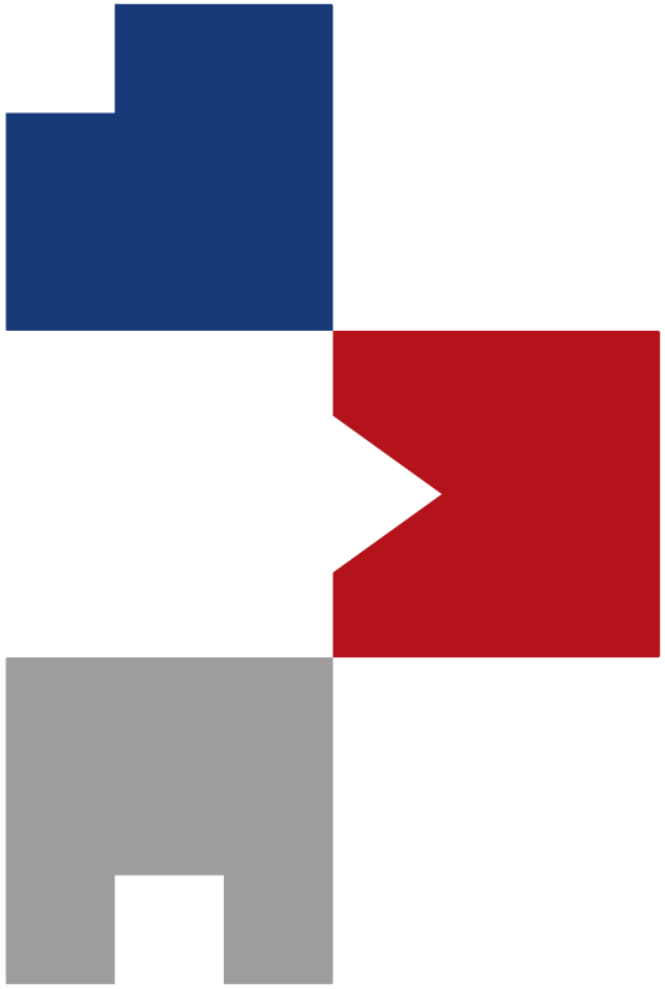

Introduction

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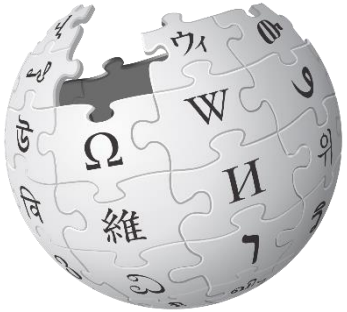
What is Computer Vision?

- **Computer vision is an interdisciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos.**
- From the perspective of engineering, it seeks to automate tasks that the human visual system can do.[1][2][3]
- "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."[9]



