

# The Ancient Secrets



# Computer Vision

# Chapter One



# Introduction

Once upon  
a time

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT MAC

Artificial Intelligence Group  
Vision Memo. No. 100.

July 7, 1966

THE SUMMER VISION PROJECT

Seymour Papert

The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

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WHEN A USER TAKES A PHOTO,  
THE APP SHOULD CHECK WHETHER  
THEY'RE IN A NATIONAL PARK...

SURE, EASY GIS LOOKUP.  
GIMME A FEW HOURS.

... AND CHECK WHETHER  
THE PHOTO IS OF A BIRD.

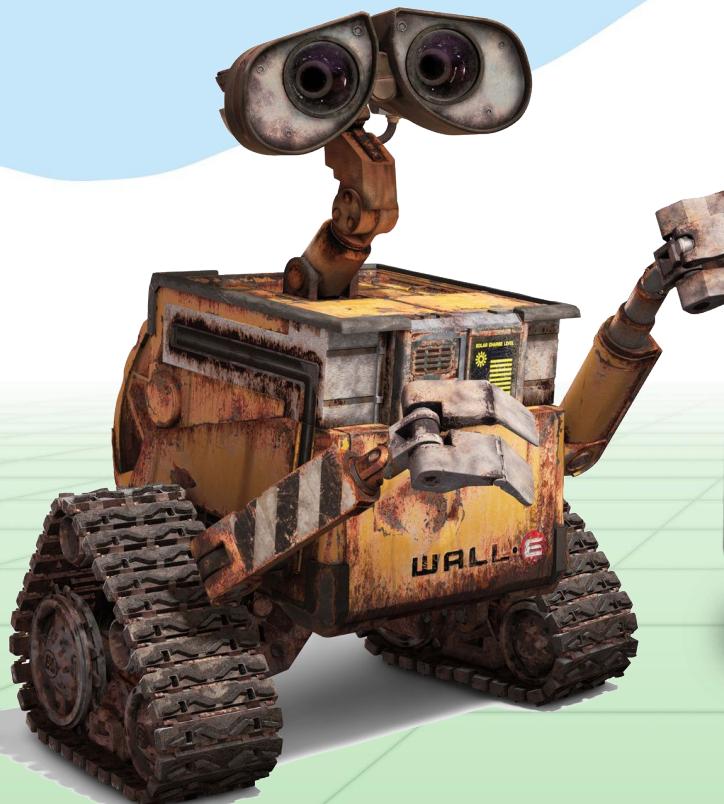
I'LL NEED A RESEARCH  
TEAM AND FIVE YEARS.



IN CS, IT CAN BE HARD TO EXPLAIN  
THE DIFFERENCE BETWEEN THE EASY  
AND THE VIRTUALLY IMPOSSIBLE.

# Computer Vision

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# What does WALL-E see?

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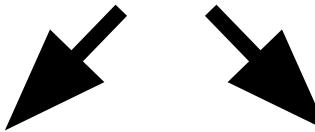
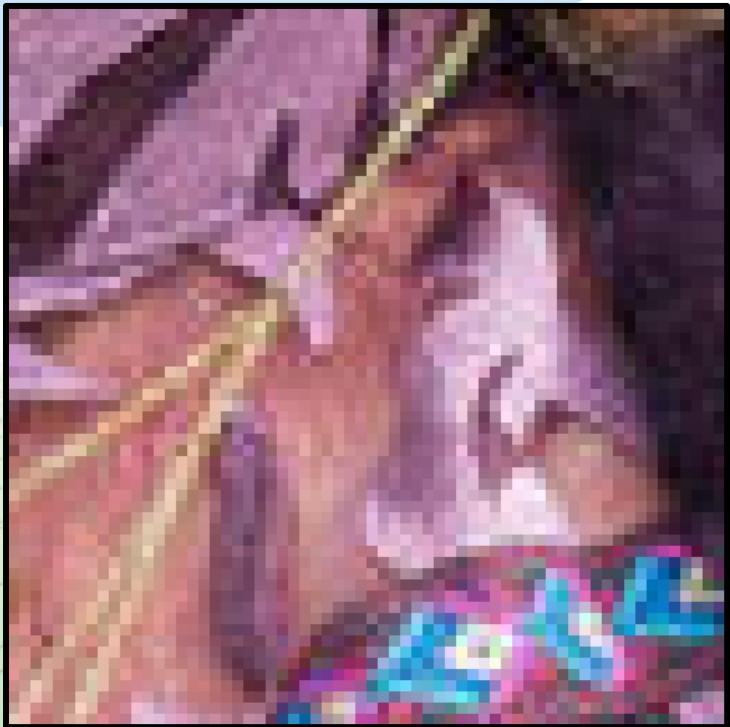
# Low-Level: Resizing

