THE UNIVERSITY OF BRITISH COLUMBIA

CPSC 425: Computer Vision

Image Credit: Devi Parikh

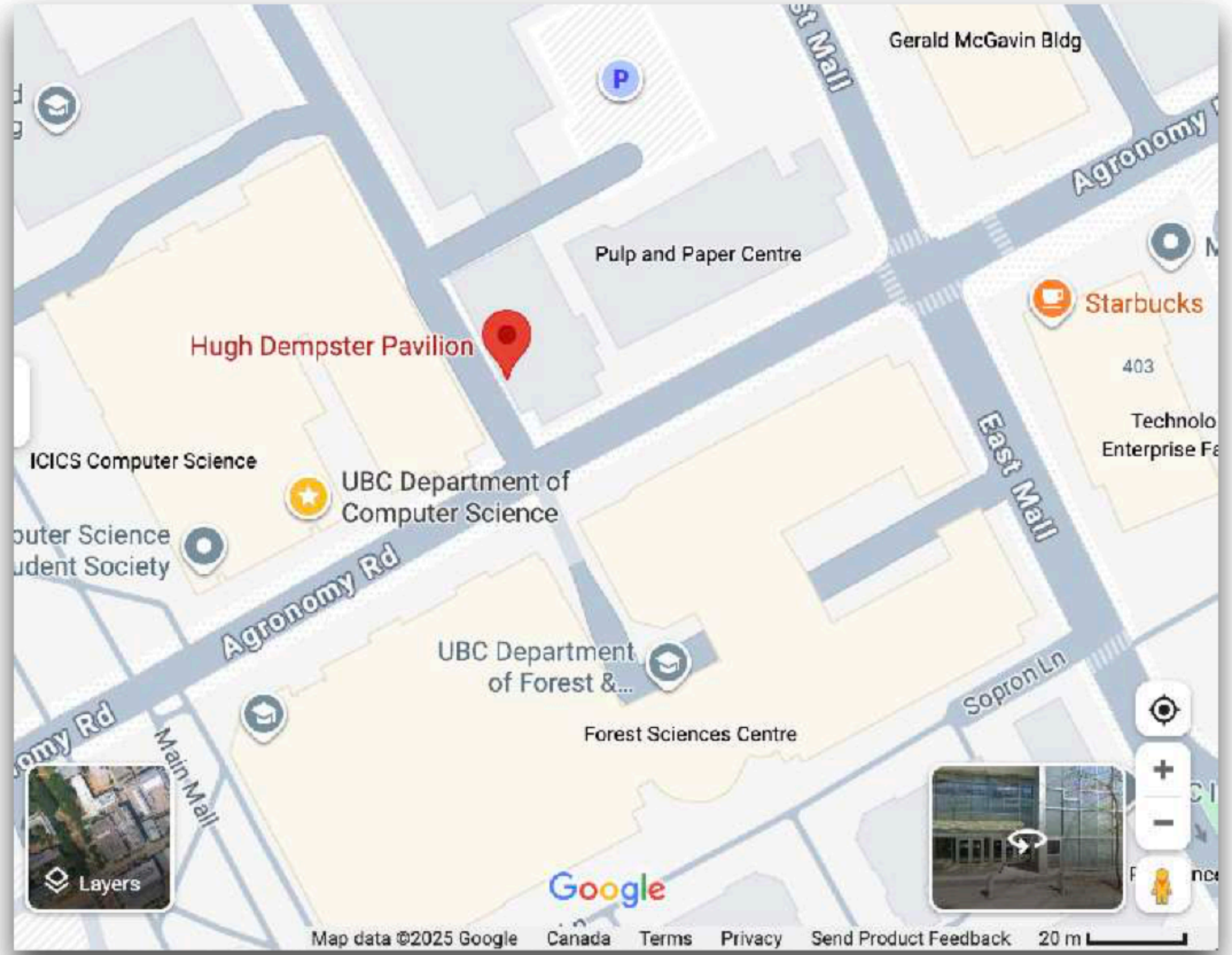
Lecture 1: Introduction and Course Logistics

Course **logistics**

Times: Tues, Thurs 5:00-6:30pm **Locations (101):** DMP, Room 301

Instructor: Leonid Sigal

E-mail: lsigal@cs.ubc.ca
Office: ICICS 119



Times: Mon, Wed 3:00-4:30pm **Locations (102):** DMP, Room 302

Course **logistics**

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Instructor: Leonid Sigal

Leon

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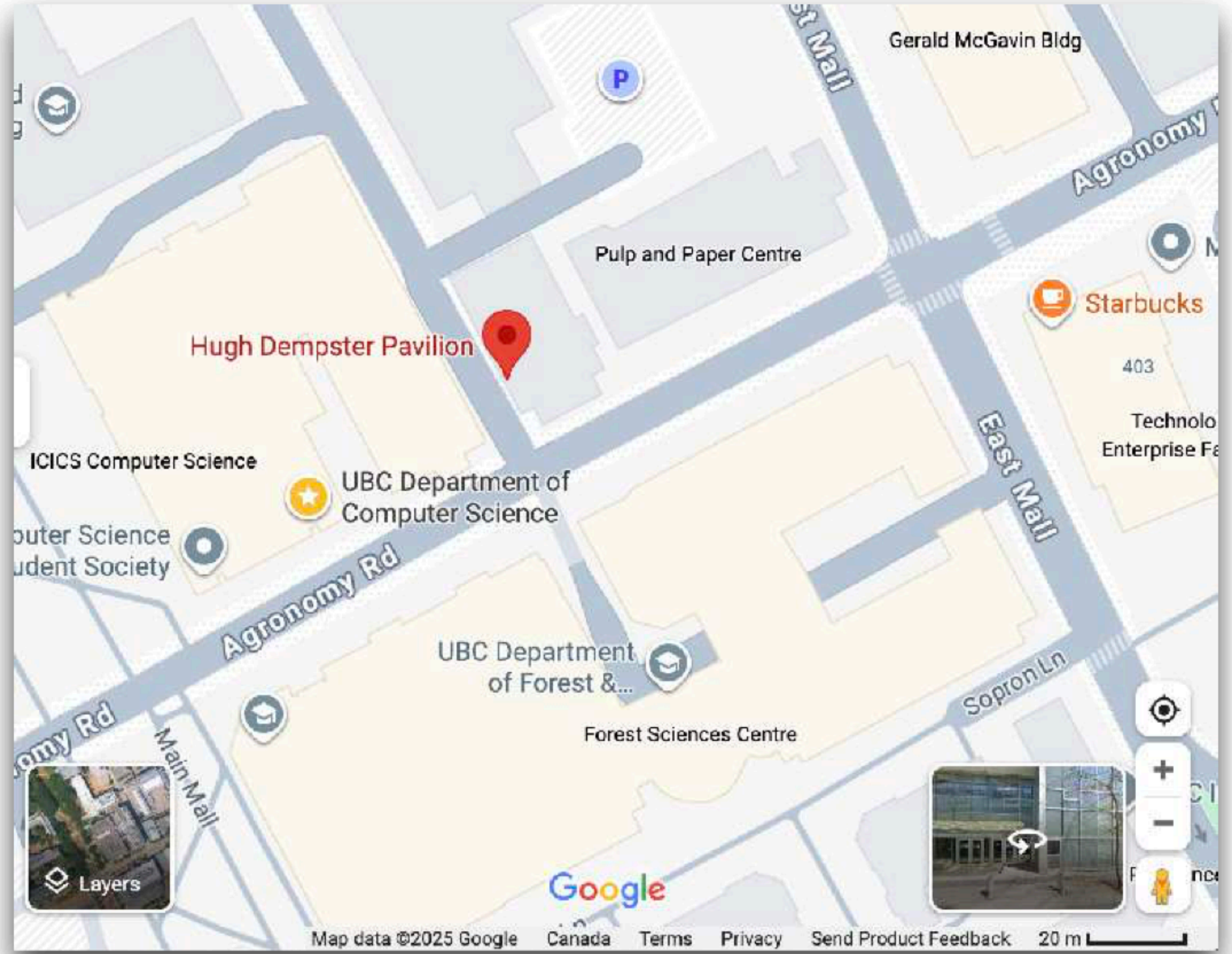

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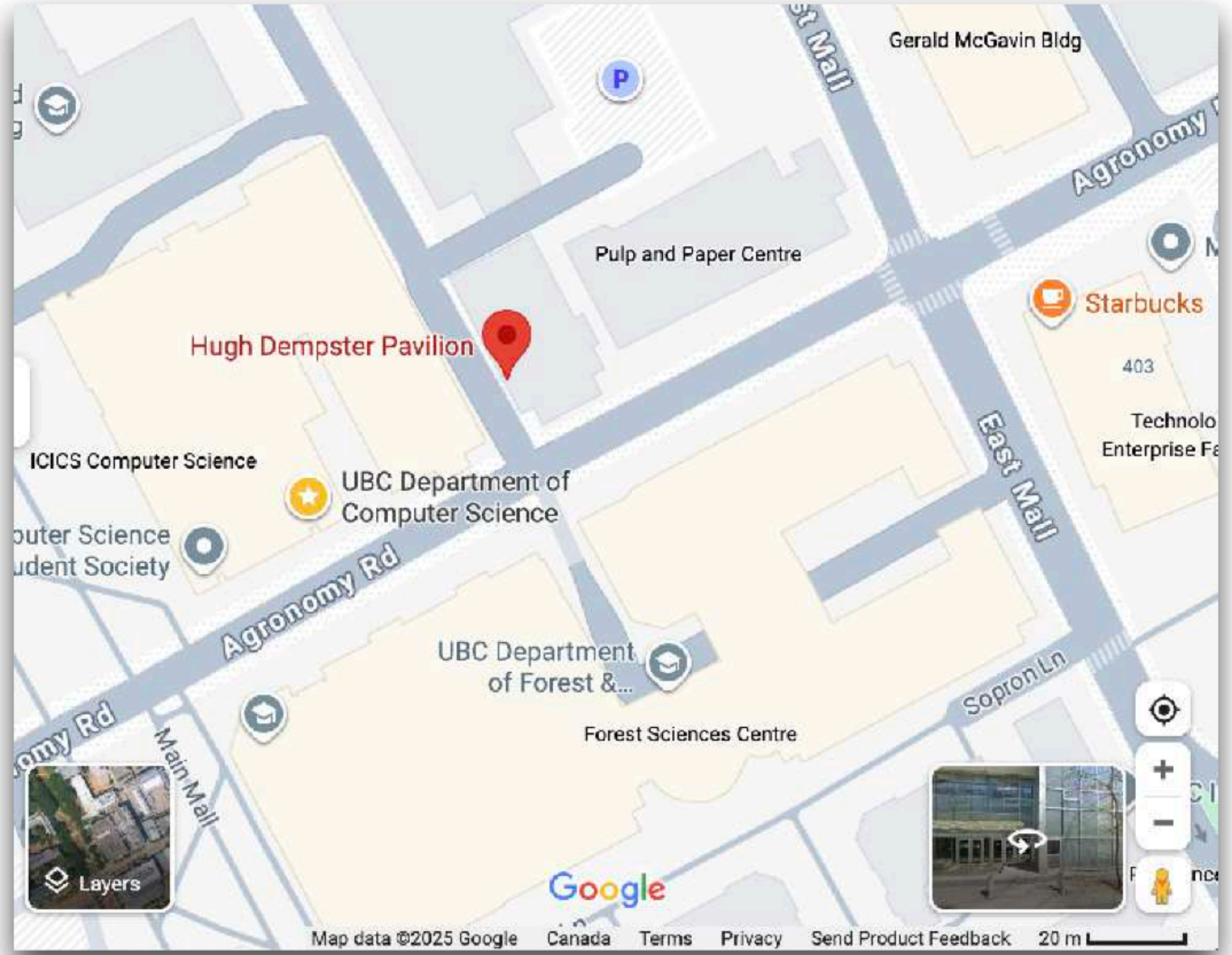

PLEAST contact me through Piazza rather than e-mail

Times: Mon, Wed 3:00-4:30pm **Locations (102):** DMP, Room 302

About **me** …

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Software Engineer
1999 - 2001

COGNEX

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PhD, MSc
2001 - 2008

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About **me …**

I have been working in **Computer Vision** for the last ~25 years

Professor
2017 -
THE UNIVERSITY OF BRITISH COLUMBIA

Senior Research Scientist
2009 - 2017
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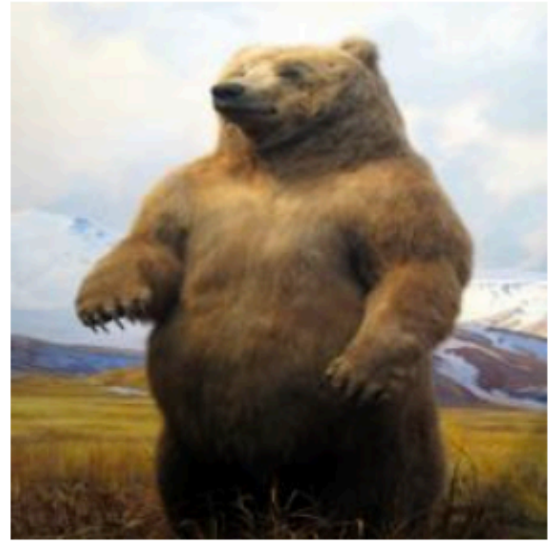
Multi-modal Learning (now known as Vision-Language Models)

Multi-modal Learning (now known as Vision-Language Models)

Dialog Information	Input image	Attended image
Current question: *What color is it's fur ?* Predicted answer: *Brown*		
Current question: *What color is the train ?* Predicted answer: *It is white and red with some blue on it*		
Current question: *Is it a sunny day ?* Predicted answer: *Yes*		

[*Seo et al., NeurIPS 2017*]

Video Understanding

[*Xu et al., WACV 2019*]

Video Understanding

[*Xu et al., WACV 2019*]

Course **logistics**

Times: Tues, Thurs 5:00-6:30pm **Locations (101):** DMP, Room 301

Instructors


Kwang Moo YI


Leonid Sigal

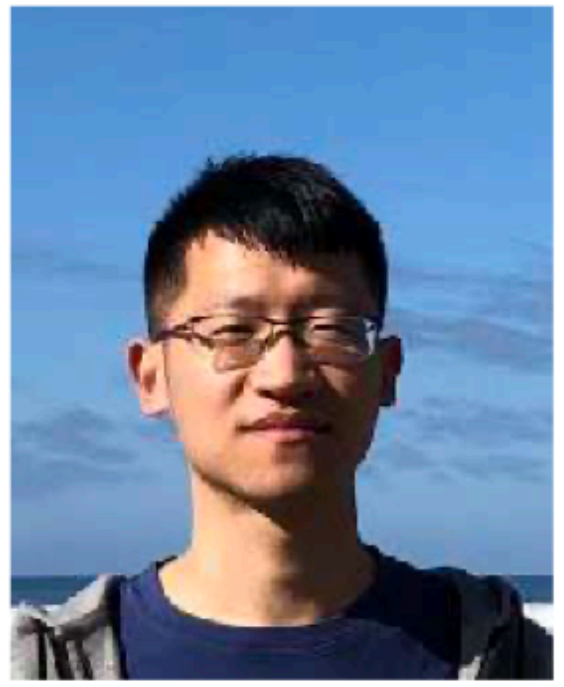
Teaching Assistants

Shivam Chandhok


Nielsen Cugito


Ailar Mahdizadeh


Oliver Oxford


Bicheng Xu


Post questions on Piazza!

Times: Mon, Wed 3:00-4:30pm **Locations (102):** DMP, Room 302

Course **logistics**

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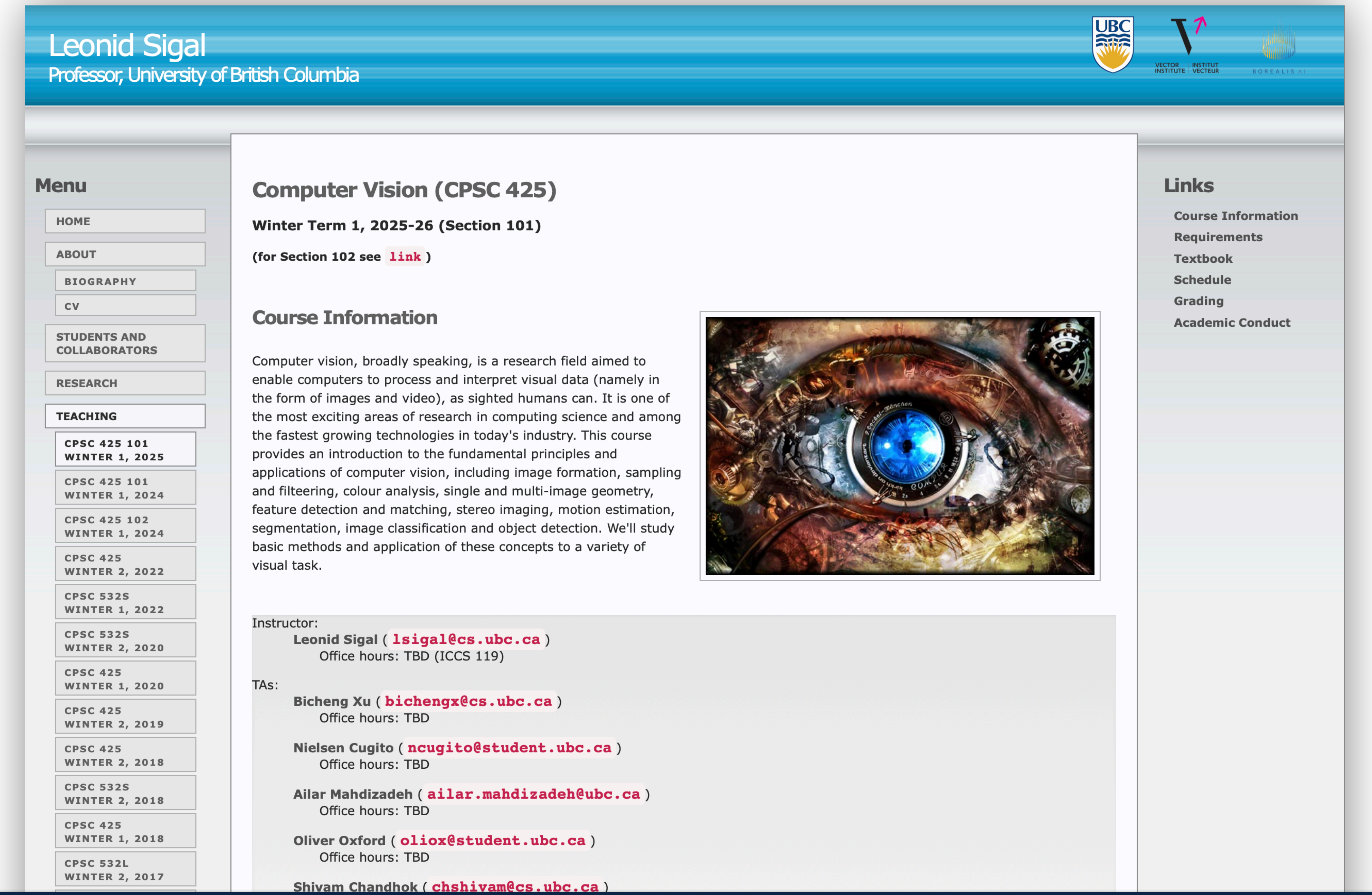
Resources we will use

Times: Mon, Wed 3:00-4:30pm **Locations (102):** DMP, Room 302

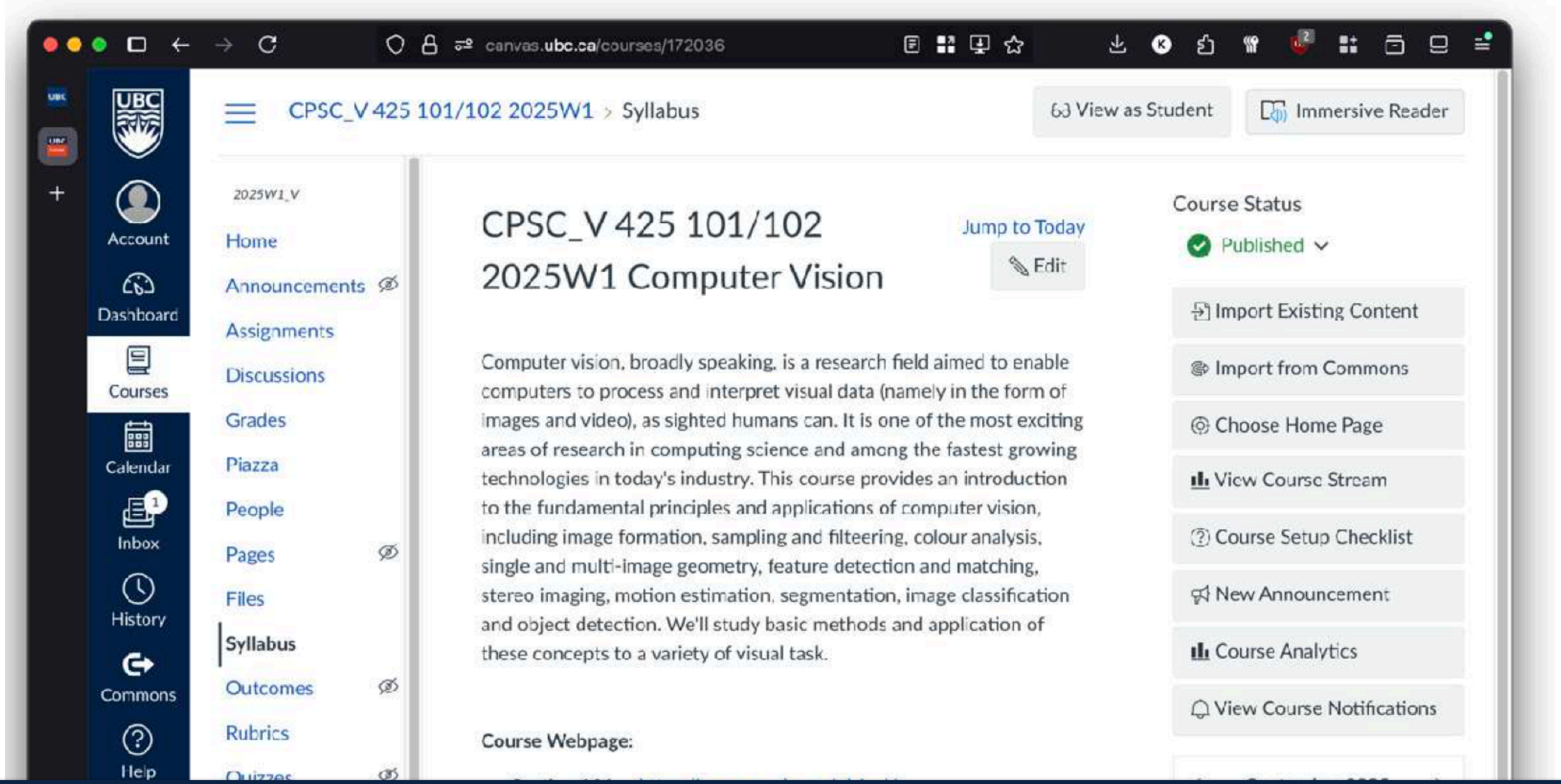
Course **Webpage**



- Schedule, Assignments
- Lecture Slides and Notes
- Readings
- Course Information (public)

Section 101: https://www.cs.ubc.ca/~lsigal/teaching25_Term1.html

Canvas

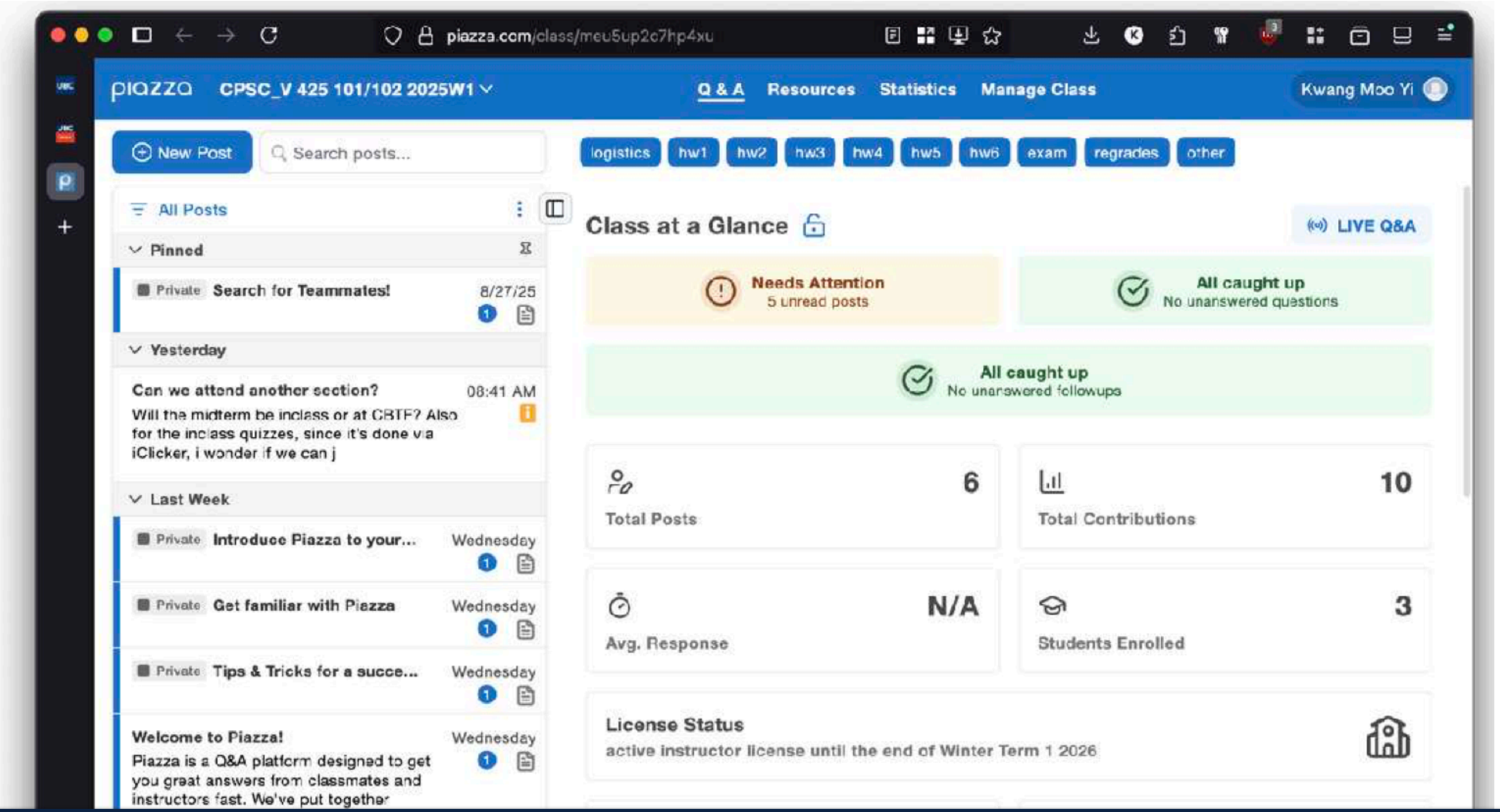


- Assignment hand-in
- Course Information (private)
- Gradescope (exams)
- Piazza link

https://canvas.ubc.ca/courses/172036

Piazza

Discussion: https://piazza.com/ubc.ca/winterterm12025/cpsc_v4251011022025w1



- Discussions and Q+A
- Confused? Likely someone else has the same question as you!
- Lecture questions, Technical Issues, Assignments …
- Do NOT expect immediate response

Link in Canvas and the course website

Office **Hours**

Will start the week of **September 15th**

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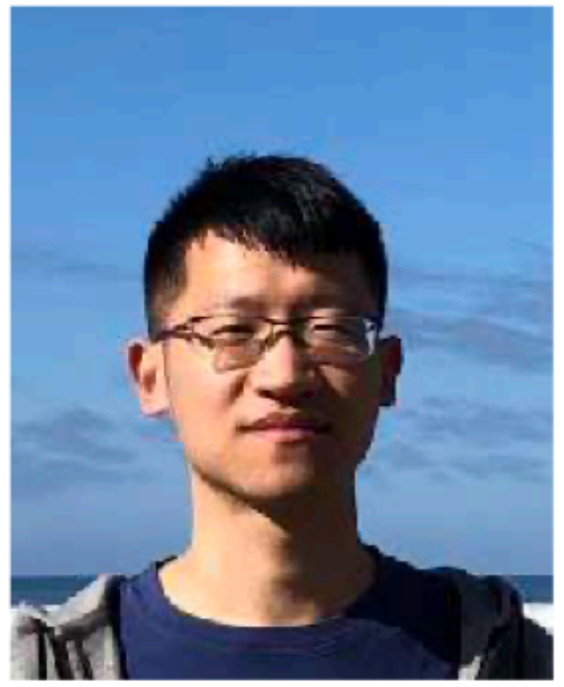


Post questions on Piazza!

See Piazza for Links and Locations (one each day of the week)

How important is **Vision**?

How important is **Vision**?

To answer this questions, we need to go back to about

…. **543 million years, B.C.**

How important is **Vision**?

To answer this questions, we need to go back to about

…. **543 million years, B.C.**

Vision is really fundamental to life and evolution

What is **Computer Vision**?

Image Credit: https://www.deviantart.com/infinitecreations/art/BioMech-Eye-168367549

What is **Computer Vision**?