Reference: Wikipedia

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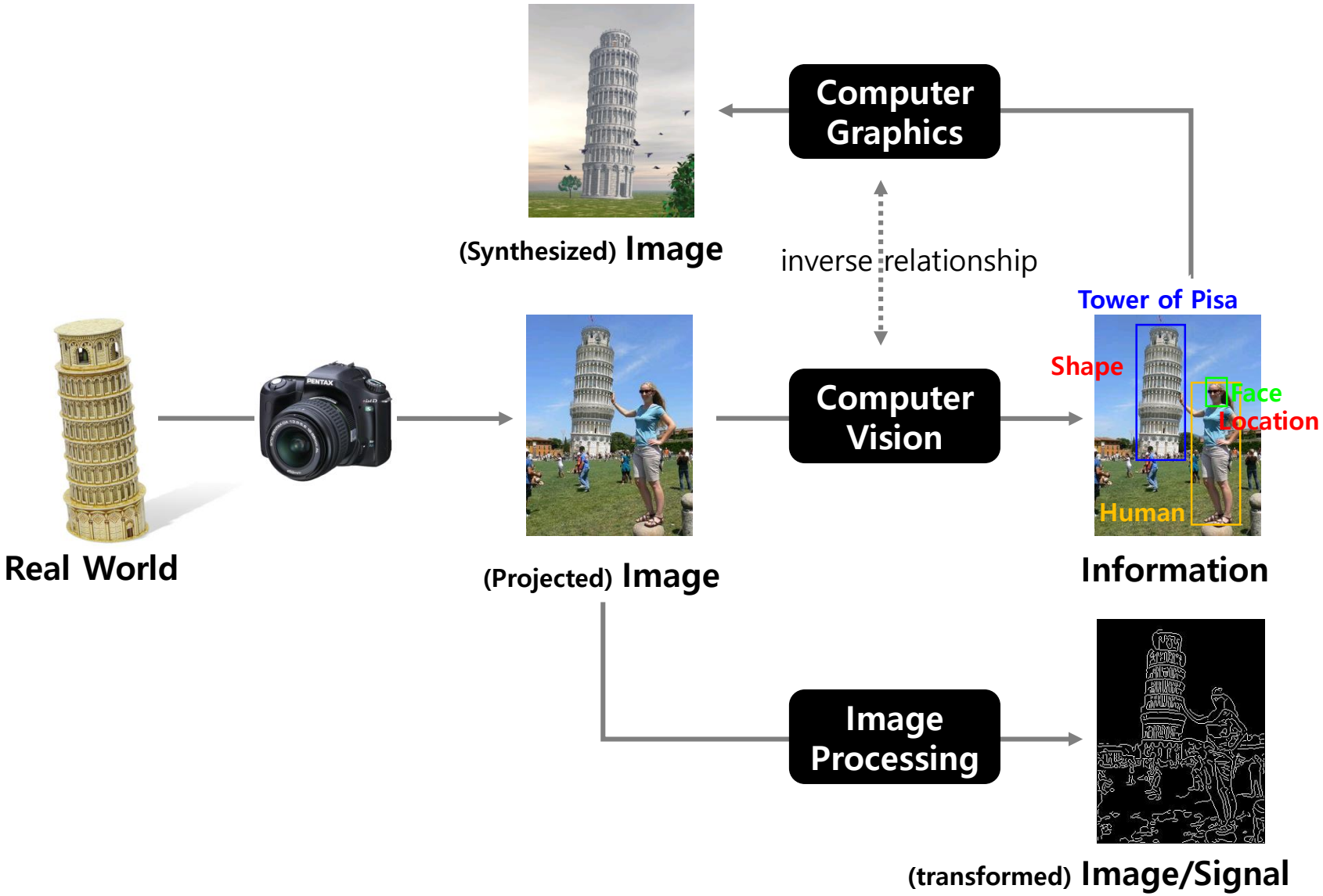
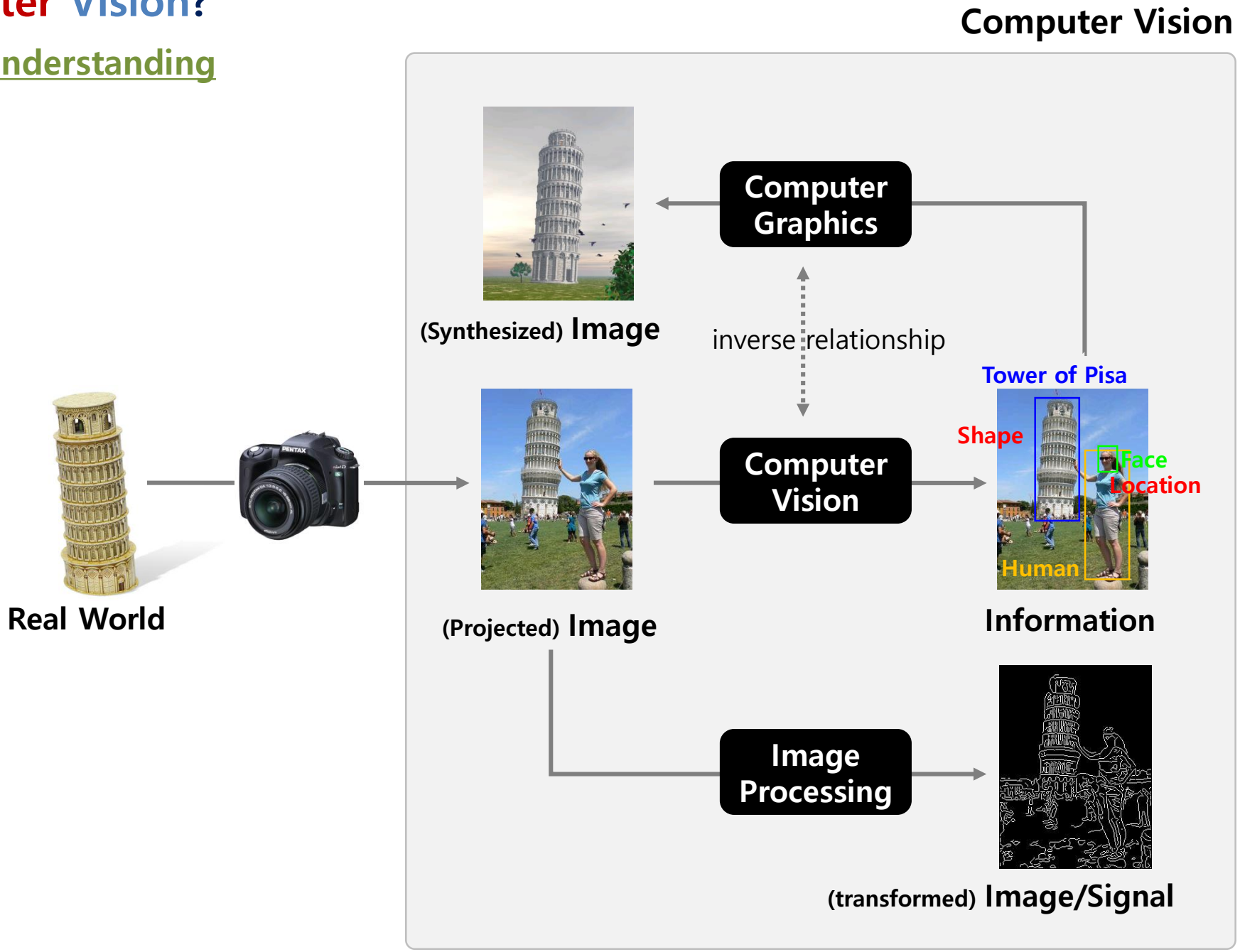
What is Computer Vision?

