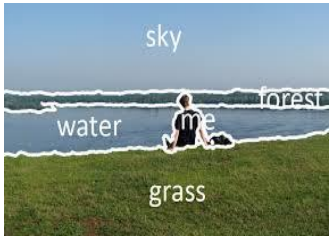
영상처리

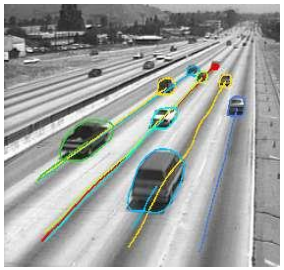
INTRODUCTION

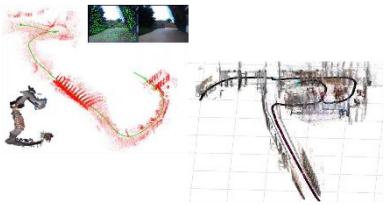
Computer Vision Problems

Vision tasks

Object recognition	Semantic segmentation	Object detection	Object tracking	Visual SLAM







Semantic segmentation

Detection/Segmentation

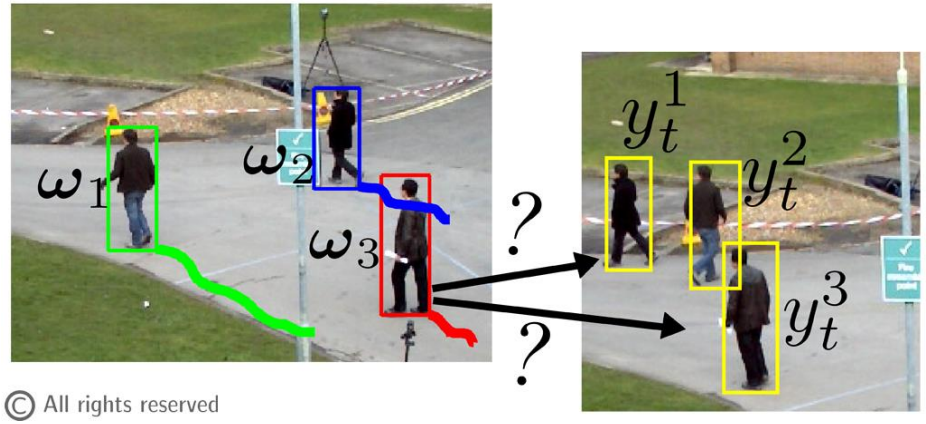
Detection? Instance Segmentation?

Object tracking

Yi Wu, Jongwoo Lim, and Ming-Hsuan Yang, "Object Tracking Benchmark",
IEEE Transactions on Pattern Analysis and Machine Intelligence, 2015

Detection/Tracking Problem

- Tracking
  - Tracking by detection
    - (+) simple
    - (-) flickering, multi objects?, missing?, false positives?
  - Detection + Data association
    - (+) multi-objects
    - (-) 복잡???,

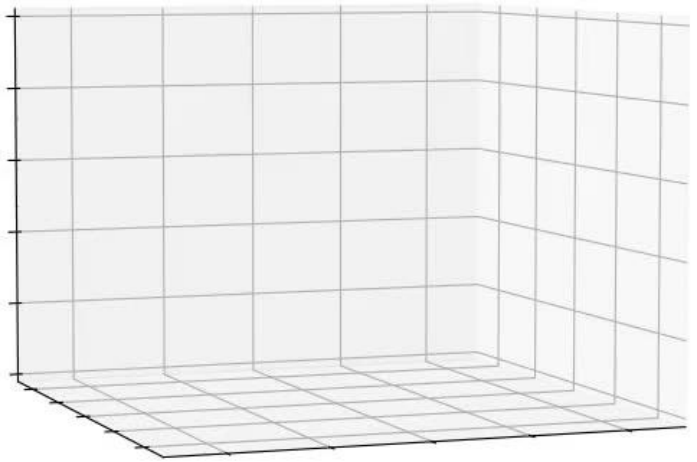


Open Pose

Detection/Tracking Problem

world

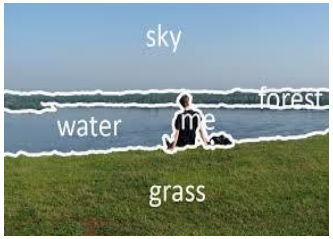
Input

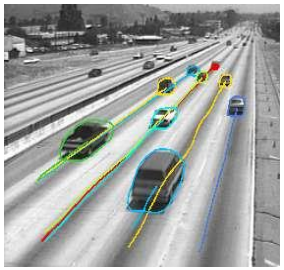


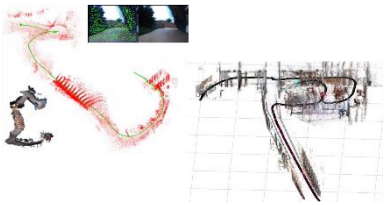
Visual SLAM

Vision tasks

Object recognition	Semantic segmentation	Object detection	Object tracking	Visual SLAM

