includes a signature. Below the check image, the software interface contains fields for "Batch No: 1001", "Sequence No: 2", "Routing No: 111907445", "Check Account No: 72344999", "Check No: 100", and "Check Amount: 653.10". The "MERCHANTREMIT" logo is visible at the bottom left, and "Enter" and "Reject" buttons are at the bottom right.

Biometrics

Fingerprint recognition

Face recognition

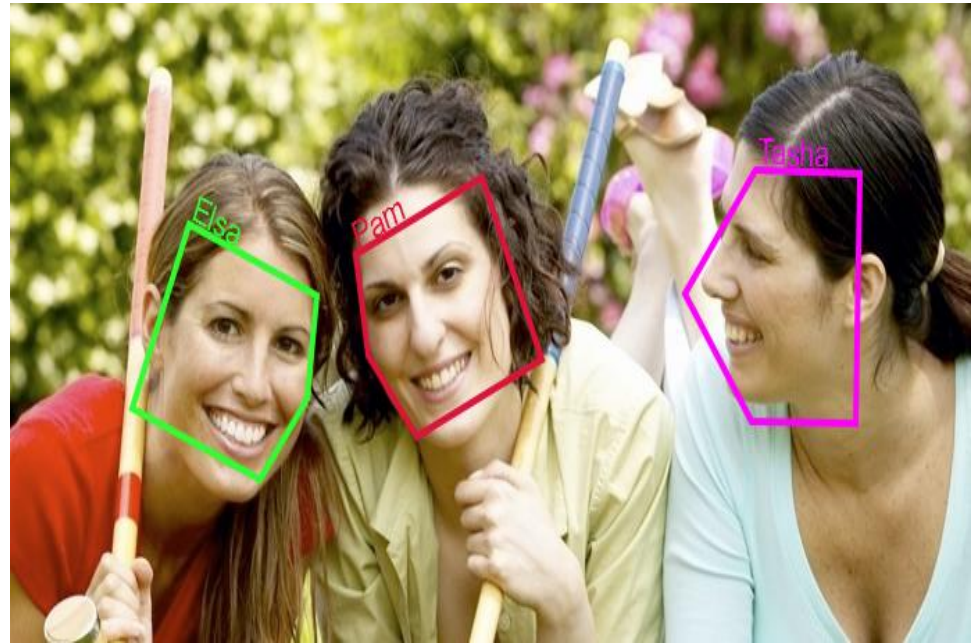


Face Detection

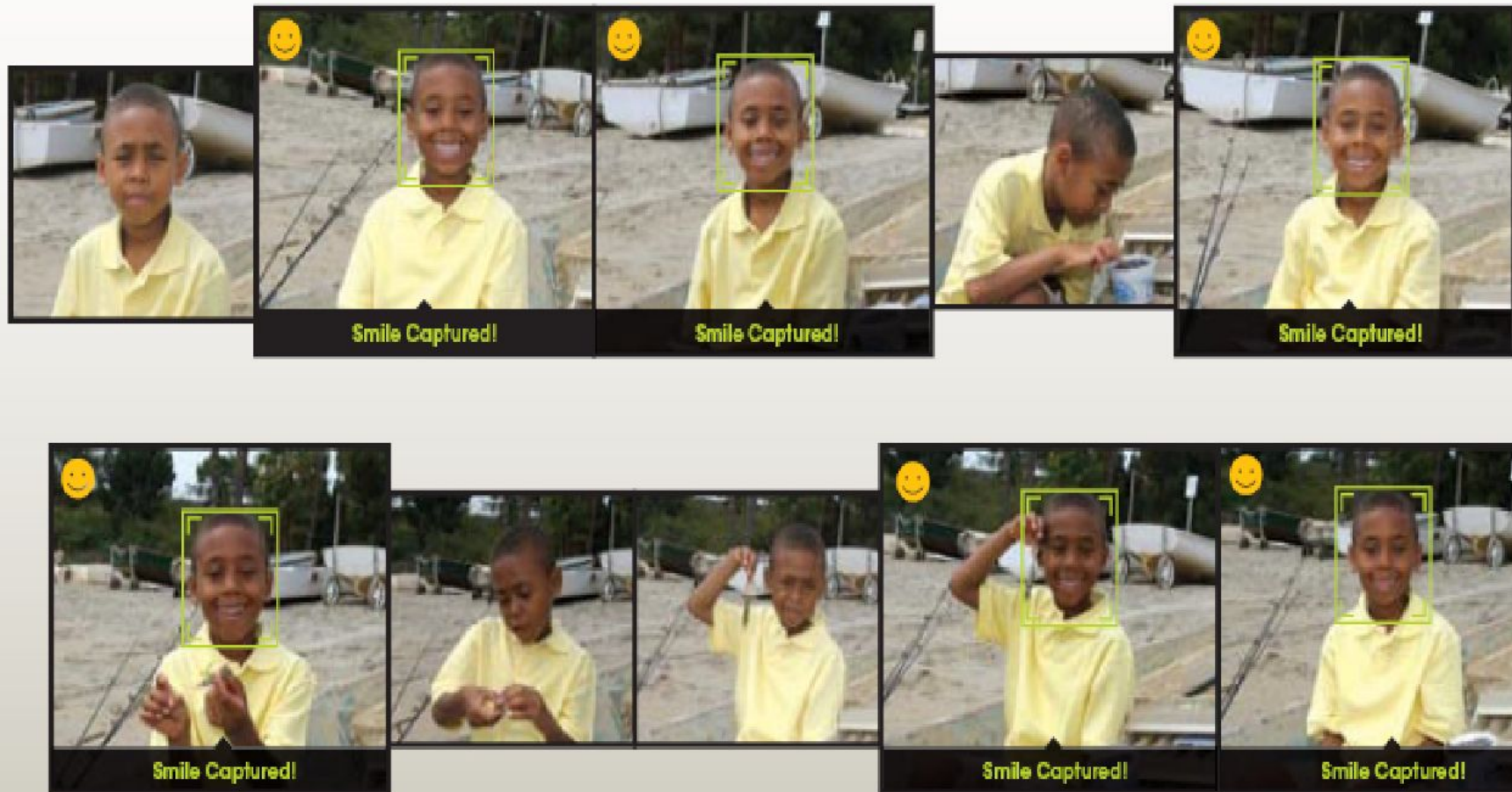


Digital Cameras

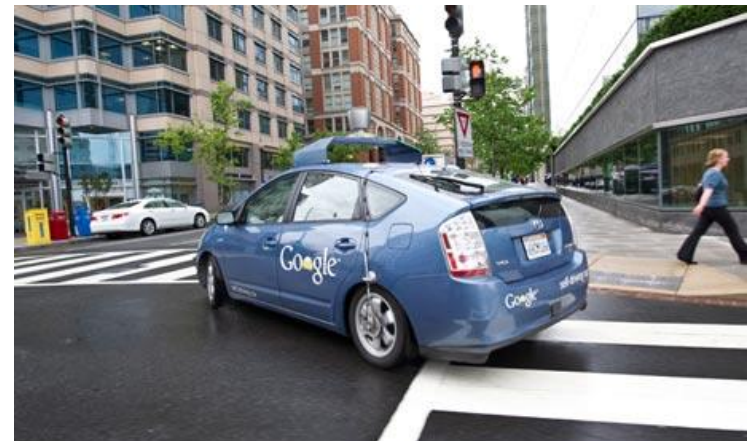
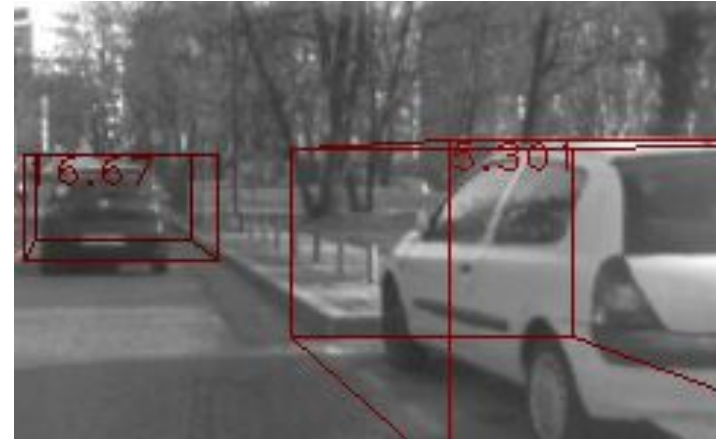
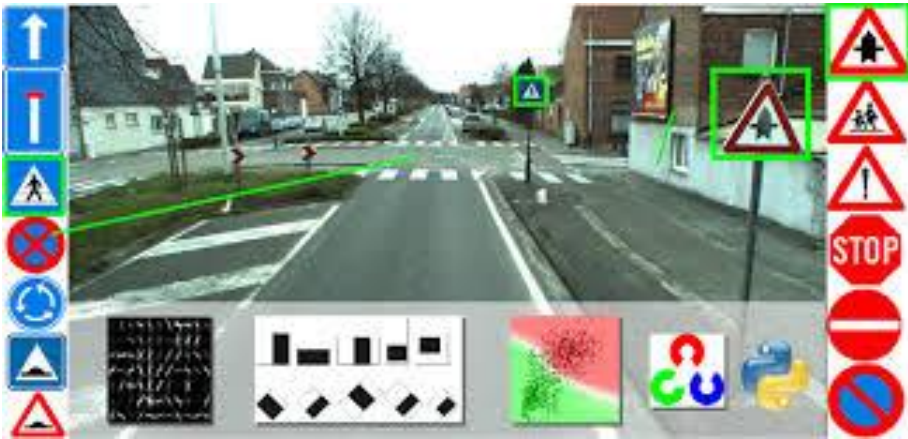
On-line services,
social networks.



Smile Detection



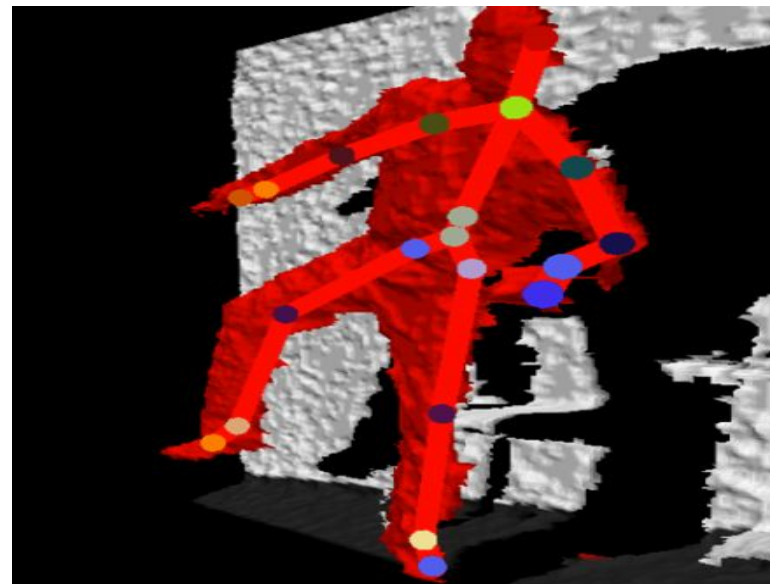
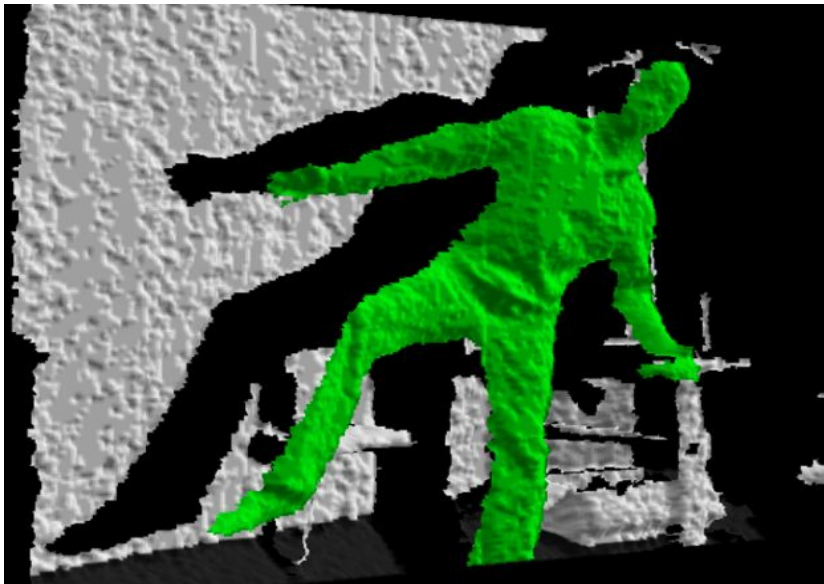
Intelligent Vehicles