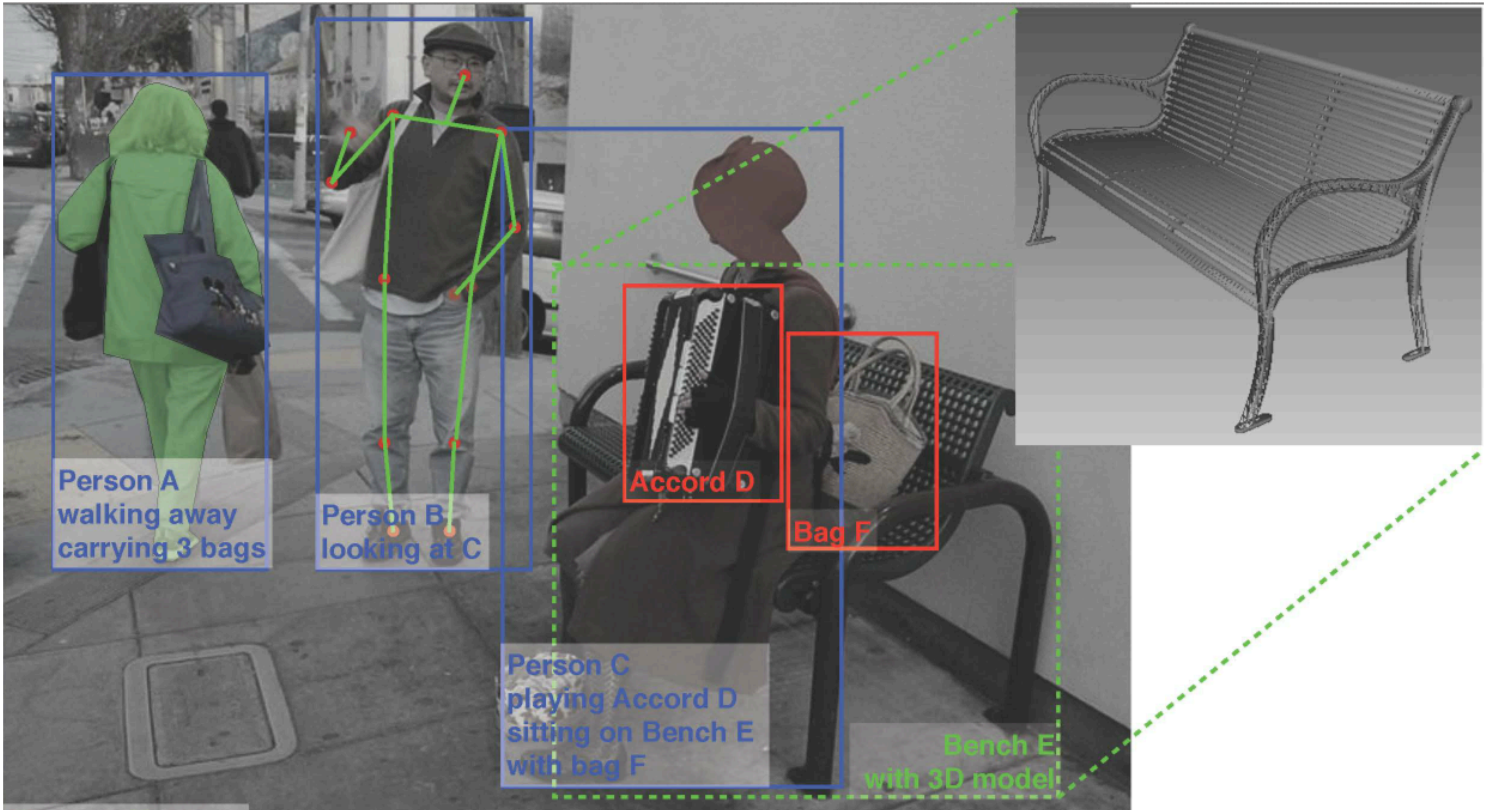
Definition #1: Compute vision, broadly speaking, is a research field aimed to enable computers to **process and interpret visual data**, as sighted humans can.

Image Credit: https://www.deviantart.com/infinitecreations/art/BioMech-Eye-168367549

What do **you** see?

Slide Credit: Jitendra Malik (UC Berkeley)

What we would like **computer to infer**?



Slide Credit: Jitendra Malik (UC Berkeley)

What we would like **computer to infer**?

Slide Credit: Jitendra Malik (UC Berkeley)

What is **Computer Vision**?

Compute vision, broadly speaking, is a research field aimed to enable computers to **process and interpret visual data**, as sighted humans can.

Image (or video) → **Sensing** Device → **Interpreting** Device → **Interpretation**

blue sky,
trees,
fountains,
UBC, …

What is **Computer Vision**?

Compute vision, broadly speaking, is a research field aimed to enable computers to **process and interpret visual data**, as sighted humans can.

Image (or video)

Sensing Device

Interpreting Device

Image Credit: https://www.flickr.com/photos/flamephoenix1991/8376271918

Interpretation

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Image Credit: https://www.flickr.com/photos/flamephoenix1991/8376271918

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Sensing Device

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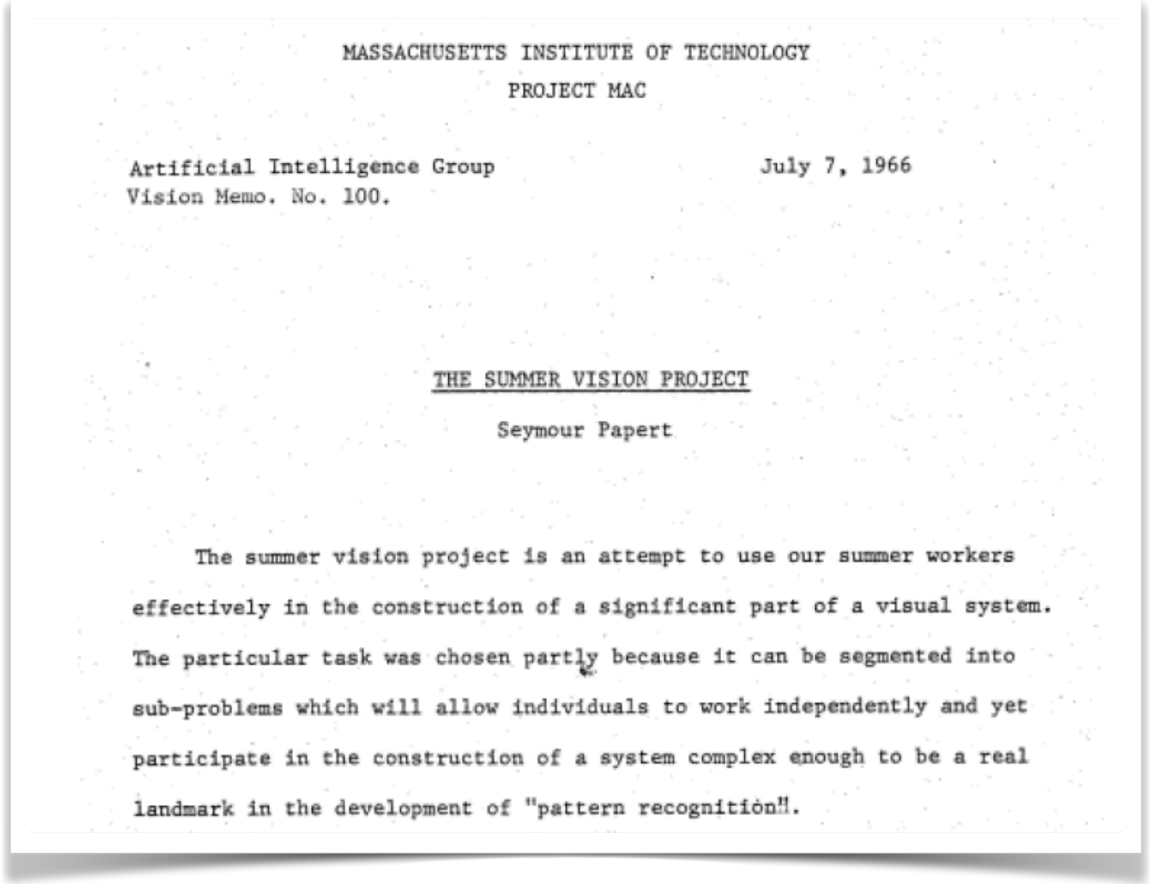
This implies a very strong connection between **Computer Vision** and **(Machine) Learning**

Computer vision … the beginning …



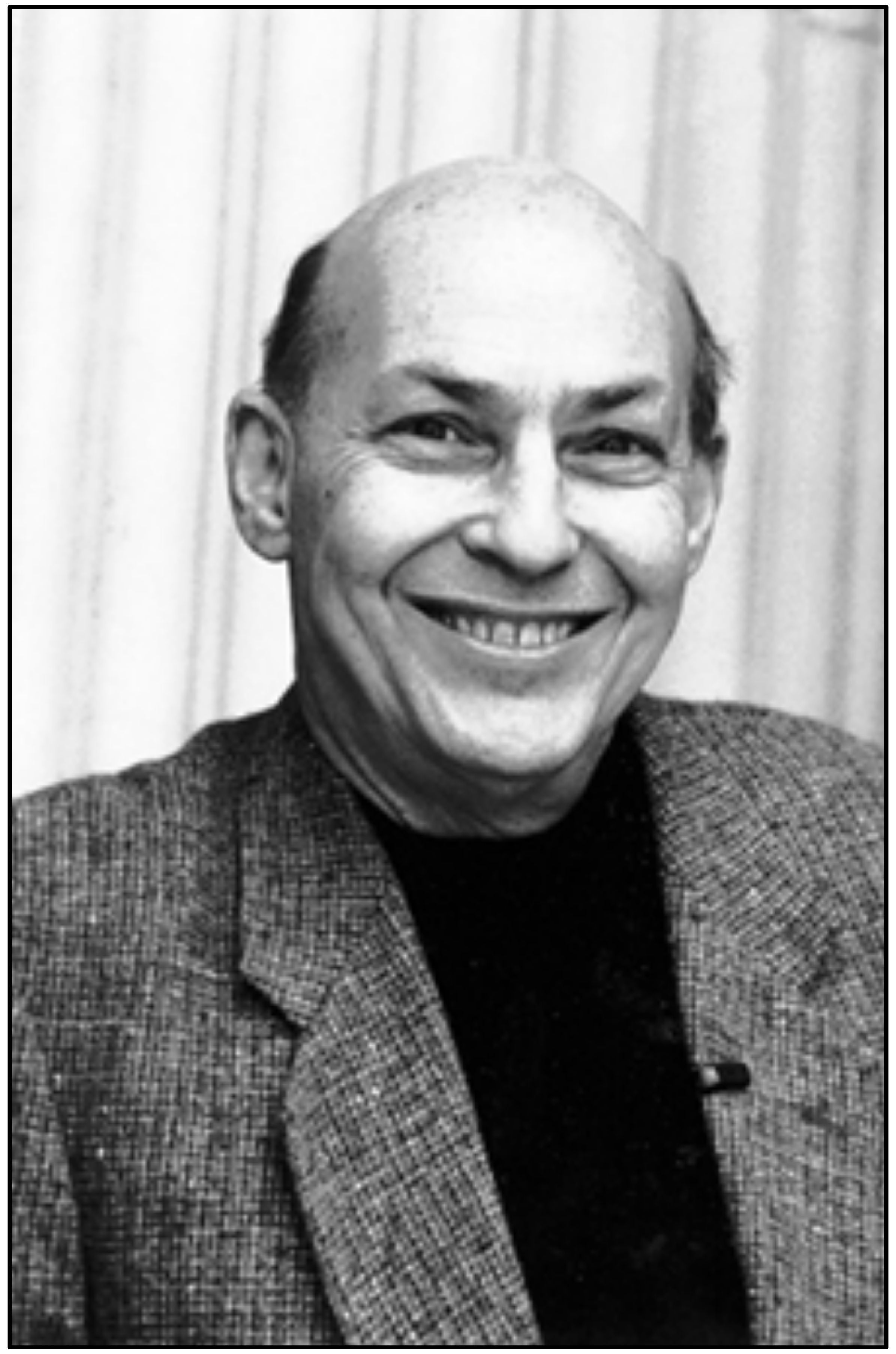
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PROJECT MAC

Artificial Intelligence Group July 7, 1966
Vision Memo. No. 100.

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".



The Summer Vision Project

"spend the summer linking a camera to a computer and getting the computer to describe what it saw"

- Marvin Minsky (1966), MIT
  Turing Award (1969)

… >50 years later

Slide Credit: Devi Parikh (GA Tech)

Computer vision … the beginning …

Gerald Sussman, MIT

"You'll notice that **Sussman** never worked in vision again!" – Berthold Horn

Slide Credit: Devi Parikh (GA Tech)

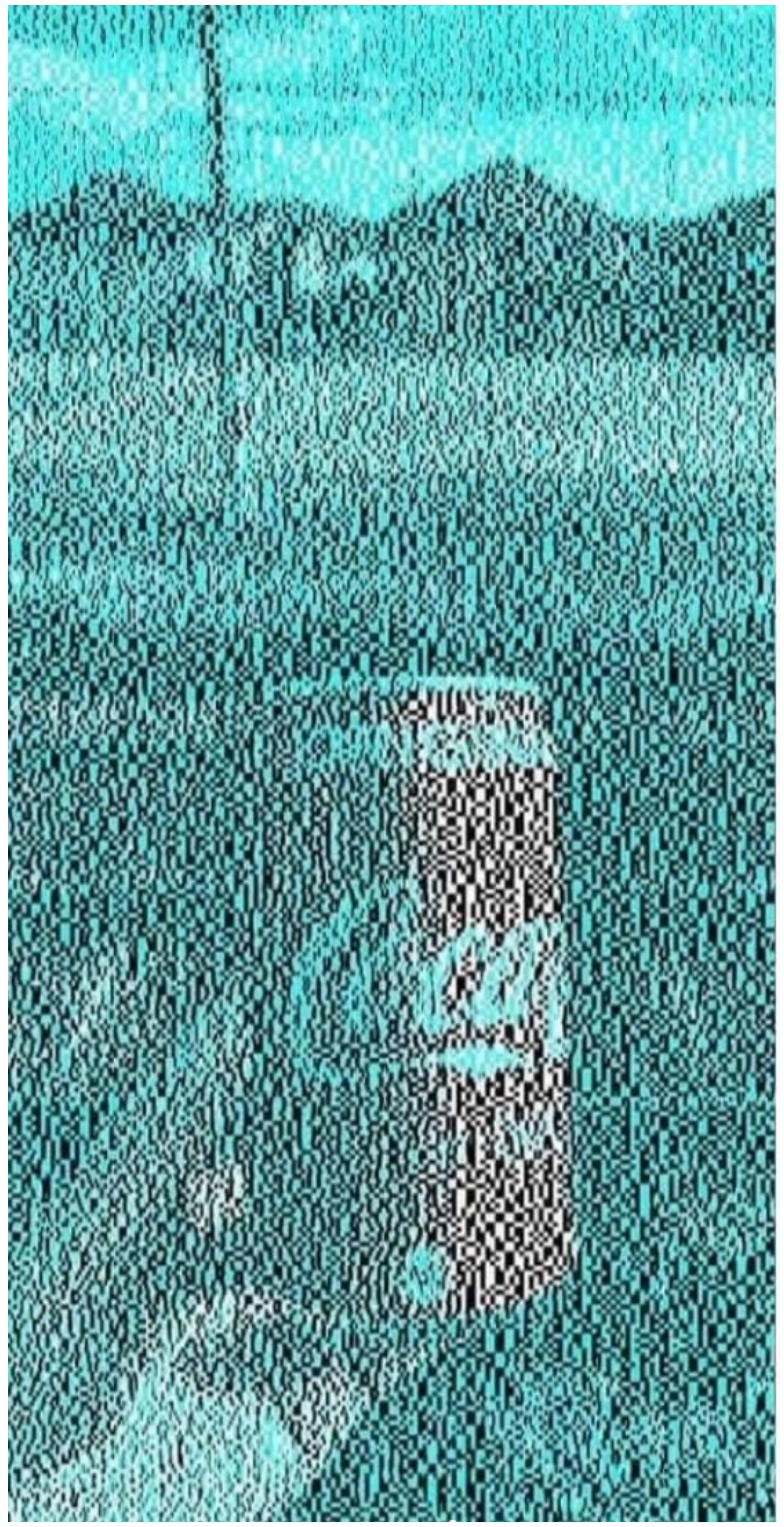
Can computers **match (or beat)** human vision?

- We’ve been at it for 50 years

Can computers **match (or beat)** human vision?

- How good is human vision?

Can computers **match (or beat)** human vision?



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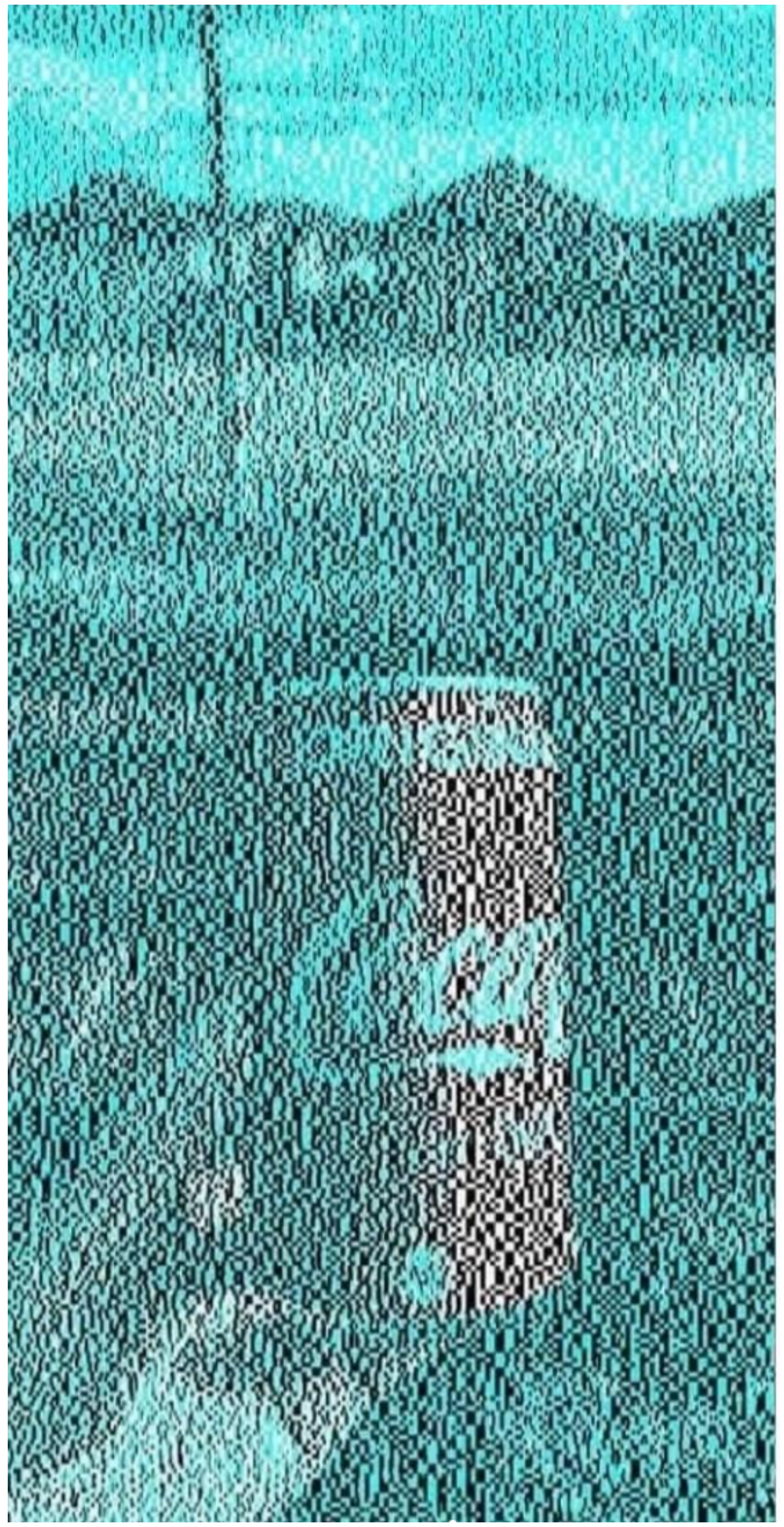

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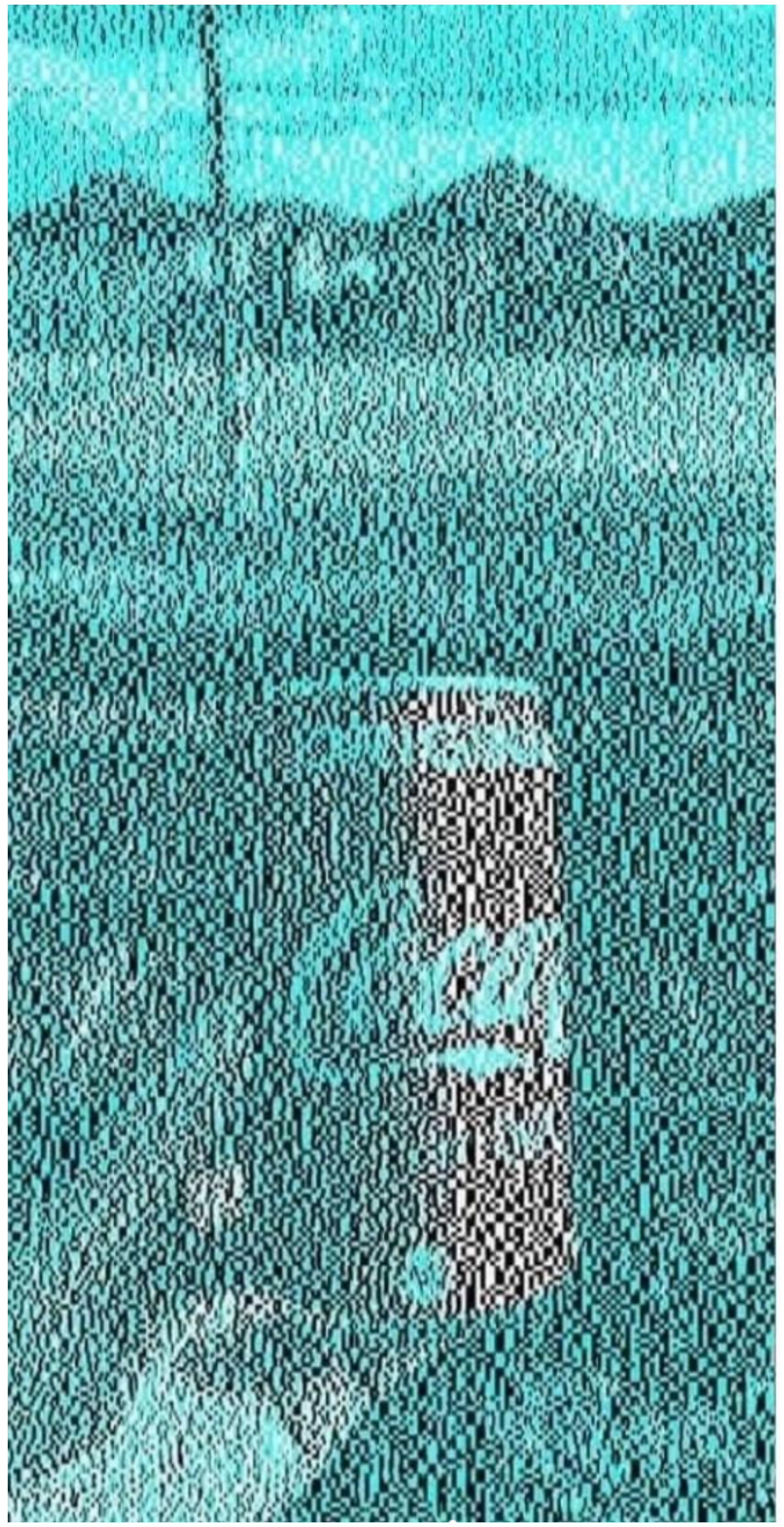

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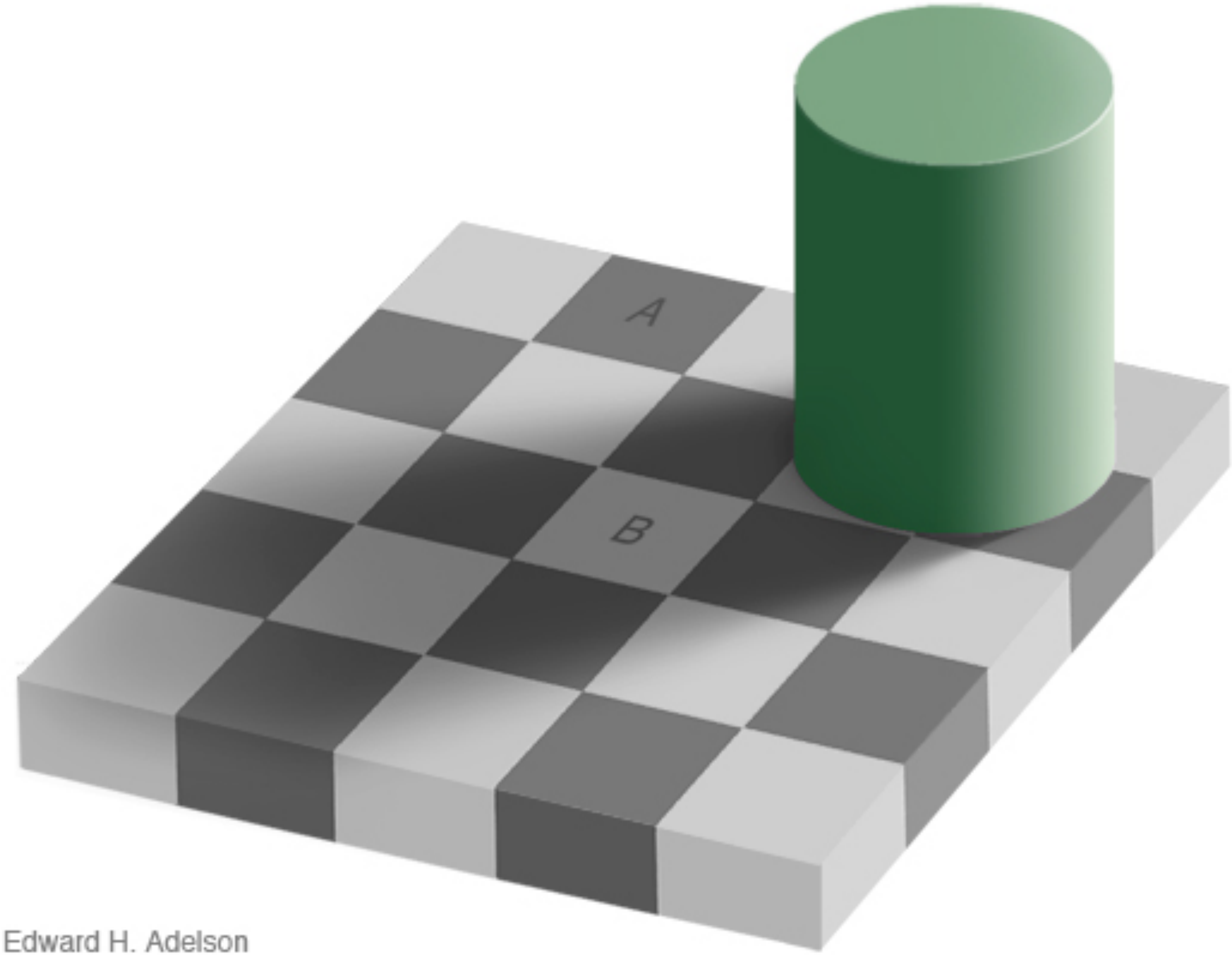
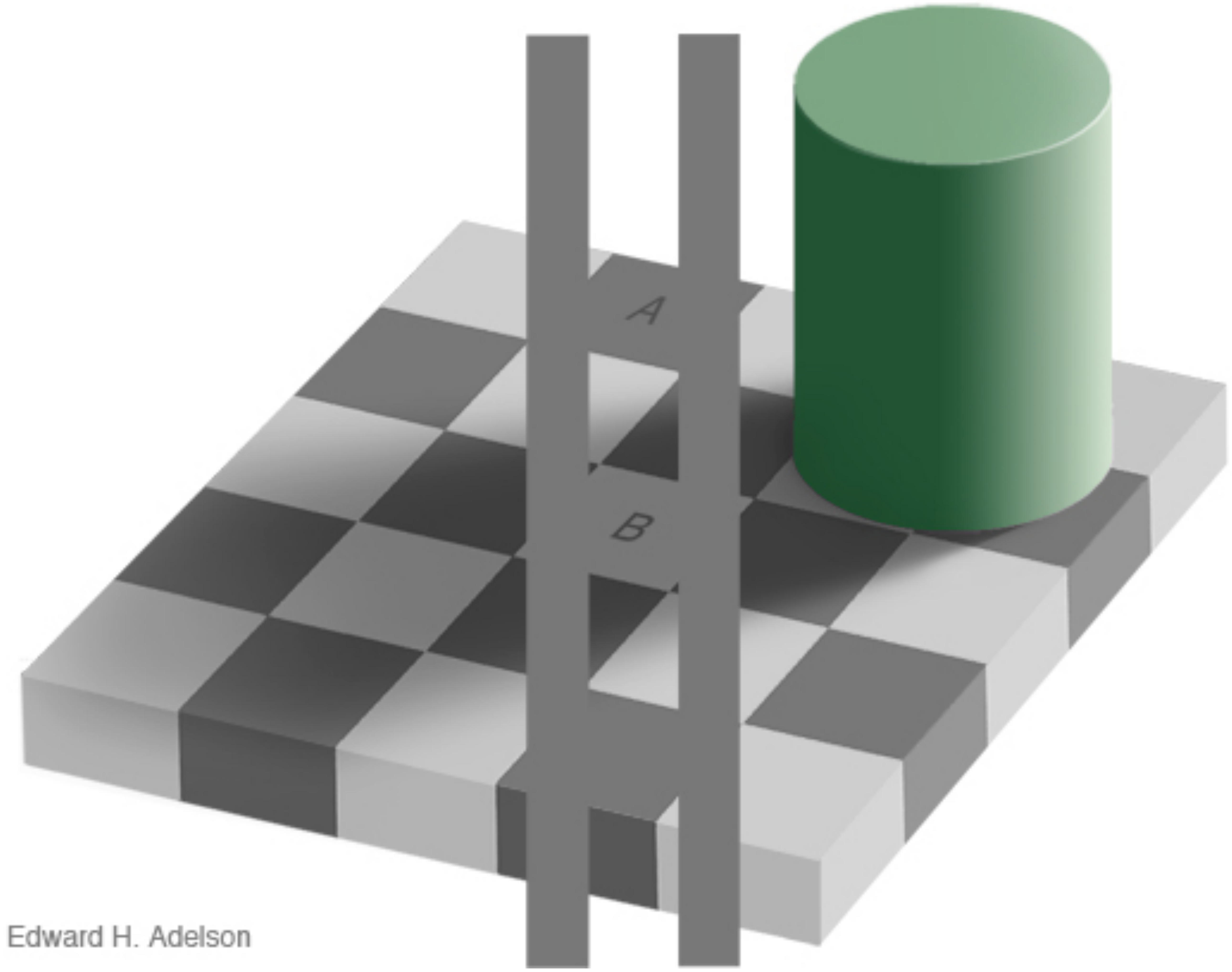


Edward H. Adelson

Can computers **match (or beat)** human vision?