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# Low-Level: Resizing

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# Low-Level: Image Adjustments

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# Low-Level: Grayscale

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# Low-Level: Exposure

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# Low-Level: Saturation

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# Low-Level: Hue

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# Low-Level: Edges

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# Low-Level: Oriented Gradients

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# Low-Level: Oriented Gradients

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# Low-Level: Segmentation (color)

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# Low-Level Vision

Photo manipulation

- Size
- Color
- Exposure
- X-Pro II

Feature extraction

- Edges
- Oriented gradients
- Segments

Low level vision is exciting!!! #latergram

#nofilter



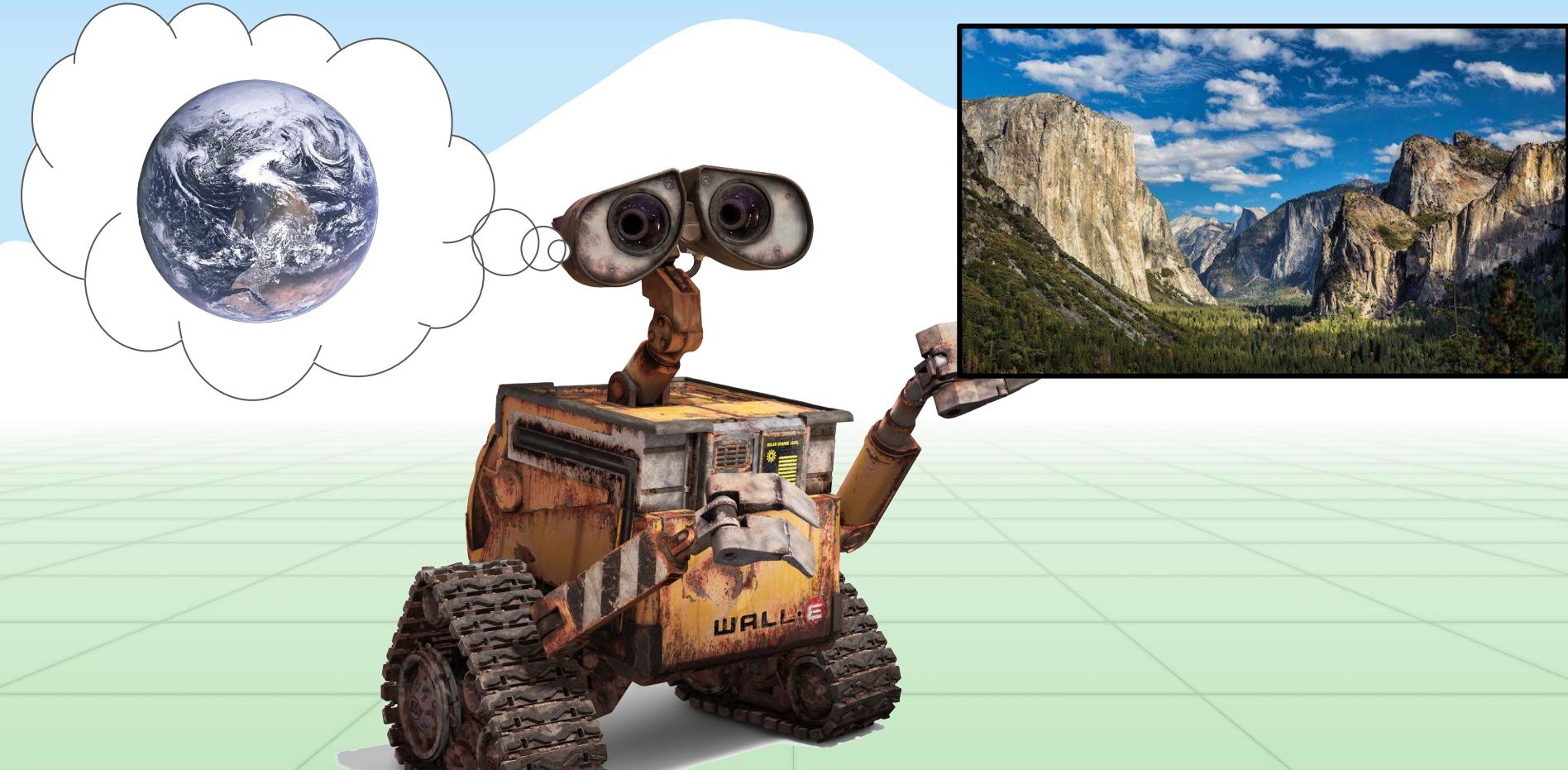
# Low-Level Vision Applications?