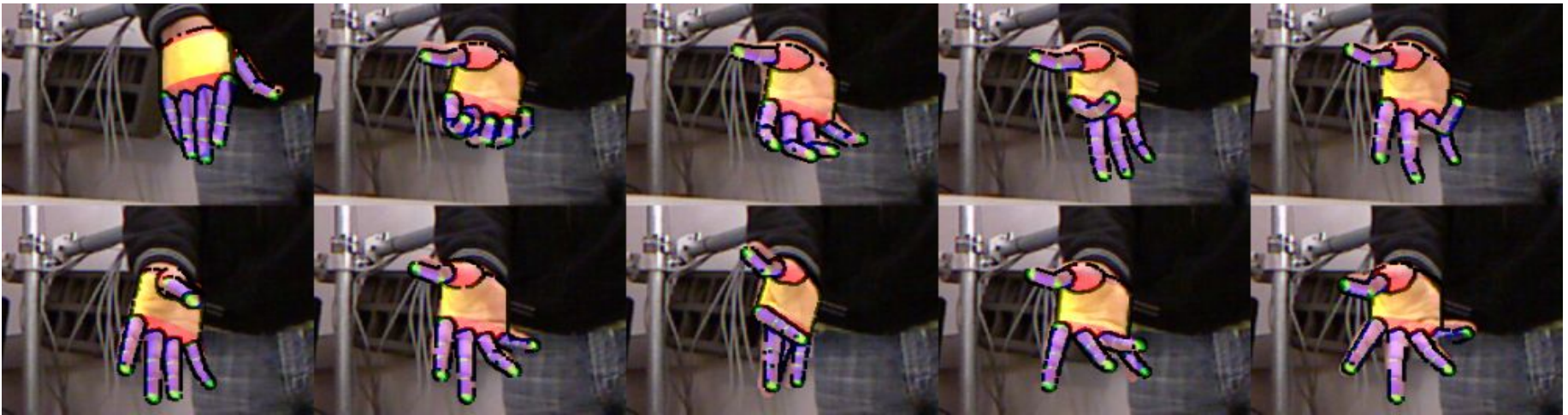
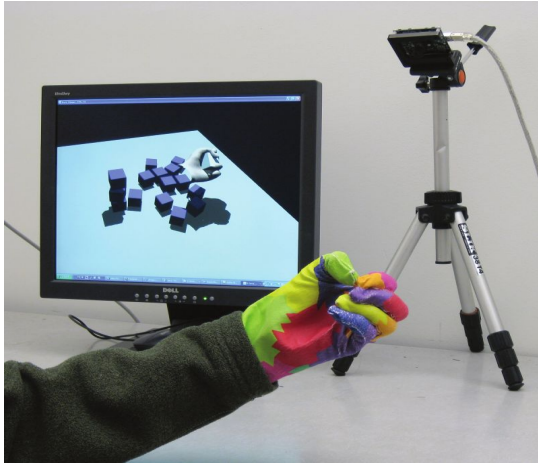
Sports



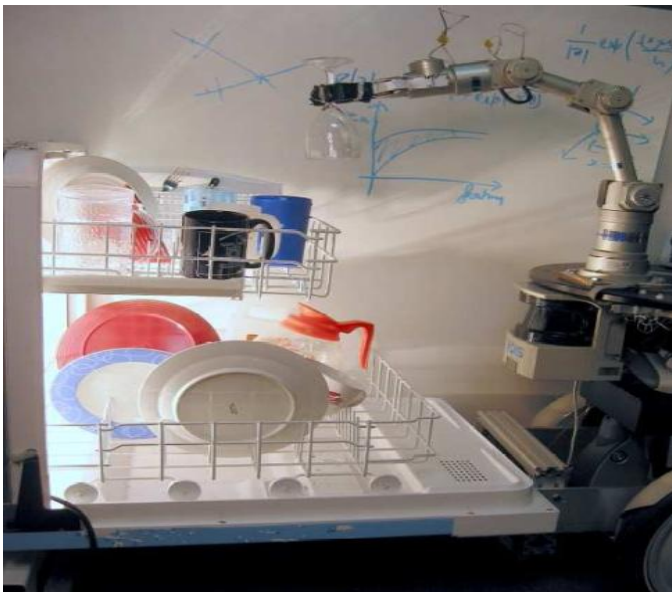
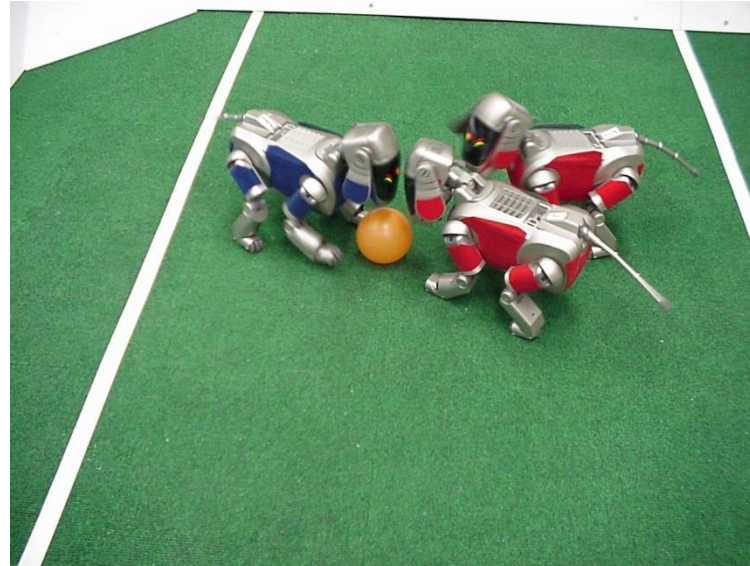
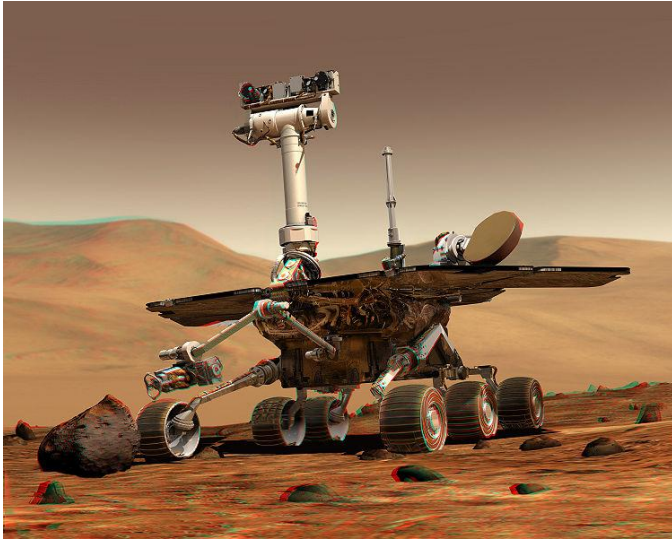
3D Body Tracking (Kinect)