Can computers **match (or beat)** human vision?

- How good is human vision?

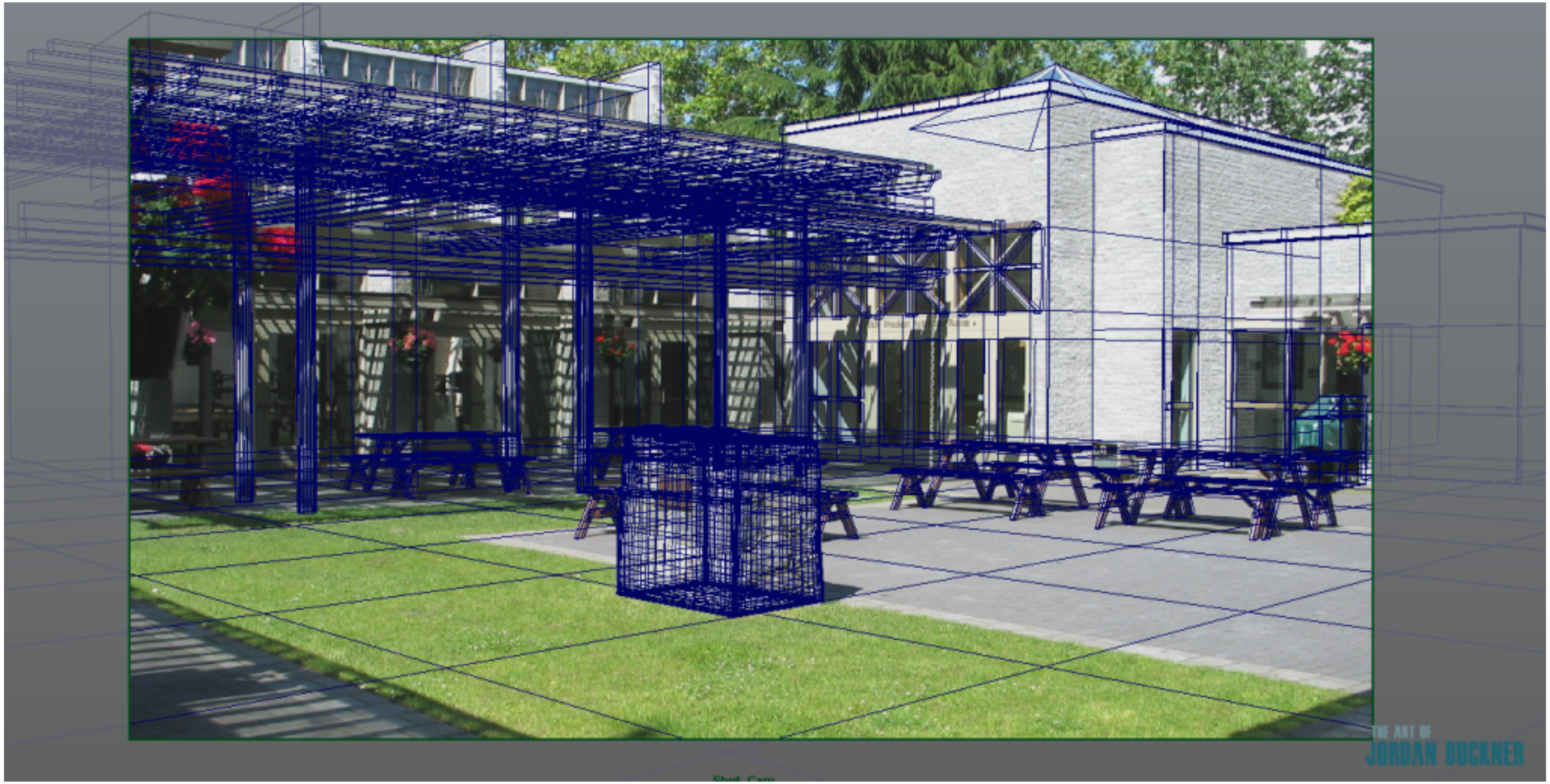
As a **measuring** device not very good, as a **functioning** device really good

Can computers **match (or beat)** human vision?

- **Yes and No** (mostly NO)

Alternative definition (#2) of computer vision

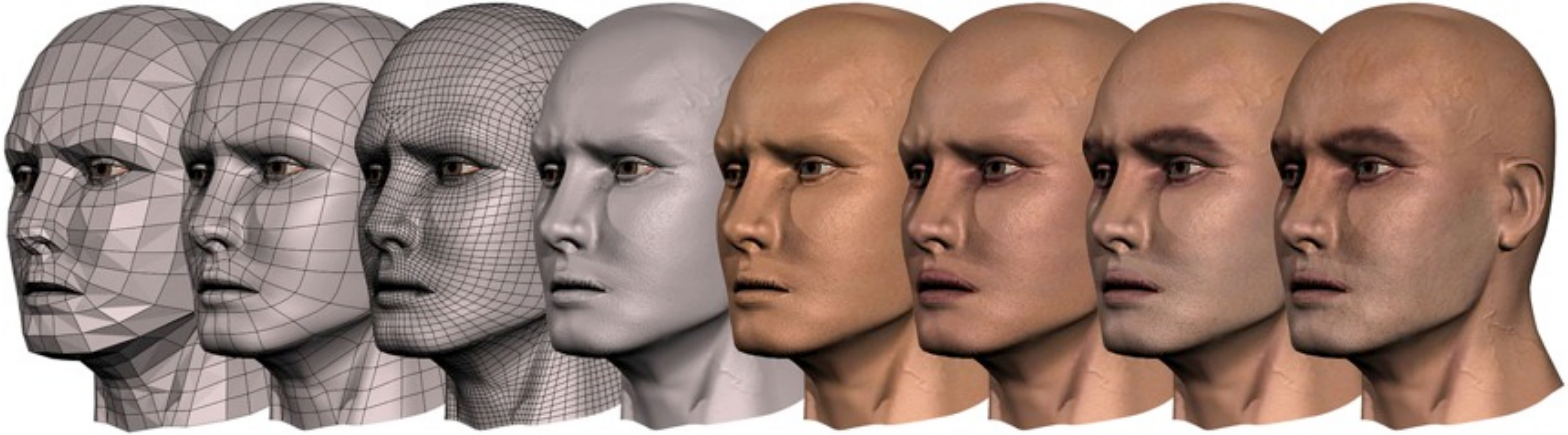
"Inverse Computer Graphics"



[J. Buckner]

Alternative definition (#2) of computer vision

“Inverse Computer Graphics”



→

Graphics

←

Vision

Computer **Vision Problems**

Slide Credit: Kristen Grauman (UT Austin)

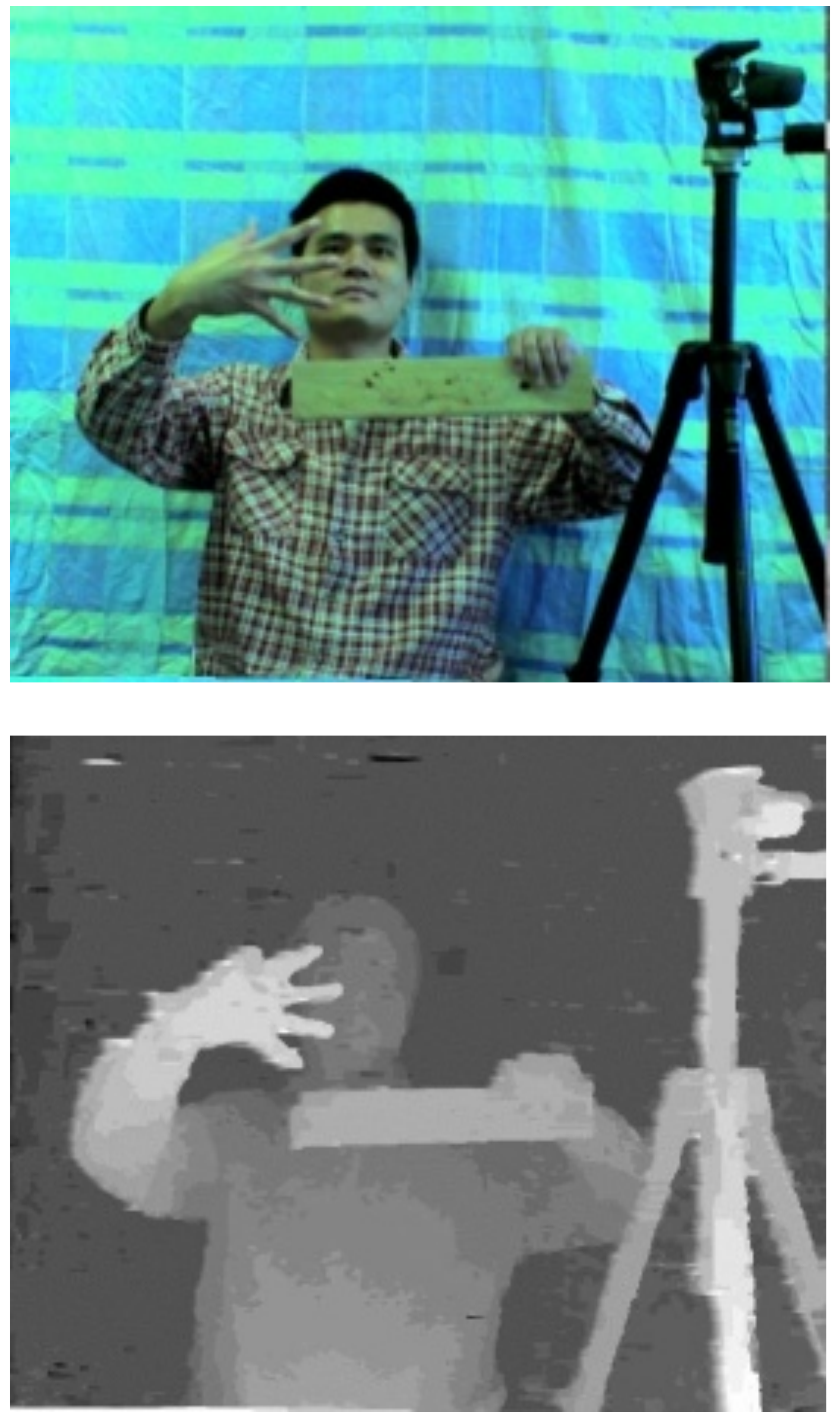
Computer **Vision Problems**

1. Computing properties of the 3D world from visual data (***measurement***)

Slide Credit: Kristen Grauman (UT Austin)

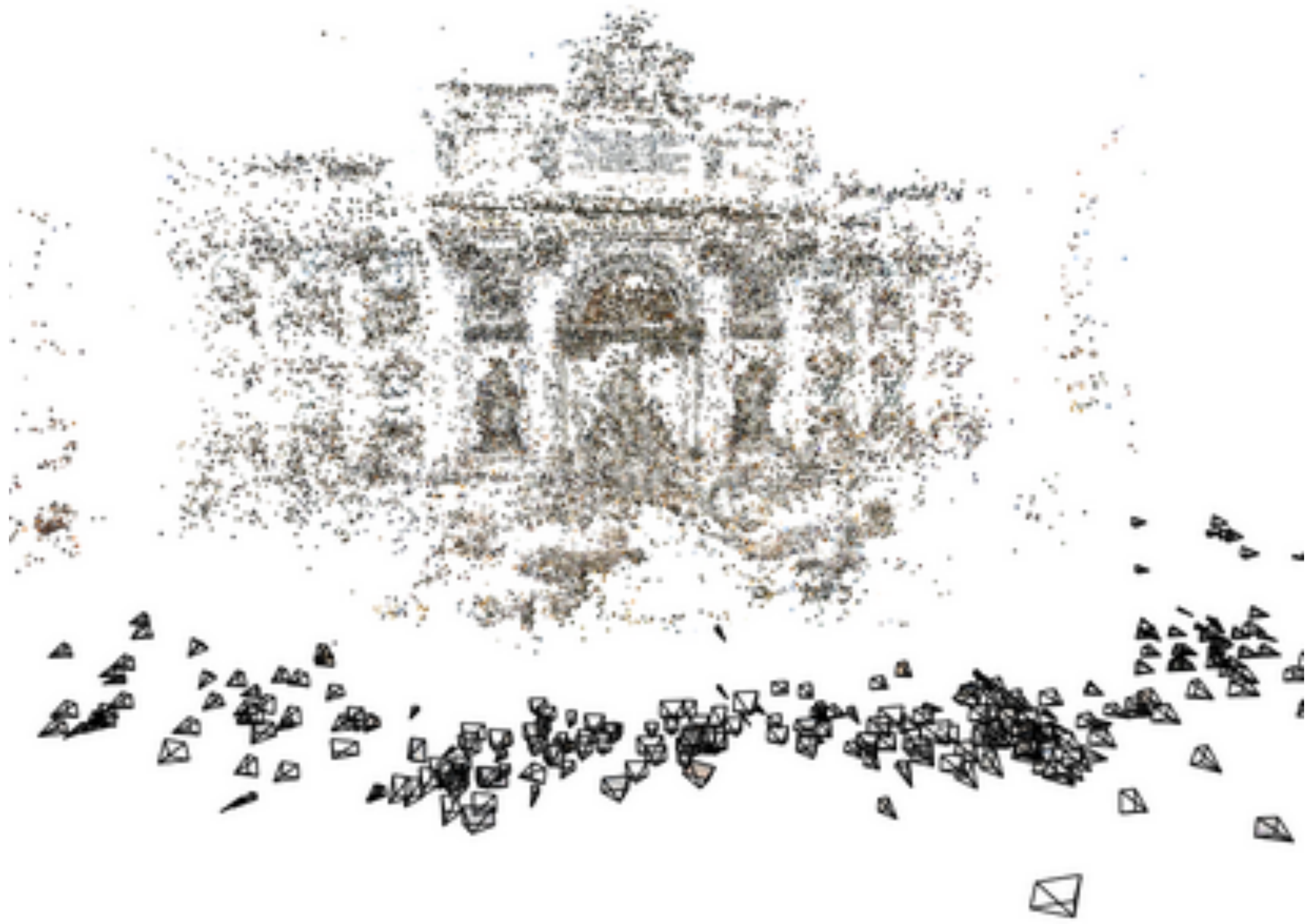
1. Vision for **Measurement**

Real-time stereo



Wang et al.

Structure from motion



Snavely et al.

Tracking

Demirdjian et al.

Slide Credit: Kristen Grauman (UT Austin)

Computer **Vision Problems**

1. Computing properties of the 3D world from visual data (***measurement***)

Ill-posed problem: real world is much more complex than what we can measure in images: 3D -> 2D

It is (literally) impossible to invert the image formation process

Slide Credit: Kristen Grauman (UT Austin)

Computer **Vision Problems**

1. Computing properties of the 3D world from visual data (***measurement***)

2. Algorithms and representations to allow a machine to recognize objects, people, scenes, and activities (***perception and interpretation***)

Slide Credit: Kristen Grauman (UT Austin)

2. Vision for **Perception and Interpretation**

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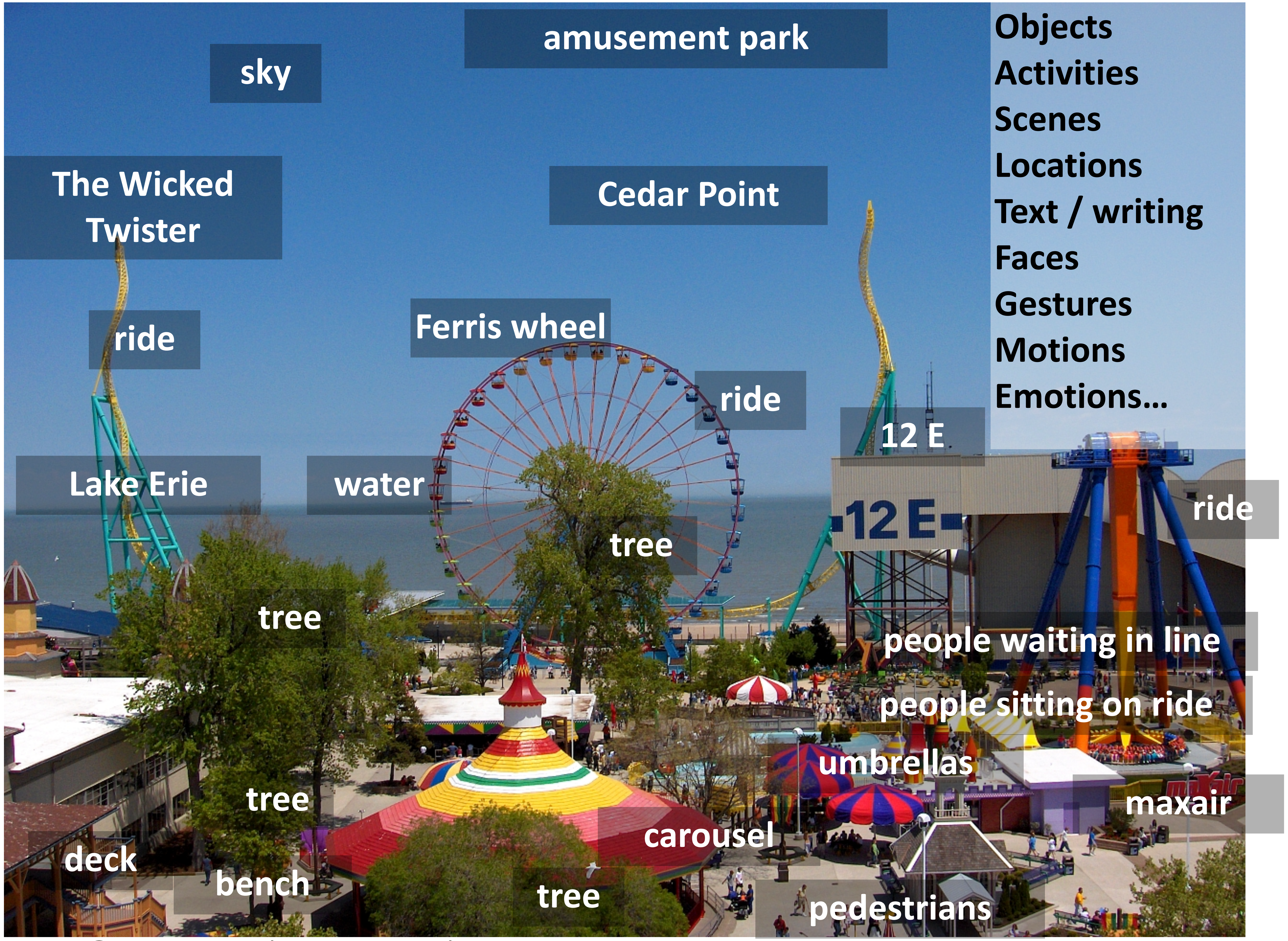

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It is computationally intensive / expensive

Slide Credit: Kristen Grauman (UT Austin)

2. Vision for **Perception and Interpretation**

~ 55% of **cerebral cortex** in humans (13 billion neurons) are devoted to vision

more human brain devoted to vision than anything else

Computer **Vision Problems**

1. Computing properties of the 3D world from visual data (***measurement***)

2. Algorithms and representations to allow a machine to recognize objects, people, scenes, and activities (***perception and interpretation***)

It is computationally intensive / expensive

We do not (fully) understand the processing mechanisms involved

Slide Credit: Kristen Grauman (UT Austin)

Computer **Vision Problems**

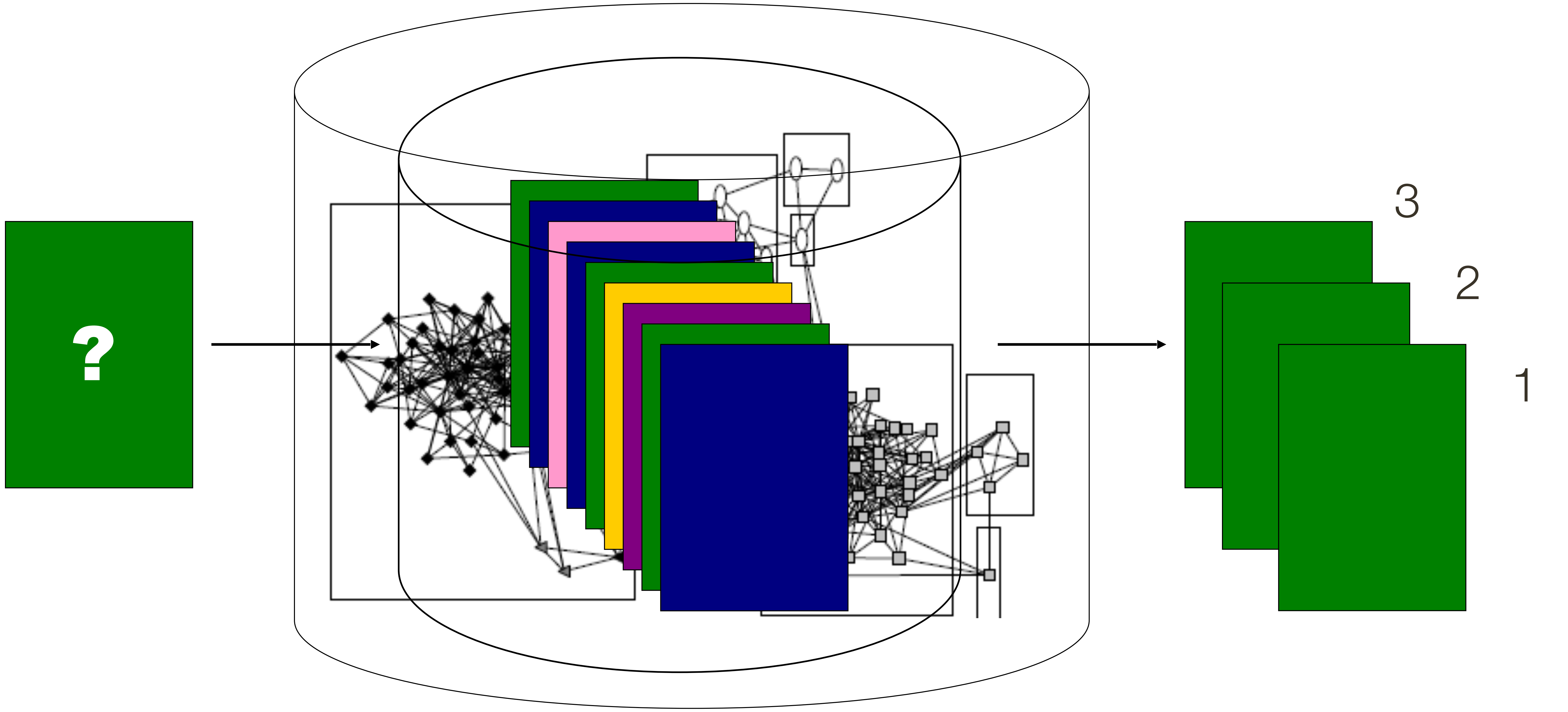
1. Computing properties of the 3D world from visual data (***measurement***)

2. Algorithms and representations to allow a machine to recognize objects, people, scenes, and activities (***perception and interpretation***)

3. Algorithms to mine, search, and interact with visual data (***search and organization***)

Slide Credit: Kristen Grauman (UT Austin)

3. **Search and Organization**



Query **Image or video archives** **Relevant content**

Slide Credit: Kristen Grauman (UT Austin)

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Scale is enormous, explosion of visual content

Slide Credit: Kristen Grauman (UT Austin)

3. **Search and Organization**

*from iStock by GettyImages

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*from iStock by GettyImages

Snapchat	WhatsApp	Facebook
31.7 Million / hour	**29.2 Million** / hour	**14.6 Million** / hour

Instagram	Flickr	YouTube
2.9 Million / hour	**0.2 Million** / hour	**18K hours** / hour

*based on article by Kimberlee Morrison in Social Times (2015)

3. **Search and Organization**

*from iStock by GettyImages

> 85% of all web content is multimedia content of visual form

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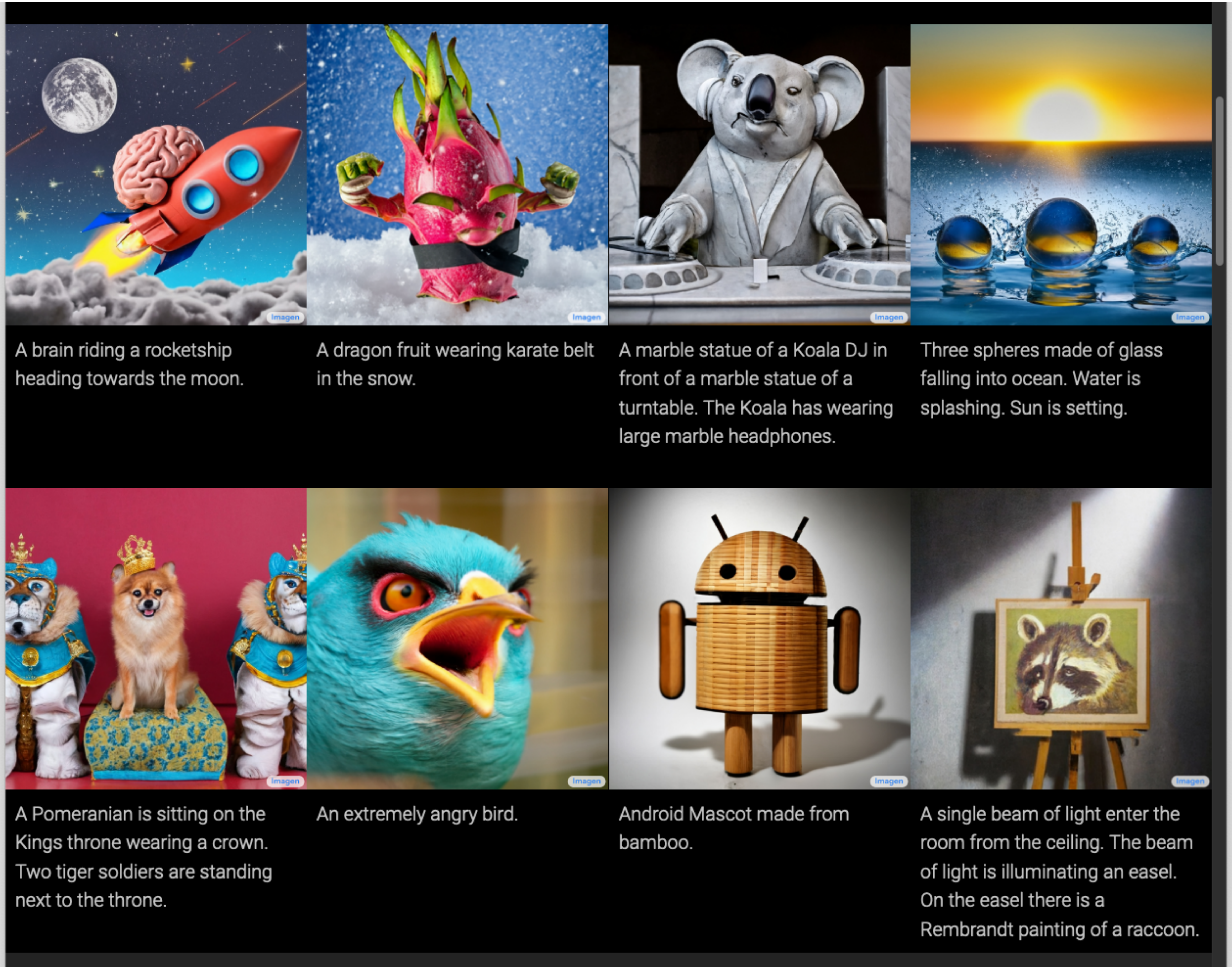
3. Algorithms to mine, search, and interact with visual data (***search and organization***)