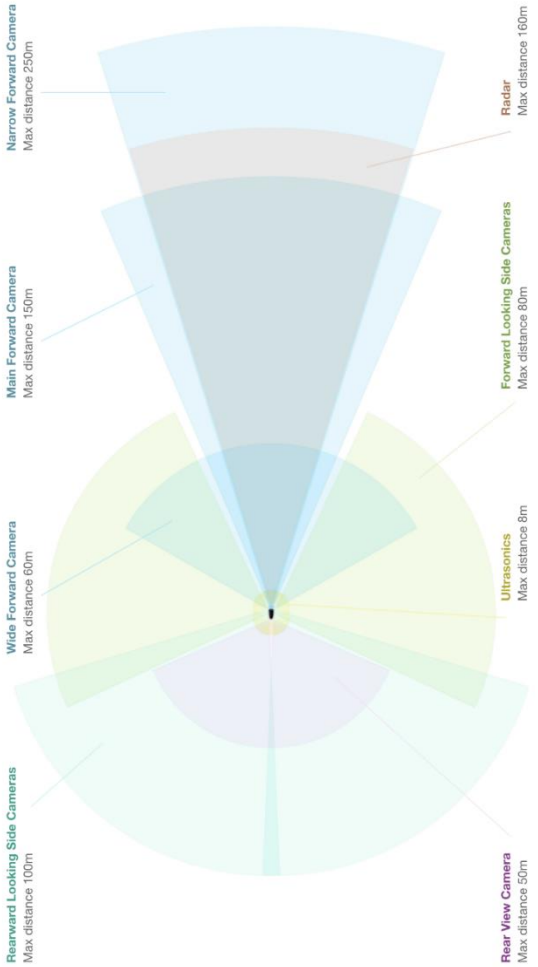




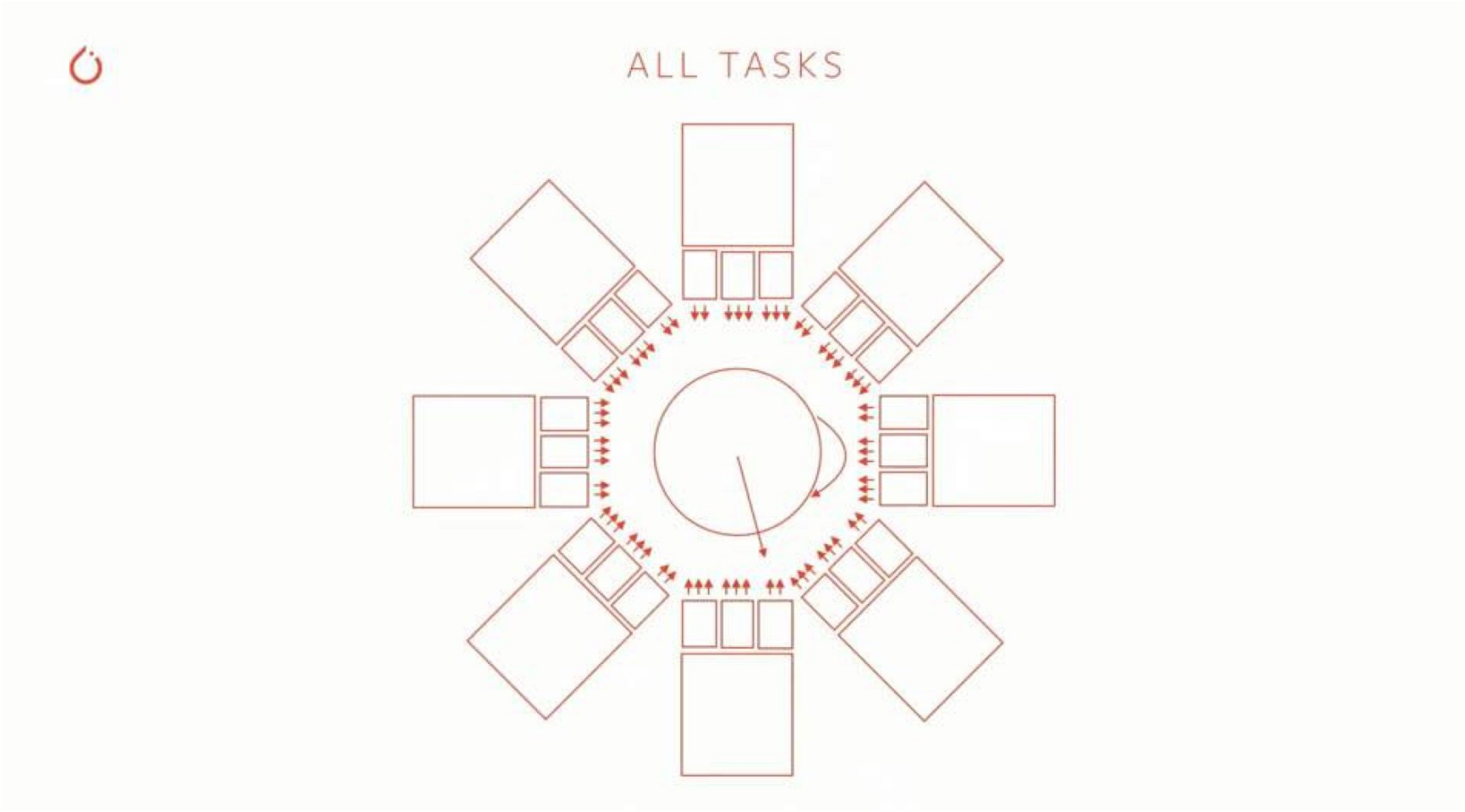


TESLA AUTOPILOT

Tesla Autopilot: 8 cameras



Tesla Autopilot: Overall Structures



Hardwares

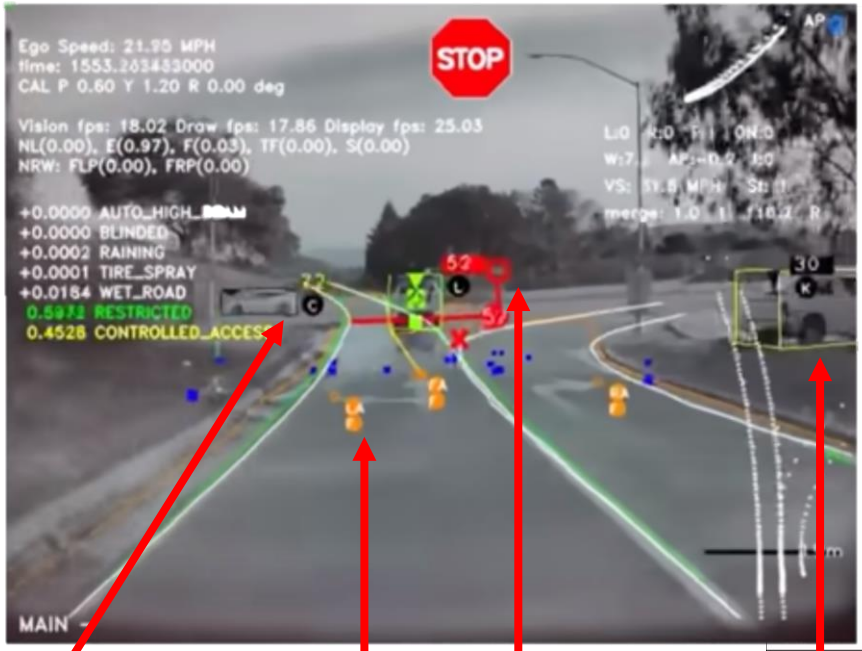
Item	HW1	HW2.0	HW2.5	HW3
Front Cameras	1	3 – Narrow 35°, Main 50°, Wide angle 120°		
Side Cameras	0	2 - 90°		
Side Rearward Cameras	0	2 – 60°		
Rear	Not used for AP	1 - 150°, RGGB*		
Inside (Model 3)	n/a	n/a	1, RGGB*	
Front/Side Camera Filters	Monochrome	RCCC*	RCCB*	
Radar	Bosch, 525 ft range		Continental, 558 ft range	
Sonar sensors	12, each with 16 ft range	12 - each with 26 ft range		
Core Processors	Mobileye EyeQ3	1 – Nvidia Parker SoC** 1 – Nvidia Pascal GPU 1 – Infineon TriCore CPU	2 – Nvidia Parker SoC** 1 – Nvidia Pascal GPU 1 – Infineon TriCore CPU	2 – Tesla chips, each including 12 Exynos 64-bit ARM cores, 2 GPUs, 2 neural network processors and 1 lockstep CPU
RAM	256 MB	6 GB	8 GB	8 GB x 2
Flash Memory				4 GB x 2
Processing Power	1x	40x	40x w/redundancy	420x w/redundancy
Frames per second	36	110	110	2300
Estimated Power	25W	250W (Idle 40W)	300W	220W
Steering Rack	Single Power	Single Power	Redundant Power	

* In a camera each pixel is represented by 4 photoreceptors, with a combination of filters: C=Clear, R=Red, G=Green, B=Blue. Multiple same filters for a pixel increases the light sensitivity. With RCCB, there is no green filter to improve nighttime light sensitivity, and green can be calculated to make a color image for the dashcam.

Light sensitivity

Single View Tasks

Numerous Sub-tasks



CAR

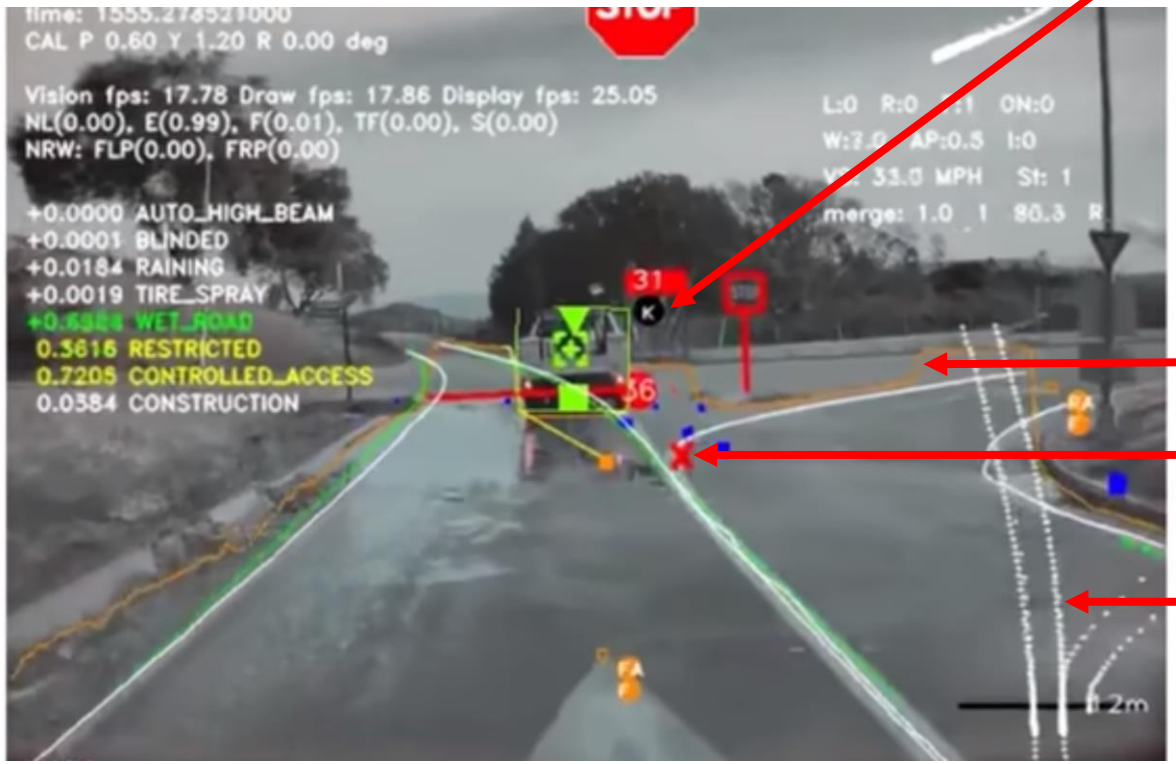
Left Arrow (LA)

Stop Sign

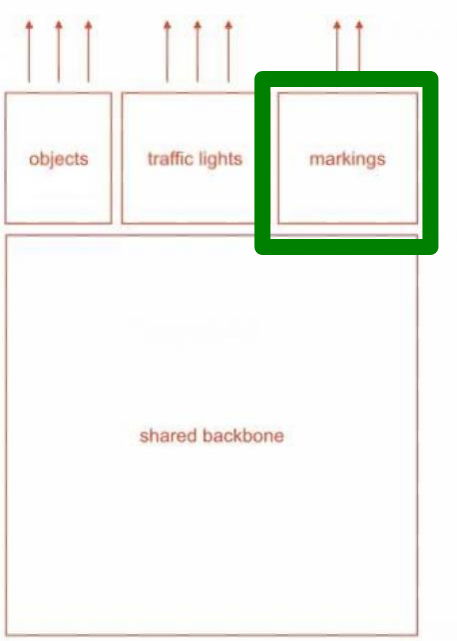
PICKUP TRUCK (YELLOW – parked)

