

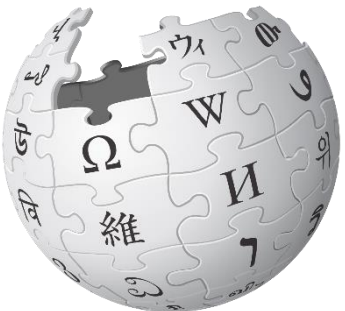


Introduction

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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]



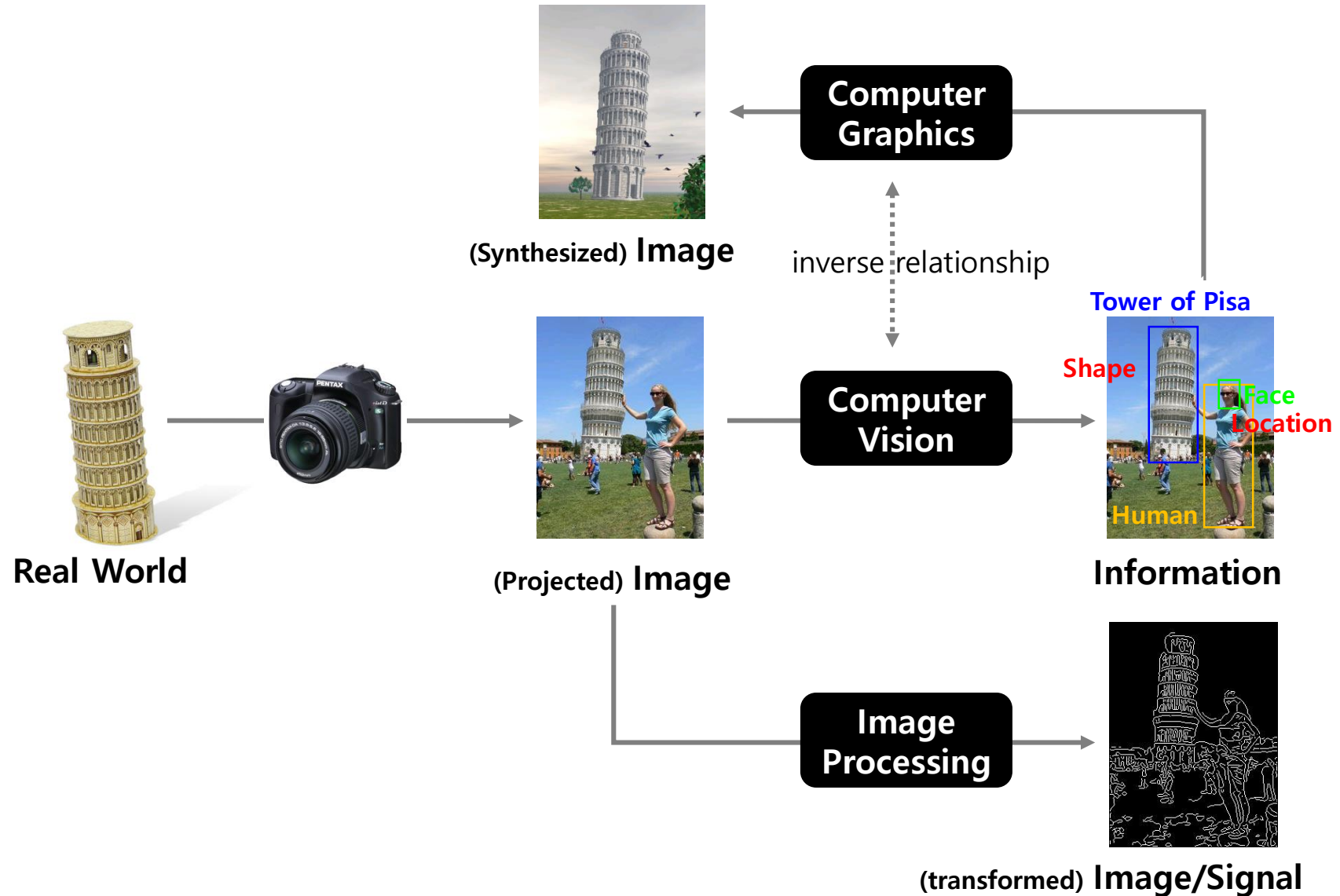
What is Computer Vision?

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What is **Computer Vision**?