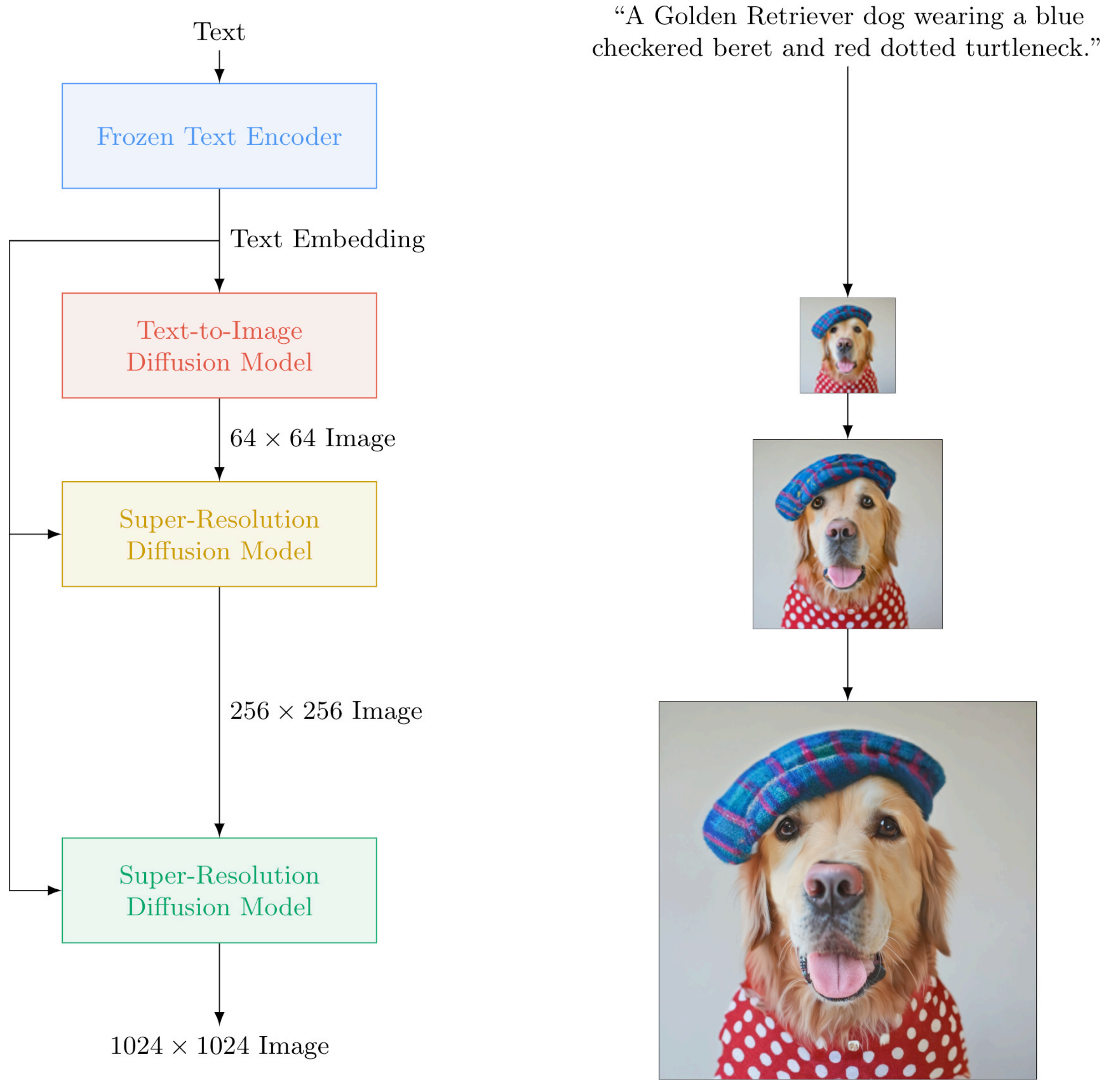
4. Algorithms for manipulation or creation of image or video content (***visual imagination***)

Slide Credit: Kristen Grauman (UT Austin)

4. Visual **Imagination**



- imagen.research.google
- Text to image generation
- Uses diffusion process, training using large dataset of text (web scale) and image-text (400M) pairs



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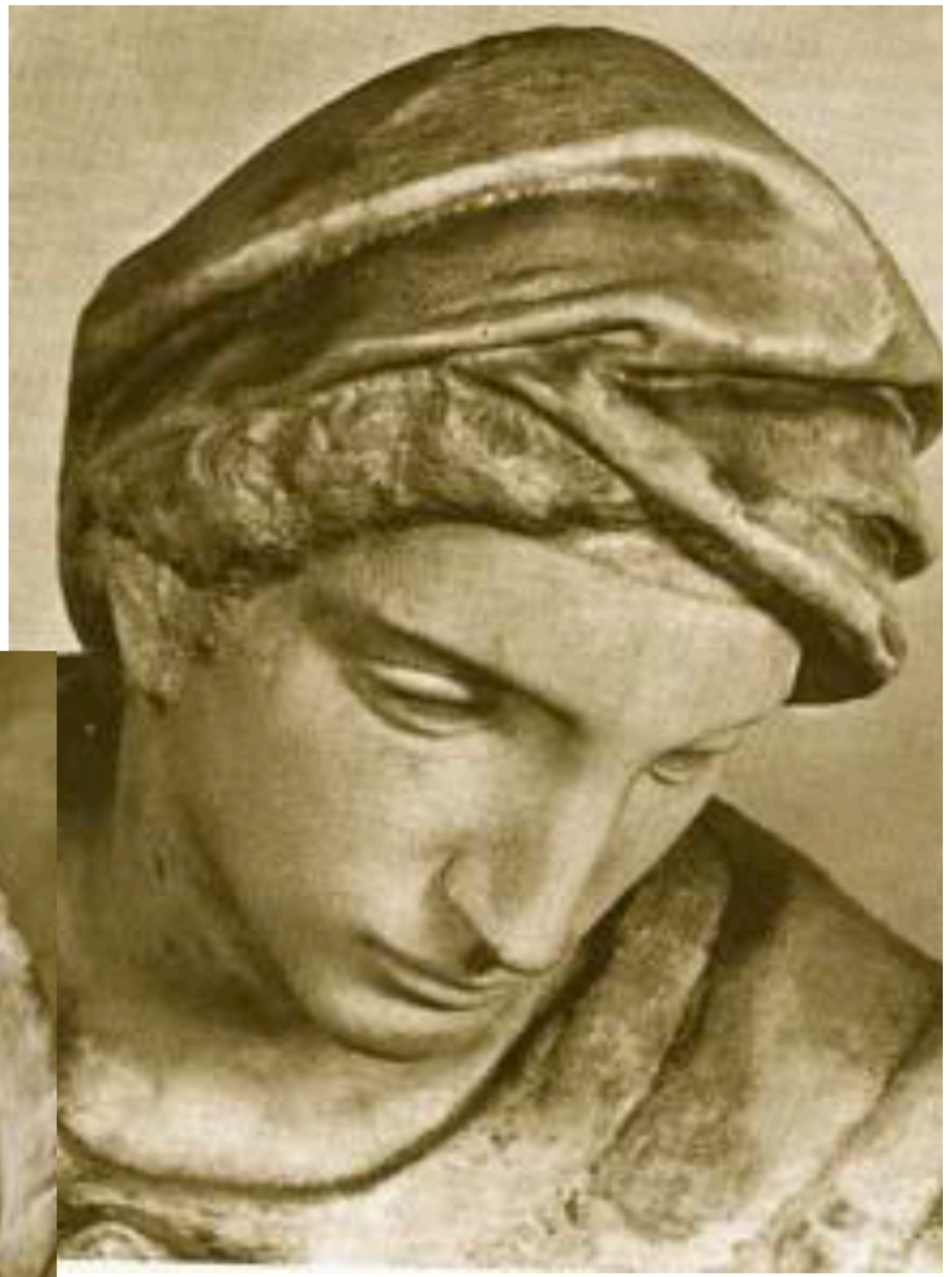
Slide Credit: Kristen Grauman (UT Austin)

Challenges: Viewpoint invariance



Michelangelo 1475-1564

*slide credit Fei-Fei, Fergus & Torralba

Challenges: Lighting

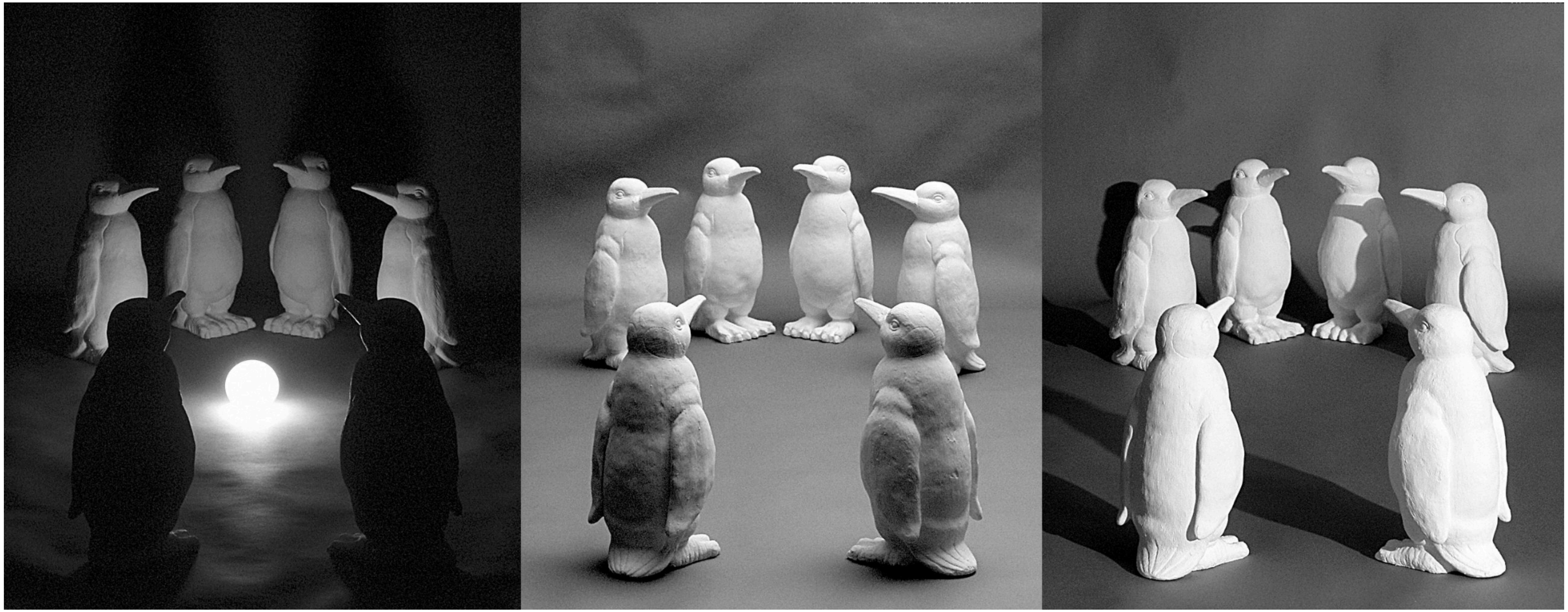


*image credit J. Koenderink

Challenges: Scale

*slide credit Fei-Fei, Fergus & Torralba

Challenges: Deformation

*image credit Peter Meer

Challenges: Occlusions

Rene Magritte 1965

Challenges: Background clutter

Kilmeny Niland 1995

Challenges: Local ambiguity and context

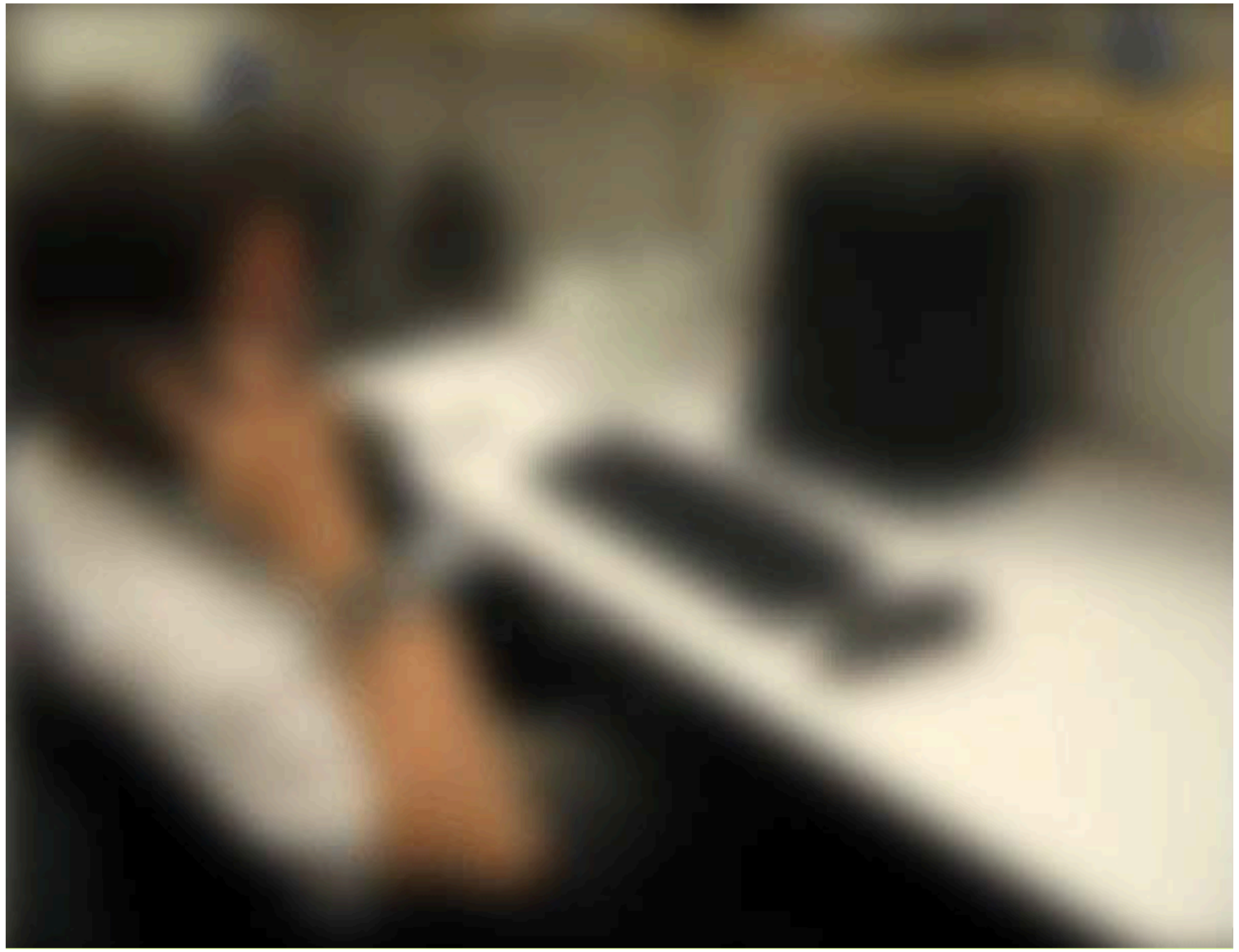


*image credit Fergus & Torralba

Challenges: Local ambiguity and context

*image credit Fergus & Torralba

Challenges: Motion

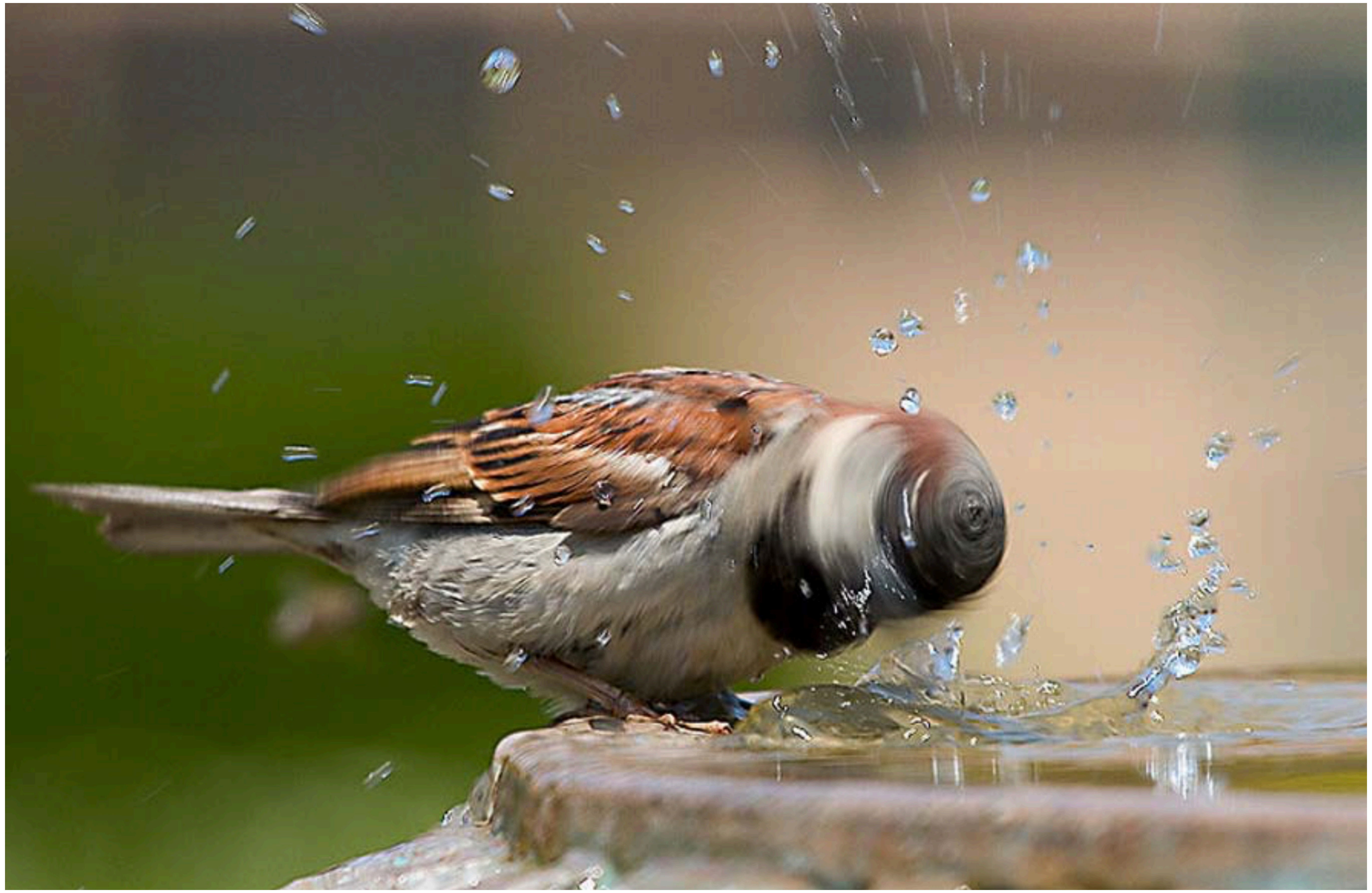


*image credit Peter Meer

Challenges: Object inter-class variation

*slide credit Fei-Fei, Fergus & Torralba

Computer Vision **Applications**

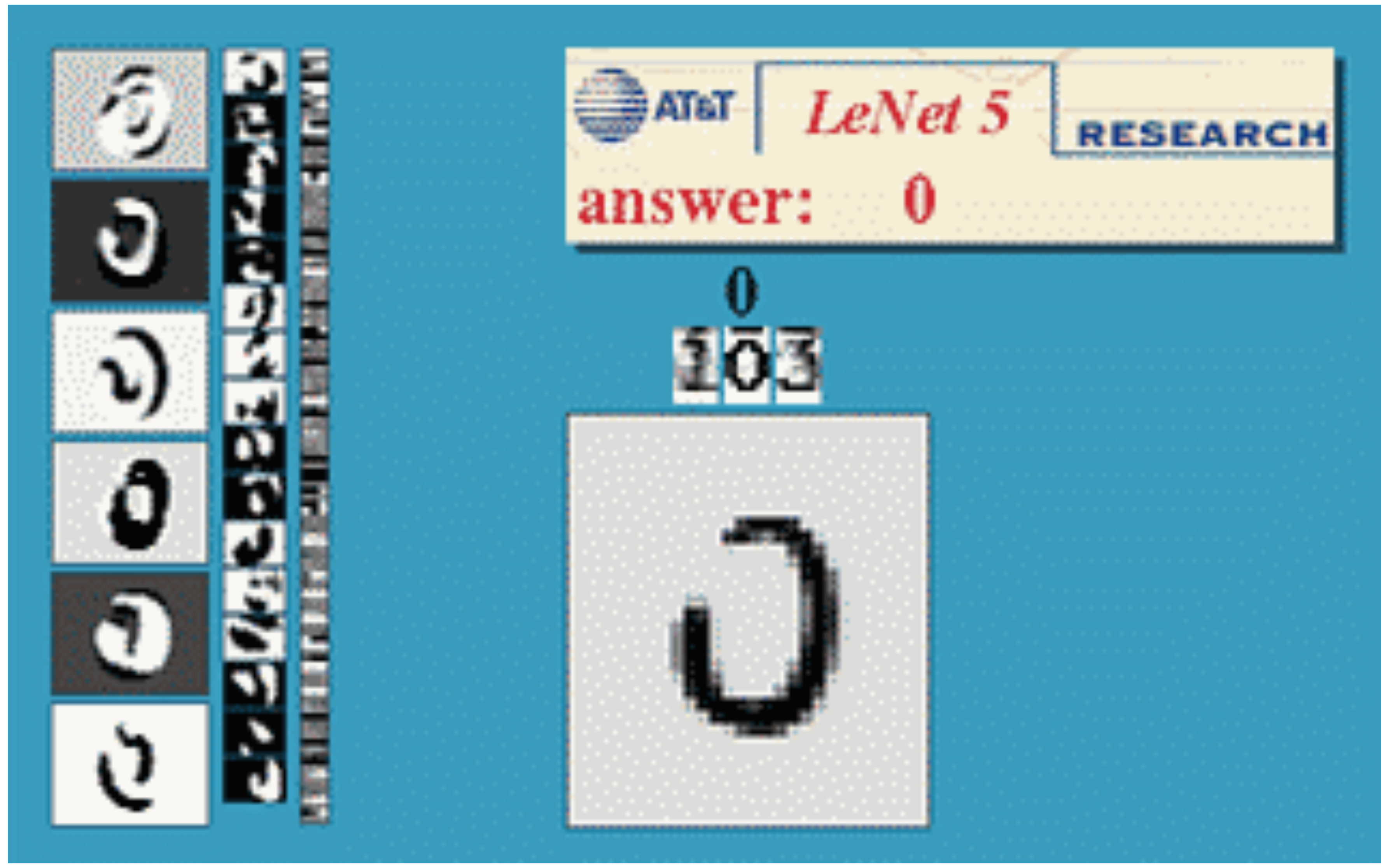
- Let's see some examples of state-of-the-art and where it is used

Optical Character Recognition (**OCR**)

Technology to convert **scanned documents to text**

(comes with any scanner now days)

Yann LeCun



Digit recognition, AT&T labs
http://www.research.att.com/~yann/

License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

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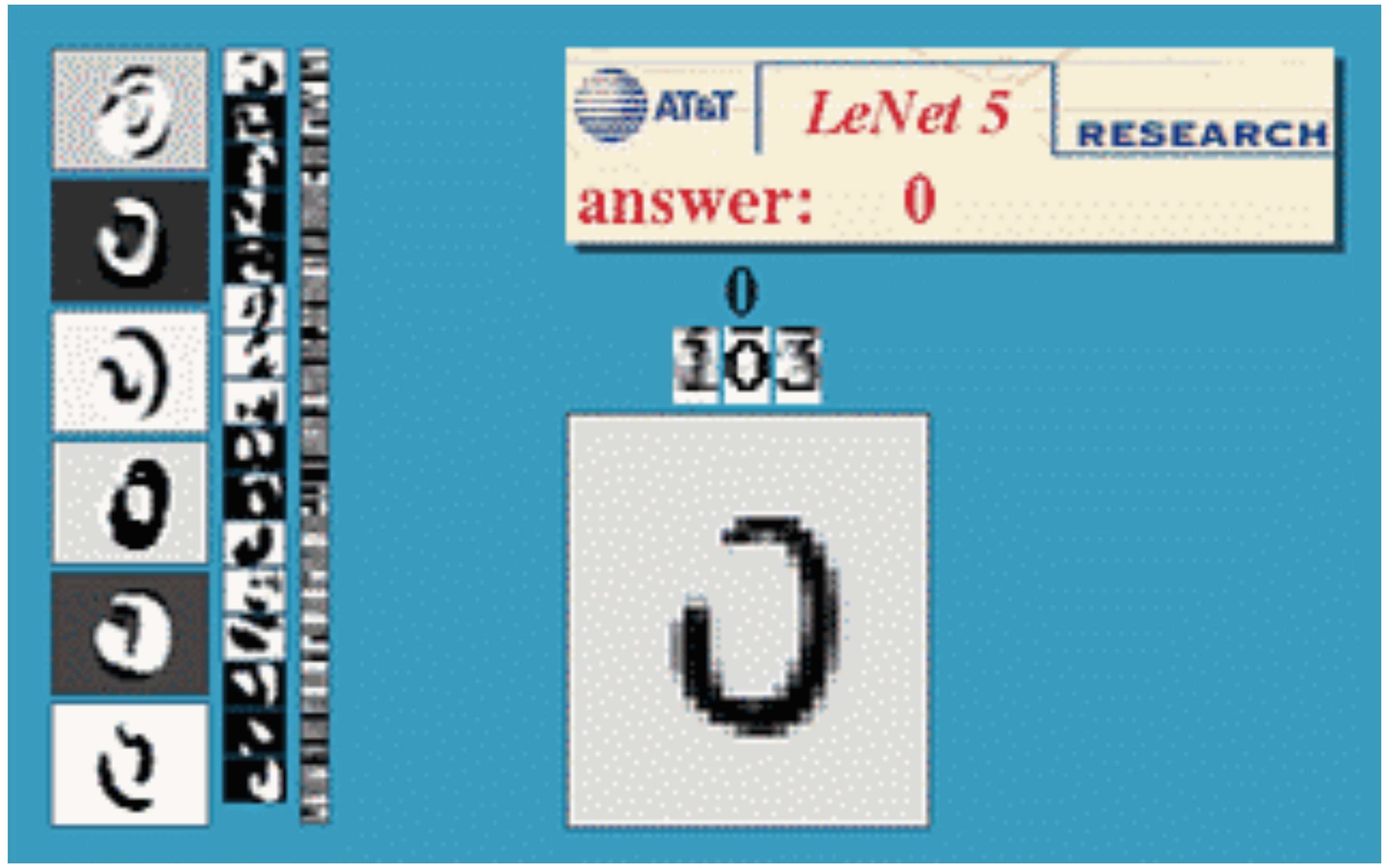


Digit recognition, AT&T labs
http://www.research.att.com/~yann/

License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Face **Detection**

Technology available in any digital camera now

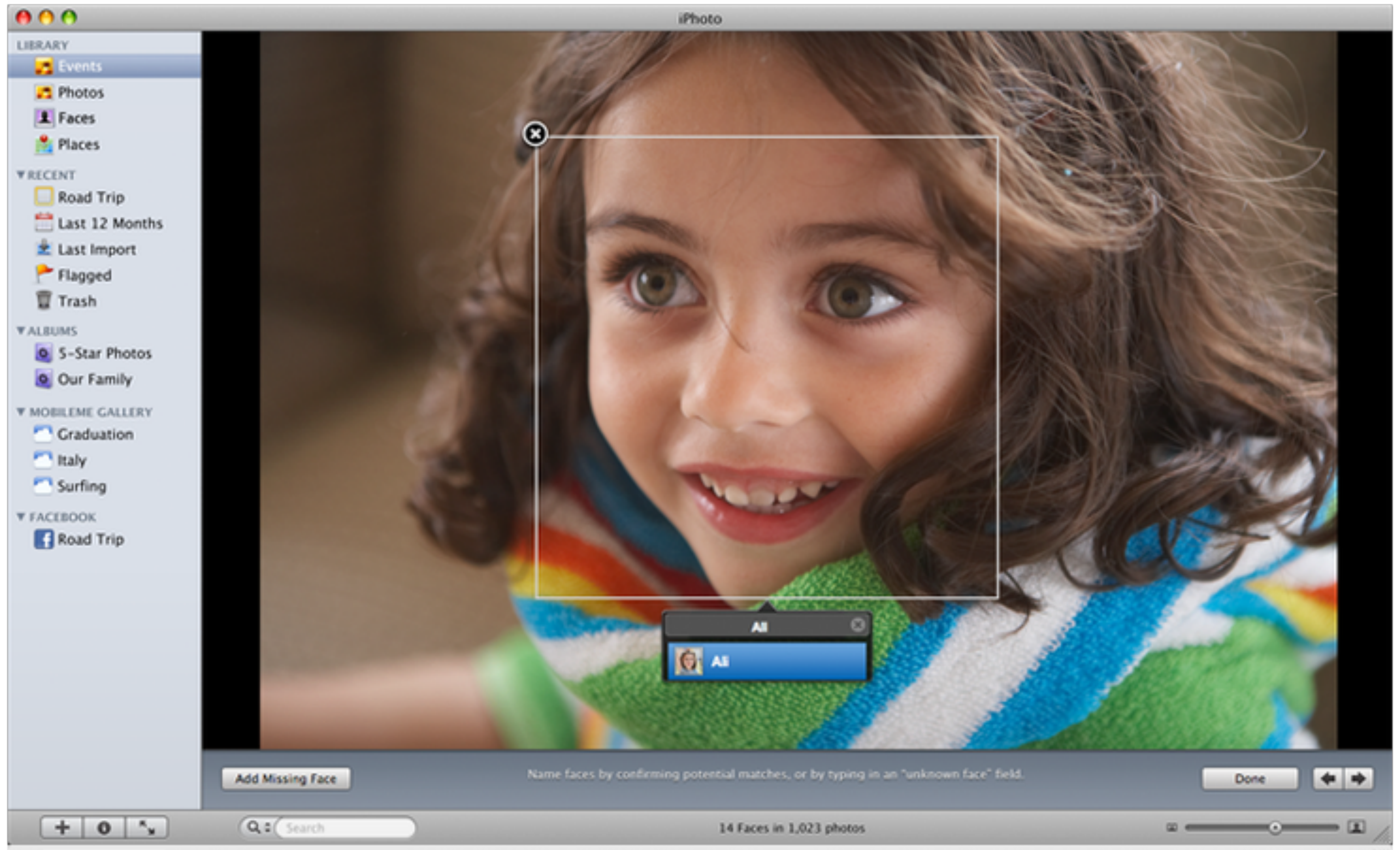
(one of the first big commercial successes of vision algorithms)