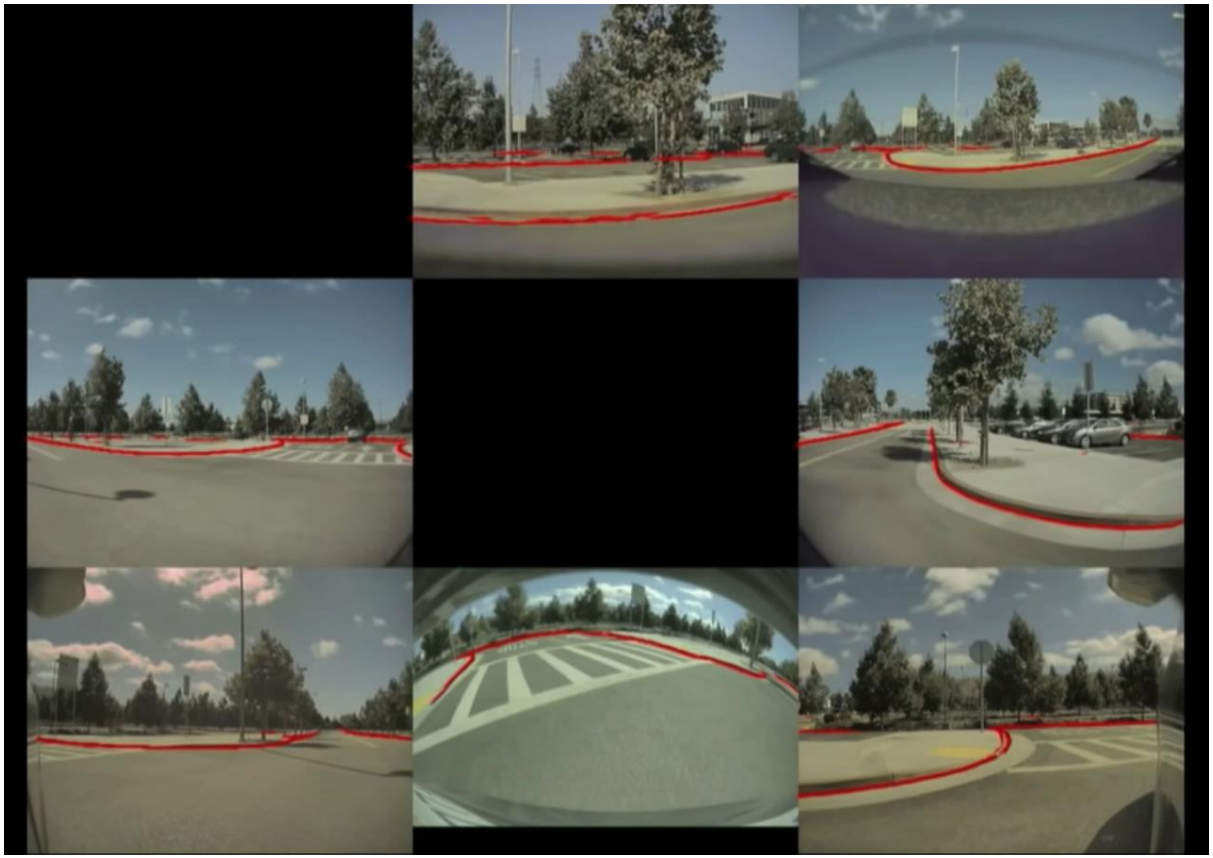
TRASH CAN

Numerous Sub-tasks

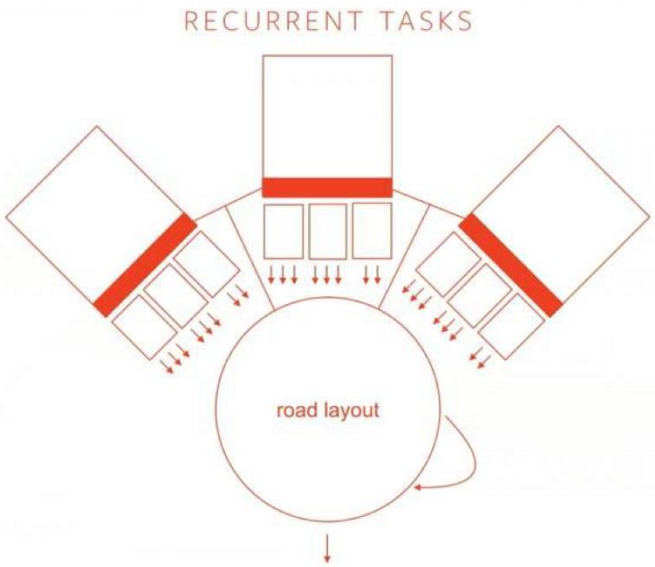


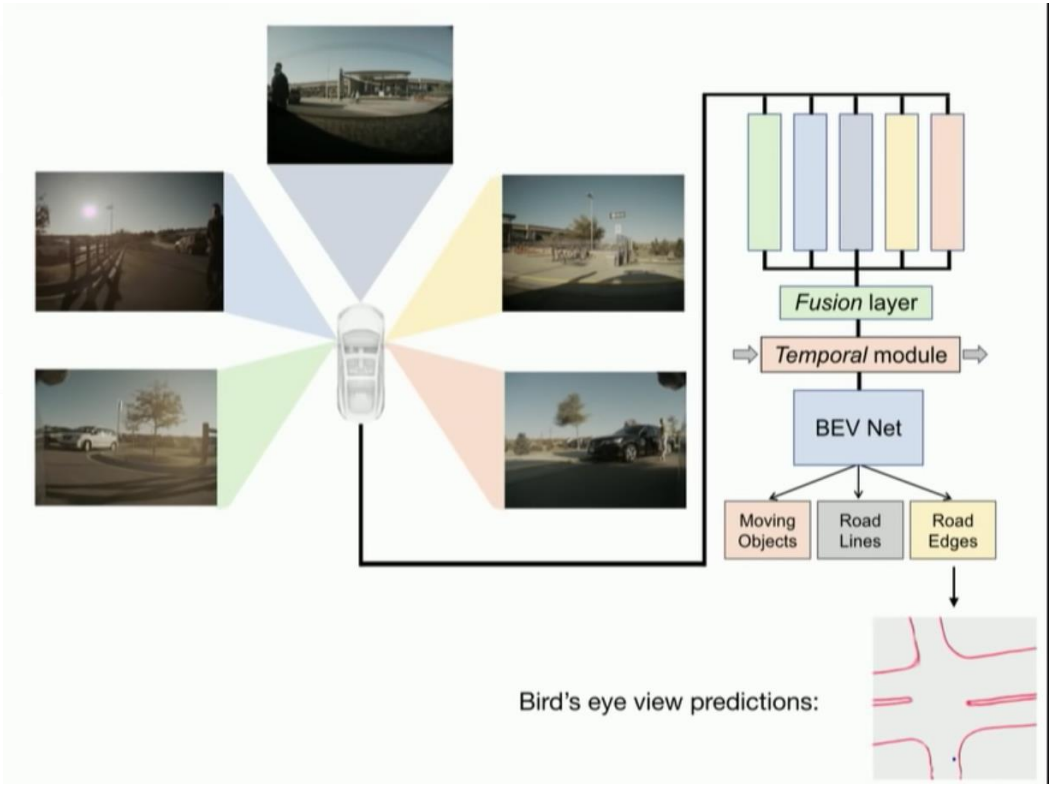
Edge detection (binary segmentation)