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Anyone?

# Mid-Level Vision

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# Mid-Level: Panorama Stitching

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# Mid-Level: Panorama Stitching

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# Mid-Level: Panorama Stitching

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# Mid-Level: Multi-View Stereo

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# Mid-Level: Multi-View Stereo

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# Mid-Level: Multi-View Stereo

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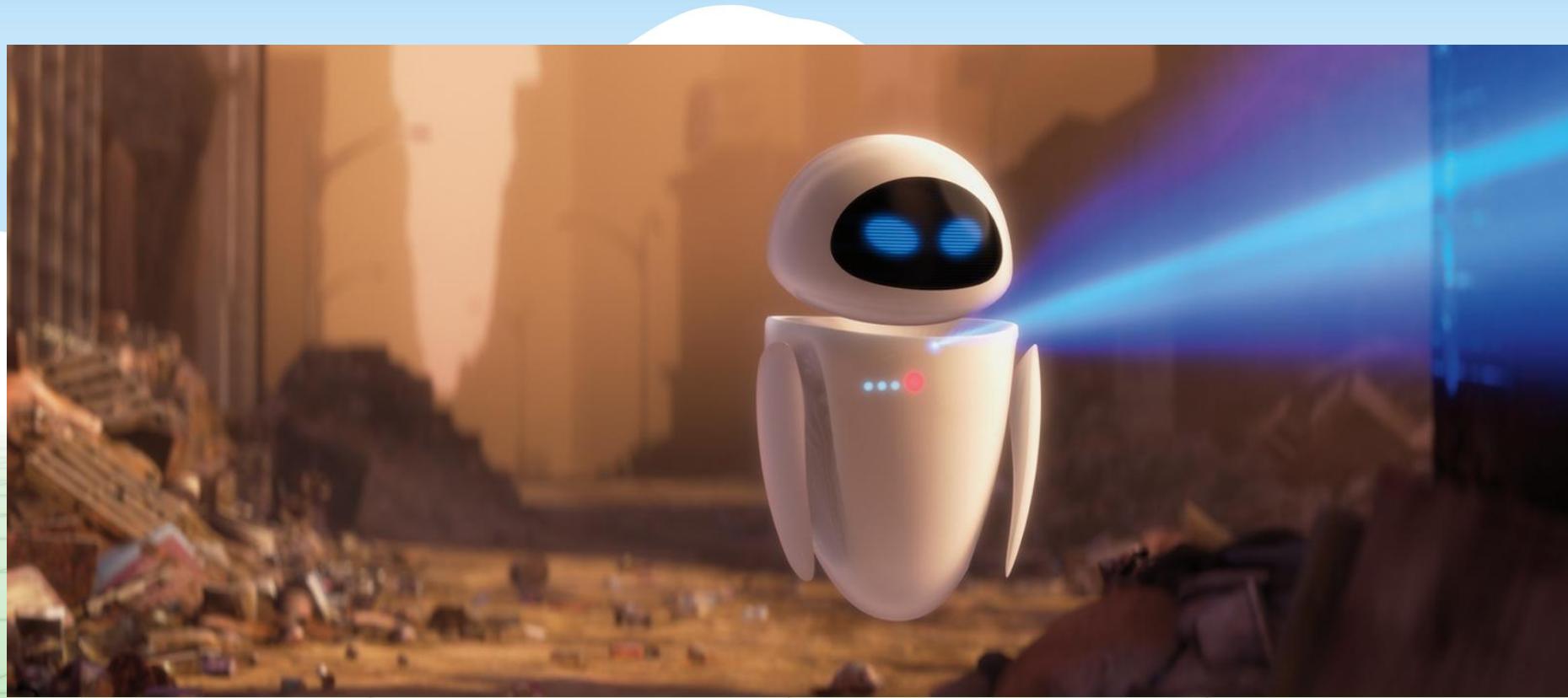
# Mid-Level: Multi-View Stereo