[Motorola]

Face **Recognition**

Facebook

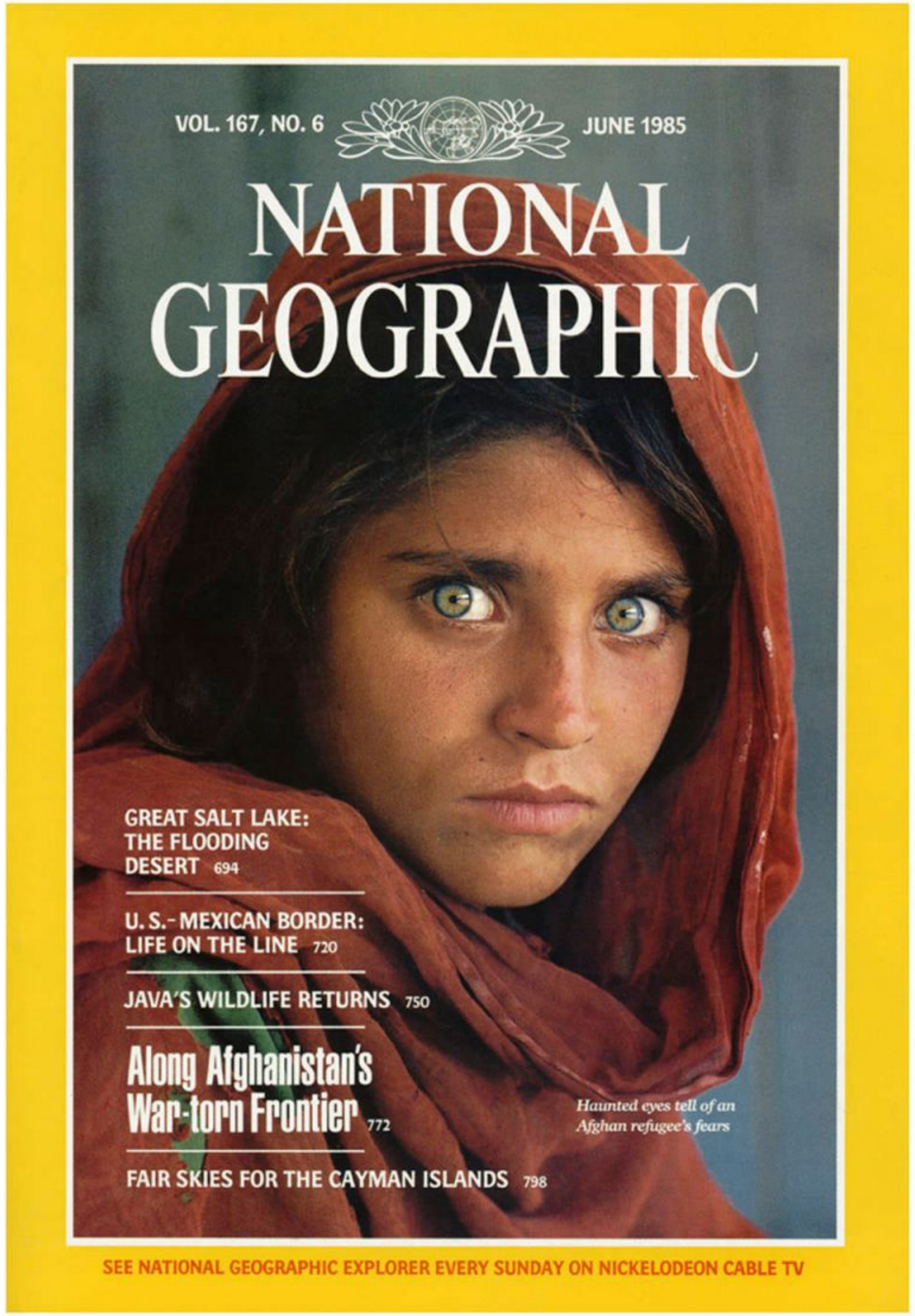
Apple's iPhoto

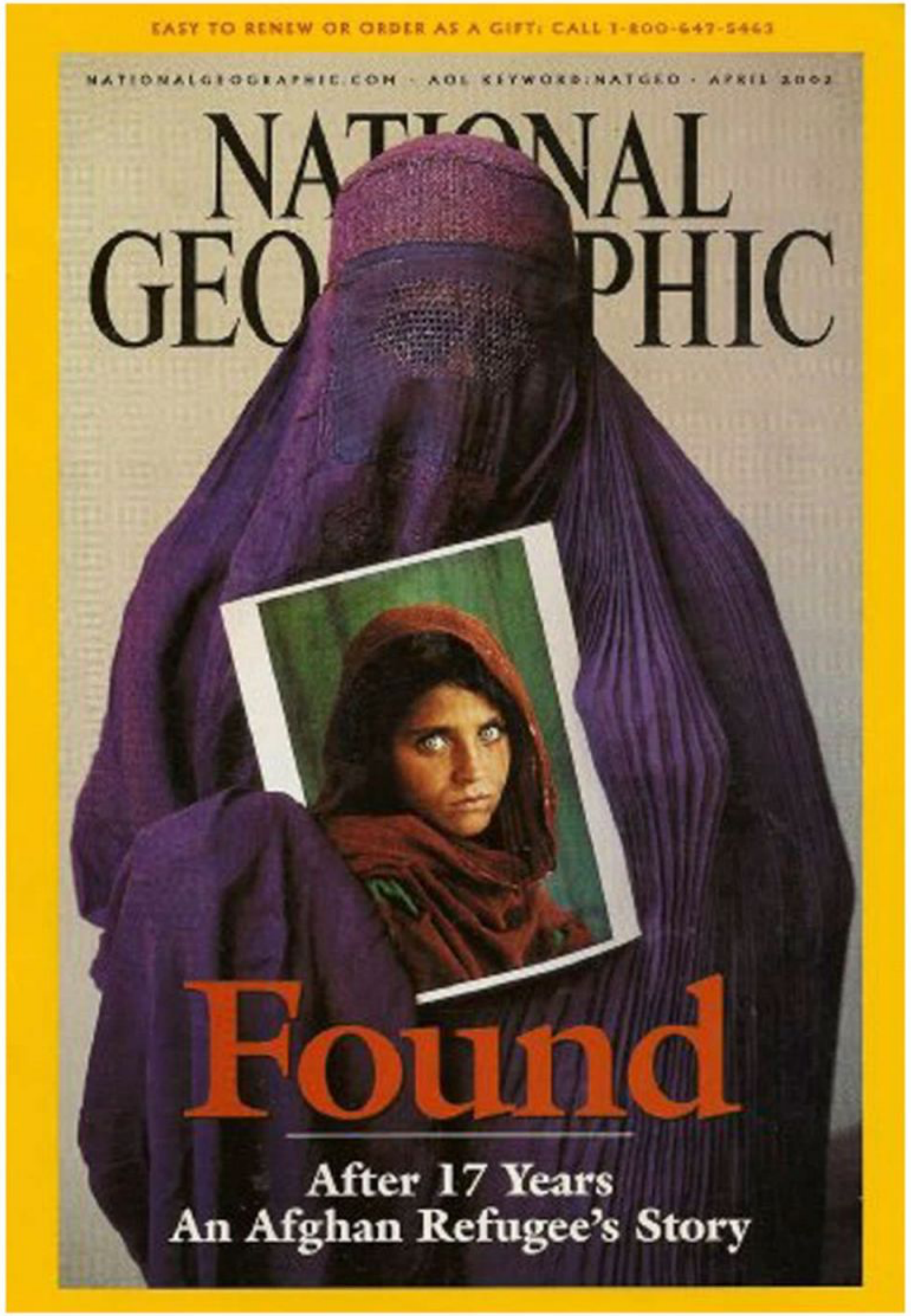


http://www.apple.com/ilife/iphoto/

Slide Credit: Devi Parikh (GA Tech) and Fei-Fei Li (Stanford)

Vision for **Biometrics** (e.g. Afghan Girl)



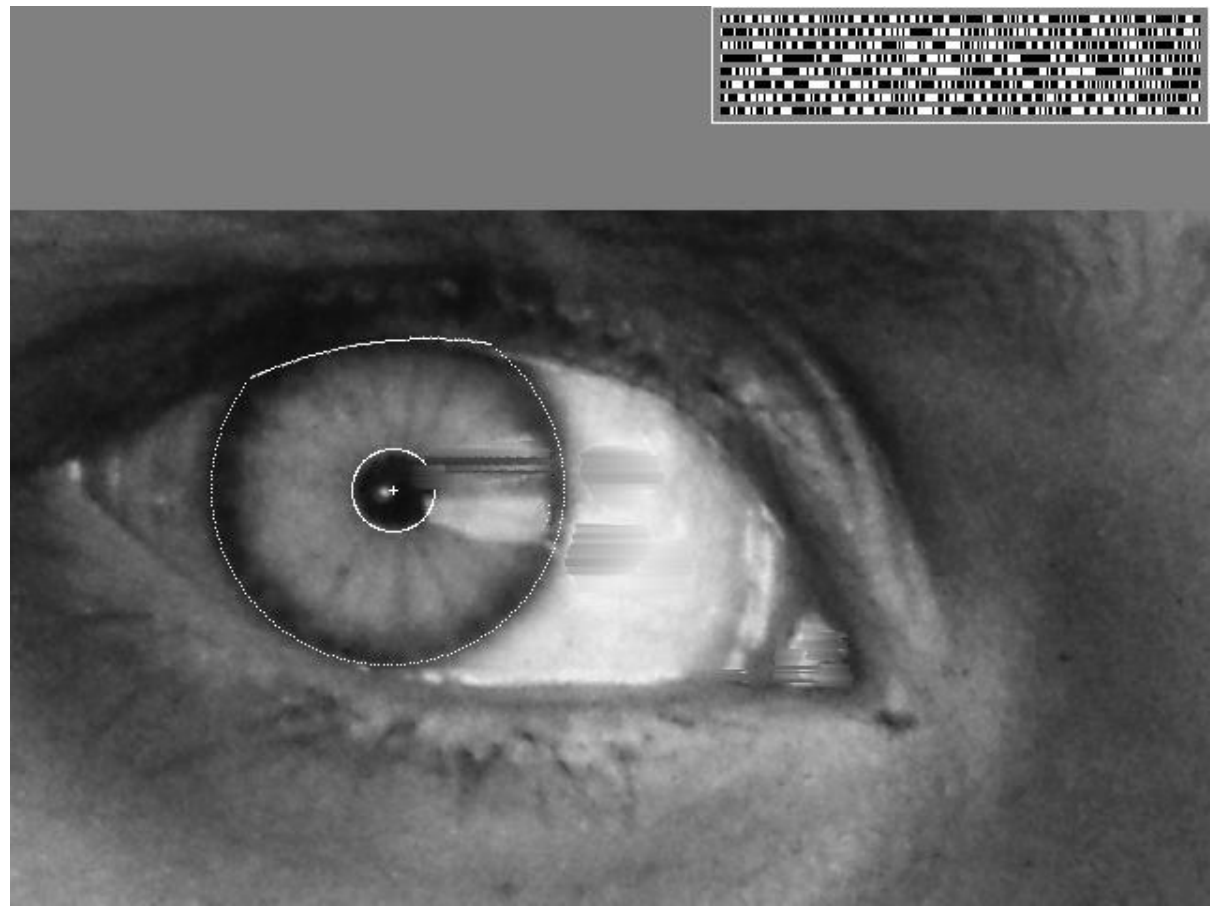


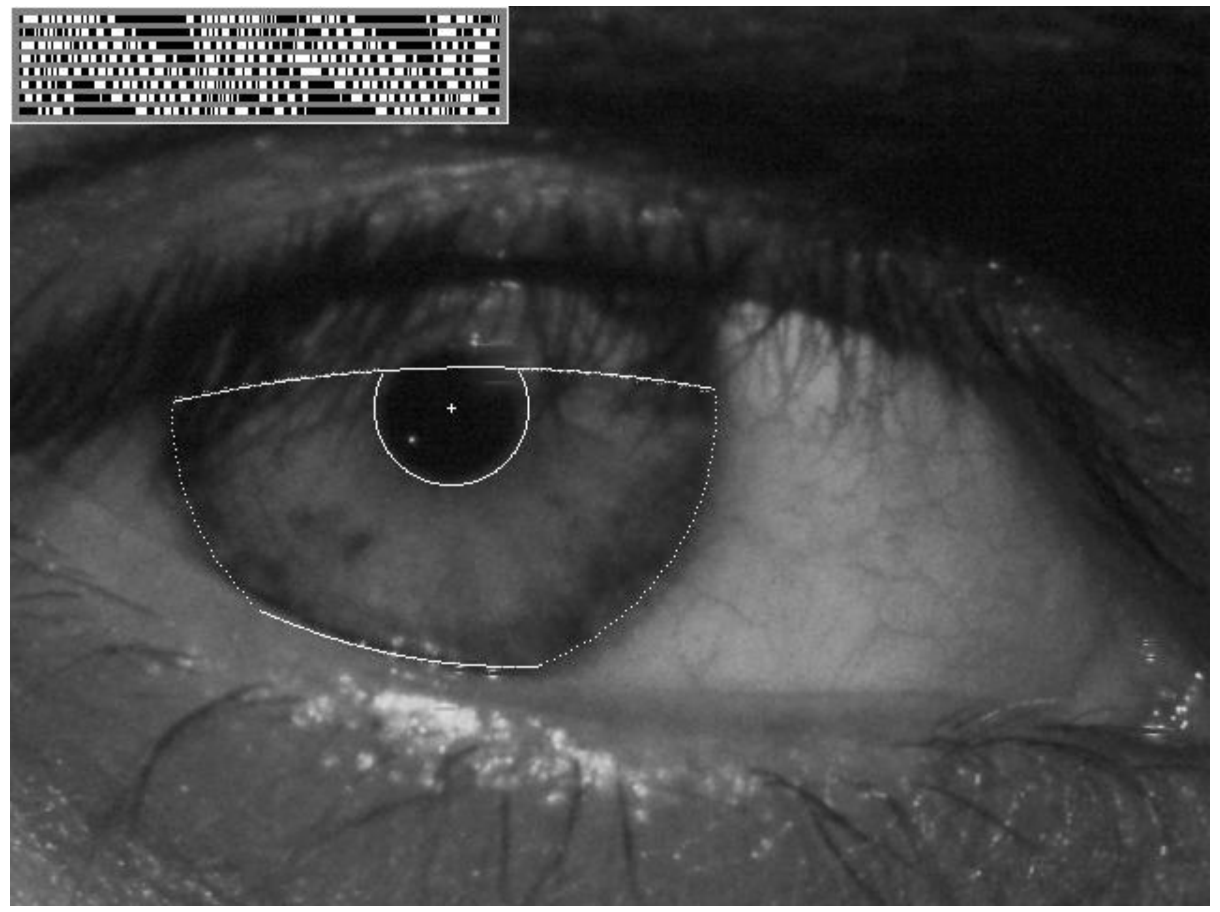
Age 12, 1984, Pakistan

Age 29, 2002

Vision for **Biometrics** (e.g. Afghan Girl)

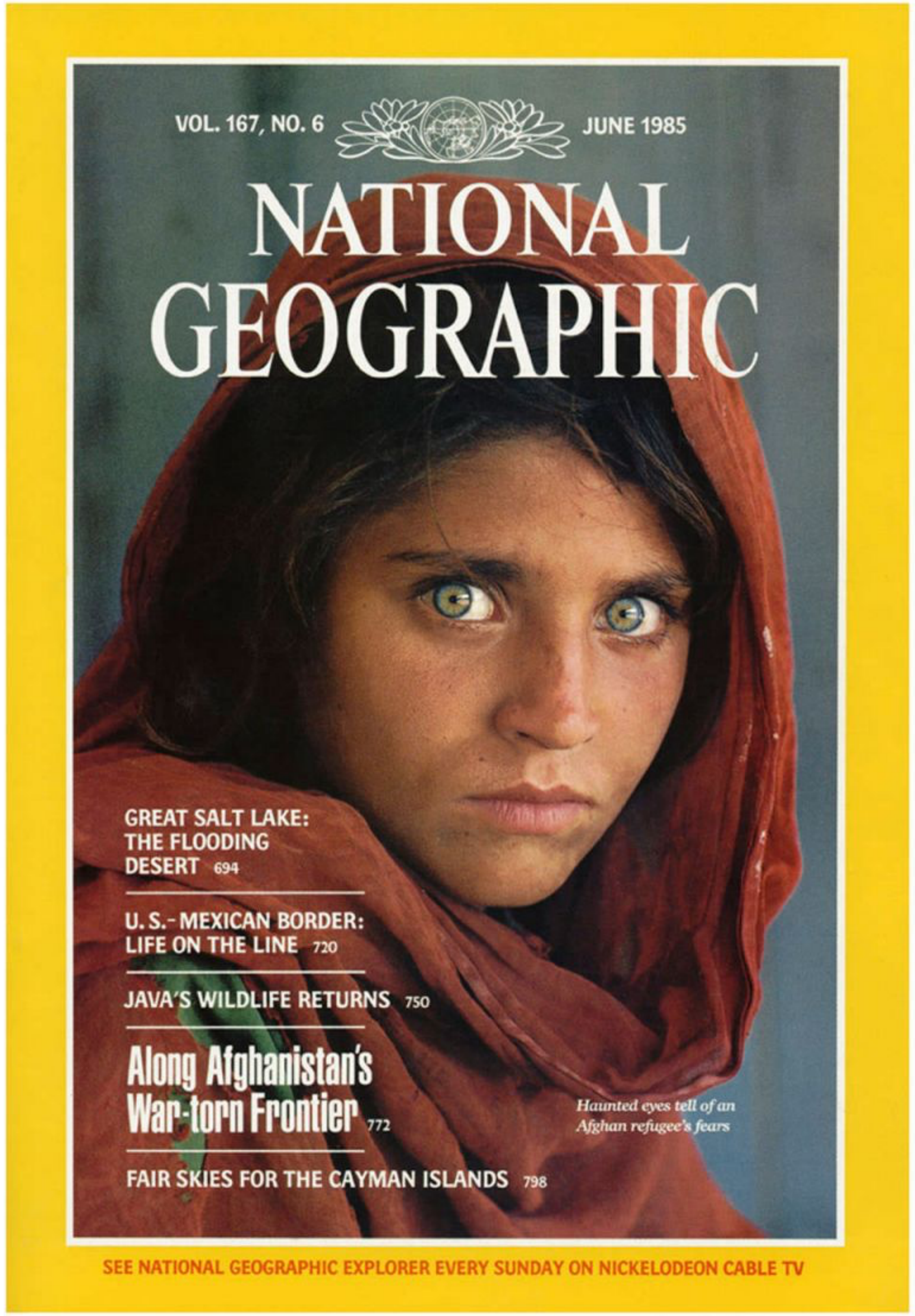
“How the Afghan Girl was Identified by Her Iris Patterns” Read the story wikipedia

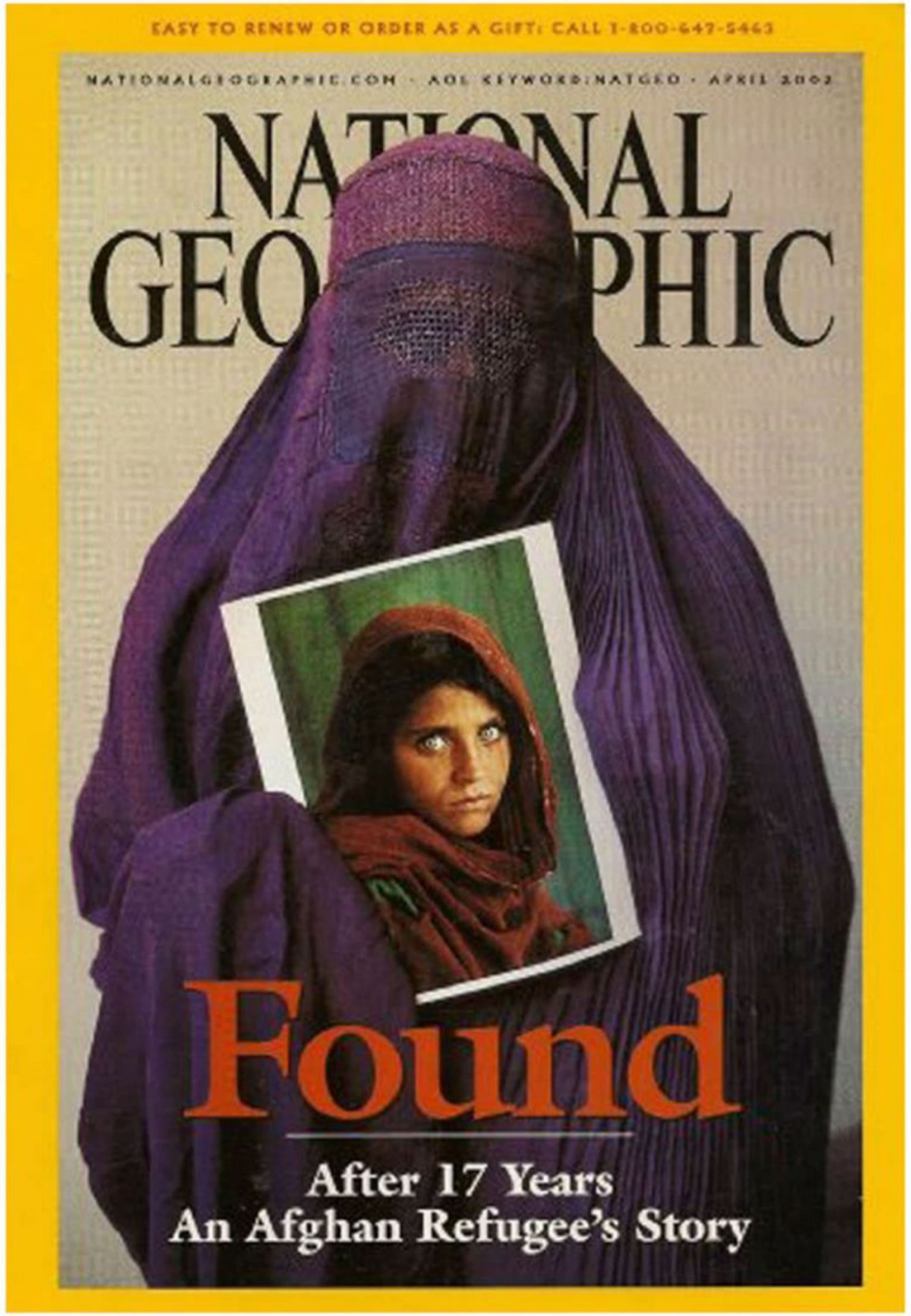




Slide Credit: James Hays (GA Tech)

Vision for **Biometrics** (e.g. Afghan Girl)





Vision for **Biometrics**

Fingerprint scanners on many new laptops, other devices

iPhone X Face ID

Face recognition systems are not part of widely used technologies

How it works and how to fool it:

https://www.youtube.com/watch?v=FhbMLmsCax0

Image Credit: James Hays (GA Tech)

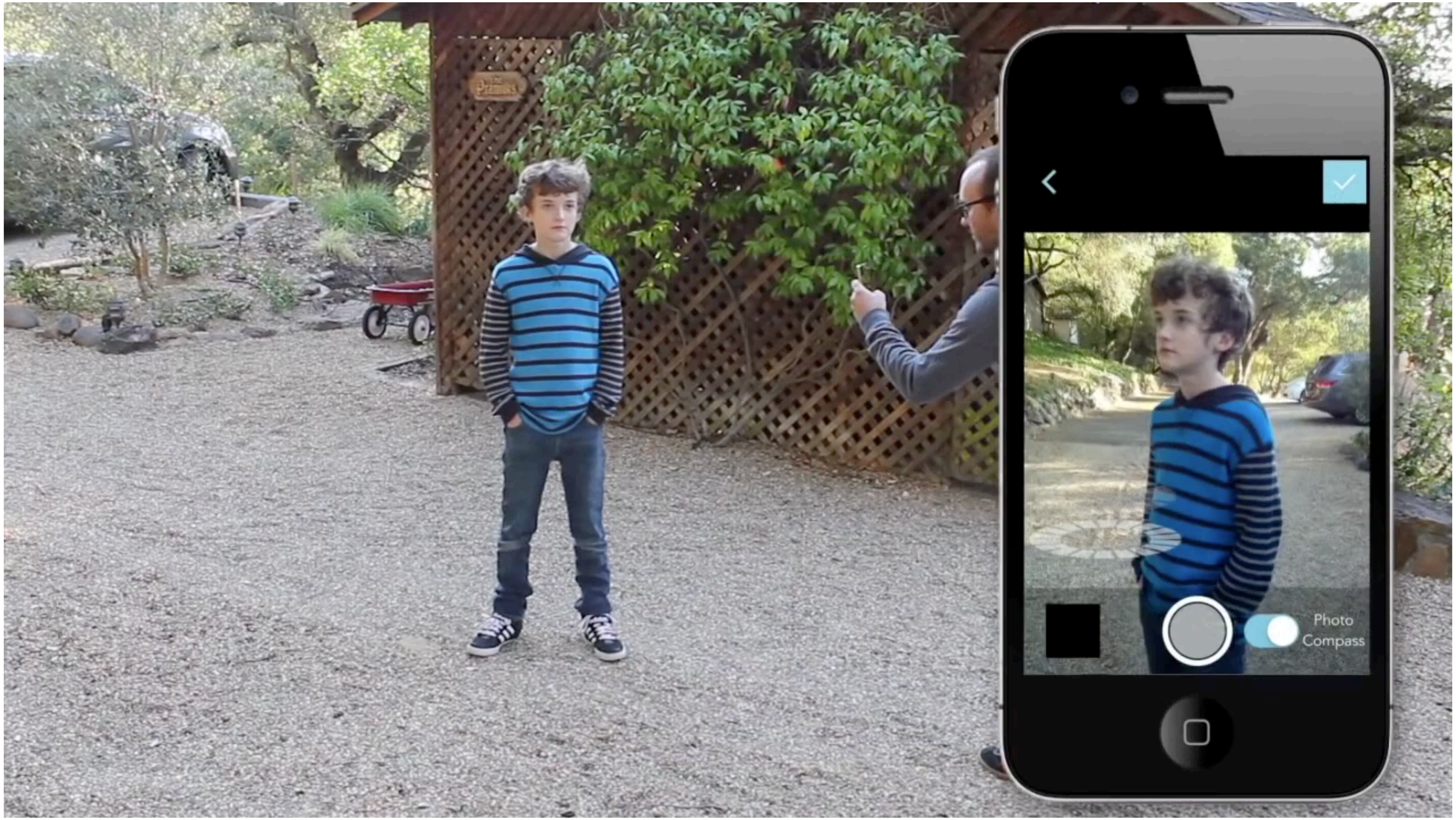
Camera **Tracking**

[Boujou — Vicon / OMG]