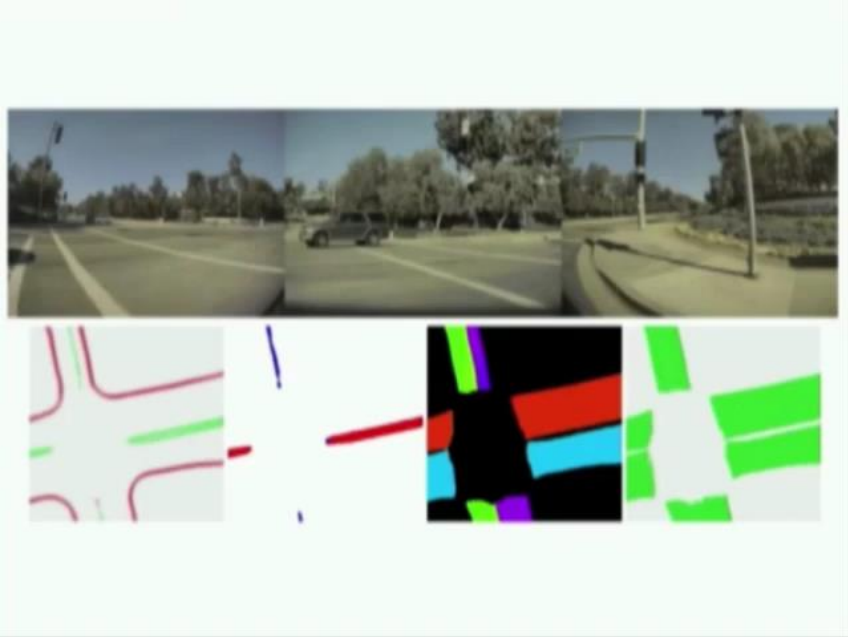


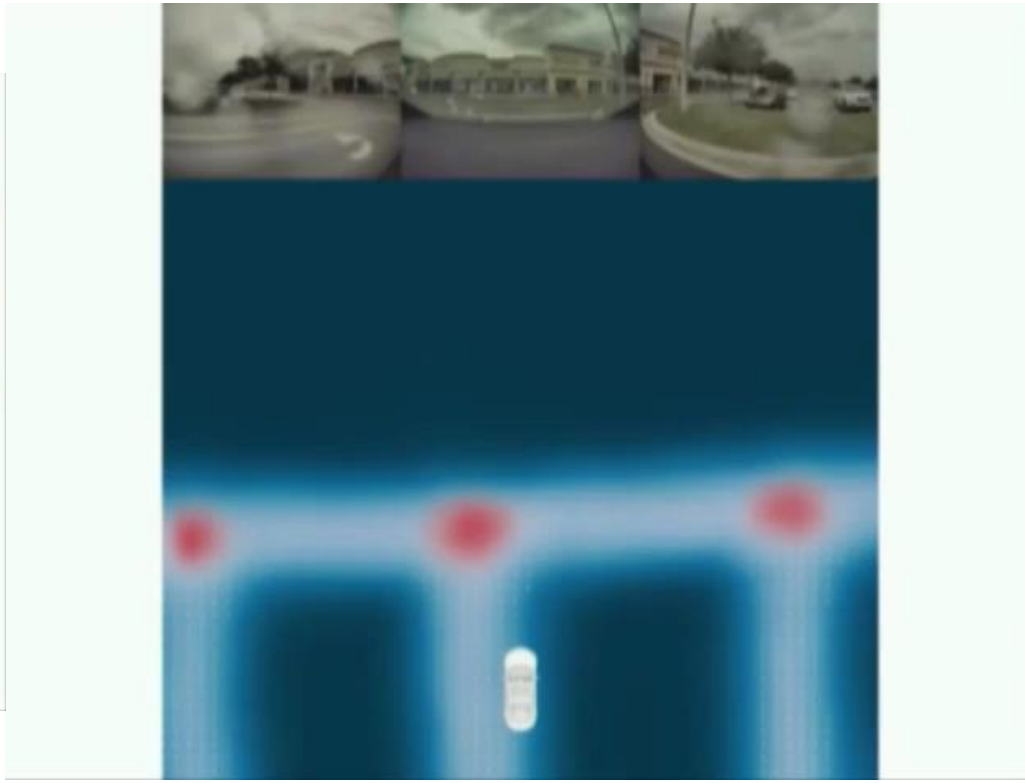
Recurrent Tasks





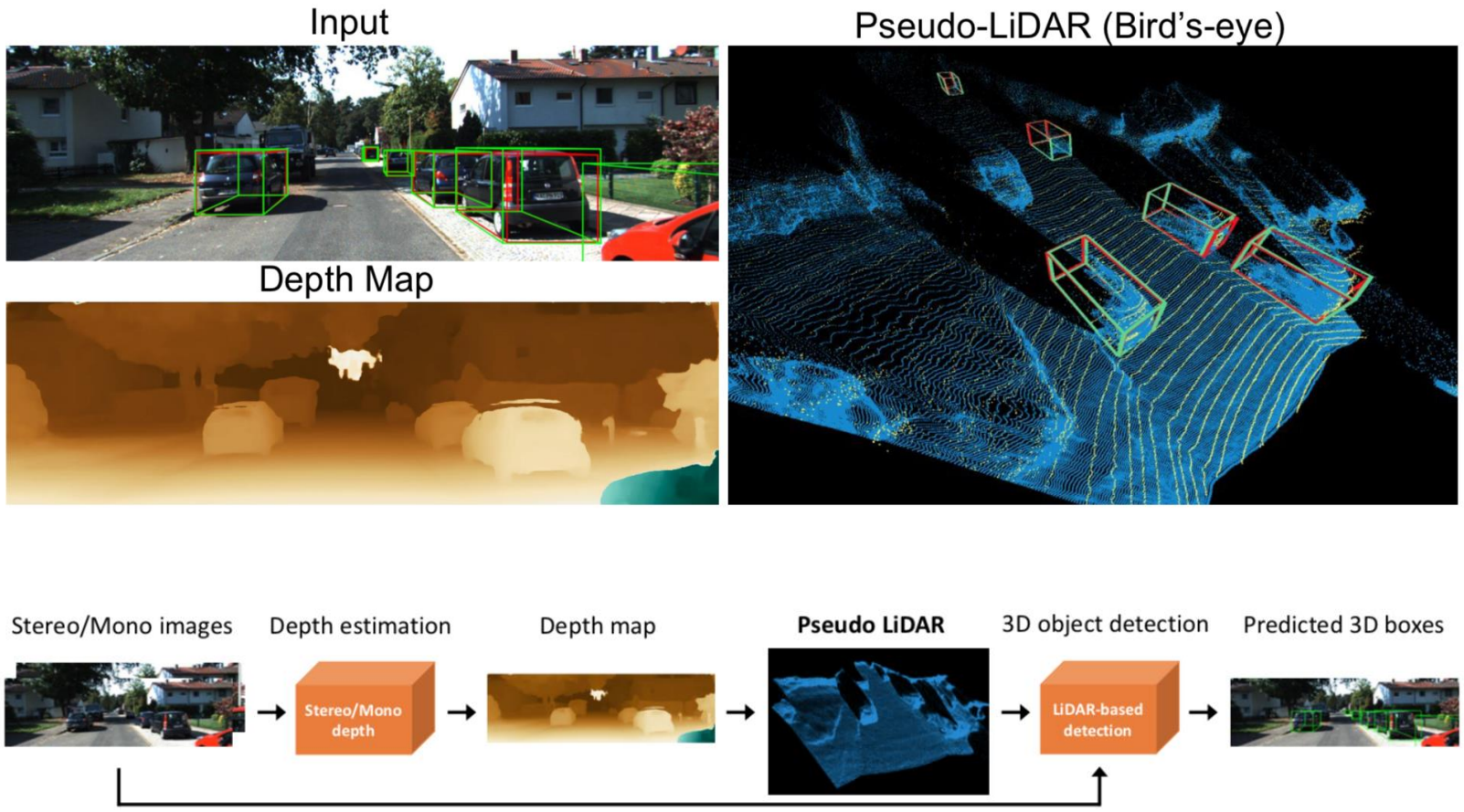
Bird Eye View

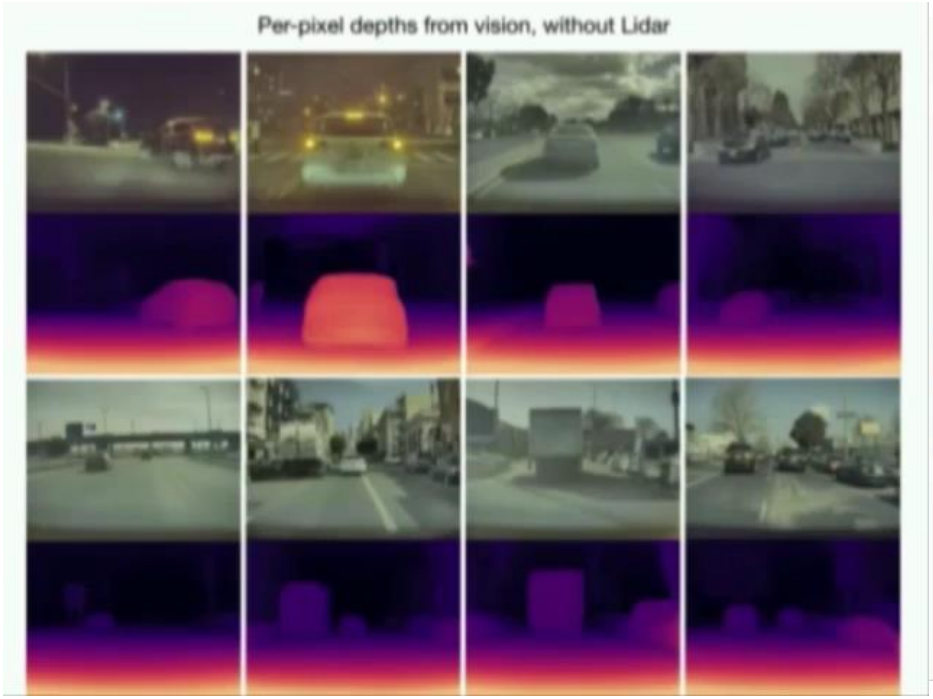


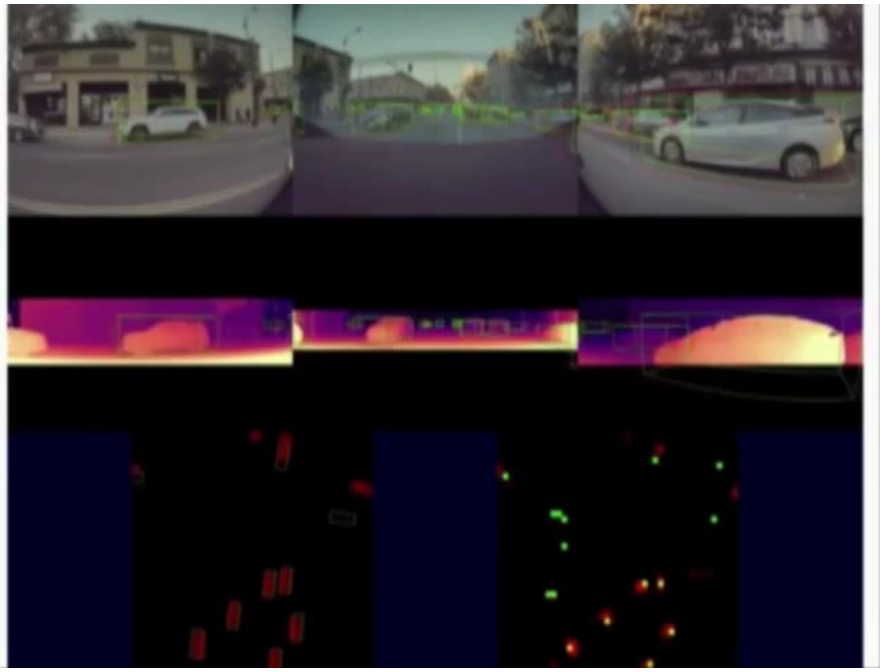


3D recognition

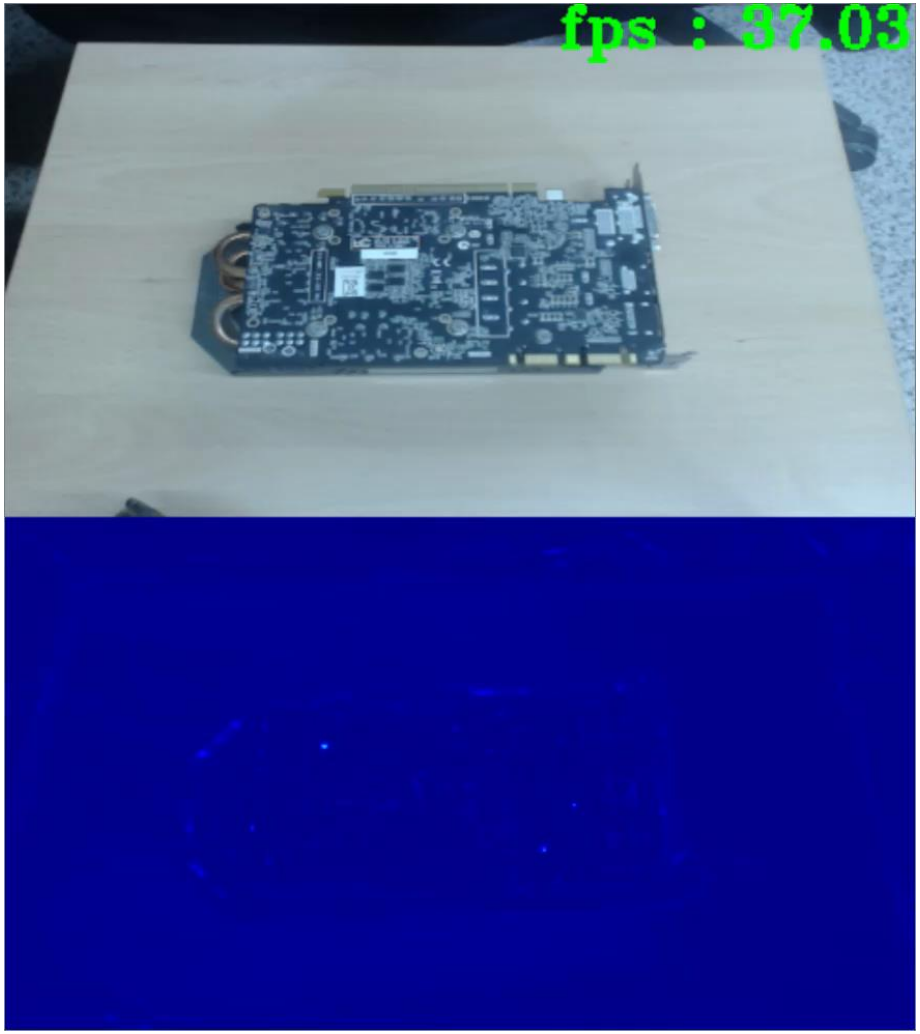