3D Hand Tracking



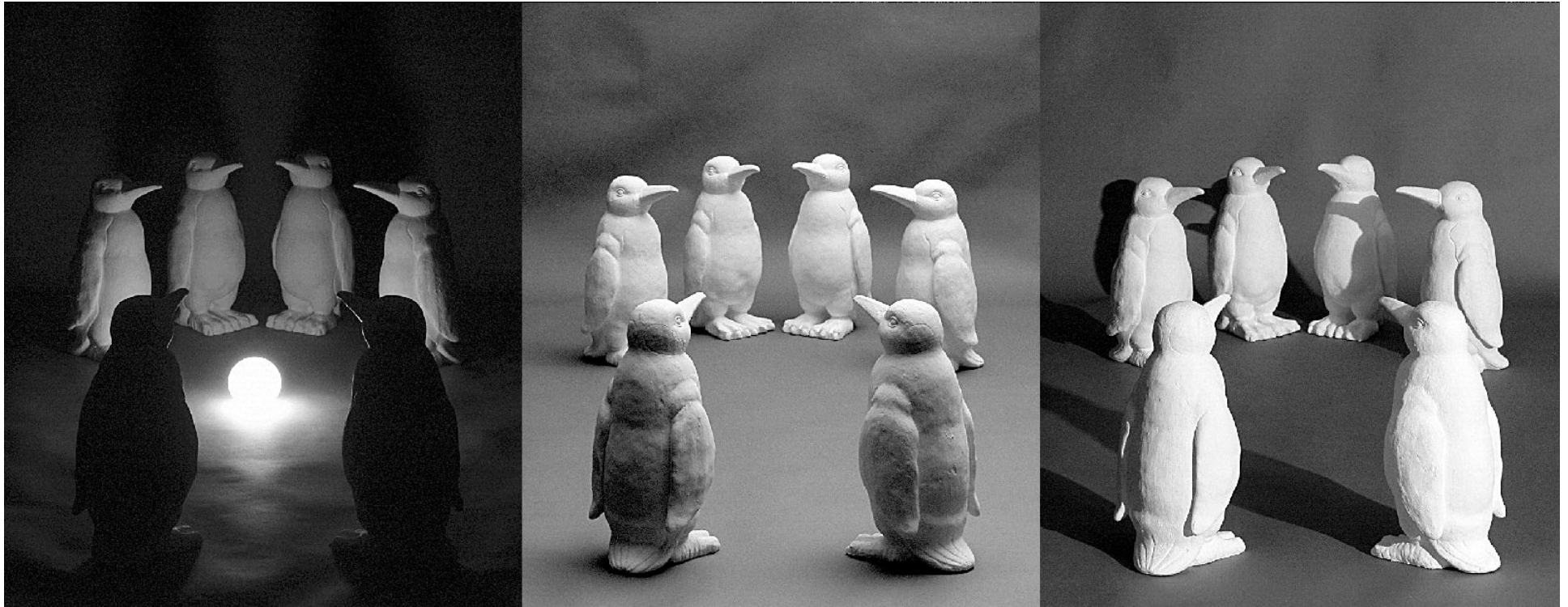
Mobile Robots



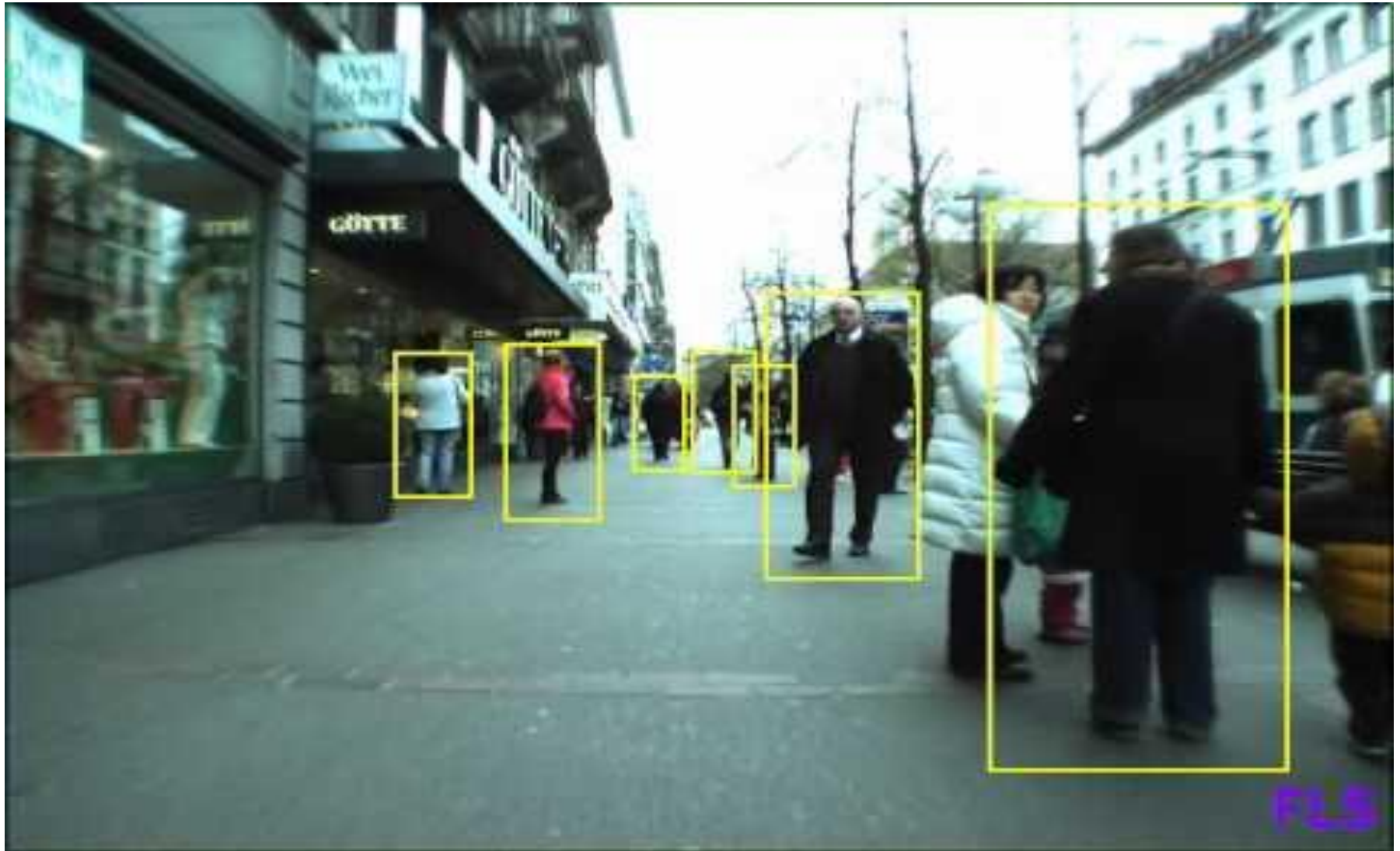
Challenges: viewpoint variation



Challenges: Illumination



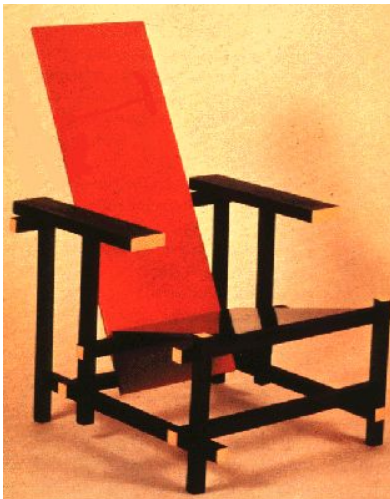
Challenges: Scale



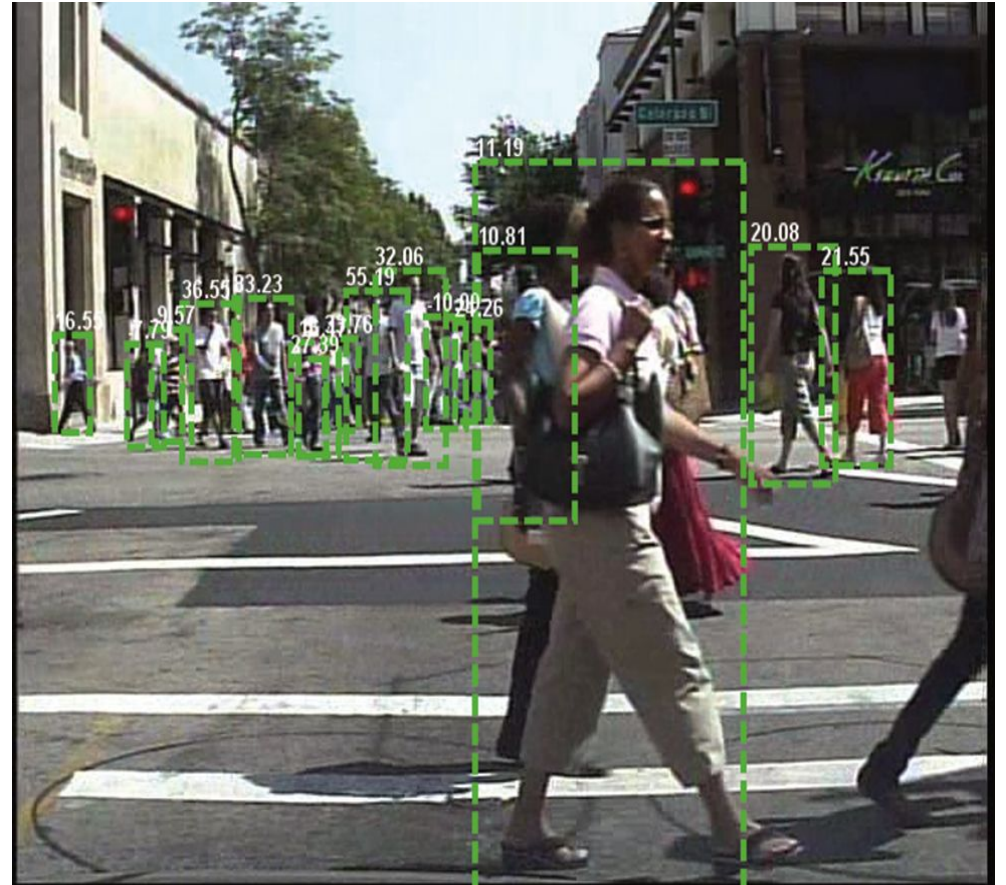