Camera **Tracking**

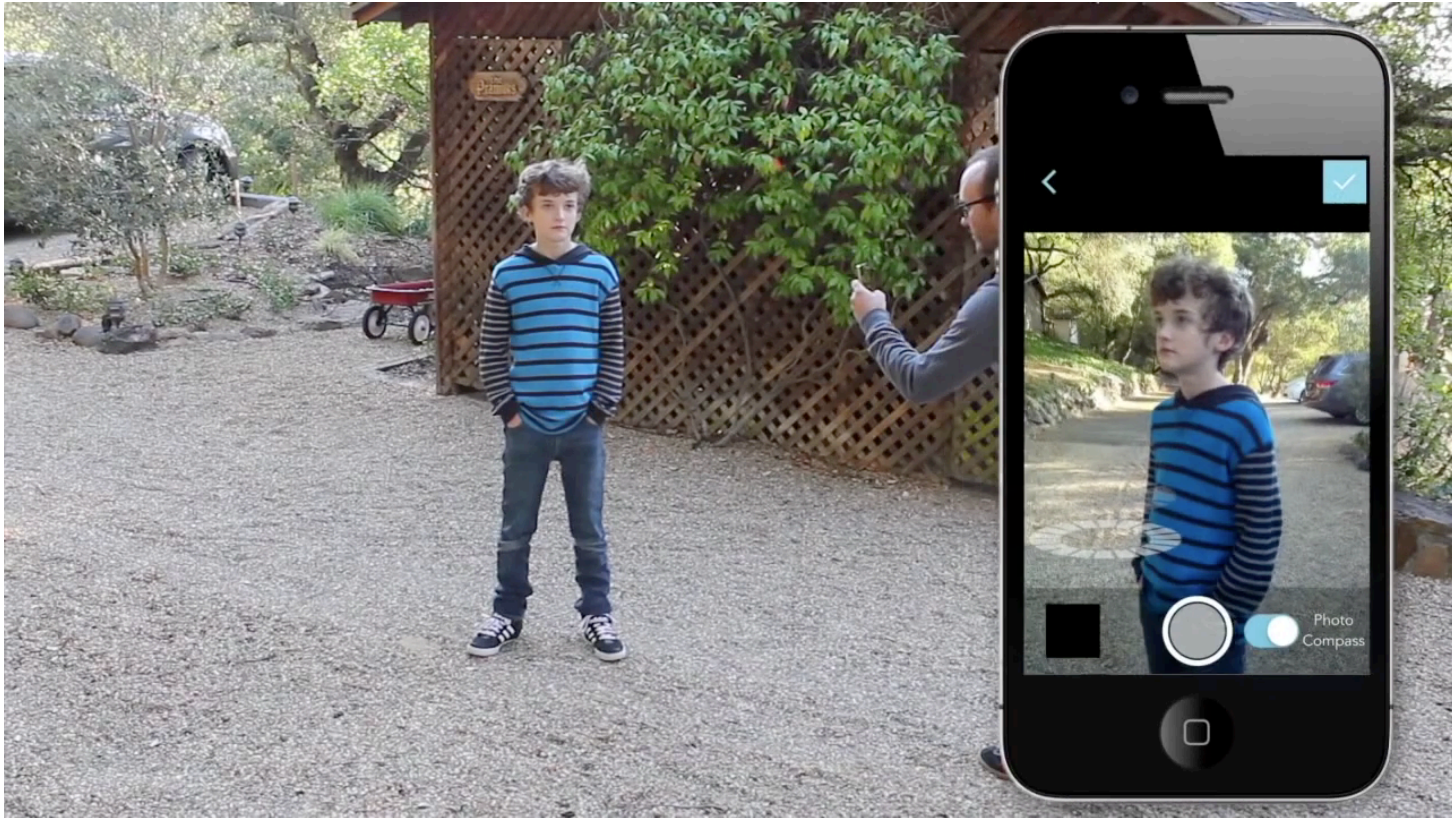
[Boujou — Vicon / OMG]

3D **Reconstruction**



[Autodesk 123D Catch]

3D **Reconstruction**

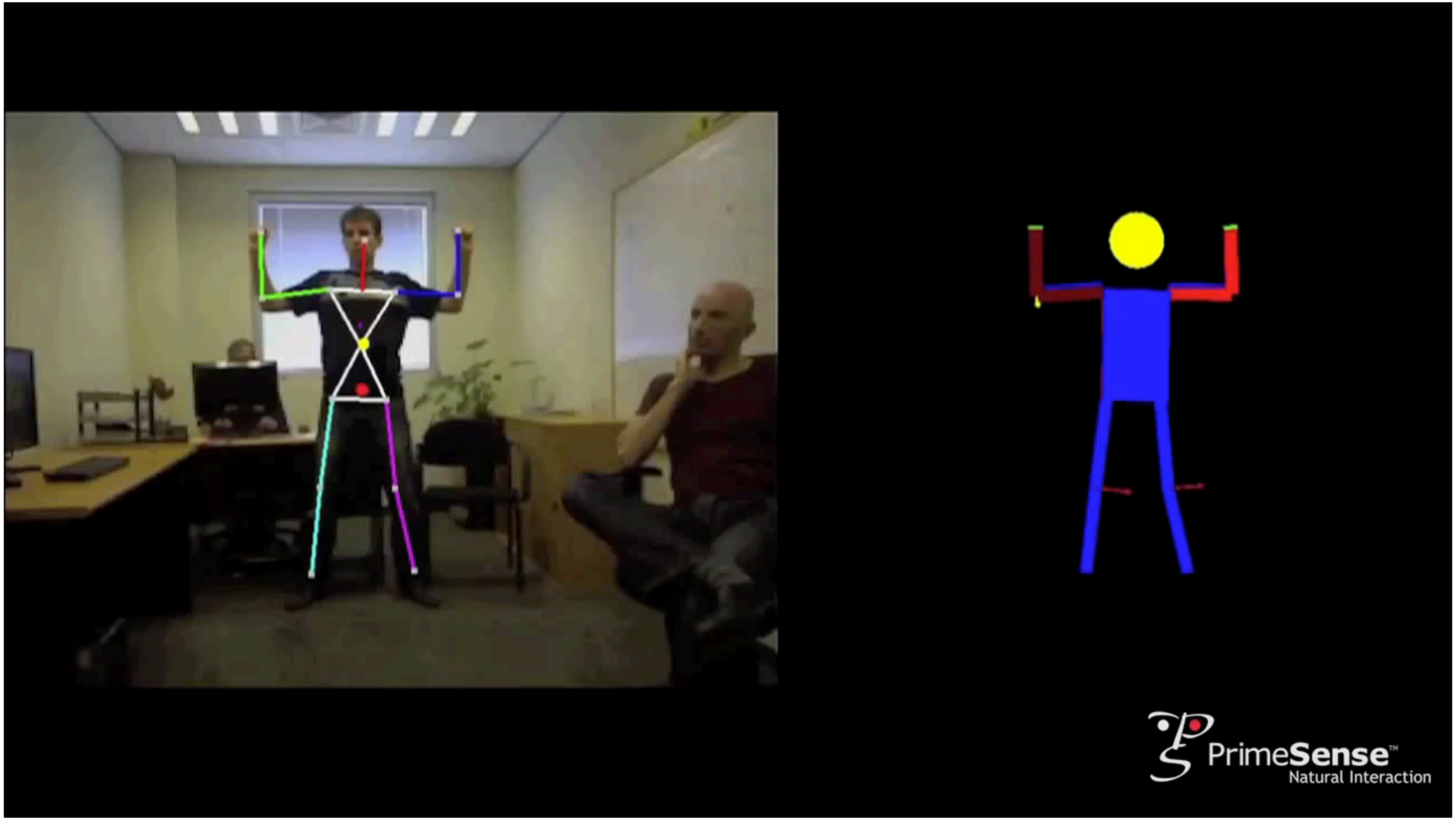


[Autodesk 123D Catch]

Body Pose Tracking

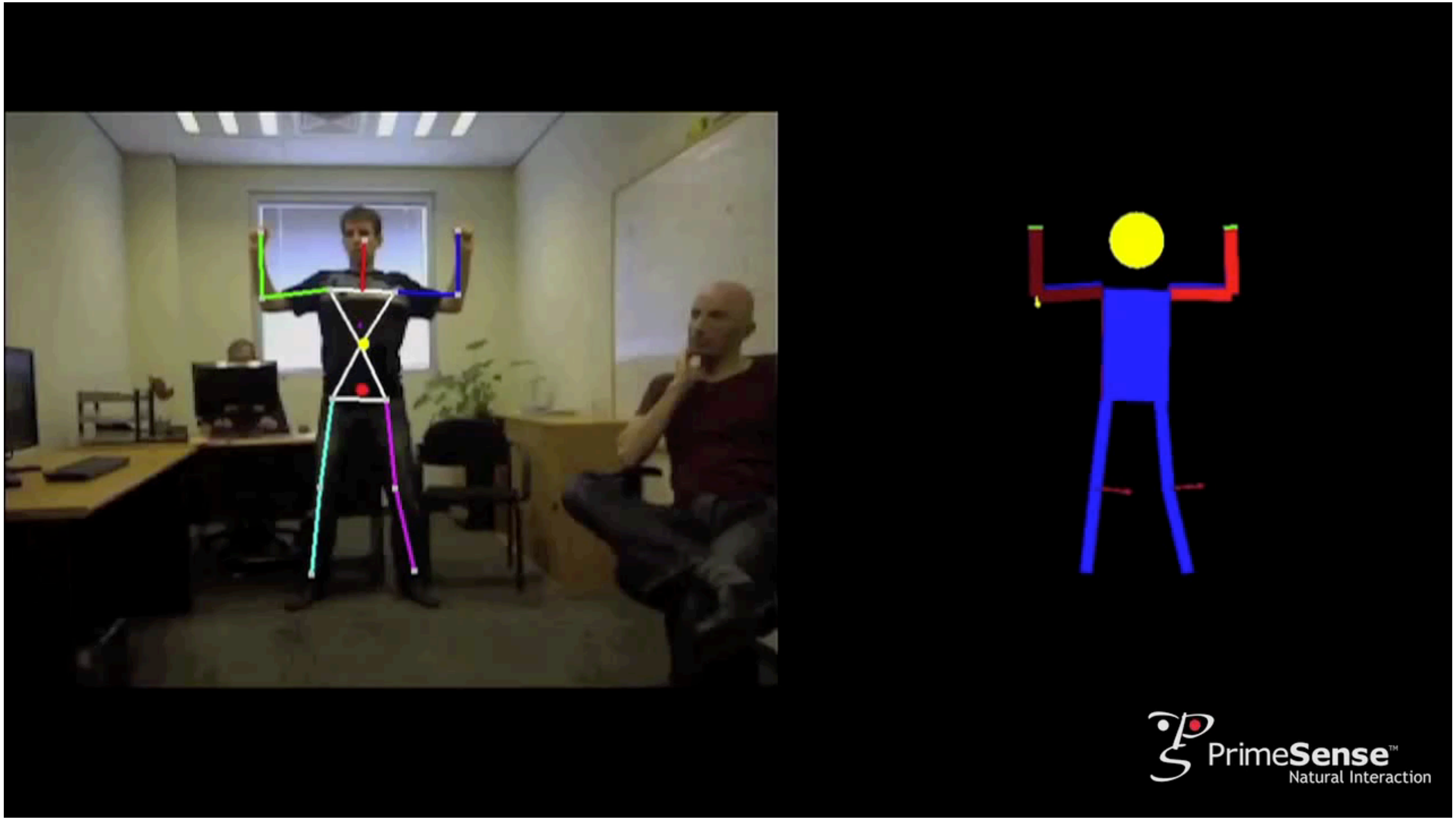
[Microsoft Xbox Kinect]

Body Pose Tracking



[PrimeSense]

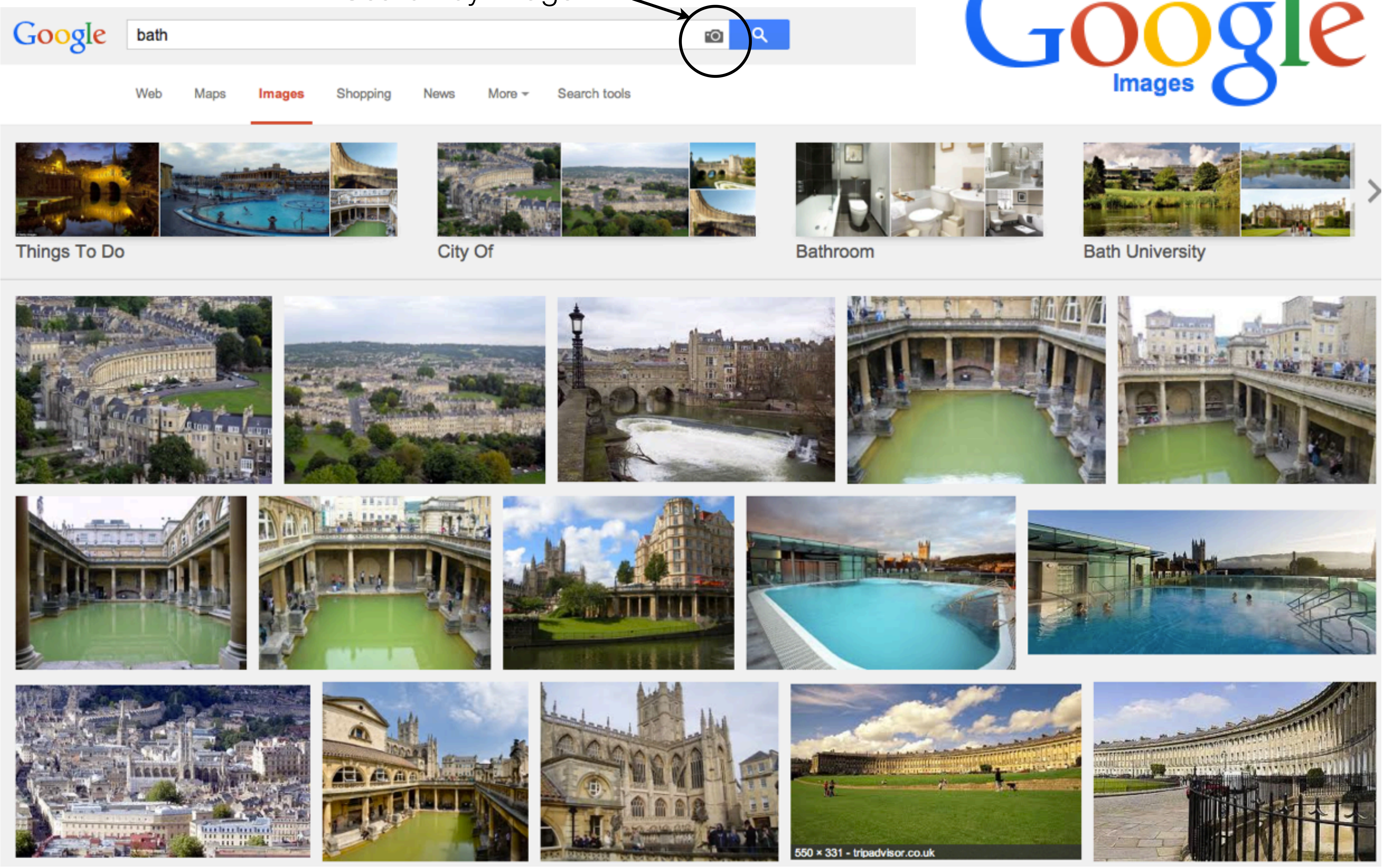
Body Pose Tracking



[PrimeSense]

Image **Recognition** and **Search**

Search by image



Self-Driving Cars

[Google]

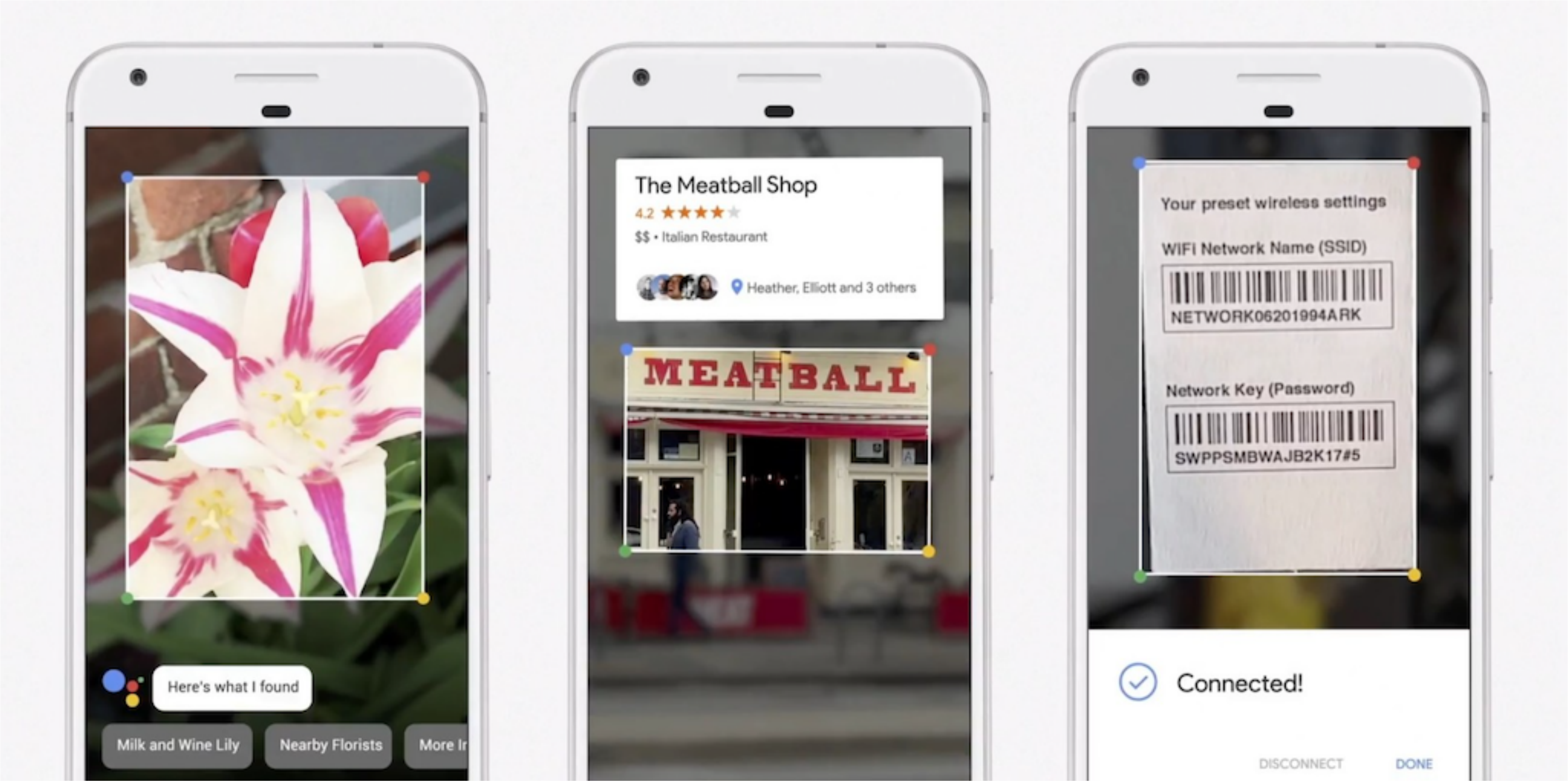
Flying Vehicles

www.skydio.com

AR / VR

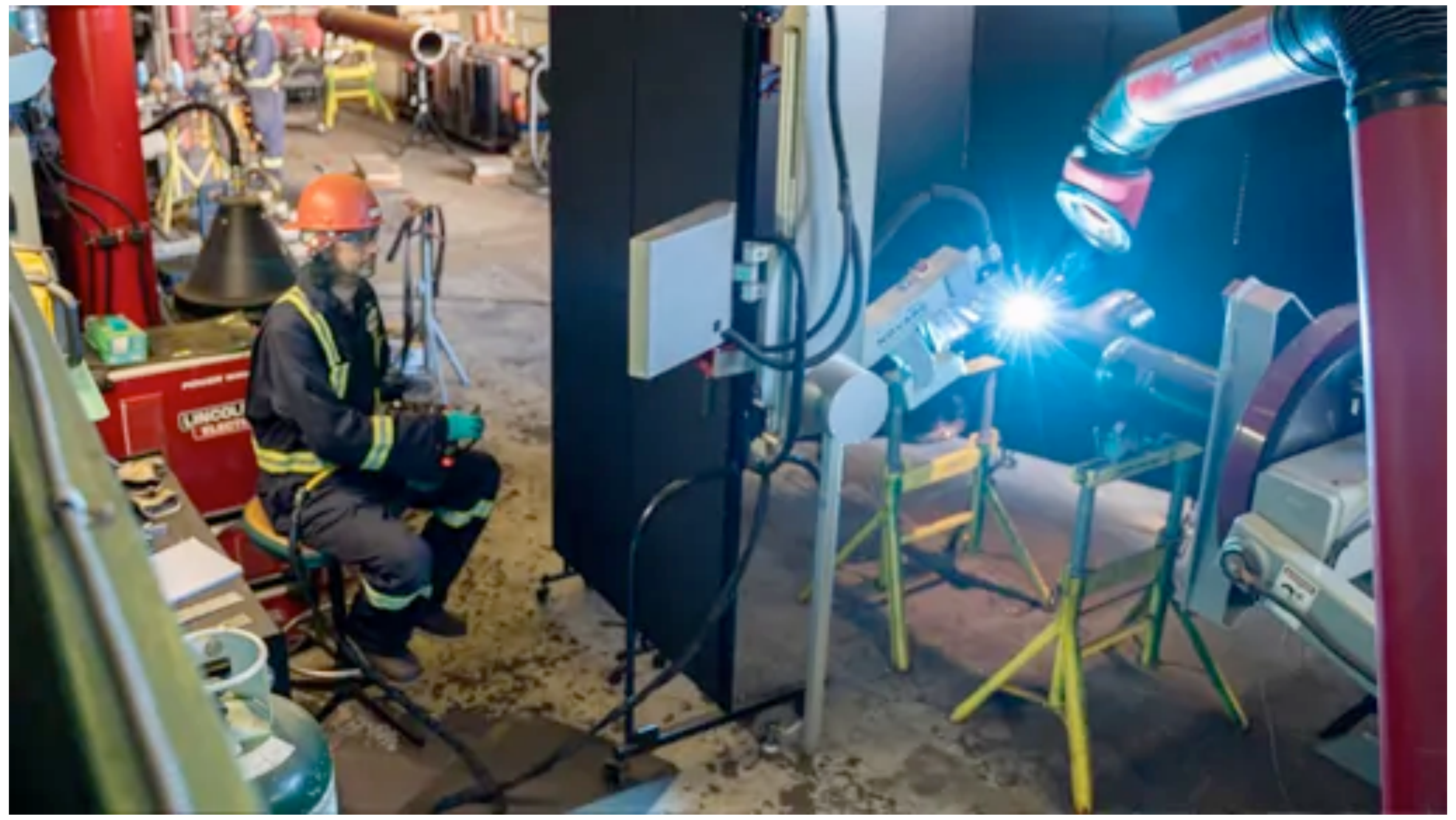
[Microsoft HoloLens]

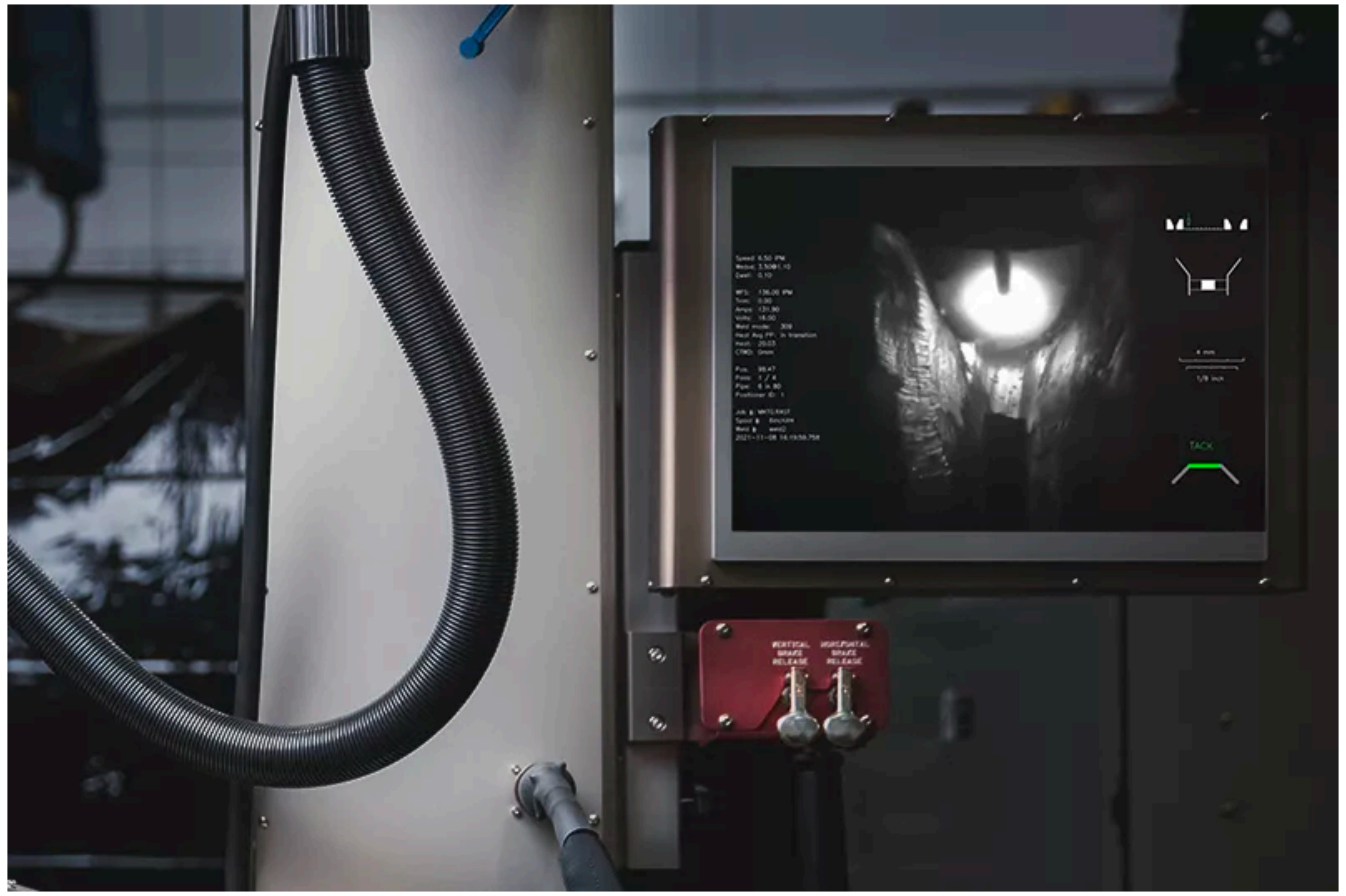
Mobile Apps



[Google Lens]