Image Understanding



What is Computer Vision?

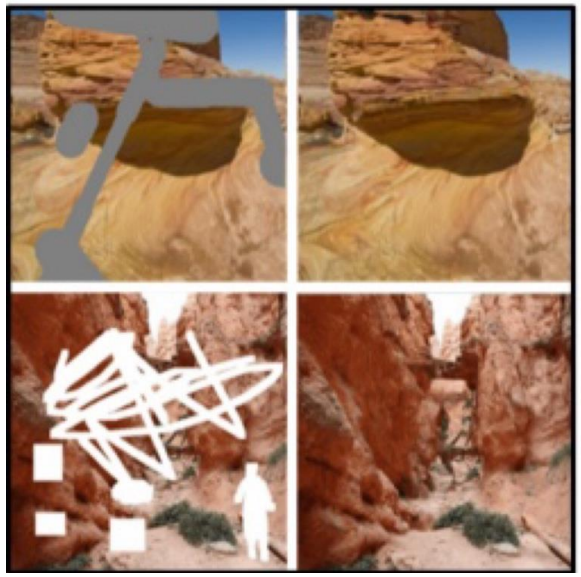
Image Understanding



Examples: Image Editing and Generation

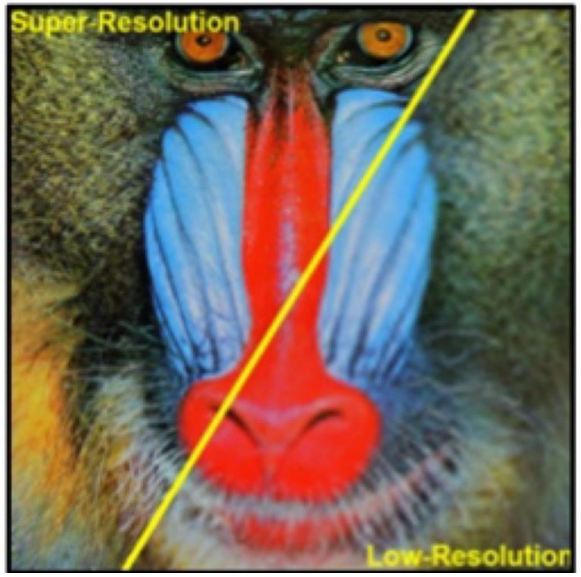
- [MMEditing](#) (2022)