Challenges: Deformation



Challenges: Appearance variation.



Challenges: Occlusion



Challenges: Background Clutter



Challenges: Ambiguity

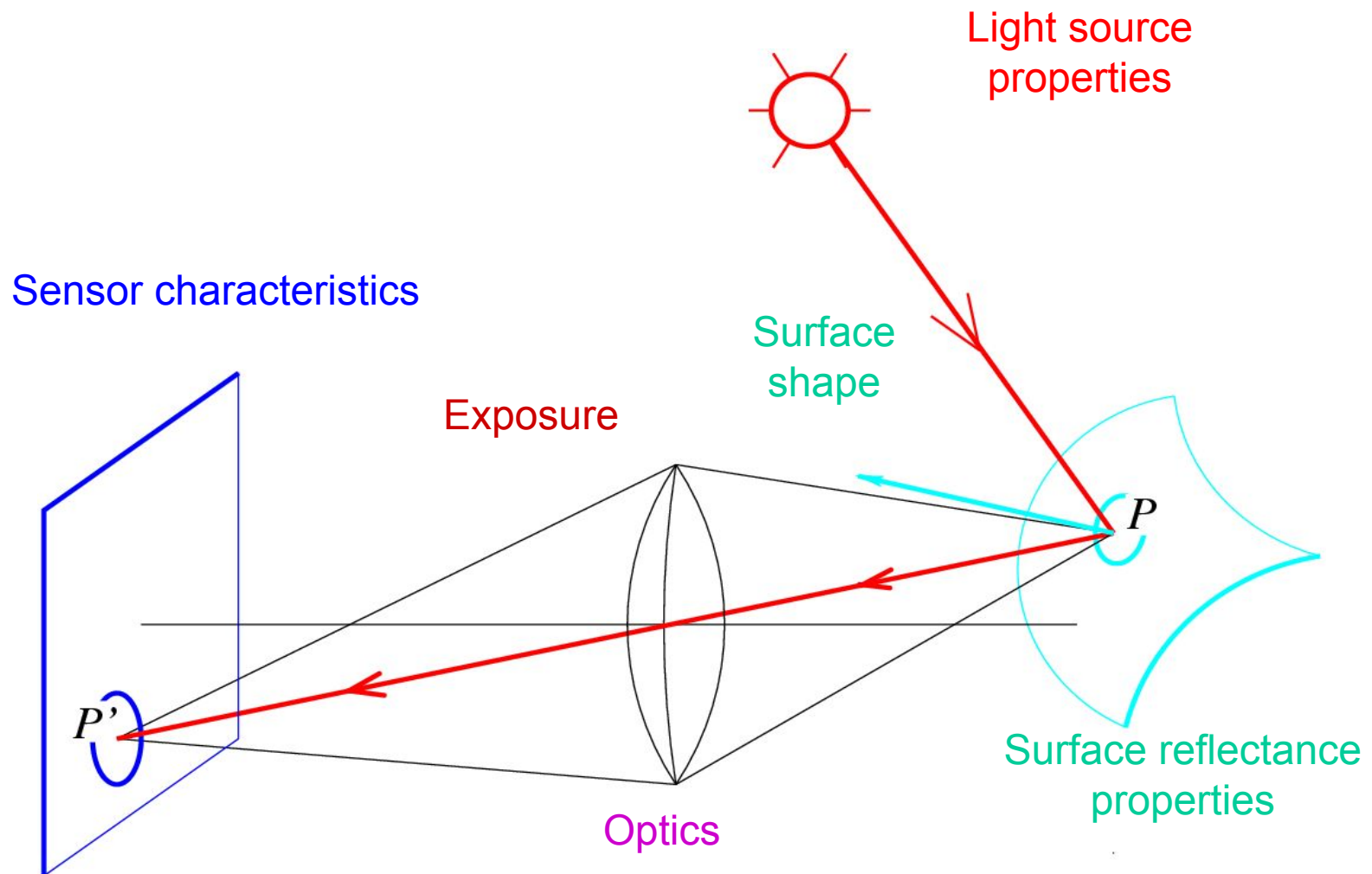
Many different 3D scenes could have given rise to a particular 2D picture.