- Pseudo Lidar Approach




Per-pixel depths from vision, without Lidar



OTHER APPLICATIONS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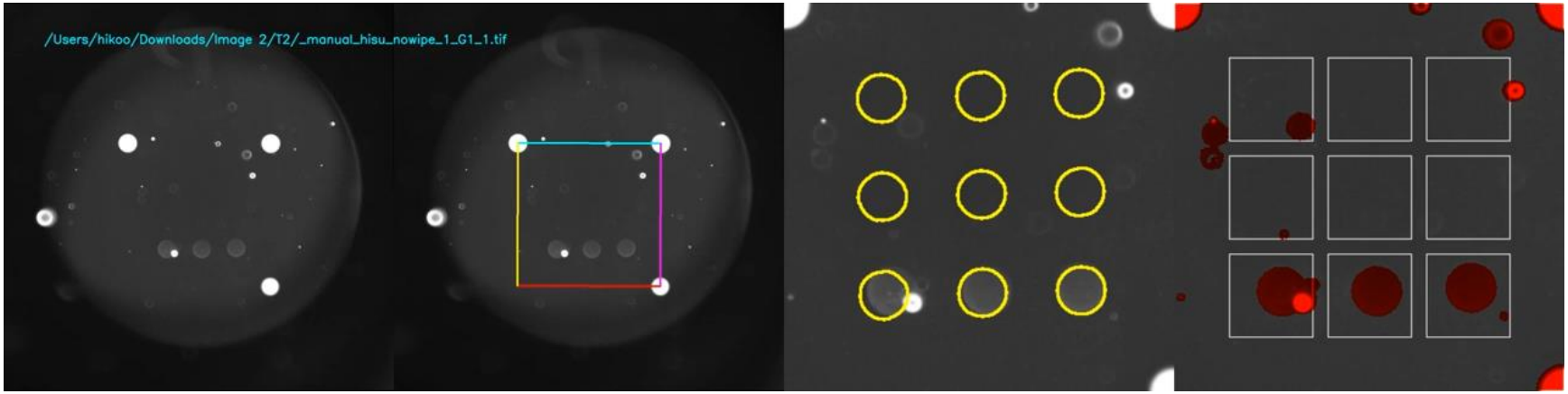
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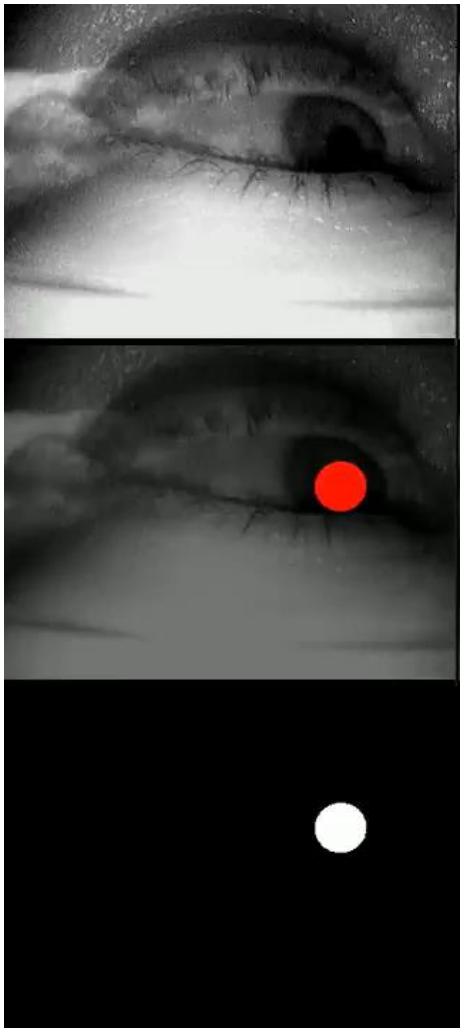
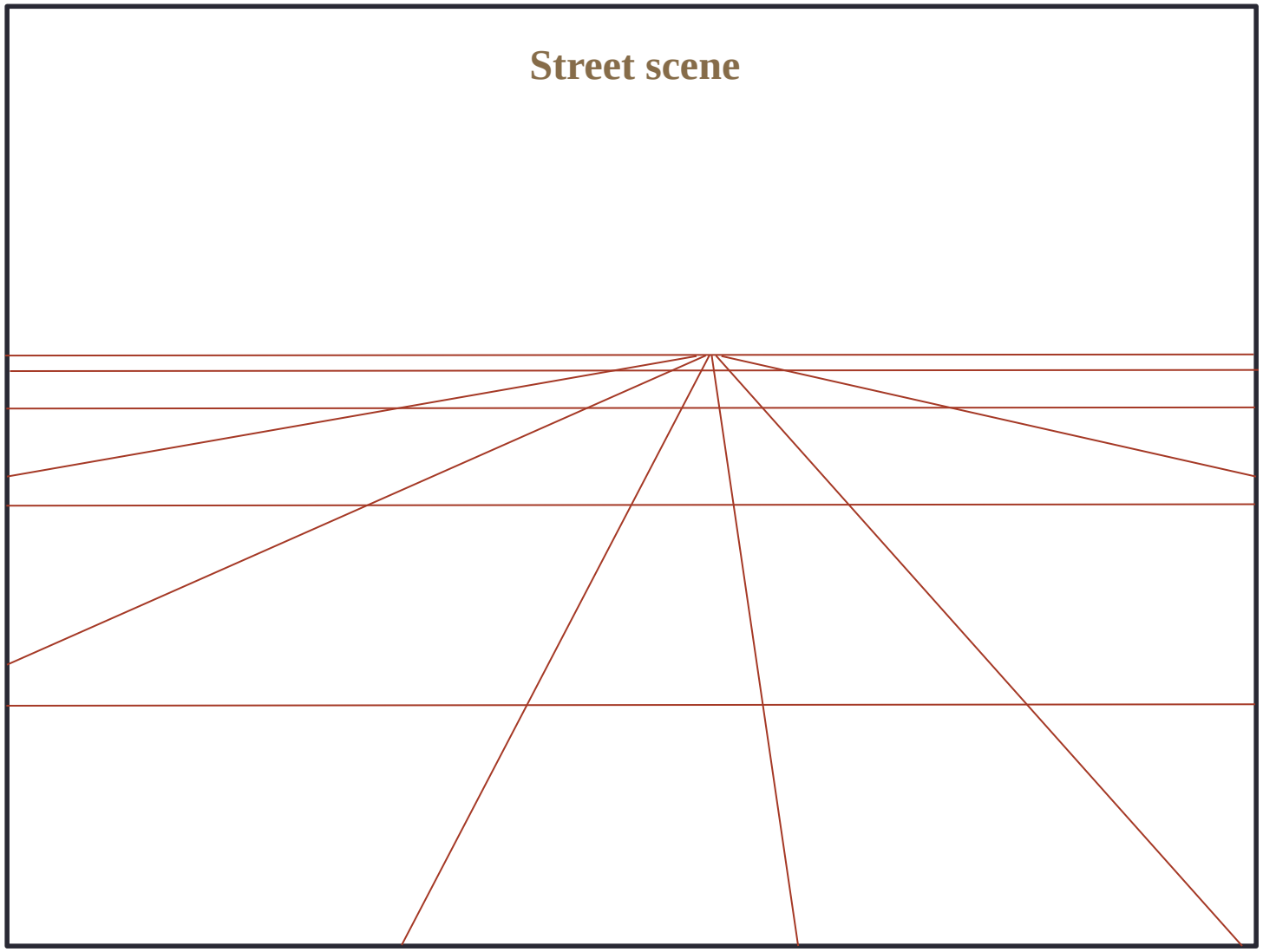