Inpainting

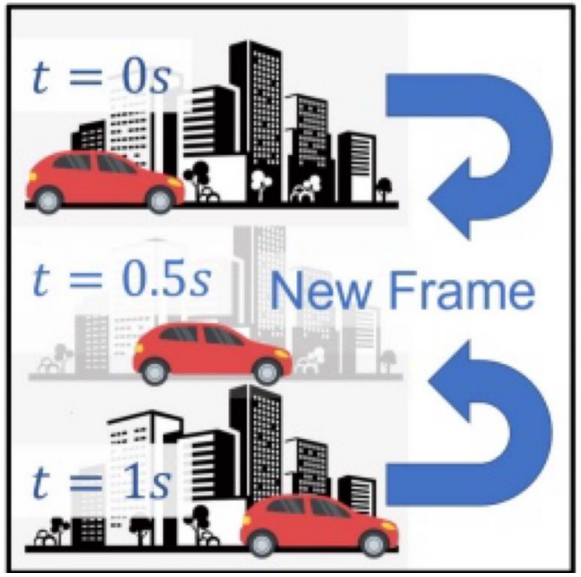


Matting

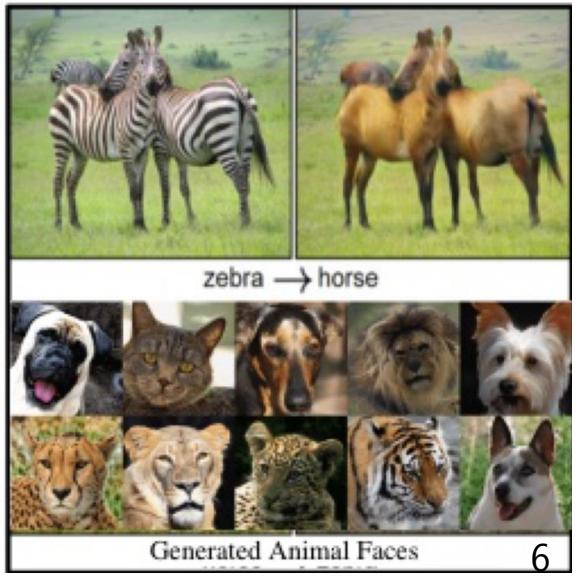
Super Resolution



Frame Interpolation



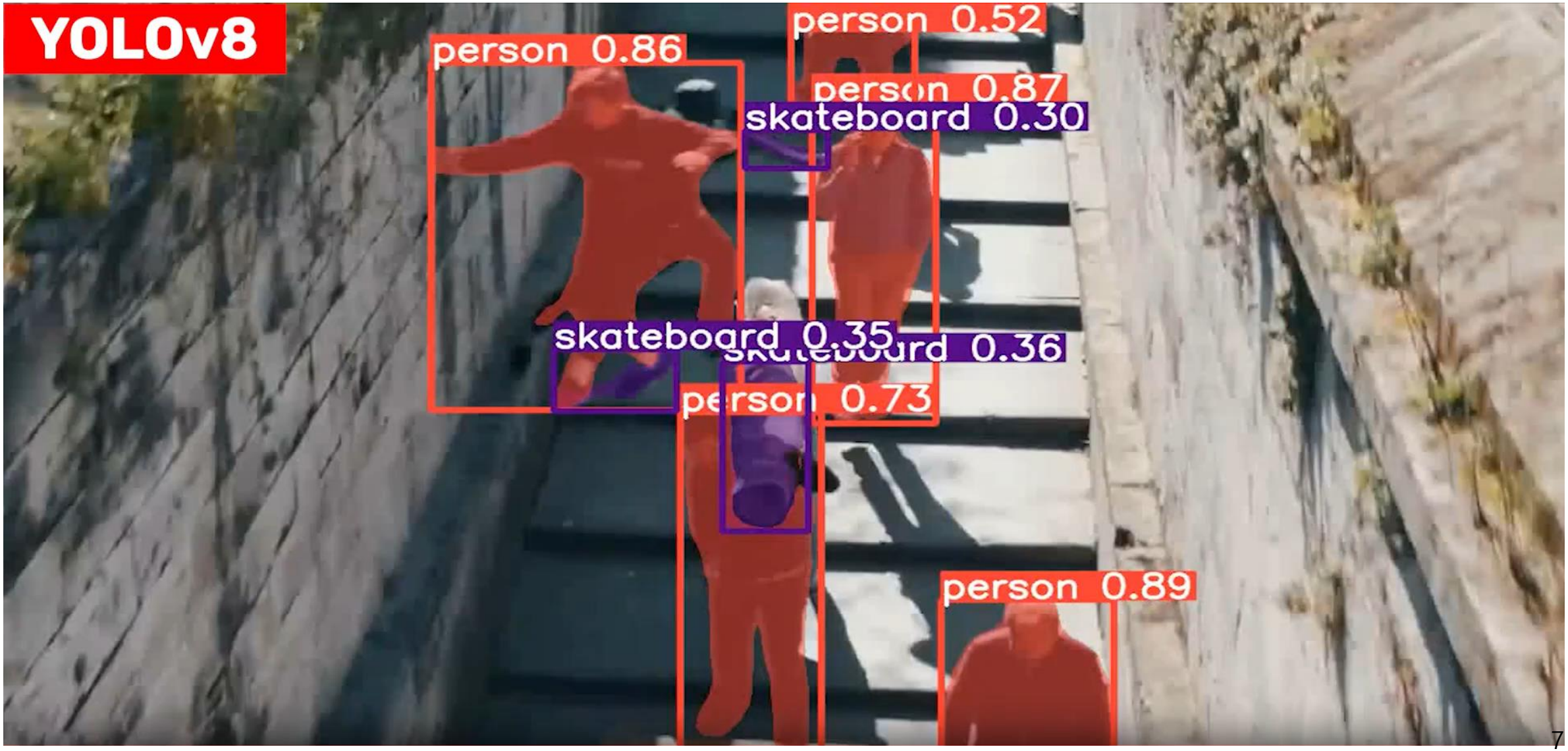
Generation



Video: LearnOpenCV (YouTube)