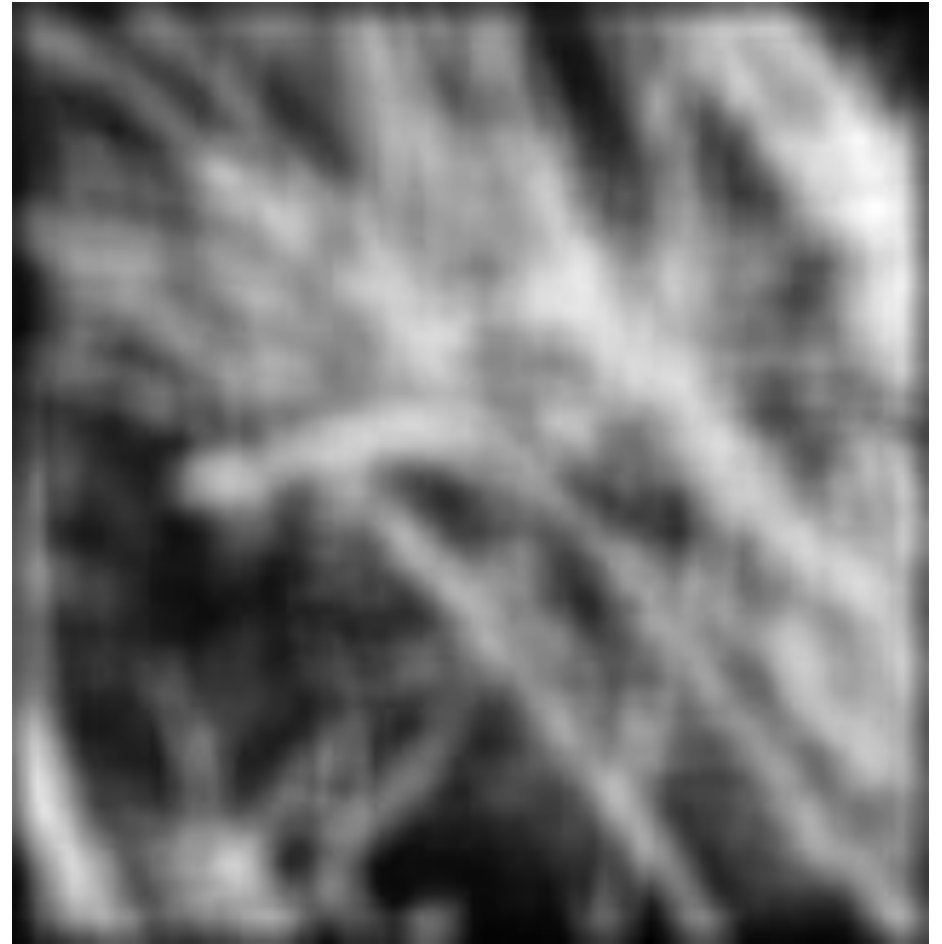
Course Overview

- .Image Formation
- .Linear Filters
- .Edge & Corner detection
- .Feature Extraction
- .Grouping and fitting
- .Hough Transform
- .Alignment
- .Stereo Vision
- .Segmentation
- .Image/Object Recognition
- .Video Recognition
- .Motion & Tracking
- .Deep Learning for Computer Vision