メトロネットワーク
Metro Network
池袋
上野
新宿
四ツ谷
永田町
大手町
東京
日本橋
茅場町
銀座
渋谷
九段下
飯田橋
表参道
六本木
恵比寿
目黒
中野
神田

COMPUTER VISION AS AN INVERSE PROBLEM

Scene type

Scene geometry

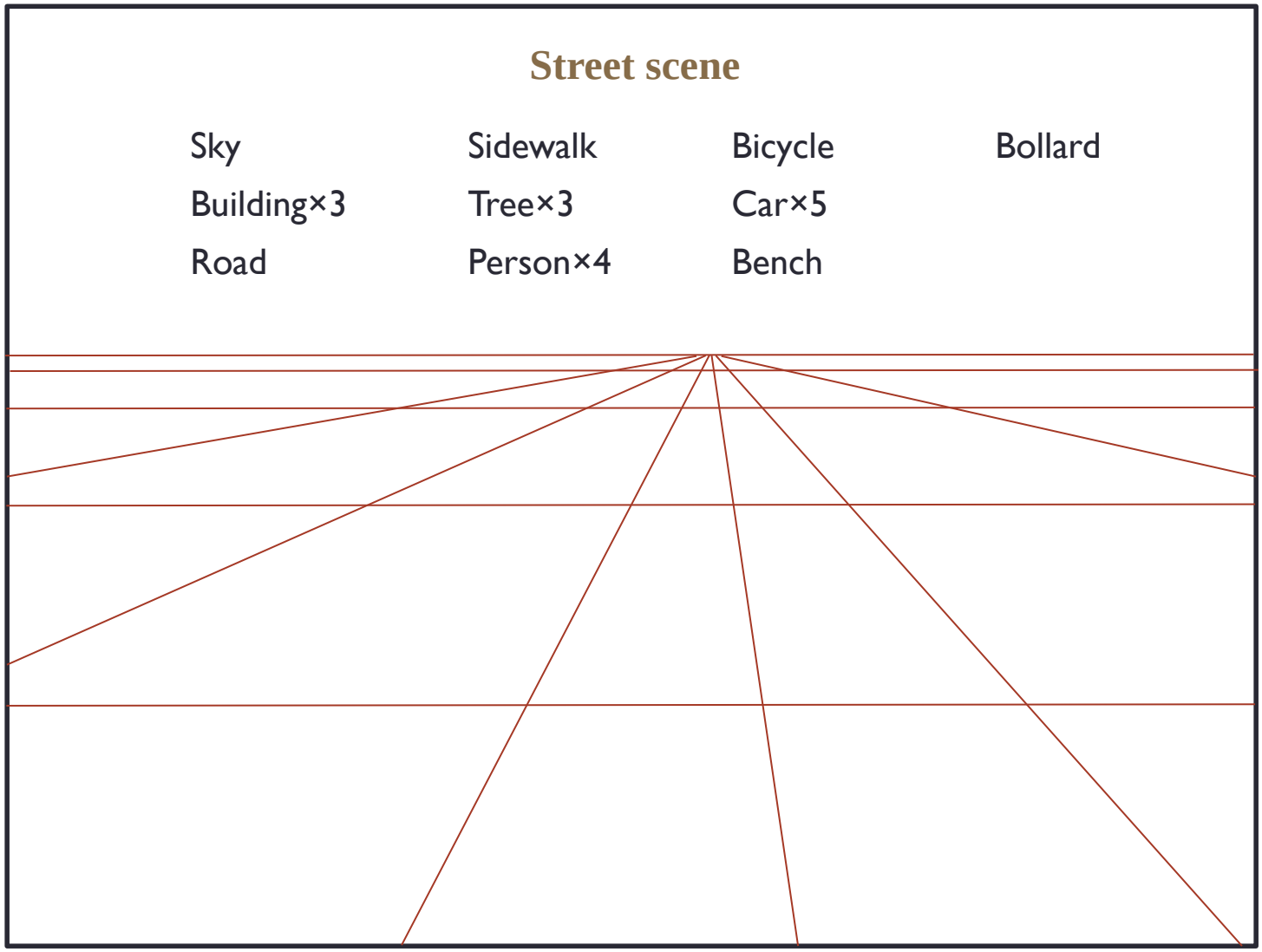


From J. Winn, MSR

Scene type

Scene geometry

Object classes



From J. Winn, MSR

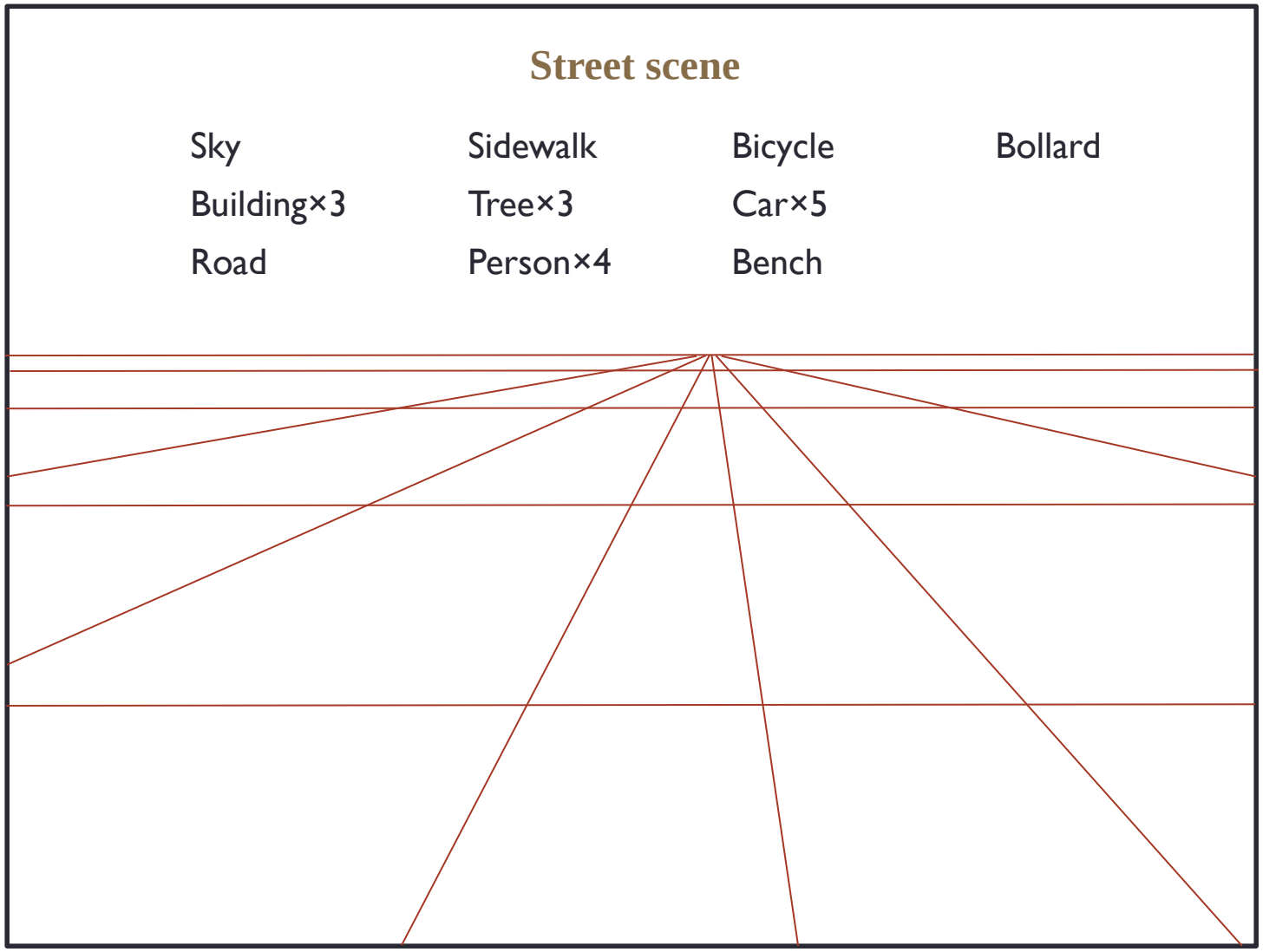
Scene type

Scene geometry

Object classes

Object position

Object orientation



From J. Winn, MSR

Scene type

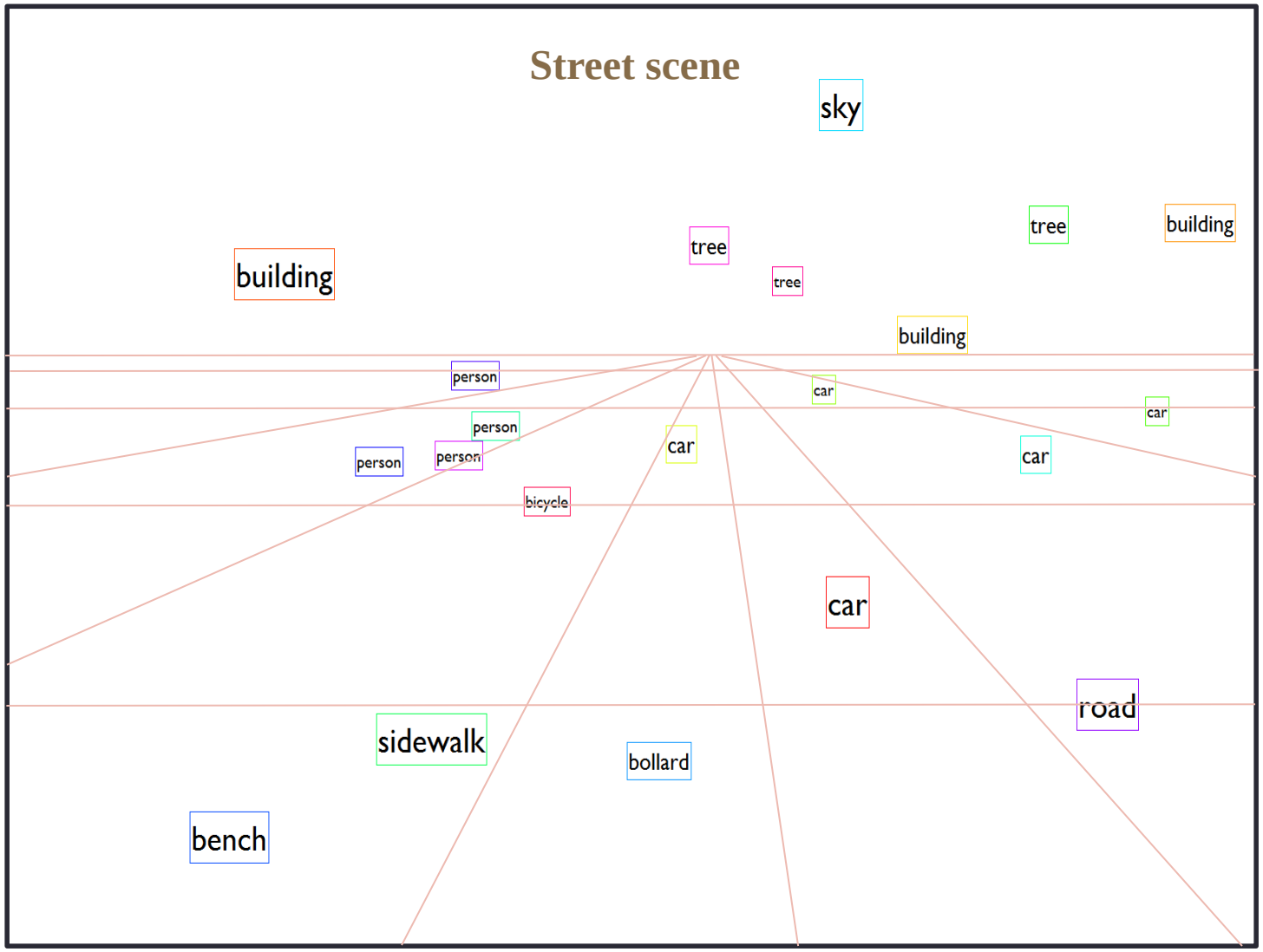
Scene geometry

Object classes

Object position

Object orientation

Object shape



From J. Winn, MSR

Scene type

Scene geometry