Examples: Object Detection (+ Instance Segmentation)

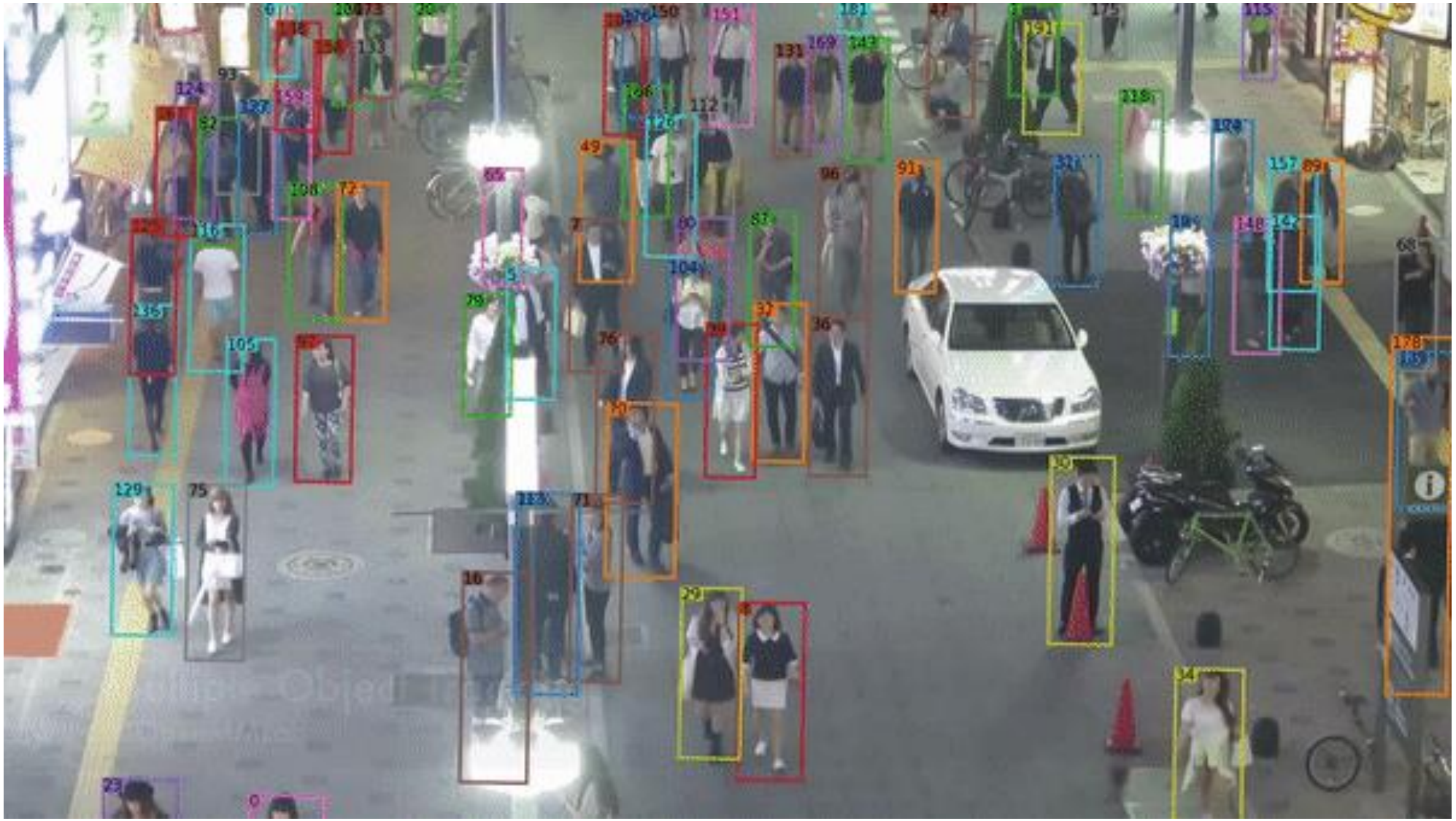
- YOLOv8 (2023)



Video: MMTracking

Examples: Multi-Object Tracking (MOT)

- **ByteTrack** (2022)