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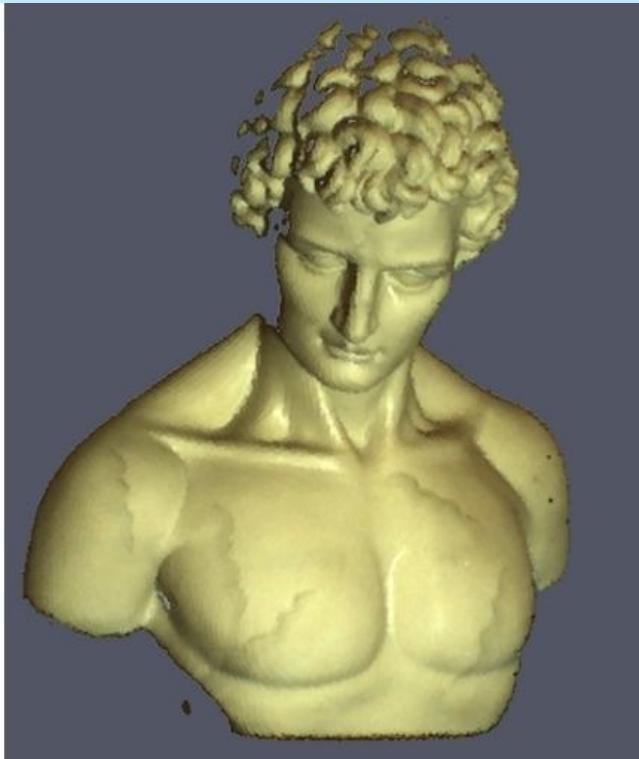
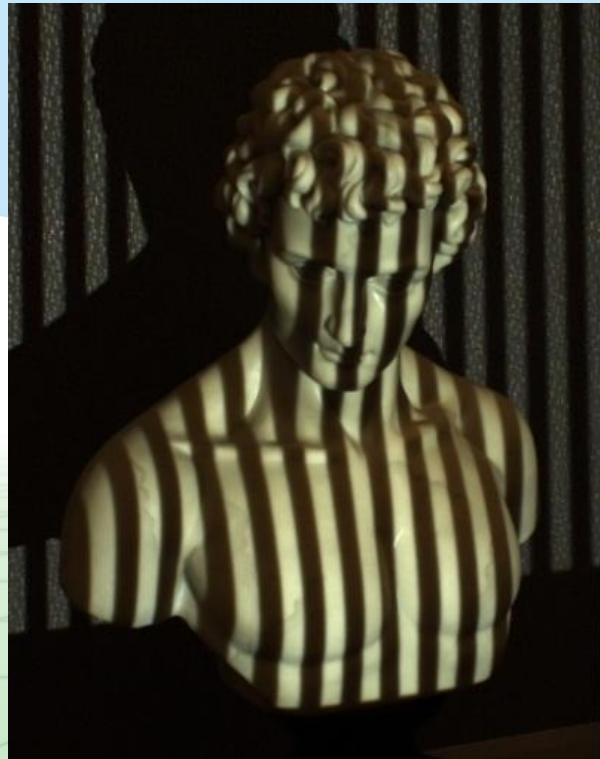
# Mid-Level: Structured Light Scan