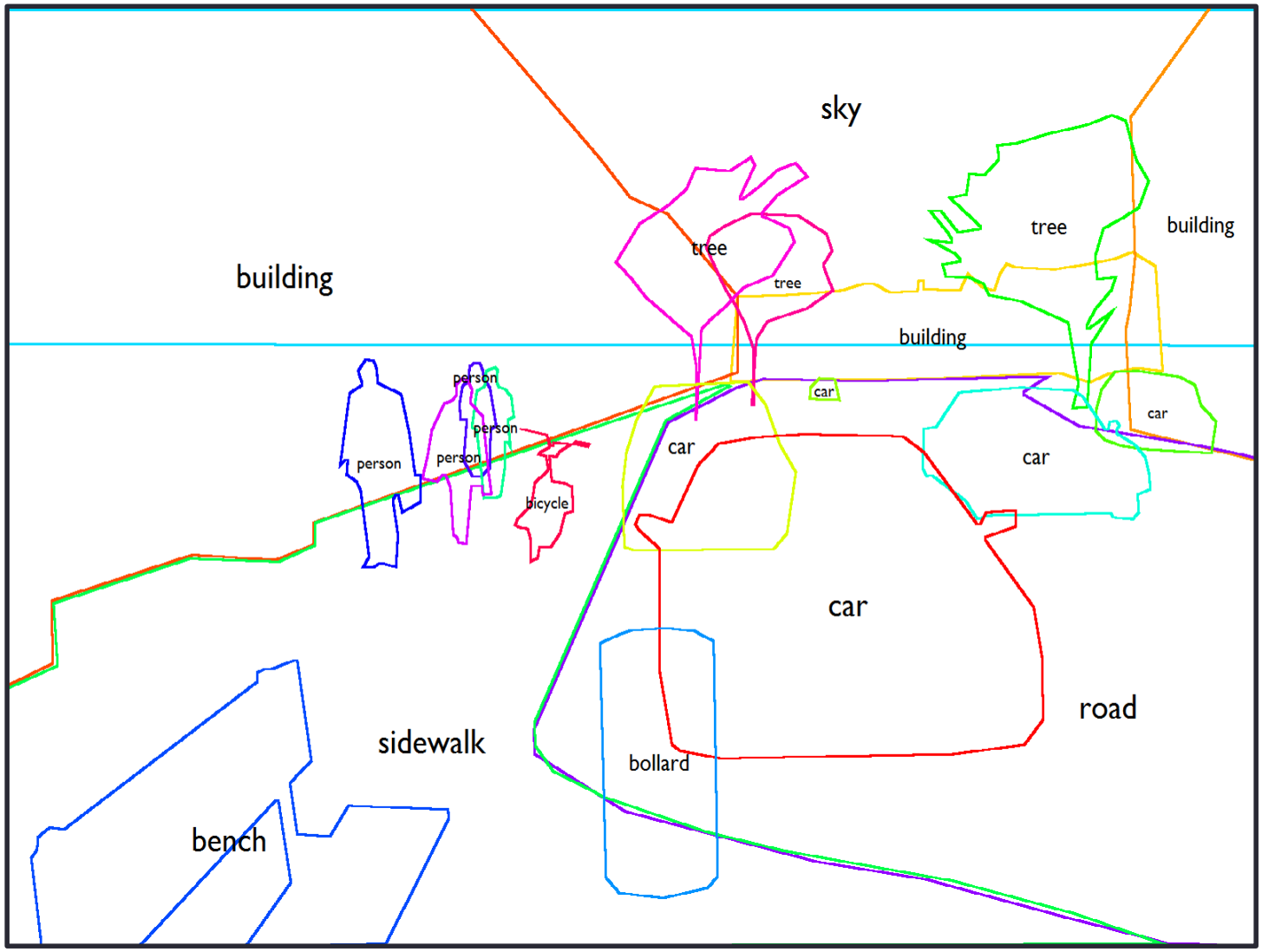
Object classes

Object position

Object orientation

Object shape

Depth/occlusions



From J. Winn, MSR

Scene type

Scene geometry

Object classes

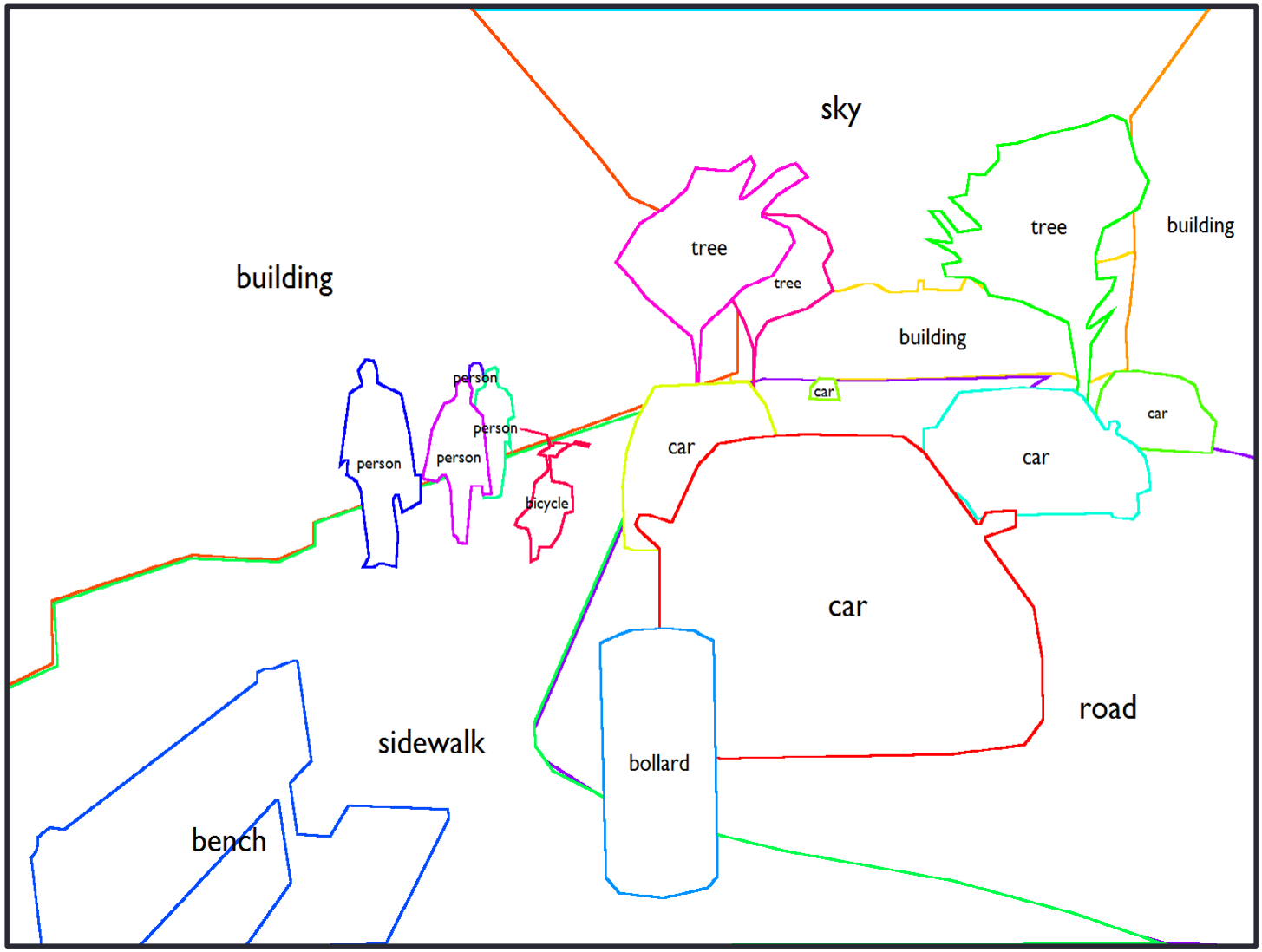
Object position

Object orientation

Object shape

Depth/occlusions

Object appearance



From J. Winn, MSR

Scene type

Scene geometry

Object classes

Object position

Object orientation

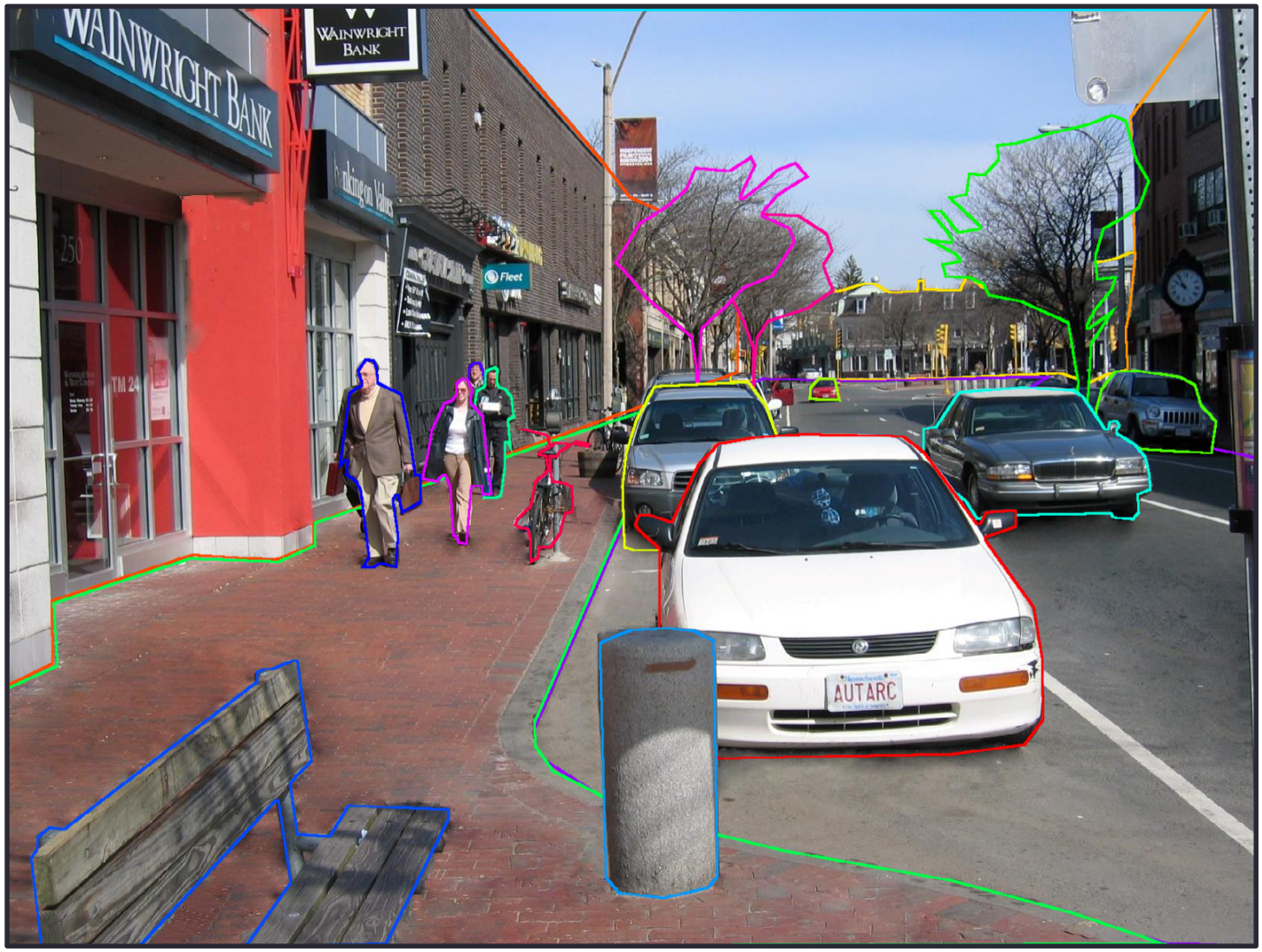
Object shape

Depth/occlusions

Object appearance

Illumination

Shadows



From J. Winn, MSR

Scene type

Scene geometry

Object classes

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Object orientation

Object shape

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Illumination

Shadows

From J. Winn, MSR

Scene type

Scene geometry

Object classes

Object position

Object orientation

Object shape

Depth/occlusions

Object appearance

Illumination

Shadows

Motion blur

Camera effects

From J. Winn, MSR

Computer vision problems = Inverse Problems

Scene type

Scene geometry

Object classes

Object position

Object orientation

Object shape

Depth/occlusions

Object appearance

Illumination

Shadows

Motion blur

Camera effects