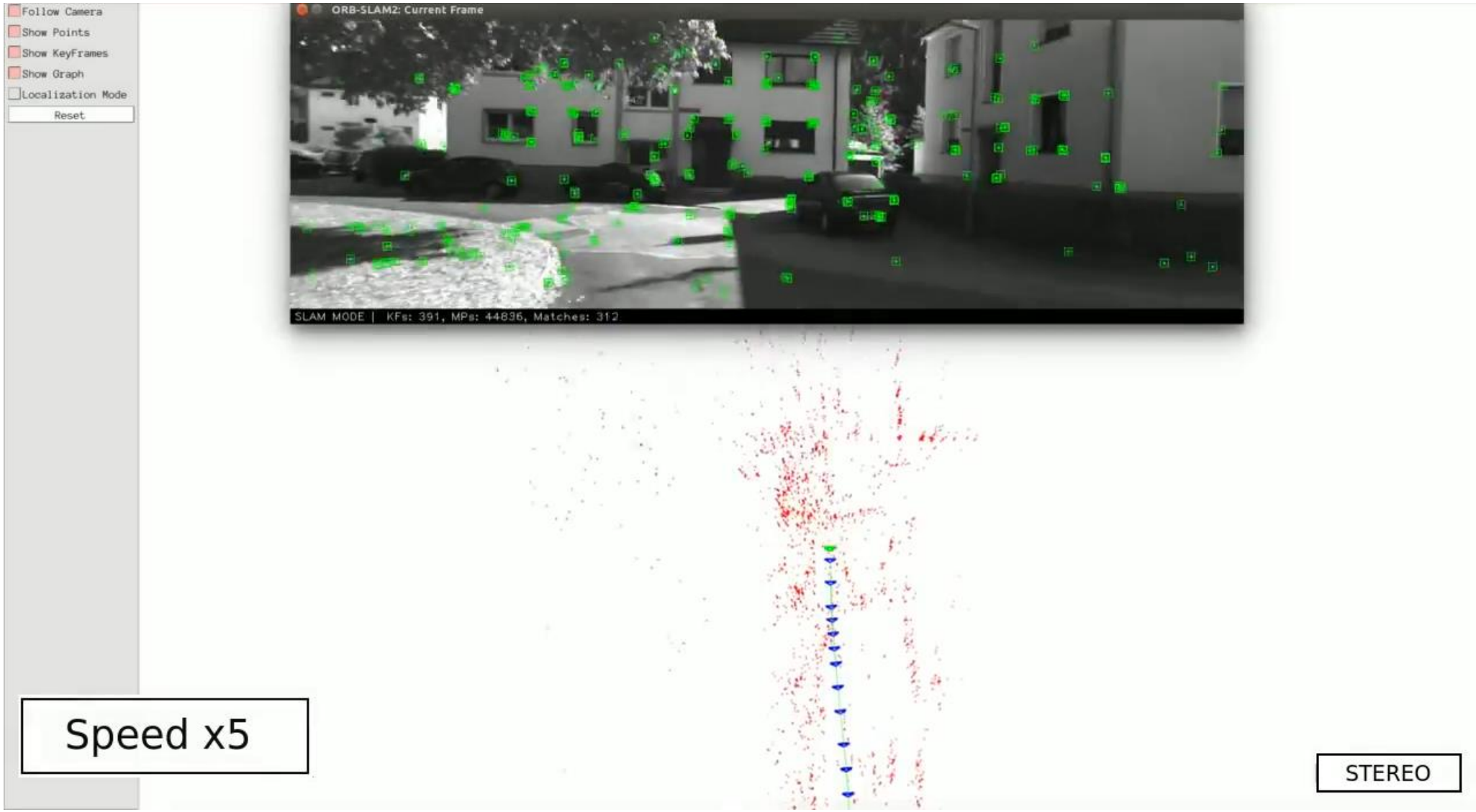
Examples: Human Pose Estimation

- **MediaPipe Holostic** (2019)

Video: Raul Mur Artal (YouTube)

Examples: Localization and Mapping

- **ORB-SLAM3** (2021)



Examples: 3D Reconstruction

- **COLMAP** (2016)

A sparse model of *central Rome* using 21K photos produced by COLMAP's SfM pipeline

Dense models of several landmarks produced by COLMAP's MVS pipeline

Examples: New View Synthesis

- NeRF (2020)

Why Do We Study Computer Vision?

- Vision is *useful*.
- Vision is *interesting*.
- Vision is *difficult*.
  - The half of primate cerebral cortex is devoted to visual processing.
  - Achieving human-level visual perception is probably "AI-complete".