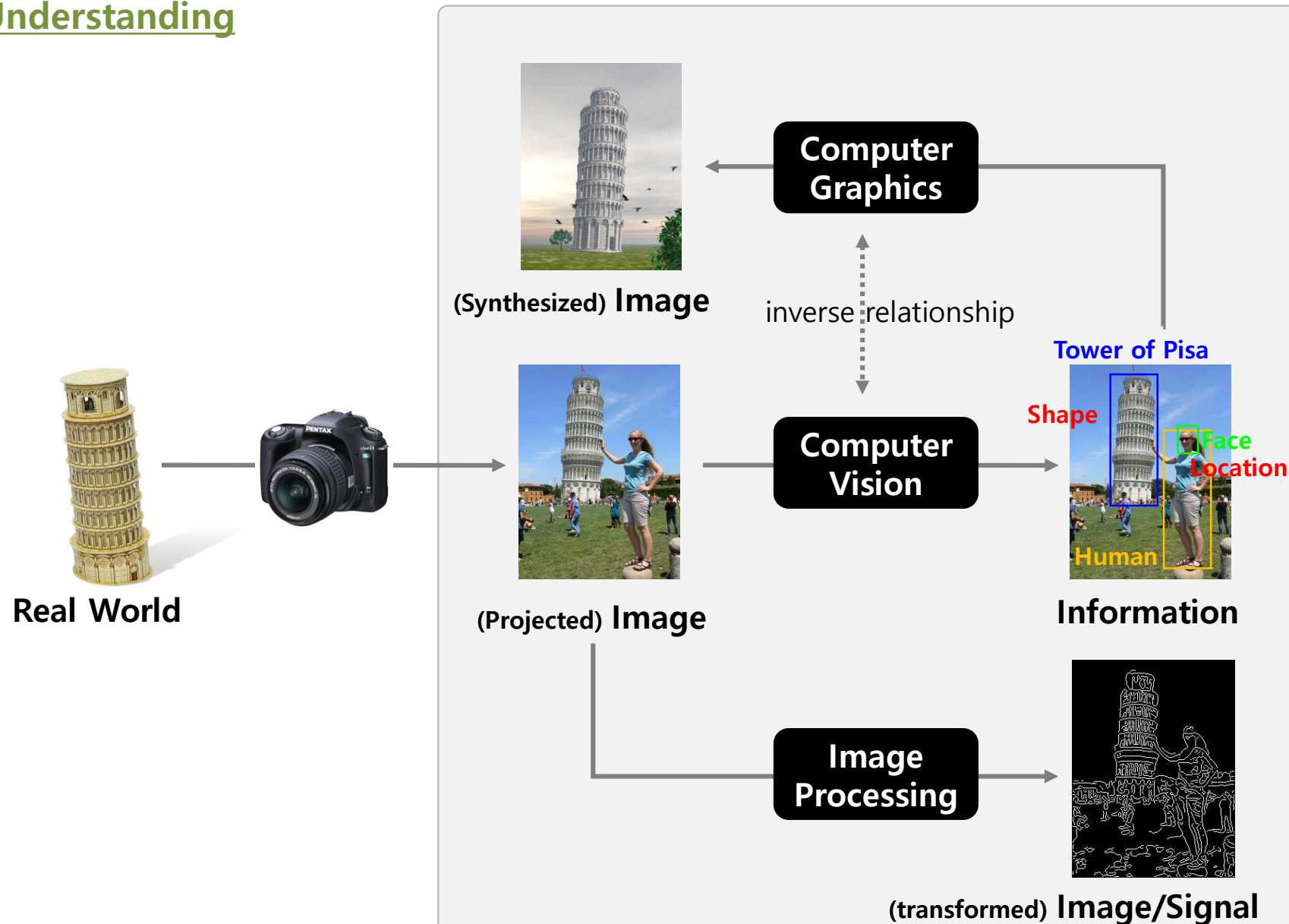
Image Understanding



What is **Computer Vision**?

Image Understanding

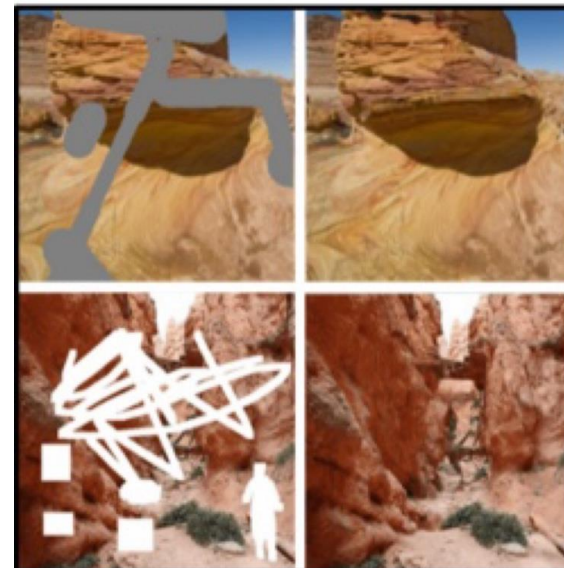
Computer Vision



Examples: Image Editing and Generation

- [MMEEditing](#) (2022)