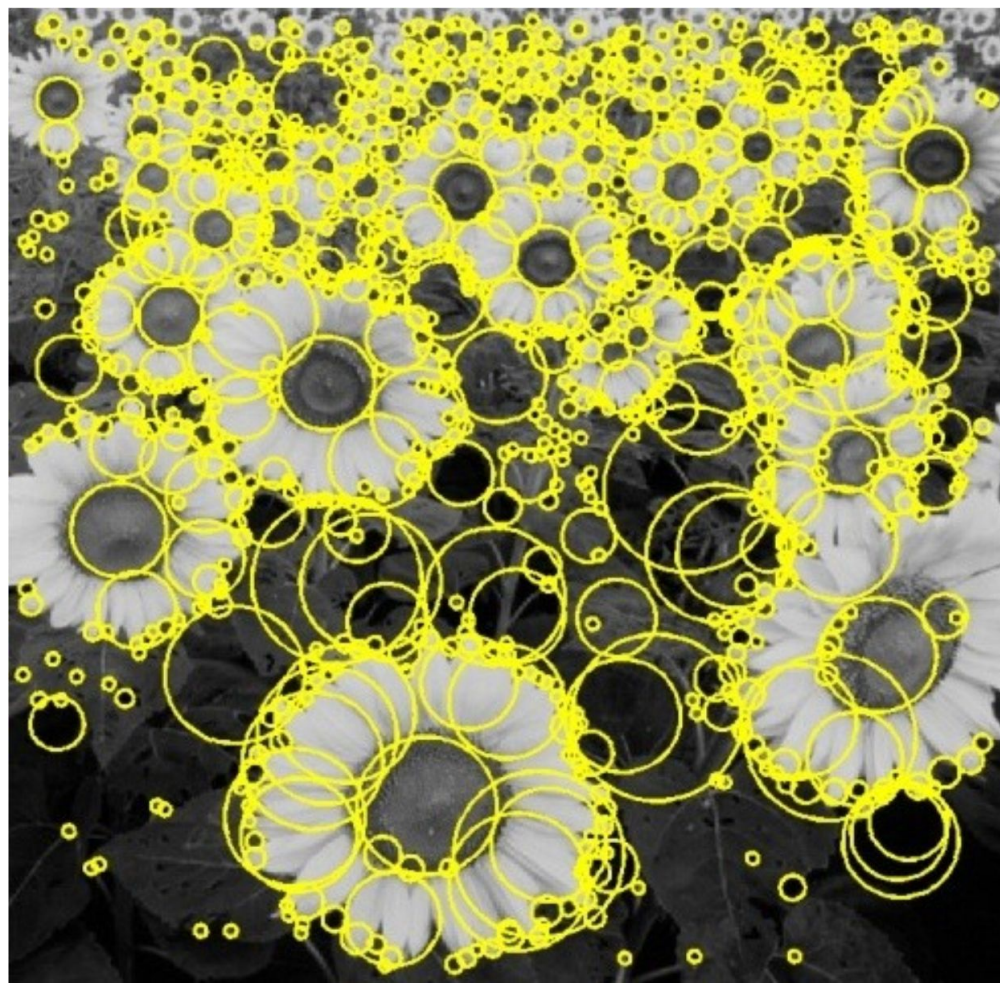
Image Formation



Filtering

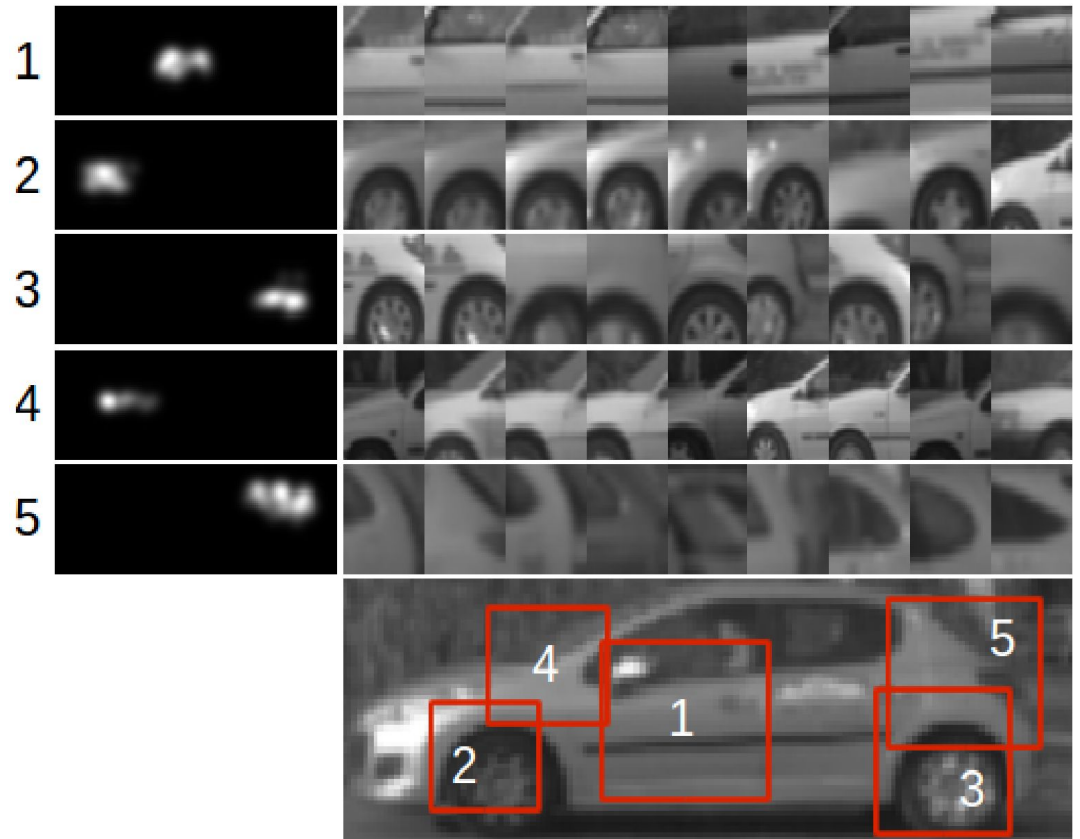
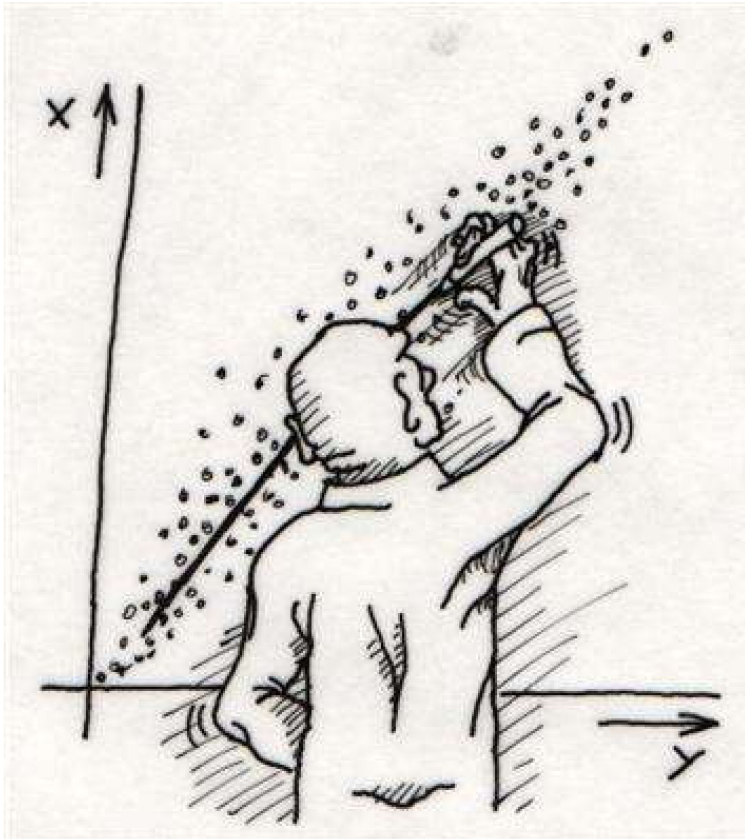


Feature Extraction



Corner and blob detection

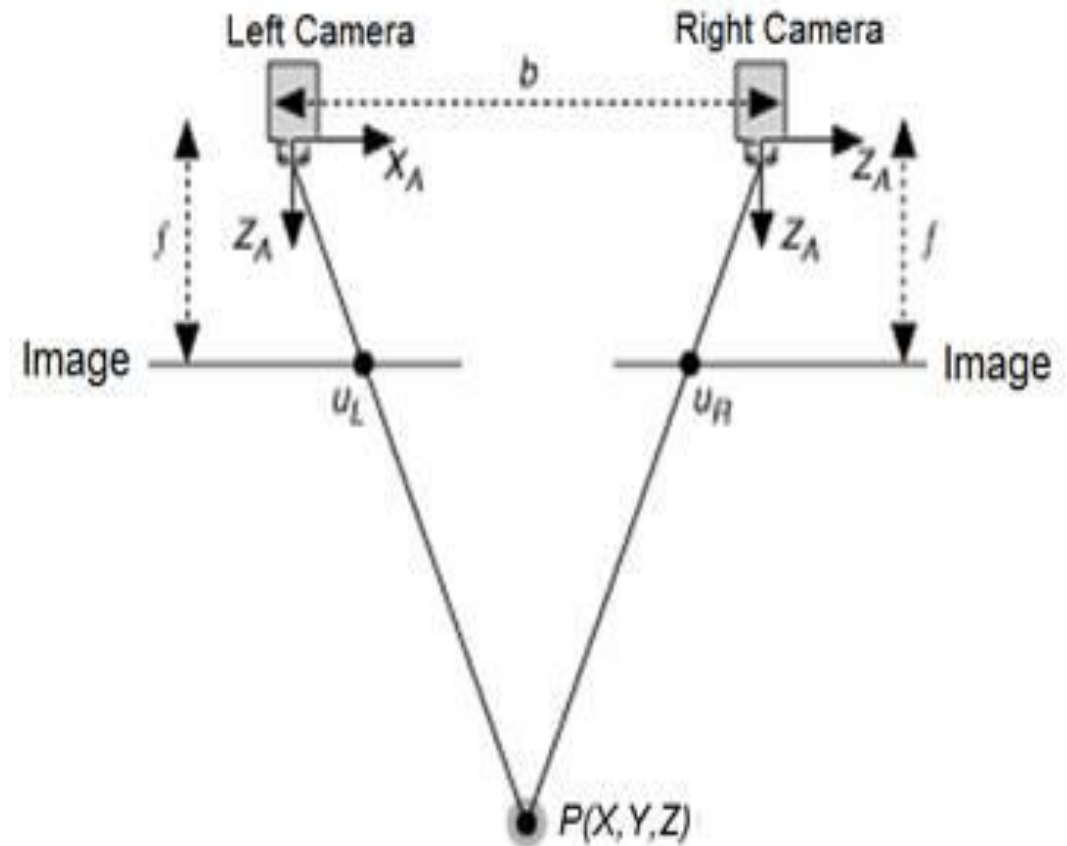
Grouping and Model Fitting



Fitting: Least squares,
Hough transform,
RANSAC.