Challenges: 2D Projection

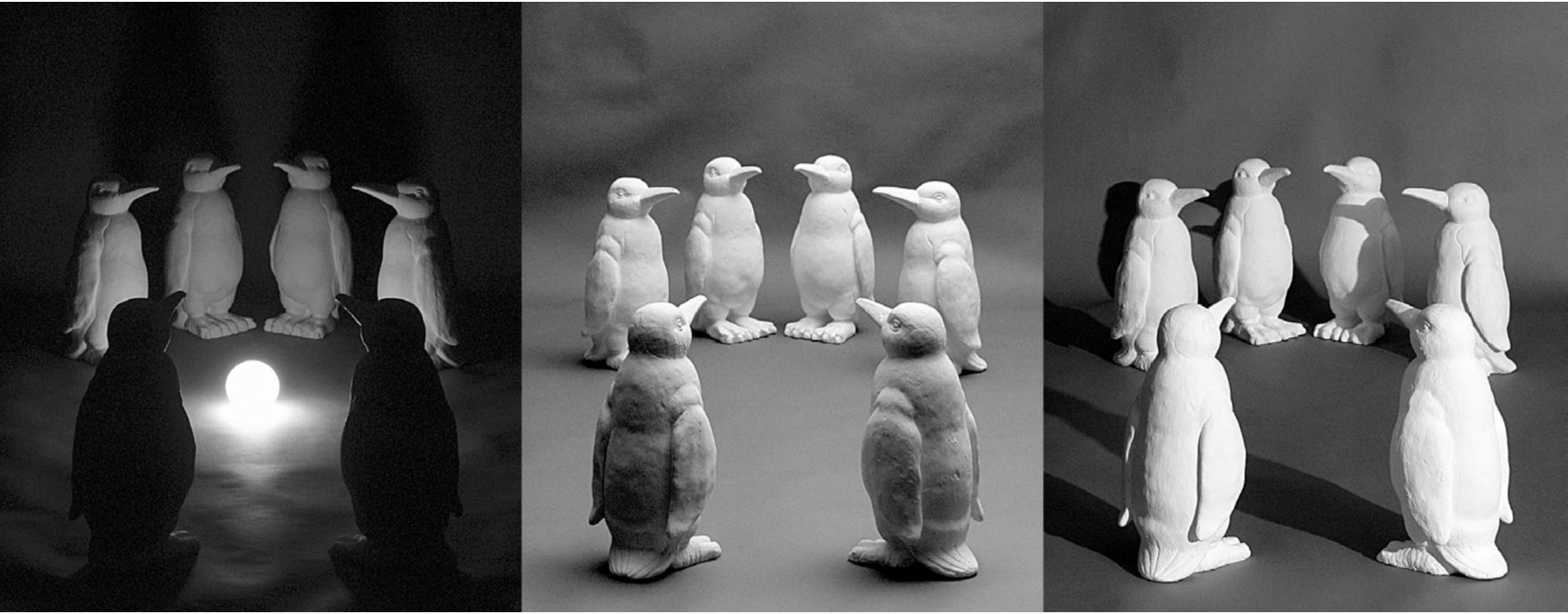
Image: Floor trick arts

Challenges: Viewpoint Variation

Michelangelo (1475-1564)

Slide: Fei-Fei Li (CS2321a)

Challenges: Illumination Change



J. Koenderink

Image: StarWars.com

Challenges: Scale Ambiguity

The Sandcrawler @ Star Wars IV: A New Hope (1977)

Slide: Fei-Fei Li (CS2321a)

Challenges: Deformation

Xu, Beihong (1943)

Challenges: Occlusion

Slide: Fei-Fei Li (CS2321a)

Magritte (1957)

Challenges: Background Clutter

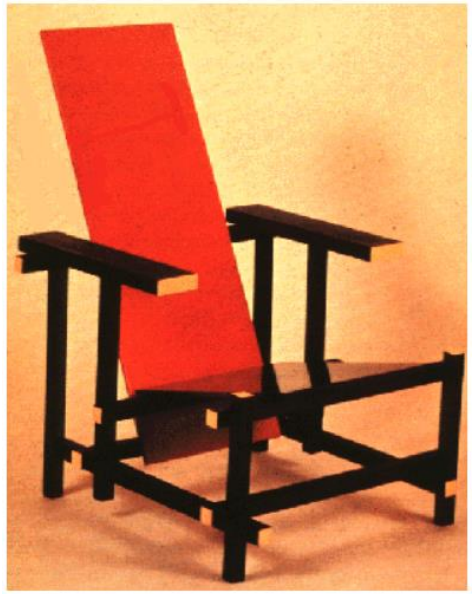
Tim Laman (National Geographic)

Slide: Fei-Fei Li (CS2321a)