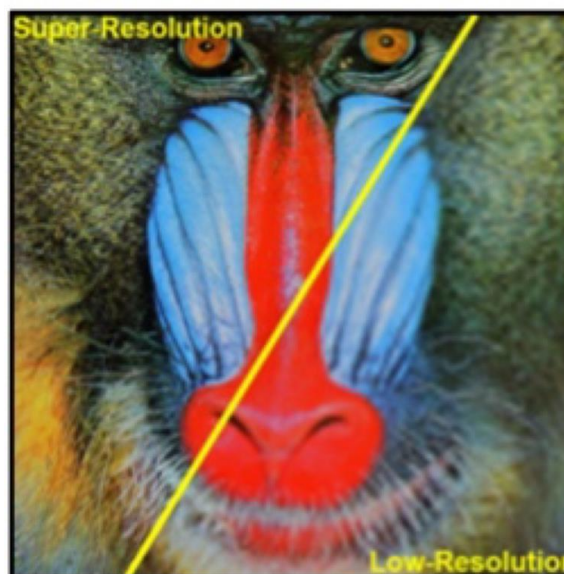
Inpainting



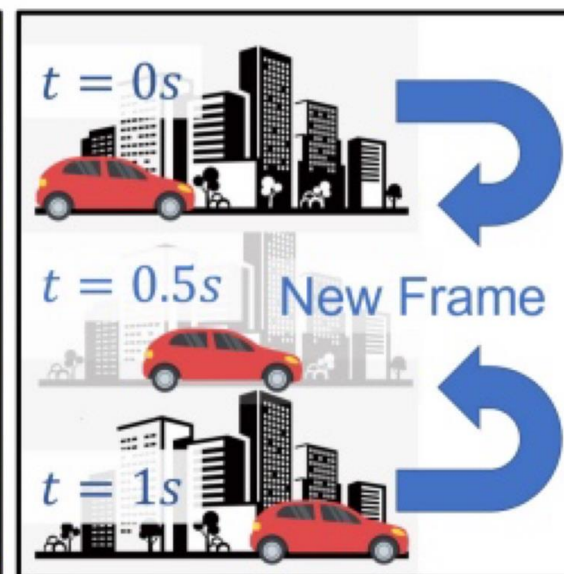
Matting



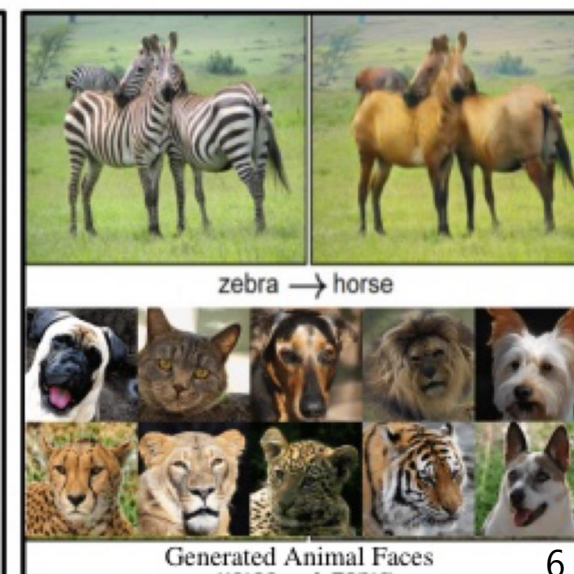
Super Resolution



Frame Interpolation

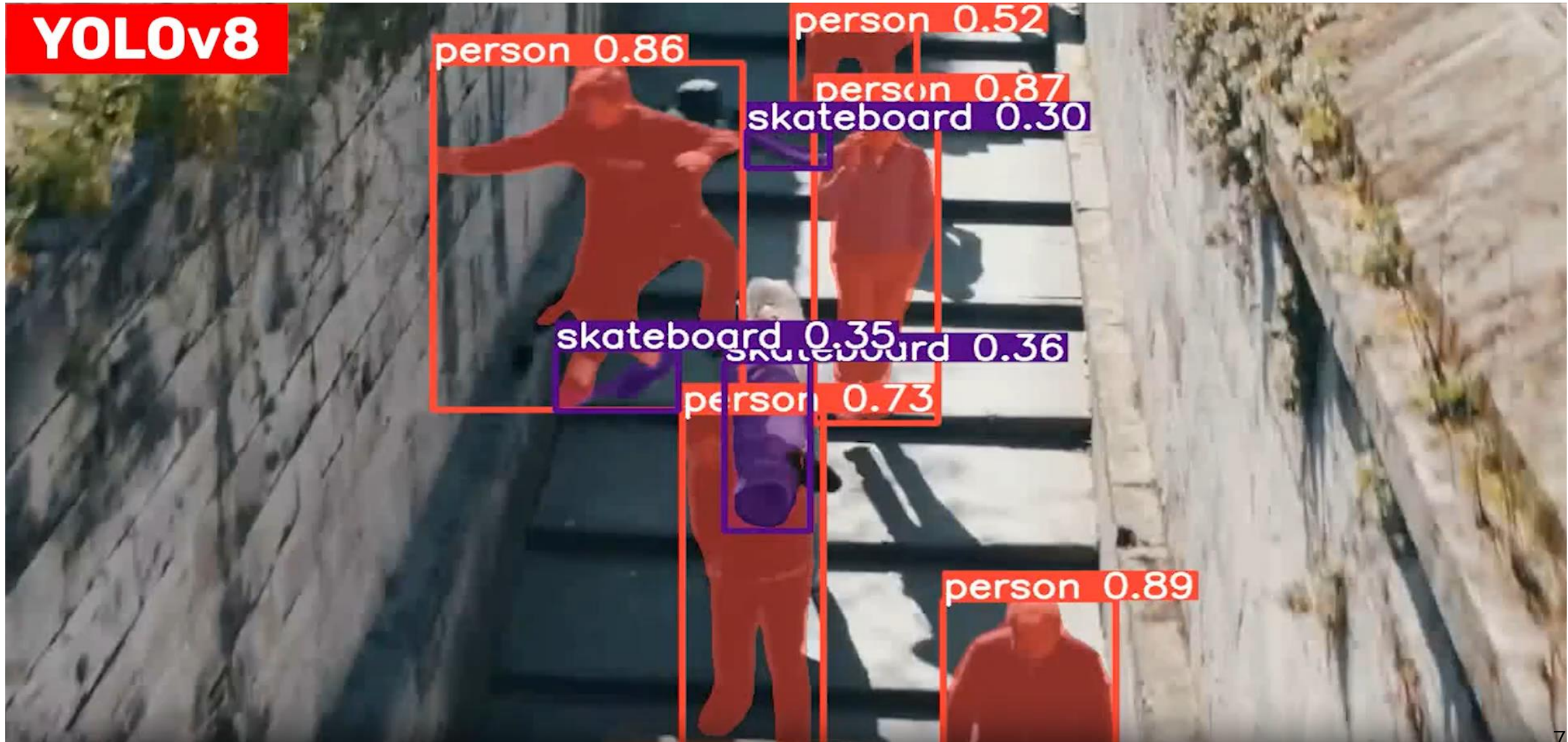


Generation