Stereo Vision

- Adds depth to the image.
- [Stereo Occupancy Grids](#)

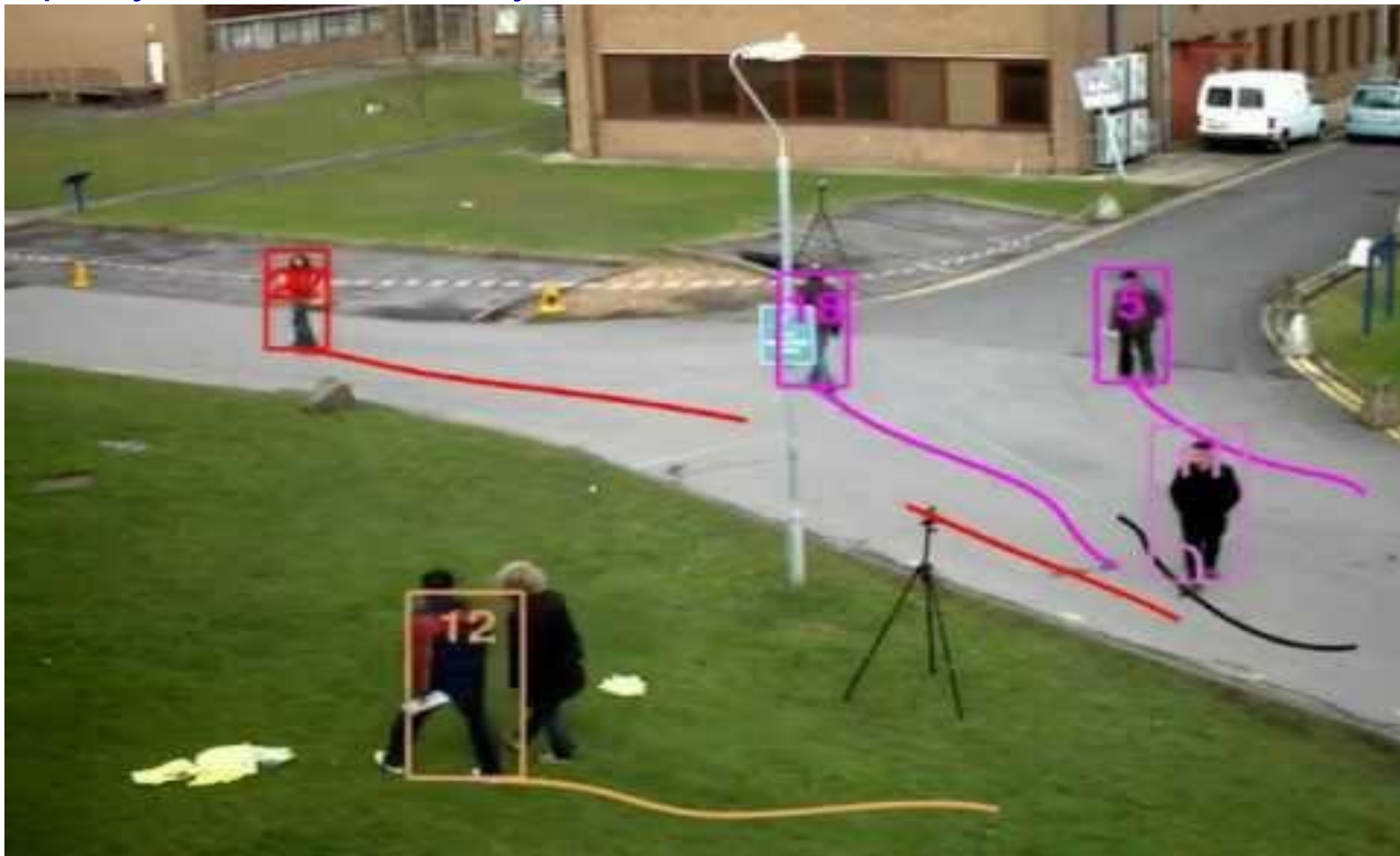


Motion and Optical Flow



Tracking

<https://youtu.be/Z9X3lhHytrQ?t=78>

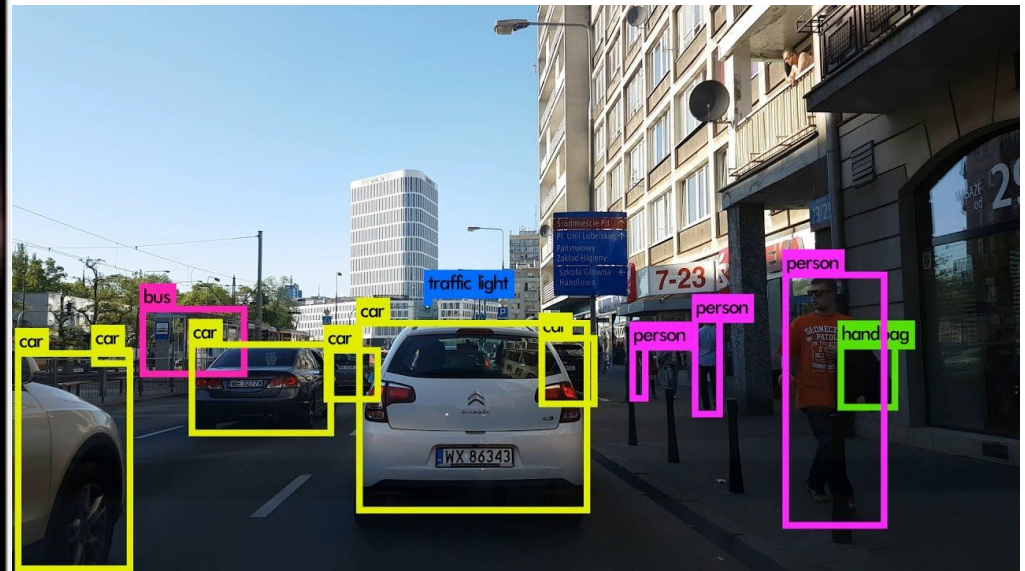


Object Segmentation vs Detection

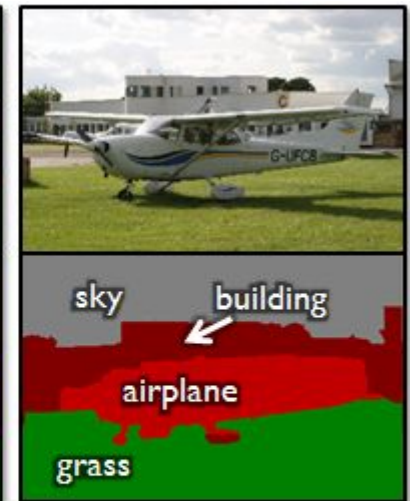
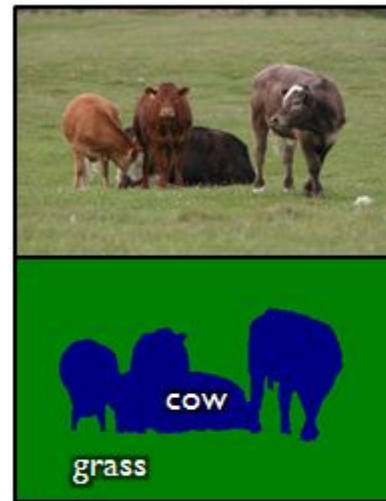
Pixel-level labels
Category only



Bounding box labels
Category + instance



Object Recognition



object classes	building	grass	tree	cow	sheep	sky	airplane	water	face	car
bicycle	flower	sign	bird	book	chair	road	cat	dog	body	boat

Image/Video Recognition

(assume given set of discrete labels)
{dog, cat, truck, plane, ...}



This image by [blake](#) is
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cat



Deep Learning