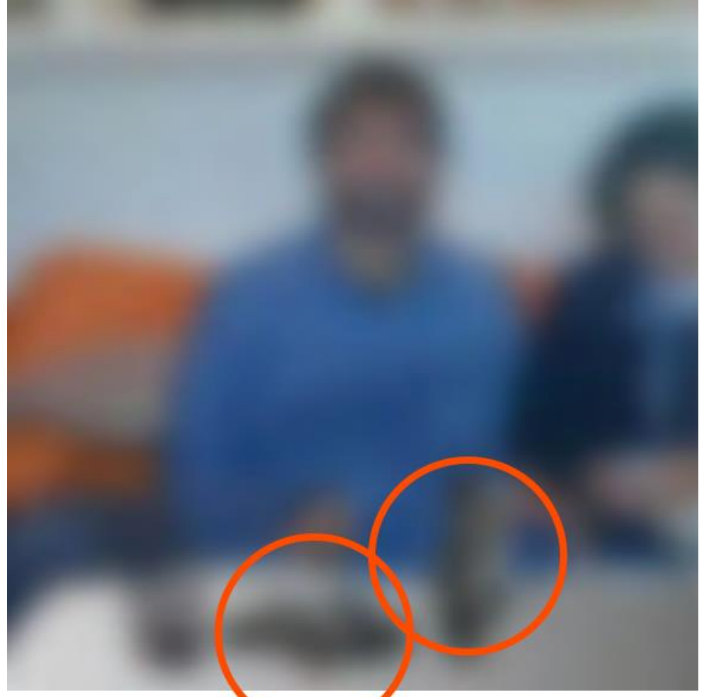
Challenges: Motion

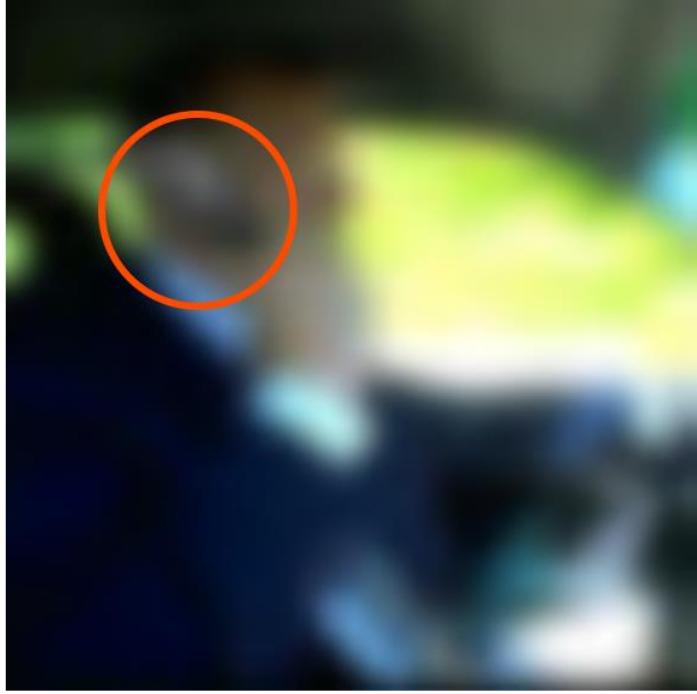
Slide: Fei-Fei Li (CS2321a)

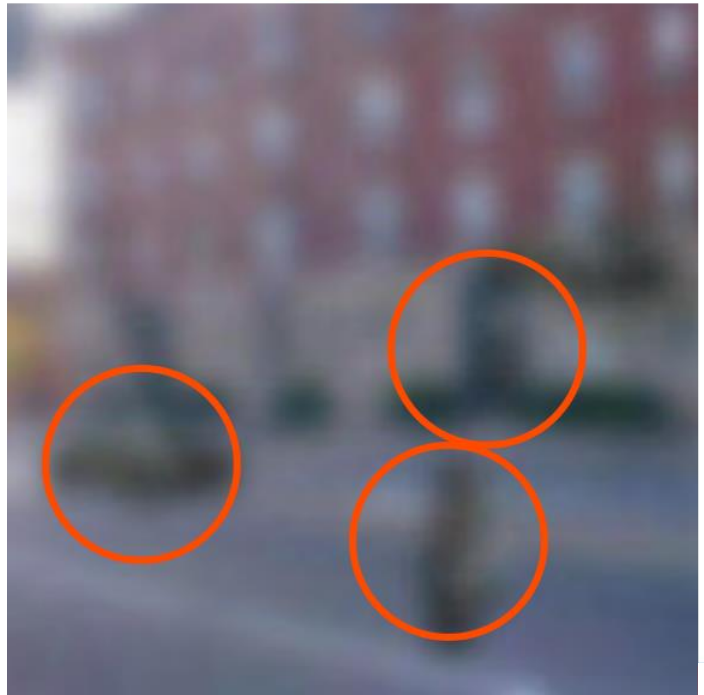
Challenges: Object Intra-class Variation



Challenges: Local Ambiguity







Slide: Fei-Fei Li (CS2321a)

Summary

- **What is computer vision?**
  - Automatic visual understanding
- **Examples**
  - Object detection, …, 3D reconstruction, …
- **Why do we study computer vision?**
  - Vision is *useful*.
  - Vision is *interesting*.
  - Vision is *difficult*.
- **Challenges**
  - 2D projection, …, object intra-class variation, …