Examples: Object Detection (+ Instance Segmentation)

- [YOLOv8](#) (2023)



Examples: Multi-Object Tracking (MOT)

- [ByteTrack](#) (2022)



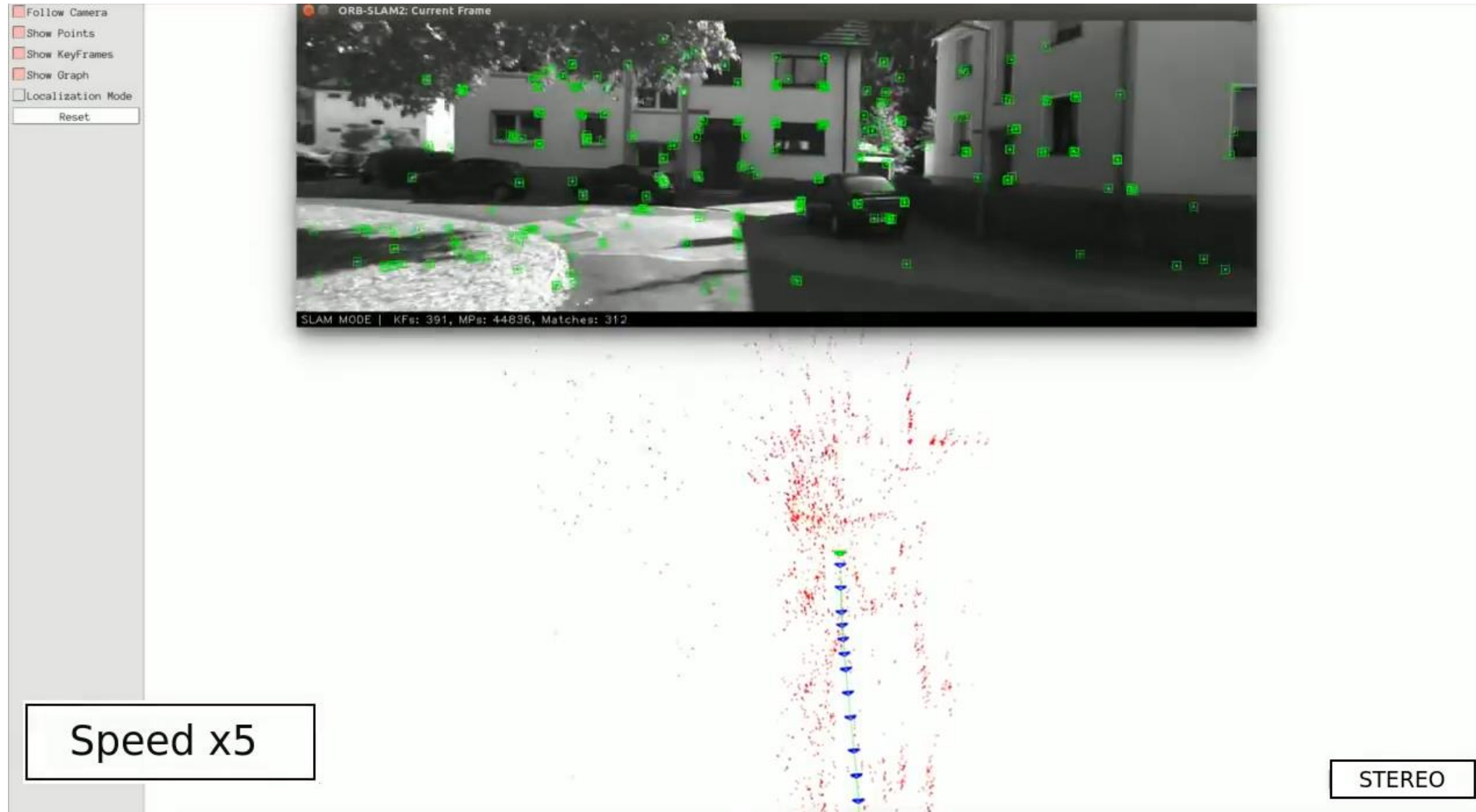
Examples: Human Pose Estimation

- [MediaPipe](#) Holistic (2019)