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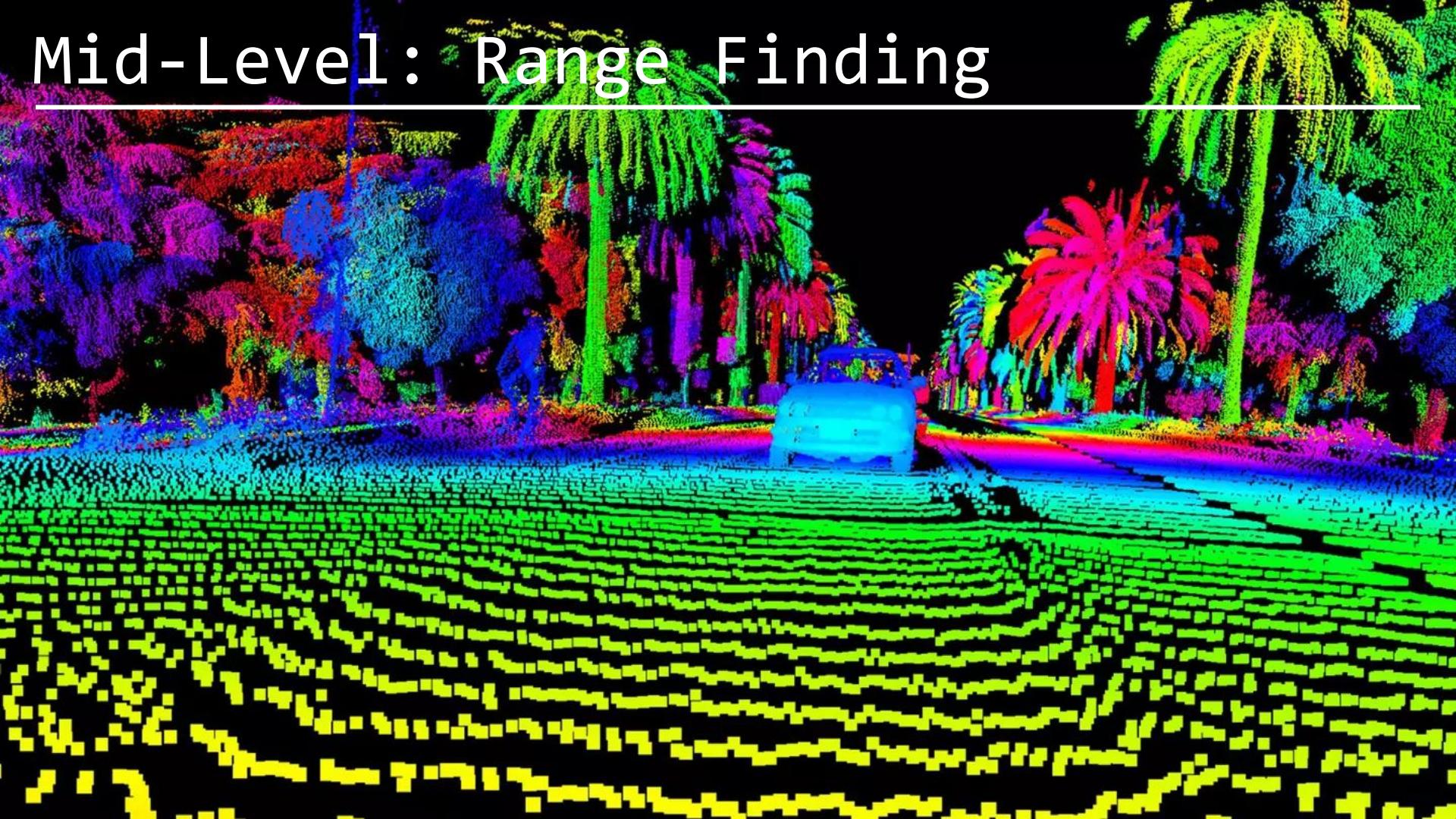