Industrial

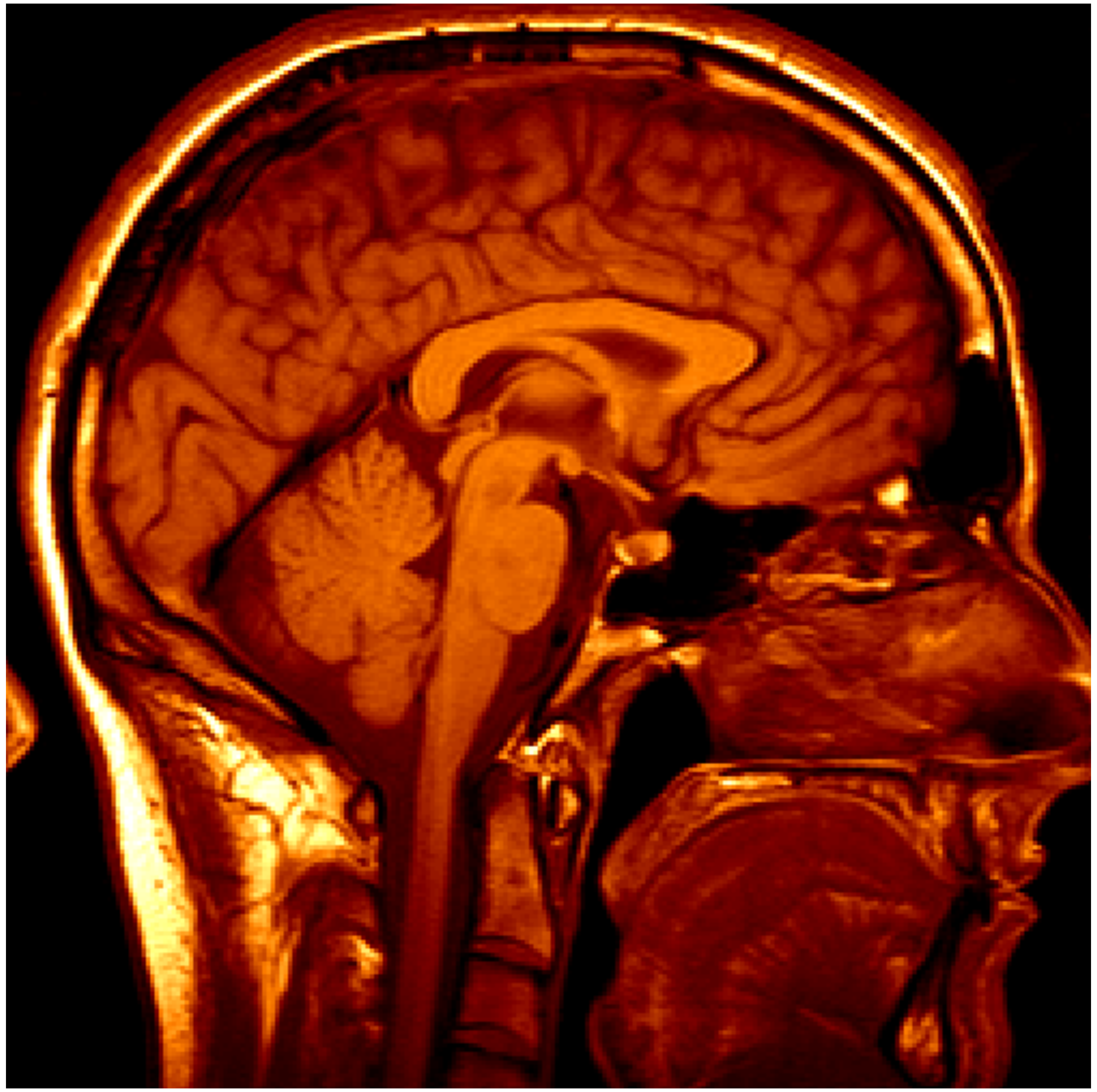




Machine Vision controlled welding robotics

NOVARC TECHNOLOGIES

Medicine

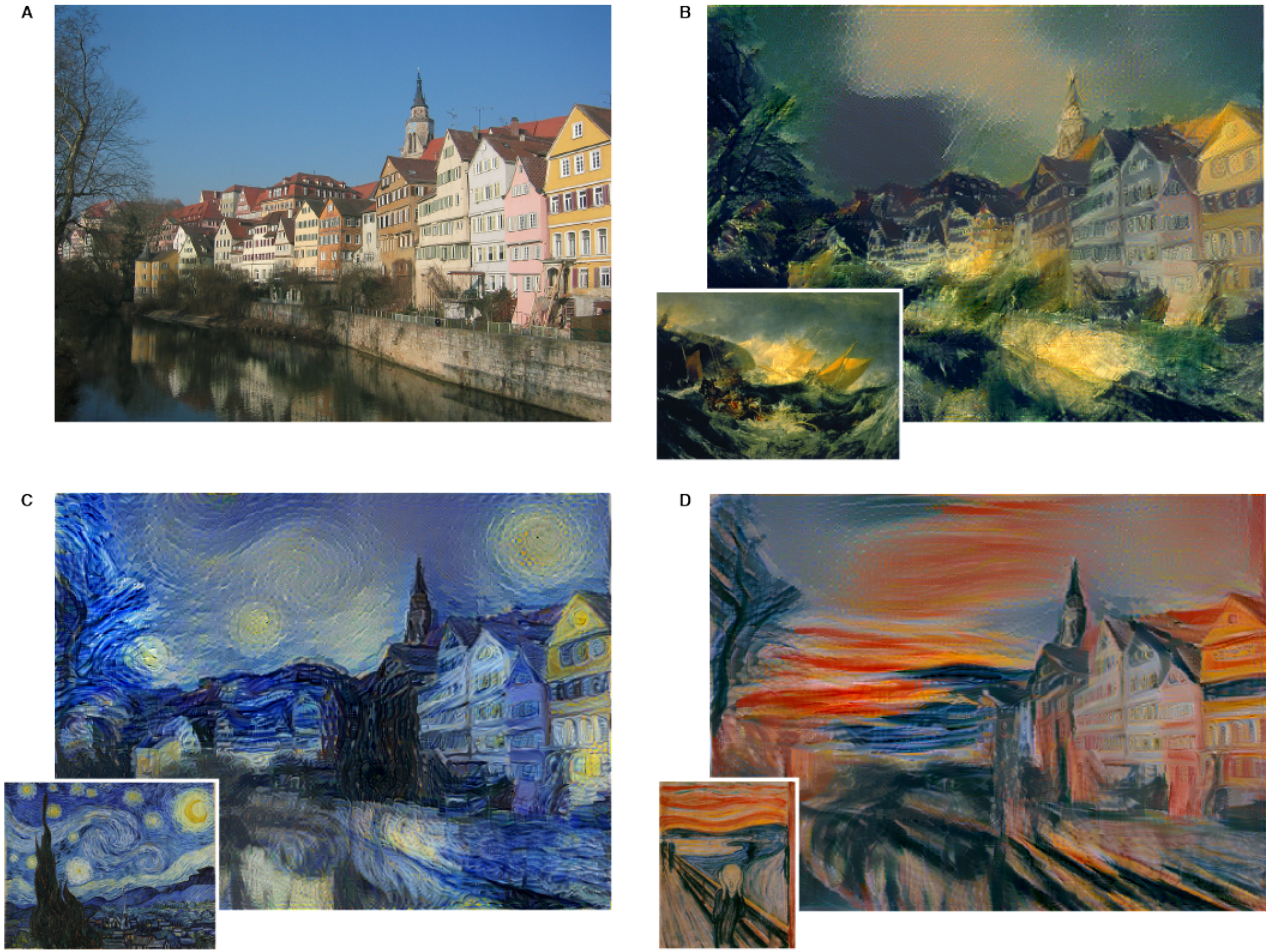


3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT

Slide Credit: James Hays (GA Tech)

Art



[Gatys, Ecker, Bethge 2015]

Art

TEXT DESCRIPTION

An astronaut   Teddy bears   A bowl of soup

riding a horse   lounging in a tropical resort in space   playing basketball with cats in space

in a photorealistic style   in the style of Andy Warhol   as a pencil drawing

→

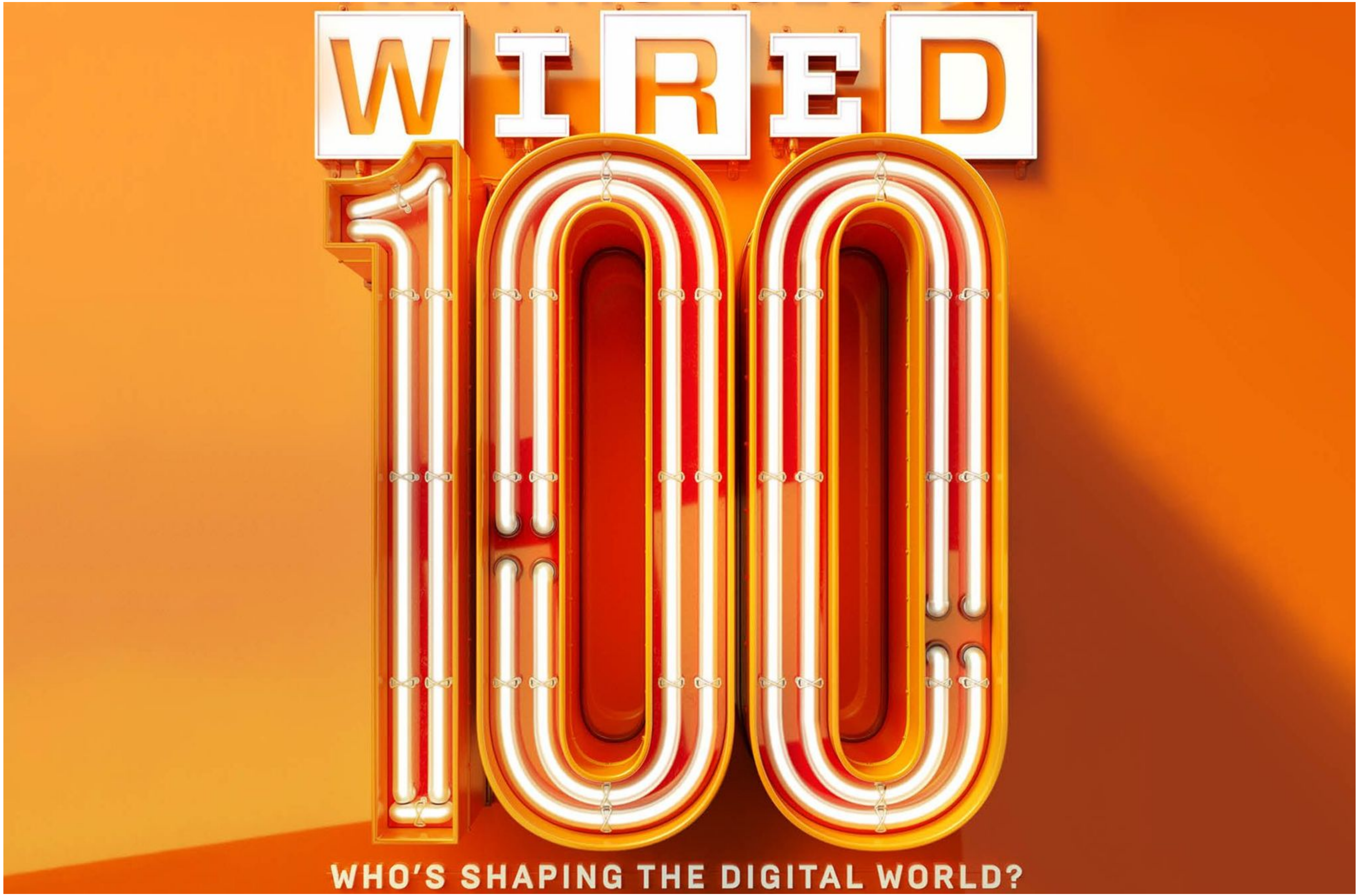
DALL·E 2

[Dall-E v2]

Why Study Computer Vision?

It is one of the **most exciting areas of research** in computer science

Among the **fastest growing technologies** in the industry today


WIRED
100
WHO'S SHAPING THE DIGITAL WORLD?

Wired's 100 **Most Influential People** in the World

63. Yann Lecun

Director of AI research, Facebook, Menlo Park

LeCun is a leading expert in deep learning and heads up what, for Facebook, could be a hugely significant source of revenue: understanding its user's intentions.

62. Richard Branson

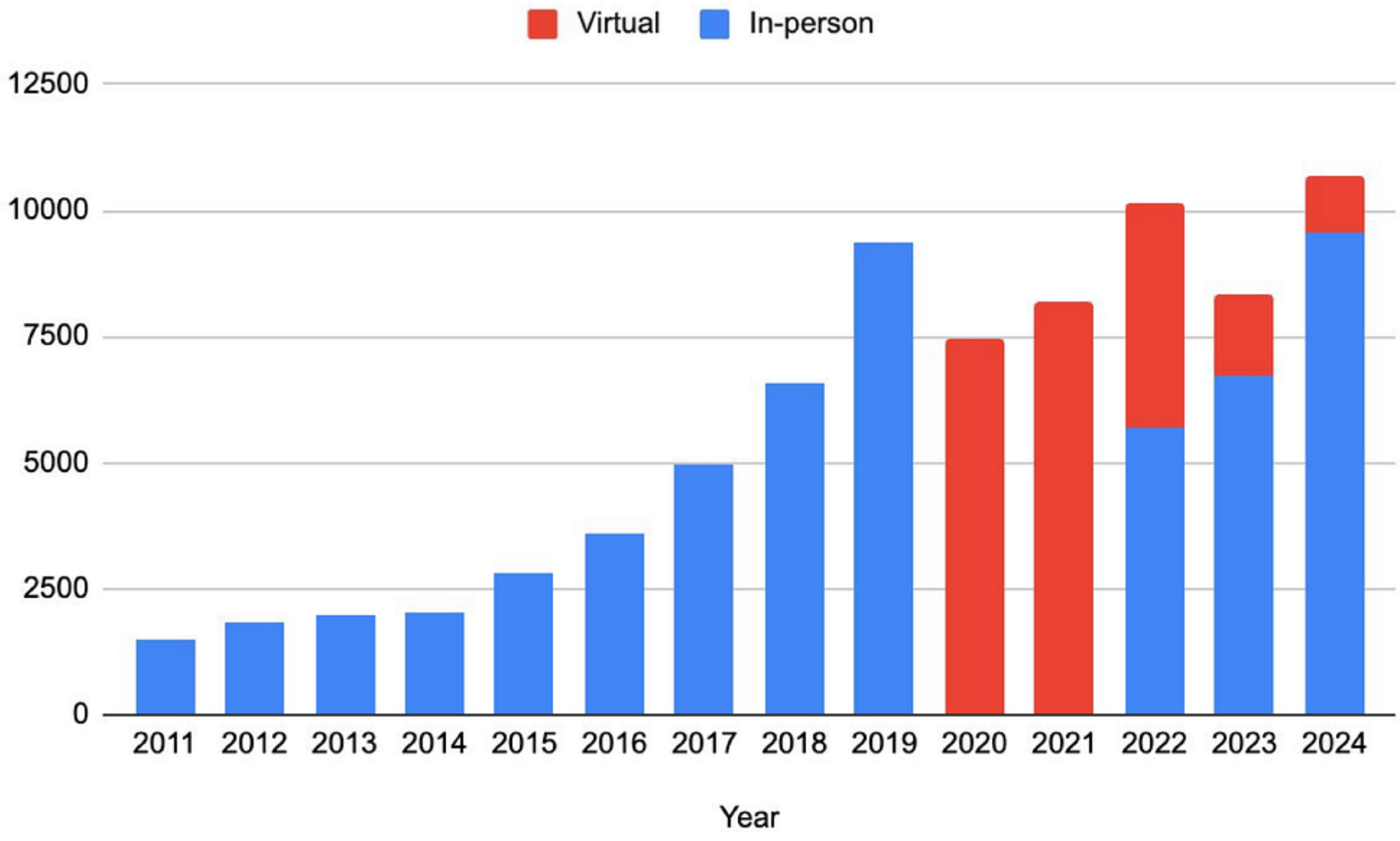
Founder, Virgin Group, London

Branson saw his personal fortune grow £550 million when Alaska Air bought Virgin America for $2.6 billion in April. He is pressing on with civilian space travel with Virgin Galactic.

61. Taylor Swift

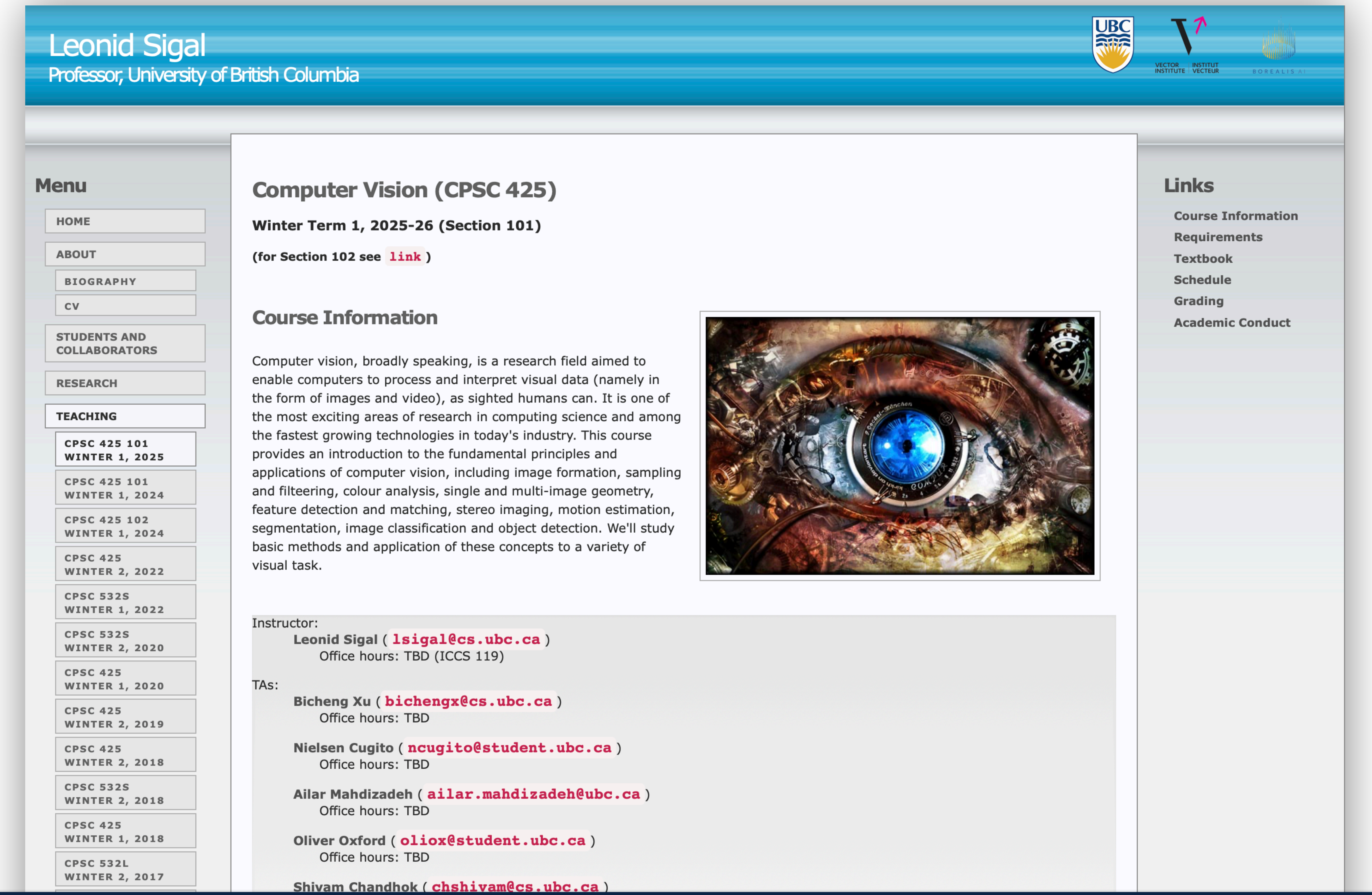
Entertainer, Los Angeles

CVPR **Attendance**



*As of 6/12

Course **Schedule**



Leonid Sigal
Professor, University of British Columbia

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CPSC 532S WINTER 2, 2020
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CPSC 425 WINTER 2, 2019
CPSC 425 WINTER 2, 2018
CPSC 532S WINTER 2, 2018
CPSC 425 WINTER 1, 2018
CPSC 532L WINTER 2, 2017

Computer Vision (CPSC 425)

Winter Term 1, 2025-26 (Section 101)

(for Section 102 see link)

Course Information

Computer vision, broadly speaking, is a research field aimed to enable computers to process and interpret visual data (namely in the form of images and video), as sighted humans can. It is one of the most exciting areas of research in computing science and among the fastest growing technologies in today's industry. This course provides an introduction to the fundamental principles and applications of computer vision, including image formation, sampling and filteering, colour analysis, single and multi-image geometry, feature detection and matching, stereo imaging, motion estimation, segmentation, image classification and object detection. We'll study basic methods and application of these concepts to a variety of visual task.

Instructor:
Leonid Sigal (lsigal@cs.ubc.ca)
Office hours: TBD (ICCS 119)

TAs:
Bicheng Xu (bichengx@cs.ubc.ca)
Office hours: TBD

Nielsen Cugito (ncugito@student.ubc.ca)
Office hours: TBD

Ailar Mahdizadeh (ailar.mahdizadeh@ubc.ca)
Office hours: TBD

Oliver Oxford (oliox@student.ubc.ca)
Office hours: TBD

Shivam Chandhok (chshivam@cs.ubc.ca)

Links

Course Information
Requirements
Textbook
Schedule
Grading
Academic Conduct

- Schedule, Assignments
- Lecture Slides and Notes
- Readings
- Course Information (public)

Section 101: https://www.cs.ubc.ca/~lsigal/teaching25_Term1.html

Topics Covered

– Image Processing (Linear Filtering, Convolution)
– Filters as Templates
– Image Feature Detection (Edges & Corners)
– Texture & Colour
– Image Feature Description (SIFT)
– Model Fitting (RANSAC, The Hough Transform)
– Camera Models, Stereo Geometry
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– Deep Learning Introduction

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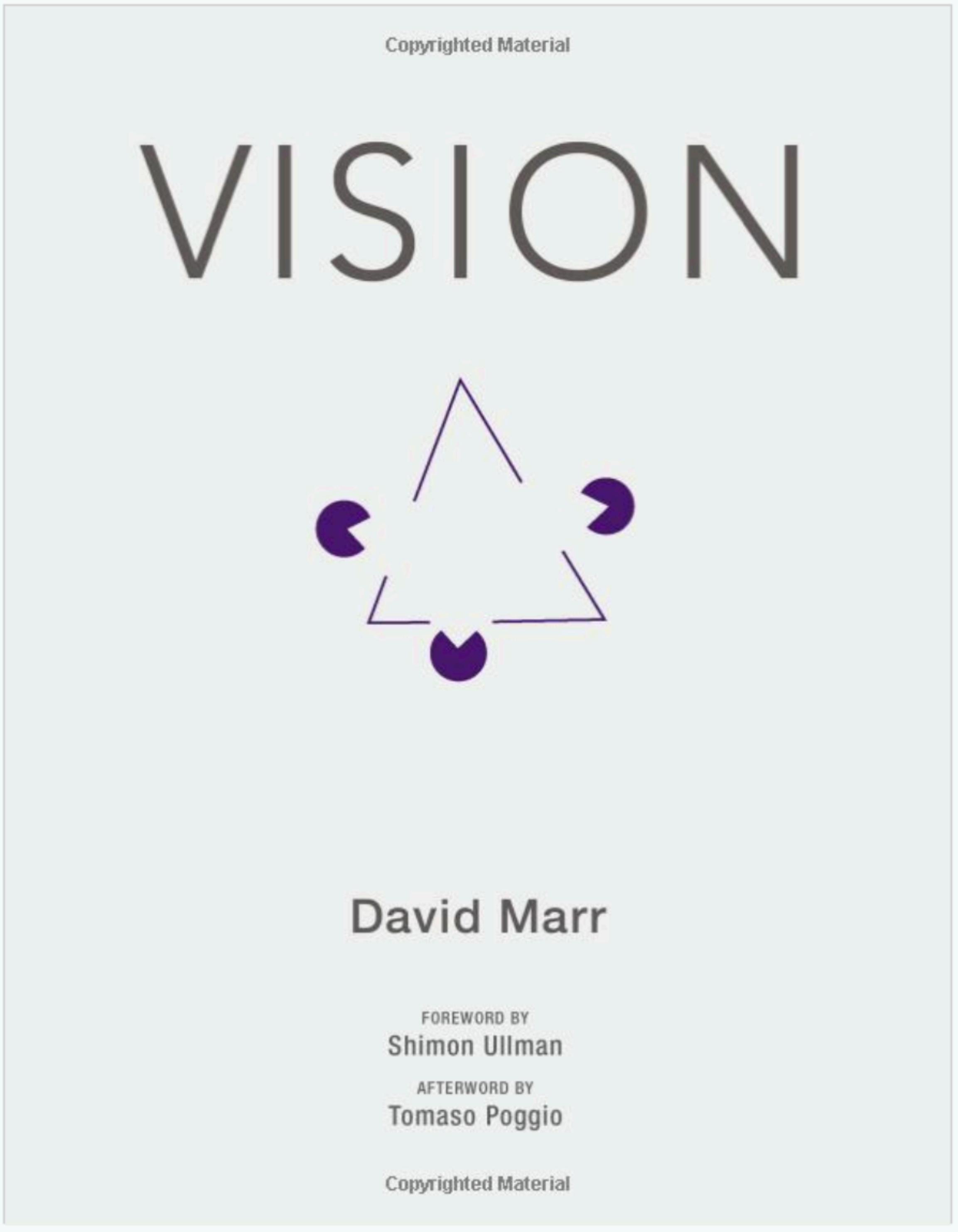
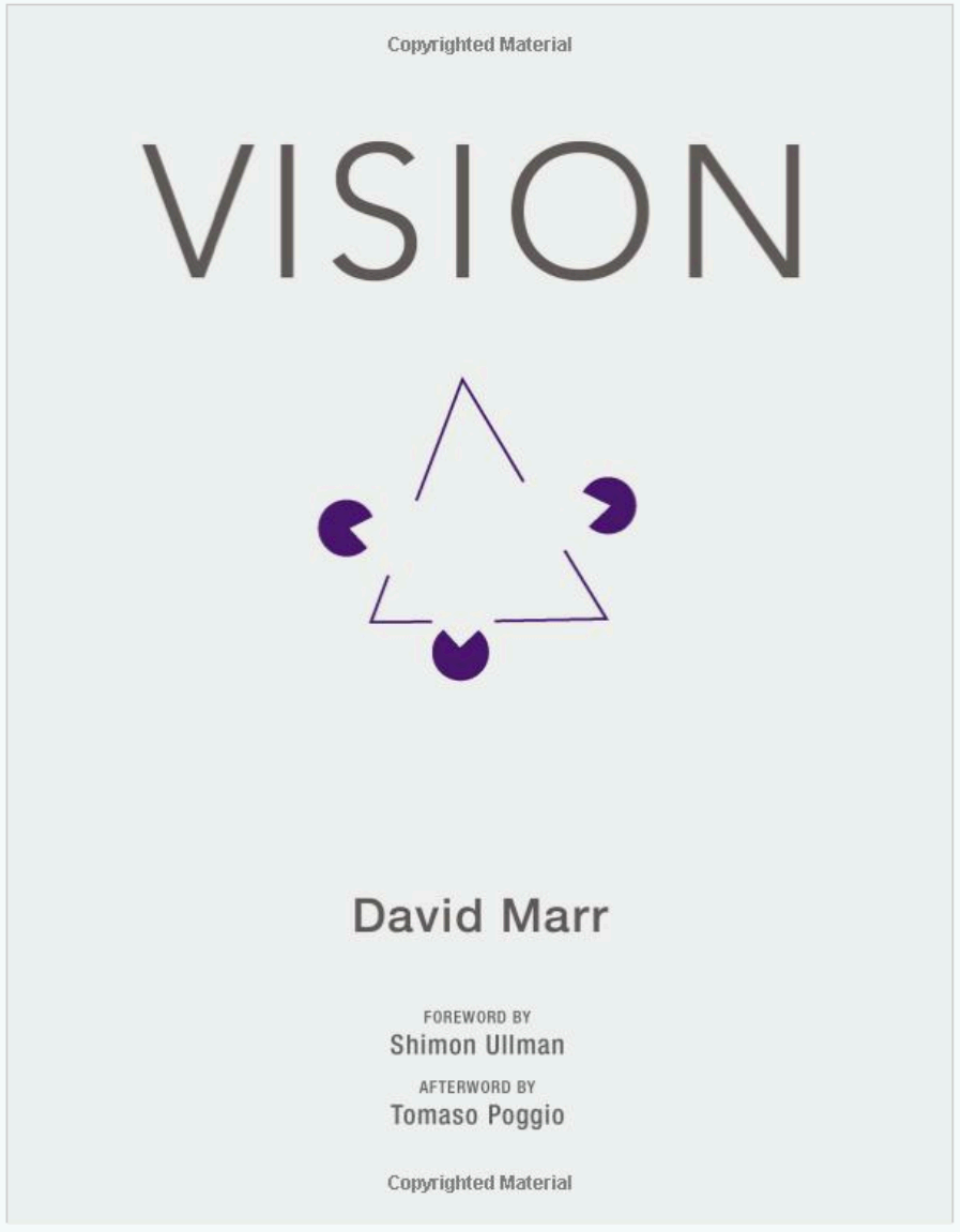
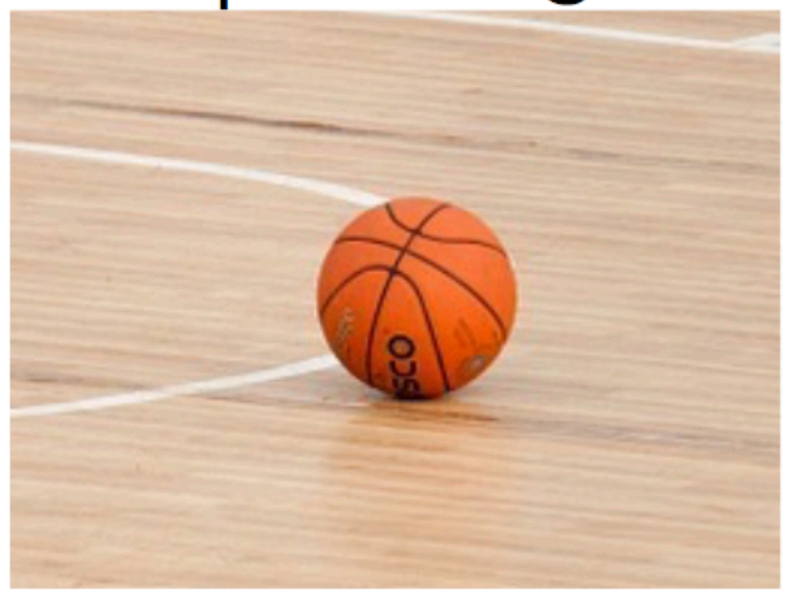