Examples: Localization and Mapping

- [ORB-SLAM3](#) (2021)



Examples: 3D Reconstruction

- [COLMAP](#) (2016)



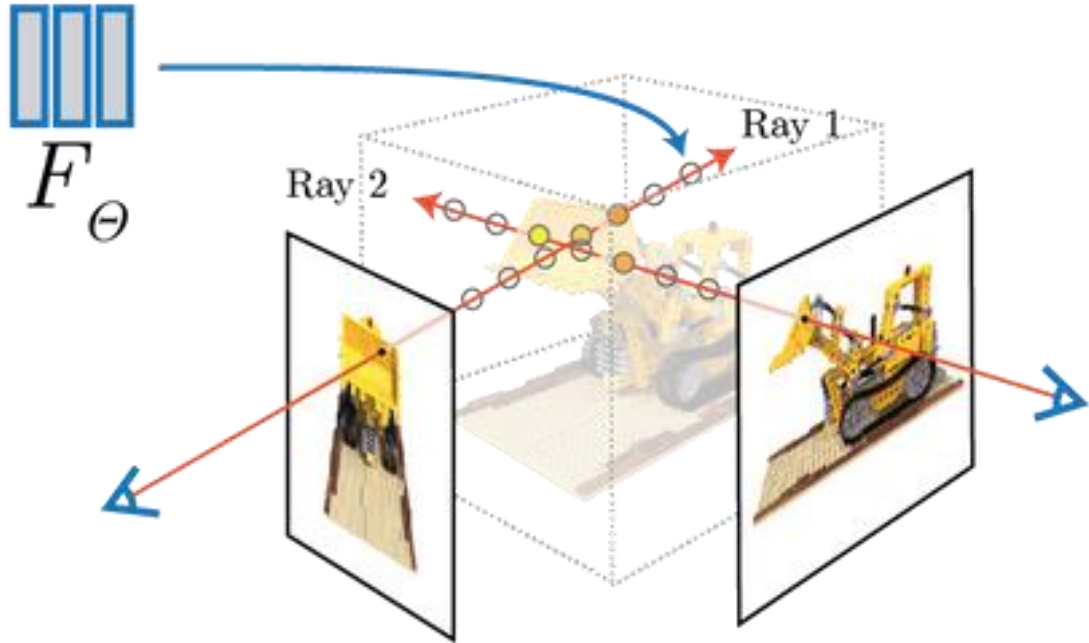
A sparse model of *central Rome* using 21K photos produced by COLMAP's SfM pipeline



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

Examples: New View Synthesis

- [NeRF](#) (2020)



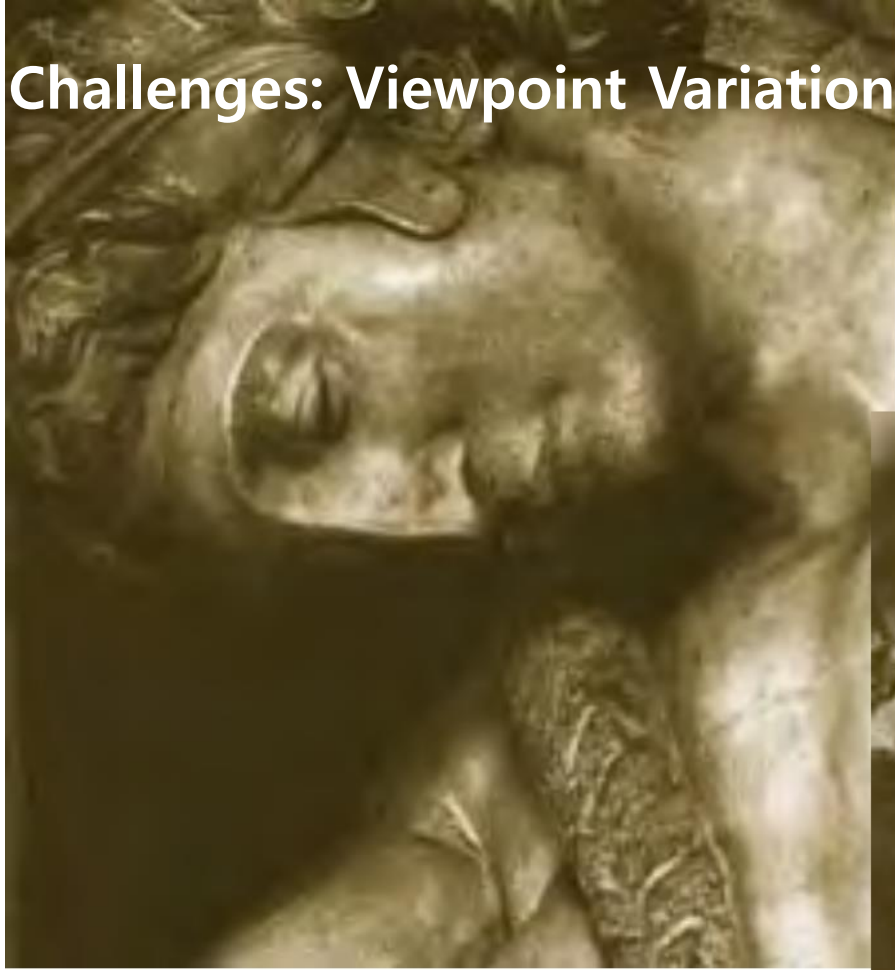
Why Do We Study Computer Vision?