# Mid-Level: Structured Light Scan

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# Mid-Level: Range Finding



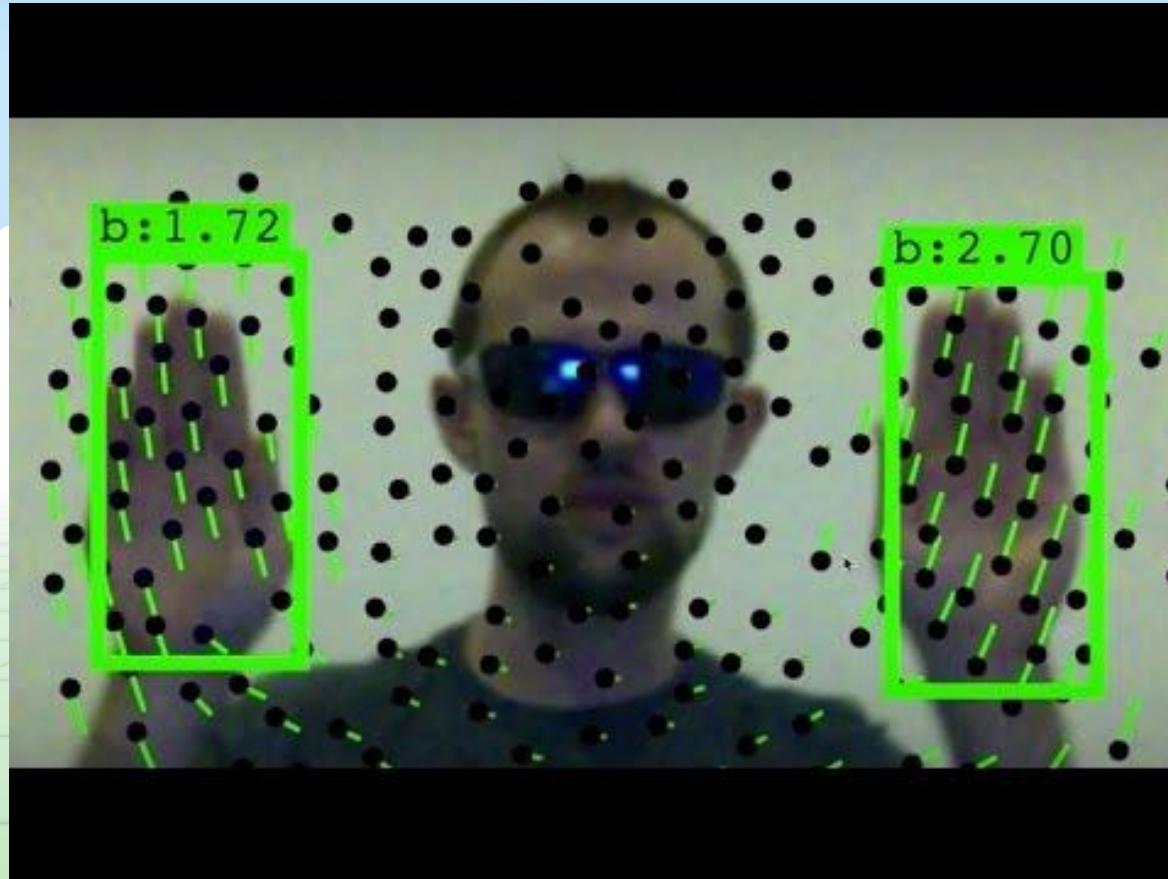
# Mid-Level: Optical Flow

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# Mid-Level: Optical Flow

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# Mid-Level: Time Lapse

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# Mid-Level Vision

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Image <-> Image

- Panoramas

Image <-> World

- Multi-view stereo
- Structure from motion
- Structured light
- LIDAR

Image <-> Time

- Optical flow
- Time lapse



# High-Level Vision

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# High-Level: Classification

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- What is in the image?