- 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



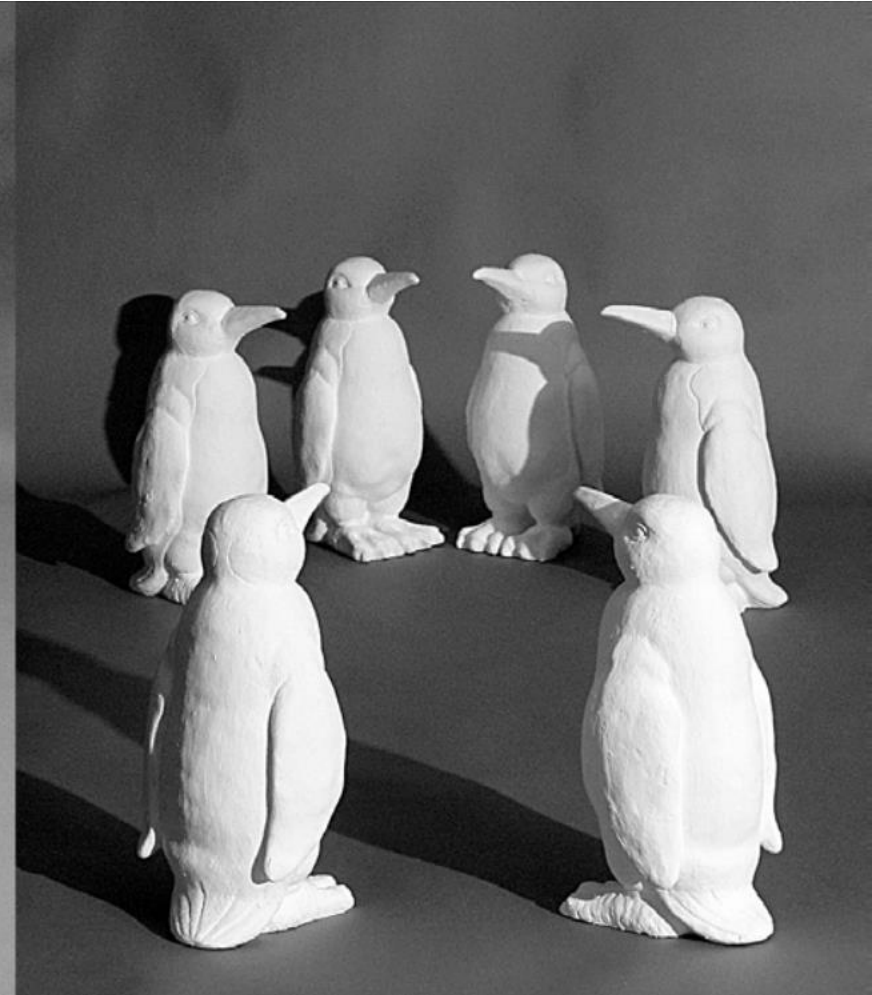
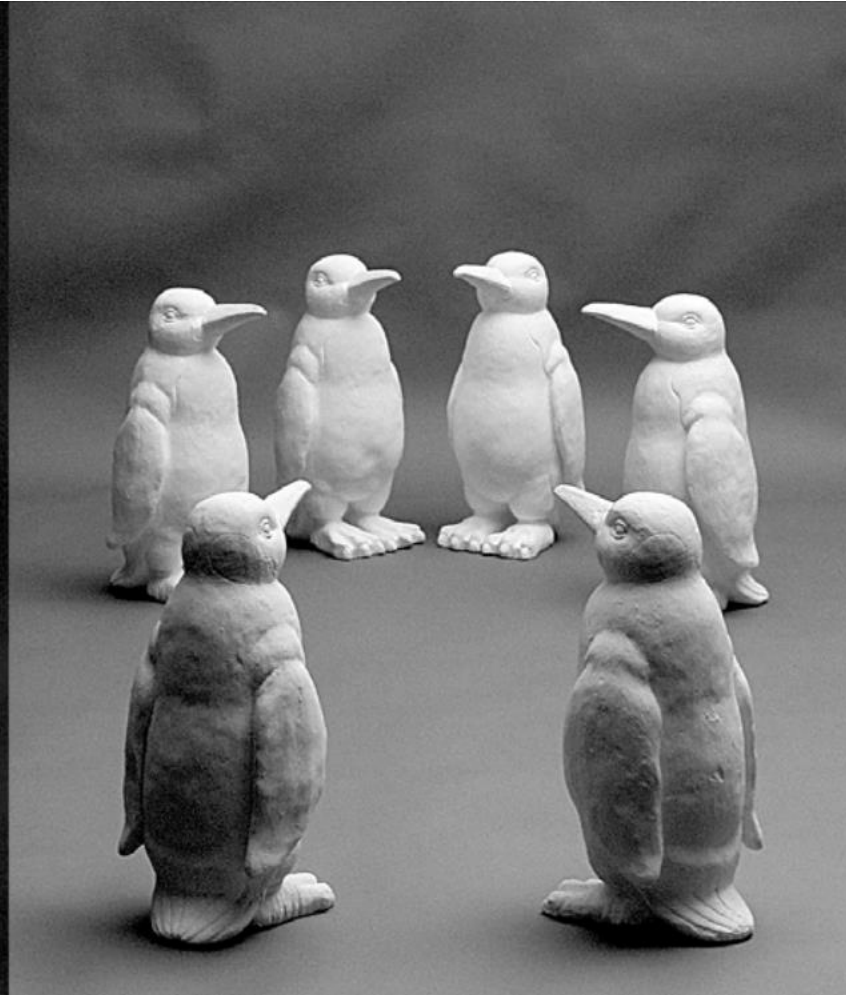
Challenges: Viewpoint Variation



Michelangelo (1475-1564)

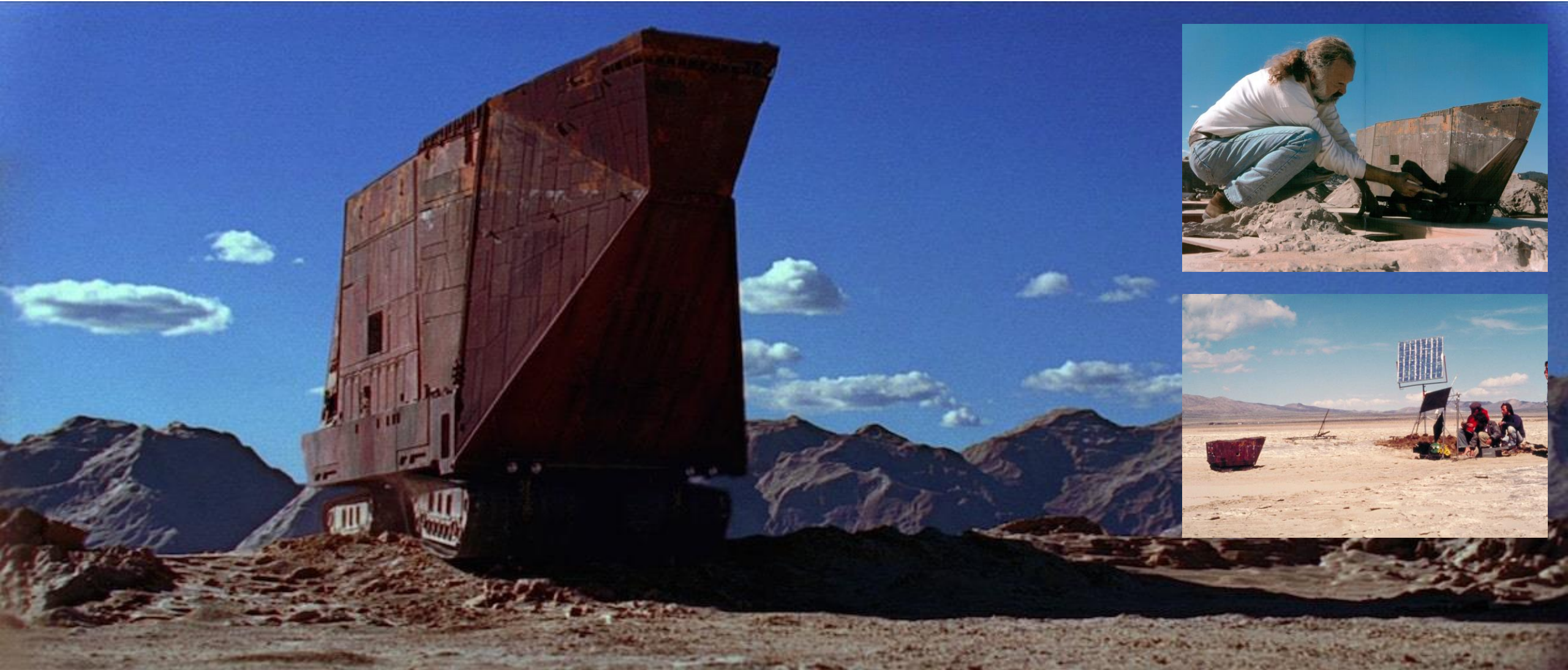


Challenges: Illumination Change



J. Koenderink

Challenges: Scale Ambiguity



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

Challenges: Deformation



Xu, Beihong (1943)

Challenges: Occlusion



Magritte (1957)

Challenges: Background Clutter

Slide: Fei-Fei Li (CS2321a)

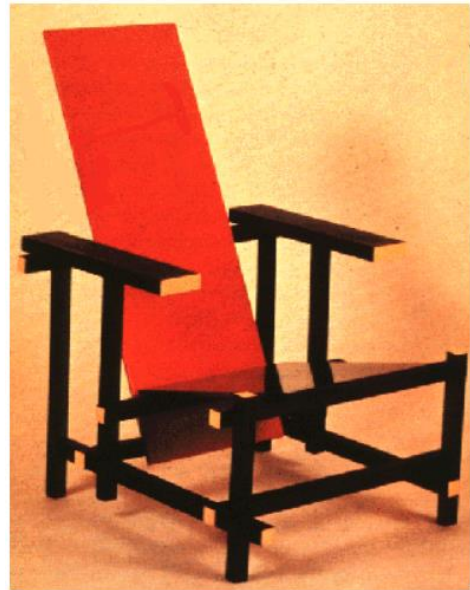


Tim Laman (National Geographic)