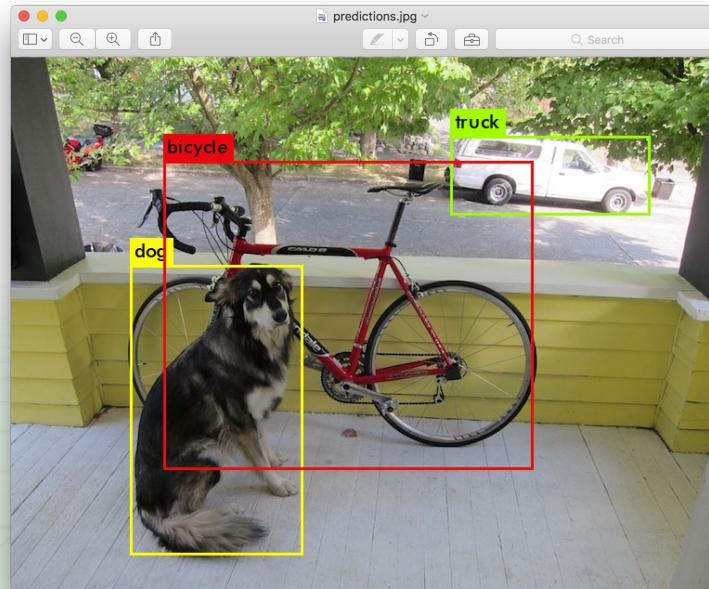
# High-Level: Tagging

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- What are ALL the things in the image?

# High-Level: Detection

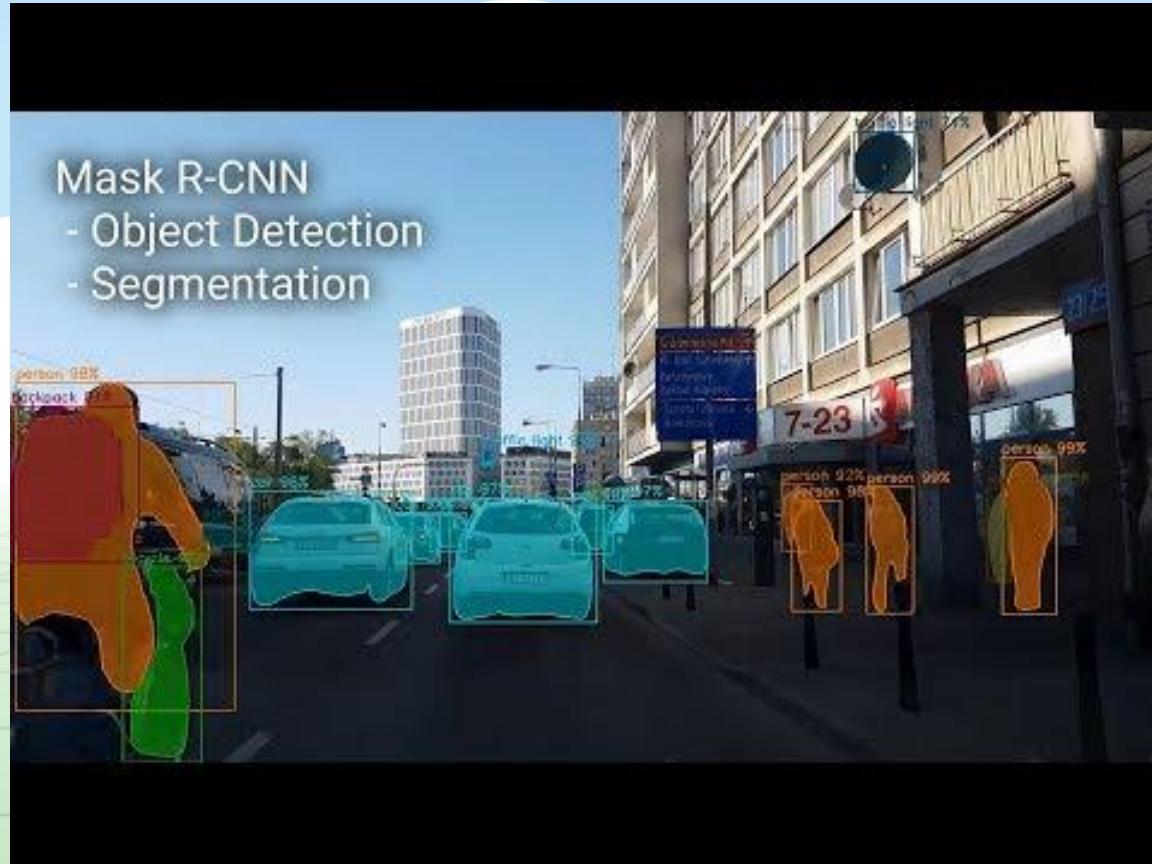
- What are ALL the things in the image?
- Where are they?