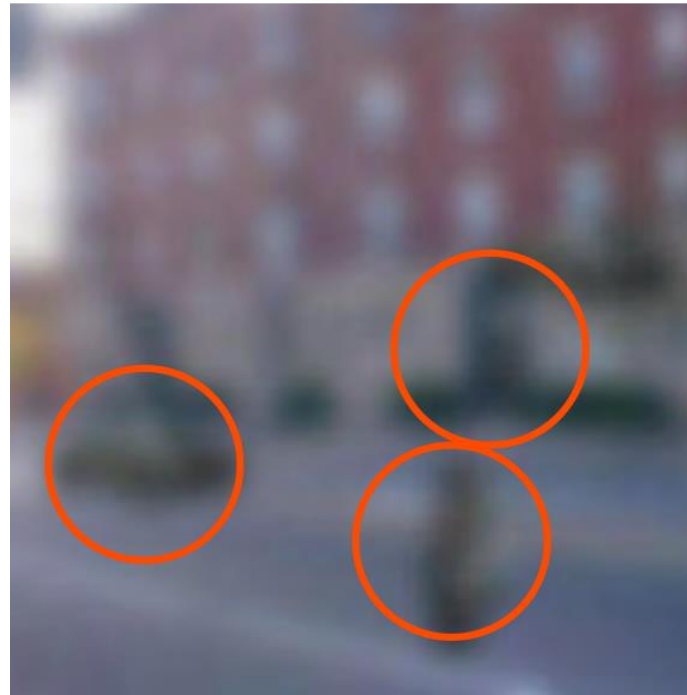
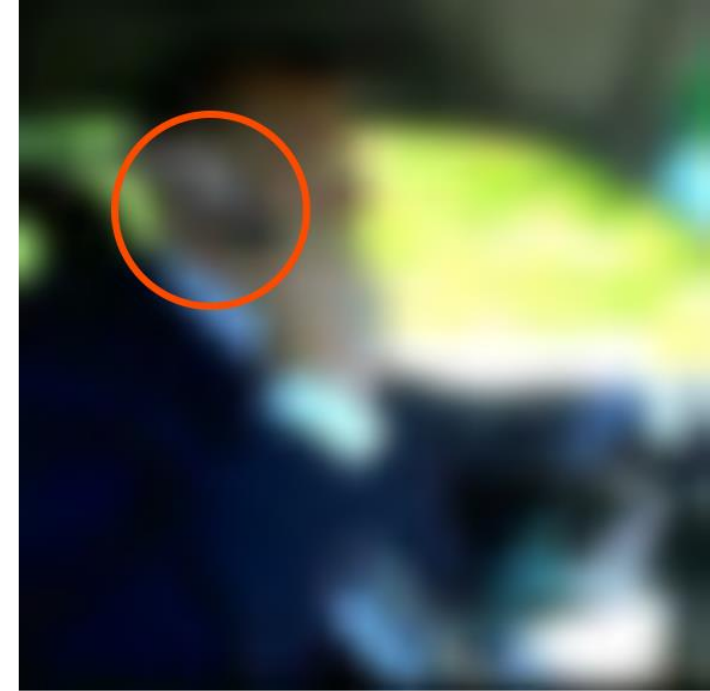
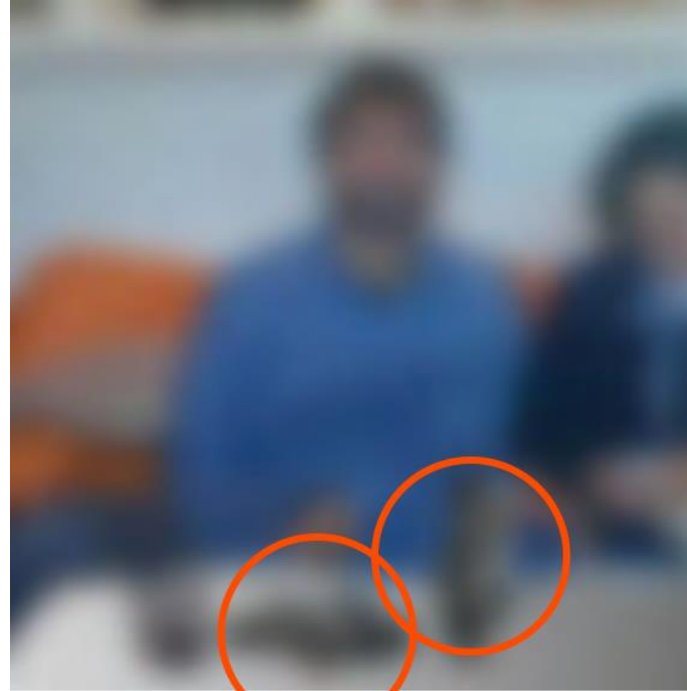
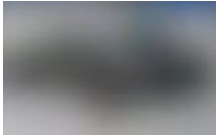
Challenges: Motion



Challenges: Object Intra-class Variation



Challenges: Local Ambiguity



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, ...