# High-Level: Semantic Segmentation



# High-Level: Instance Segmentation



# High-Level: So many other things

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- Single image 3D
- Game playing
- Super-resolution
- Retrieval
- Other cool things, yay!

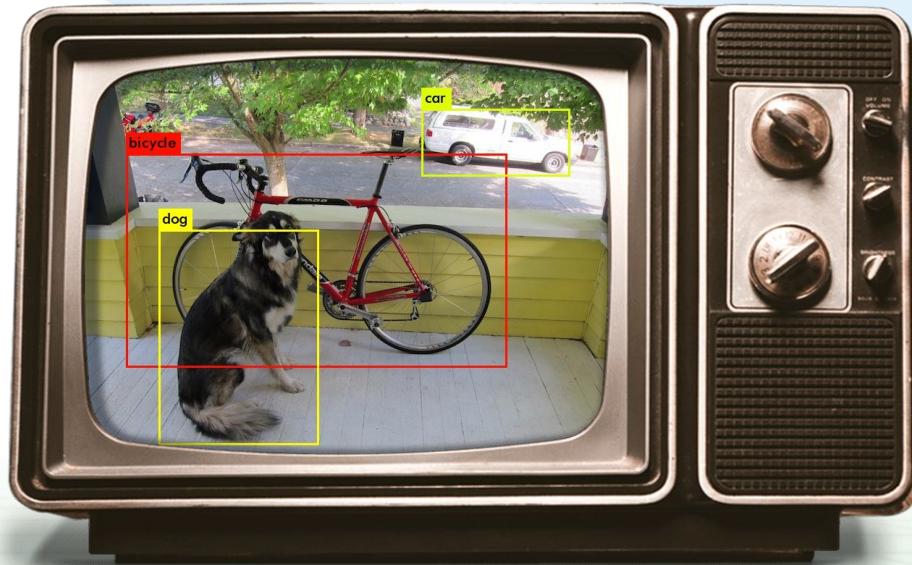
# High-Level Vision

Semantics!

- Image classification
- Object detection
- Segmentation

Applications

- Retrieval
- Robots?
- and...????



# Assignments

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Build a vision library from the ground up

Mostly in C

Play with advanced tools, neural networks

Beginning: lots of skeleton code, explanations

End: less guidance, more experimentation

Tentatively 8 assignments (this may get cut down)

Due Thursdays at Midnight (by popular demand)

# Final Project

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Use your library or any modern vision tools or frameworks to do something cool!

We'll provide default project ideas but it is very open ended. If you are interested in something specific this is your chance to explore!

Teams are encouraged

# Grading

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8 assignments - 80%

Final project - 20%

4 late days to use when you want  
Up to 10% penalty per day after.

# Collaboration

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Do: talk to each other, ask for help, give help, explain concepts, talk about examples, google terms or concepts, lots of wikipedia!

Don't: read other peoples code, copy code, search for code, etc.

Use any resource that helps you understand the material and concepts, don't go looking for shortcuts around understanding just to finish an assignment. Submit all your own work.

# Office hours: TBD

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We have some awesome TAs, all are graduate students in computer vision. We will get you through this class, don't worry!

# Questions??

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Mattermost!

Sign up with GitLab, link is on website

Also, email or anonymous feedback, see website for details.