David **Marr**, 1970s

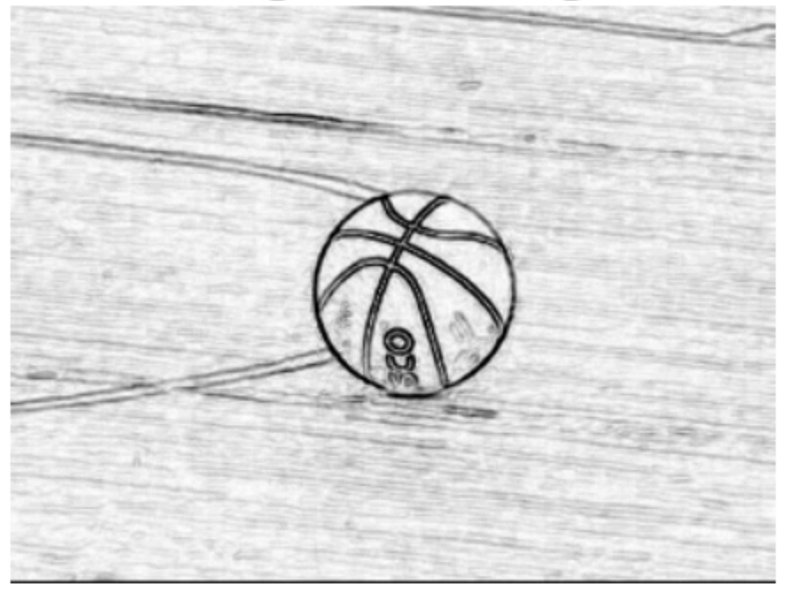


David **Marr**, 1970s

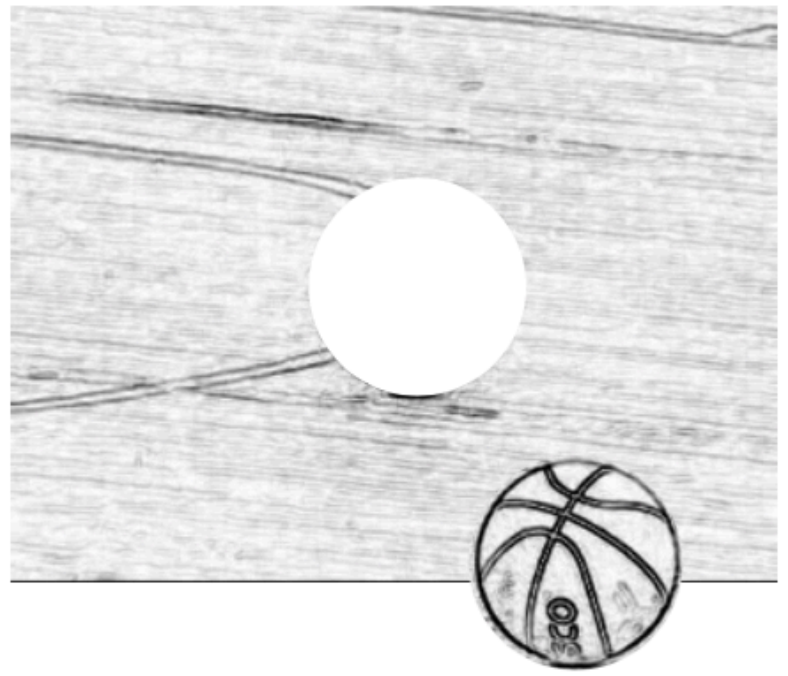
Input image



Edge image



2 ½-D sketch

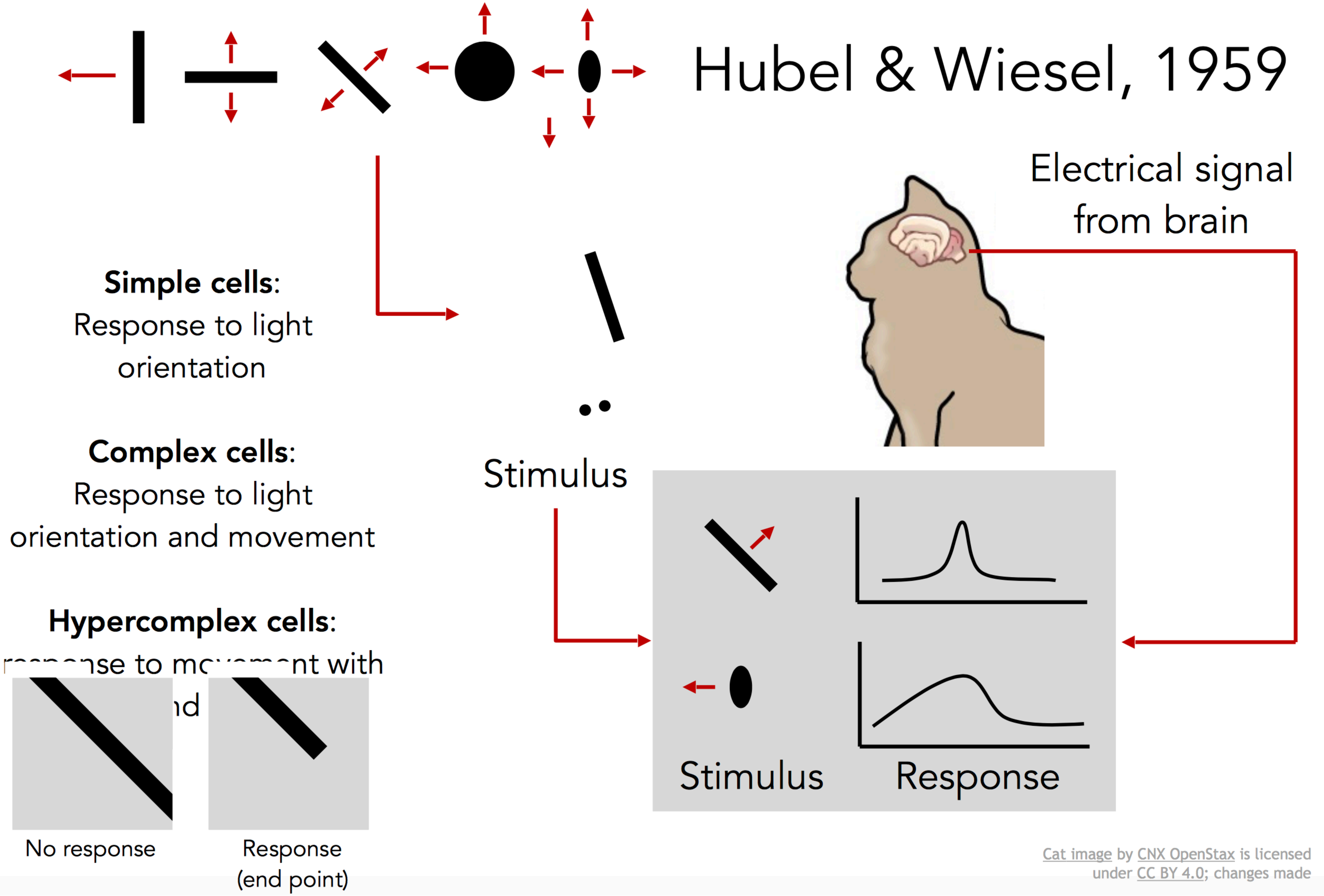


3-D model

Input Image	→	Primal Sketch	→	2 ½-D Sketch	→	3-D Model Representation
Perceived intensities		Zero crossings, blobs, edges, bars, ends, virtual lines, groups, curves boundaries		Local surface orientation and discontinuities in depth and in surface orientation		3-D models hierarchically organized in terms of surface and volumetric primitives

[Stages of Visual Representation, **David Marr**]

Human vision …



* slide from Fei-Dei Li, Justin Johnson, Serena Yeung, **cs231n Stanford**

Topics Covered

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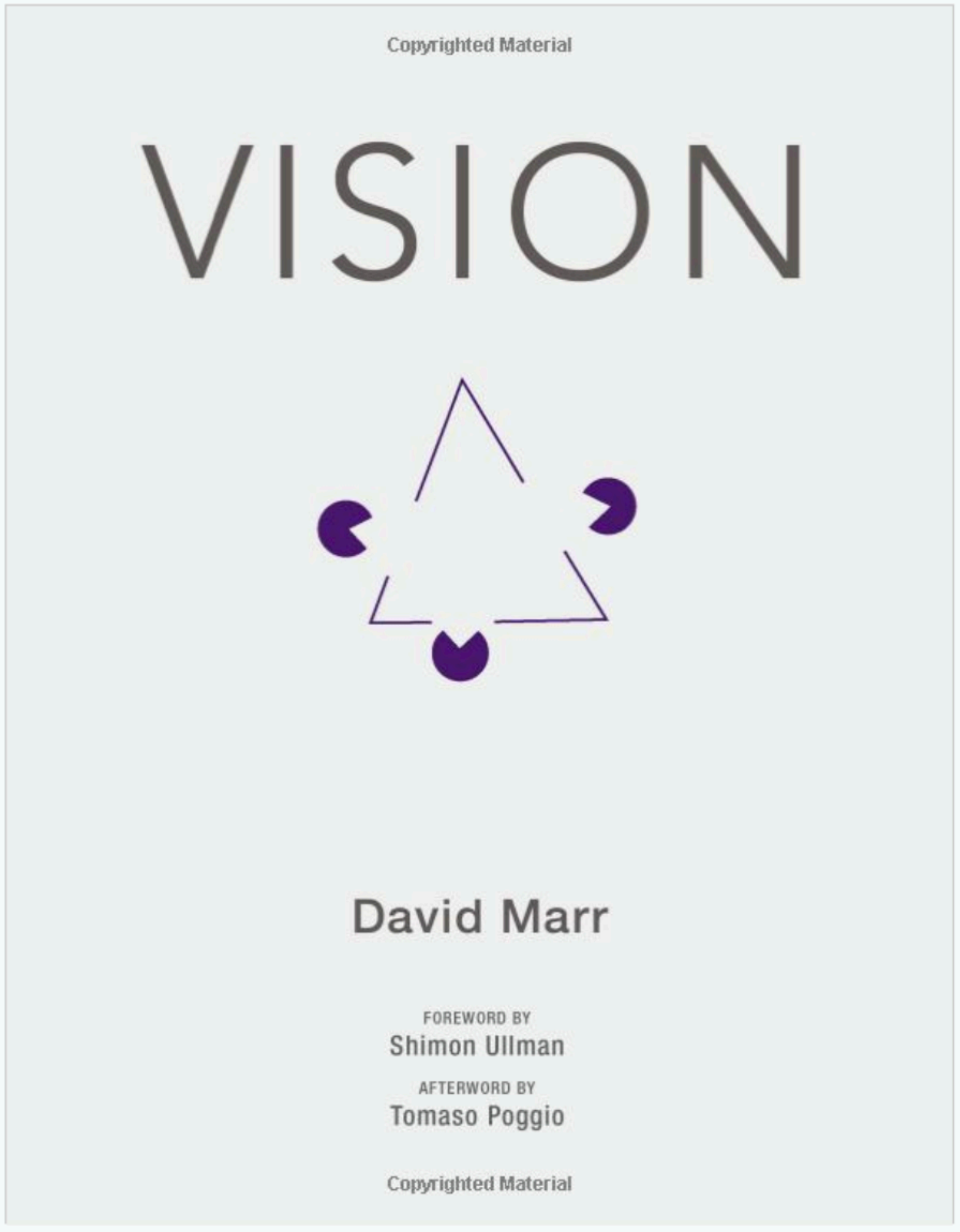

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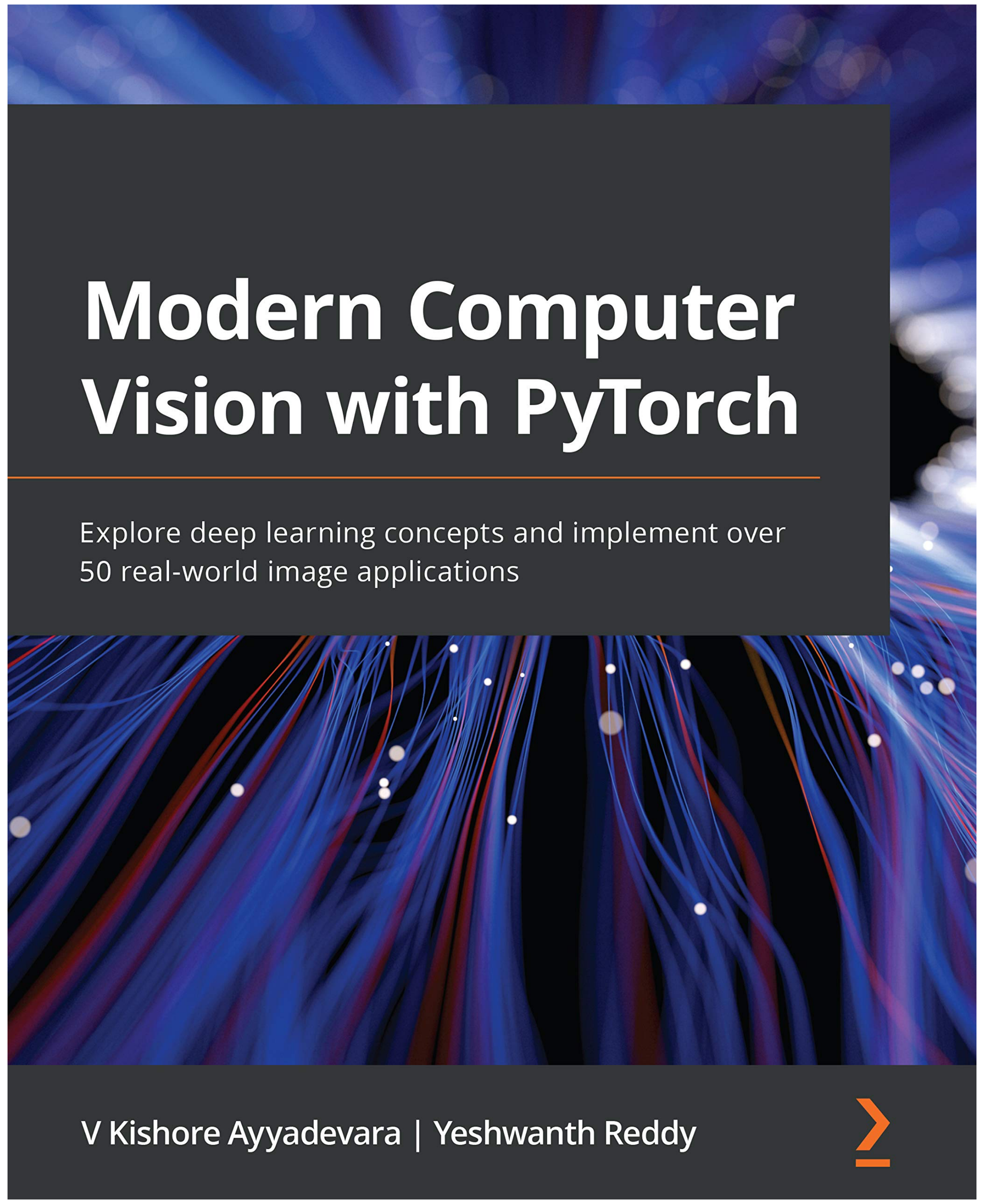
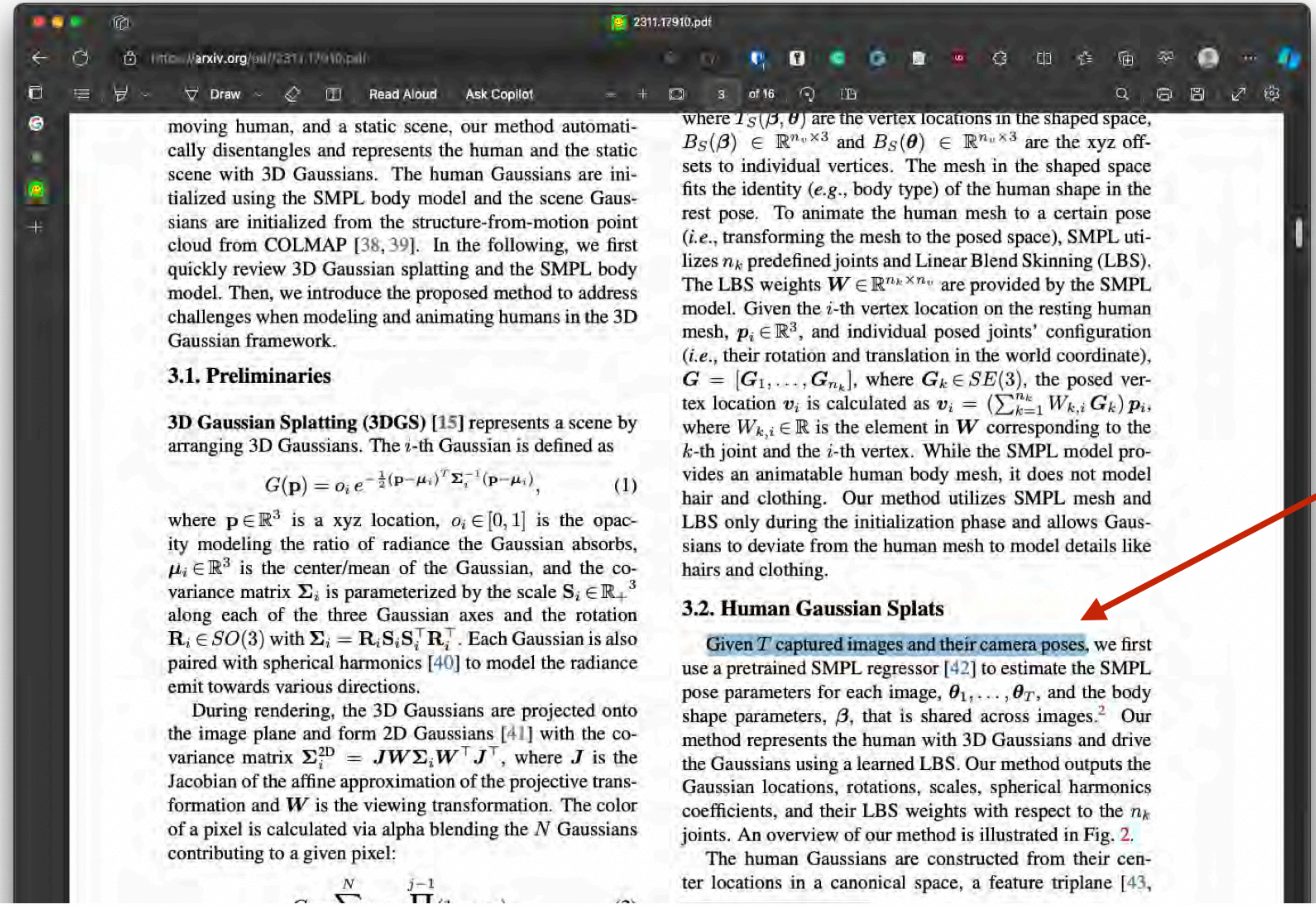


Modern Approaches **Rely on a Lot of Traditional Stuff**



moving human, and a static scene, our method automatically disentangles and represents the human and the static scene with 3D Gaussians. The human Gaussians are initialized using the SMPL body model and the scene Gaussians are initialized from the structure-from-motion point cloud from COLMAP [38, 39]. In the following, we first quickly review 3D Gaussian splatting and the SMPL body model. Then, we introduce the proposed method to address challenges when modeling and animating humans in the 3D Gaussian framework.

3.1. Preliminaries

3D Gaussian Splatting (3DGS) [15] represents a scene by arranging 3D Gaussians. The i-th Gaussian is defined as

$$G(\mathbf{p}) = o_i\, e^{-\frac{1}{2}(\mathbf{p}-\boldsymbol{\mu}_i)^T \boldsymbol{\Sigma}_i^{-1}(\mathbf{p}-\boldsymbol{\mu}_i)}, \qquad (1)$$

where $\mathbf{p}\in\mathbb{R}^3$ is a xyz location, $o_i\in[0,1]$ is the opacity modeling the ratio of radiance the Gaussian absorbs, $\boldsymbol{\mu}_i\in\mathbb{R}^3$ is the center/mean of the Gaussian, and the covariance matrix $\boldsymbol{\Sigma}_i$ is parameterized by the scale $\mathbf{S}_i\in\mathbb{R}_+^3$ along each of the three Gaussian axes and the rotation $\mathbf{R}_i\in SO(3)$ with $\boldsymbol{\Sigma}_i = \mathbf{R}_i\mathbf{S}_i\mathbf{S}_i^\top\mathbf{R}_i^\top$. Each Gaussian is also paired with spherical harmonics [40] to model the radiance emit towards various directions.

During rendering, the 3D Gaussians are projected onto the image plane and form 2D Gaussians [41] with the covariance matrix $\boldsymbol{\Sigma}_i^{2D} = \boldsymbol{J}\boldsymbol{W}\boldsymbol{\Sigma}_i\boldsymbol{W}^\top\boldsymbol{J}^\top$, where $\boldsymbol{J}$ is the Jacobian of the affine approximation of the projective transformation and $\boldsymbol{W}$ is the viewing transformation. The color of a pixel is calculated via alpha blending the N Gaussians contributing to a given pixel:

where $T_S(\boldsymbol{\beta},\boldsymbol{\theta})$ are the vertex locations in the shaped space, $B_S(\boldsymbol{\beta}) \in \mathbb{R}^{n_v\times 3}$ and $B_S(\boldsymbol{\theta}) \in \mathbb{R}^{n_v\times 3}$ are the xyz offsets to individual vertices. The mesh in the shaped space fits the identity (*e.g.*, body type) of the human shape in the rest pose. To animate the human mesh to a certain pose (*i.e.*, transforming the mesh to the posed space), SMPL utilizes n_k predefined joints and Linear Blend Skinning (LBS). The LBS weights $\boldsymbol{W}\in\mathbb{R}^{n_k\times n_v}$ are provided by the SMPL model. Given the i-th vertex location on the resting human mesh, $\boldsymbol{p}_i\in\mathbb{R}^3$, and individual posed joints' configuration (*i.e.*, their rotation and translation in the world coordinate), $\boldsymbol{G} = [\boldsymbol{G}_1,\ldots,\boldsymbol{G}_{n_k}]$, where $\boldsymbol{G}_k\in SE(3)$, the posed vertex location $\boldsymbol{v}_i$ is calculated as $\boldsymbol{v}_i = (\sum_{k=1}^{n_k} W_{k,i}\boldsymbol{G}_k)\,\boldsymbol{p}_i$, where $W_{k,i}\in\mathbb{R}$ is the element in $\boldsymbol{W}$ corresponding to the k-th joint and the i-th vertex. While the SMPL model provides an animatable human body mesh, it does not model hair and clothing. Our method utilizes SMPL mesh and LBS only during the initialization phase and allows Gaussians to deviate from the human mesh to model details like hairs and clothing.

3.2. Human Gaussian Splats

Given T captured images and their camera poses, we first use a pretrained SMPL regressor [42] to estimate the SMPL pose parameters for each image, $\boldsymbol{\theta}_1,\ldots,\boldsymbol{\theta}_T$, and the body shape parameters, $\boldsymbol{\beta}$, that is shared across images.[2] Our method represents the human with 3D Gaussians and drive the Gaussians using a learned LBS. Our method outputs the Gaussian locations, rotations, scales, spherical harmonics coefficients, and their LBS weights with respect to the n_k joints. An overview of our method is illustrated in Fig. 2.

The human Gaussians are constructed from their center locations in a canonical space, a feature triplane [43,

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Course Origins

CPSC 425 was originally developed by **Bob Woodham** and has evolved over the years. Much of the material this year is adapted from material prepared by Bob, as well extensions developed by others who taught this course

<u>Previously taught by:</u>

— 2024-2025 Term 2 by **Kwang Moo Yi** & **Matthew Brown**
— 2024-2025 Term 1 by **Leonid Sigal**
— 2023-2024 Term 2 by **Kwang Moo Yi**
— 2023-2024 Term 1 by **Matthew Brown**
— 2022-2023 Term 2 by **Leonid Sigal**
— 2022-2023 Term 1 by **Matthew Brown**
— 2021-2022 Term 1 & 2 by **Jim Little**
— 2020-2021 Term 1 by **Leonid Sigal**
— 2019-2020 Term 2 by **Leonid Sigal**
— 2019-2020 Term 1 by **Jim Little**
— 2018-2019 Term 1 & 2 by **Leonid Sigal**
— 2016-2017 Term 2 by **Jim Little**
— 2015-2016 Term 2 by **Fred Tung**
— 2015-2015 Term 2 by **Jim Little**

How to **Learn** from the **Course**?

— The course is very **broad**, but relatively **shallow** introduction to a very diverse and complex field that draws material from geometry, statistics, AI, machine learning, computer graphics, psychology and many others.

— It is easy to think that material is easy and course requires no studying

— Part of your job should be going over the slides and carefully analyzing not just what is on them, but the underlying assumptions, algorithmic steps and so on

— Don’t strive for “**template matching**” strive for true “**understanding**”

Grading Criteria

Short **canvas quizzes**: 10%

Programming Assignments: 40%

6 graded and 1 ungraded (optional) assignment

Midterm Exam (October 21st): 15%

Final Exam (TBD): 35%

iClicker Setup

Quizzes will be run via iClicker

Please make sure you have an iClicker account with your student ID:

https://lthub.ubc.ca/guides/iclicker-cloud-student-guide/

You should set **UBC** as the **institution**, use the **same email** as for your **canvas** account, and enter your **student number** in the student ID field.

You should be automatically added and the course:

CPSC 425 101 2025W1 Computer Vision Section 102

iClicker Quizzes

Setup before class! We'll do a test next week.

Join the class as student.iclicker.com

There will be around 6 multiple choice questions per quiz
— 1/2 point for participation
— 1/2 point for correct answer
*not all clicker quizzes are worth the same # of points, depends on # of questions

The clicker questions contribute 10% to your total grade.

Missing quiz policy: If you miss a quiz for a legitimate and documented reason, that quiz will be dropped (legitimate reasons: illness, conference travel, etc.) You are required to contact instructor and provide proof within 1 week of missed quiz.

Assignments (done individually)

There will be **7 assignments** in total (6 marked)

— Approximately 1 every 2 weeks

— You will hand these in by 11:59pm on the due date (read hand in instructions and late policy on course webpage)

You will use the **Python**, with the following libraries: Python Imaging Library (PIL), NumPy, Matplotlib, SciPy, Scikit-Learn

— Assignment 0 (which is ungraded) will introduce you to this.

Assignments contribute 40% to your final score

Midterm Exam

Scheduled for **October 21st**

— Here **in class** during the lecture period

— Closed book, no notes allowed

Multiple choice, true / false and short answer questions

— Aimed to test your “understanding” of the content of the course

The Midterm exam will contribute 15% to your final score

Final Exam

The Final exam is held during the regular examination period, and is scheduled by the Registrar's Office

Similar to the midterm but longer and with more extensive short/medium answer questions

The Final exam will contribute 35% to your final score

Final Exam

You **don’t need to pass the final** to pass the course

The grade you earn is the grade you get!

Grading issues & **Academic** Misconduct

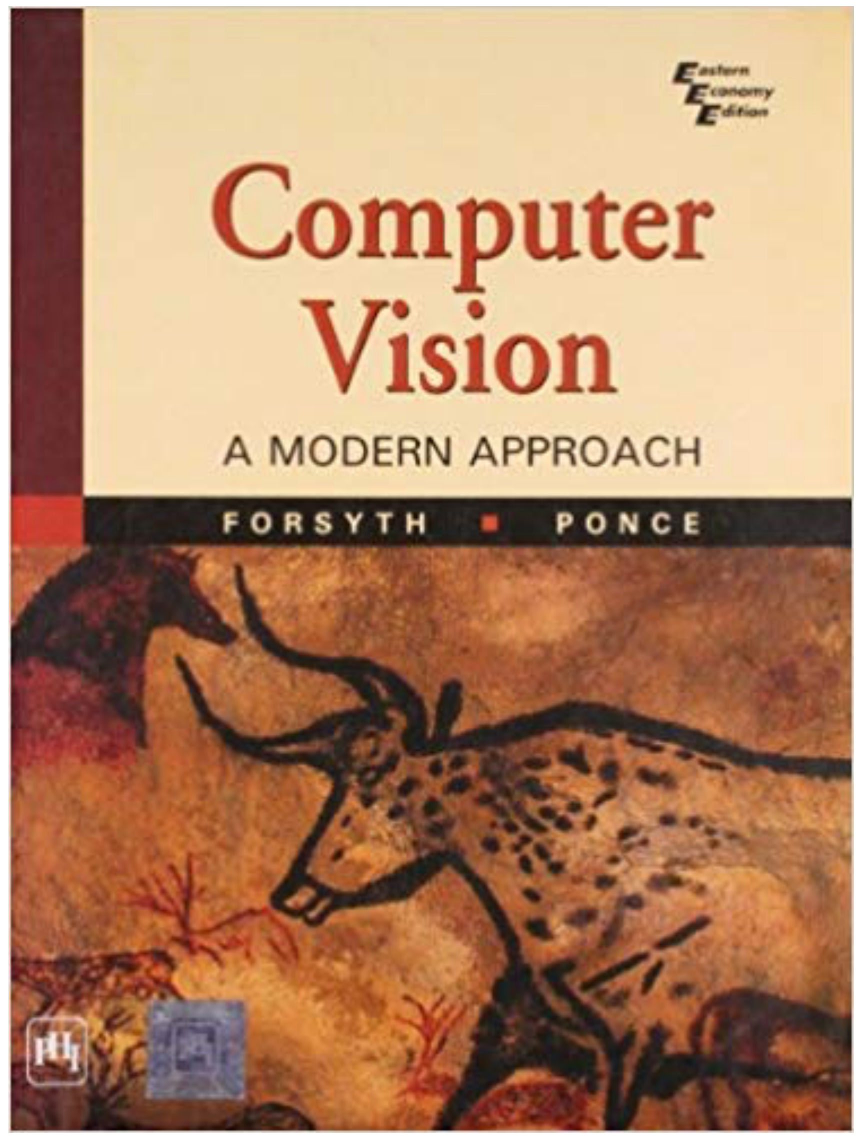
Strict policy: Grading mistakes happen, it's just a nature of life. If you see an issue with your grade, you have 1 week from the release of any assignment grade to bring a specific issue to our attention.

(Regrade requests are handled as private messages through Piazza)

Academic Misconduct: Please don't do it. Trust me it is not worth it.

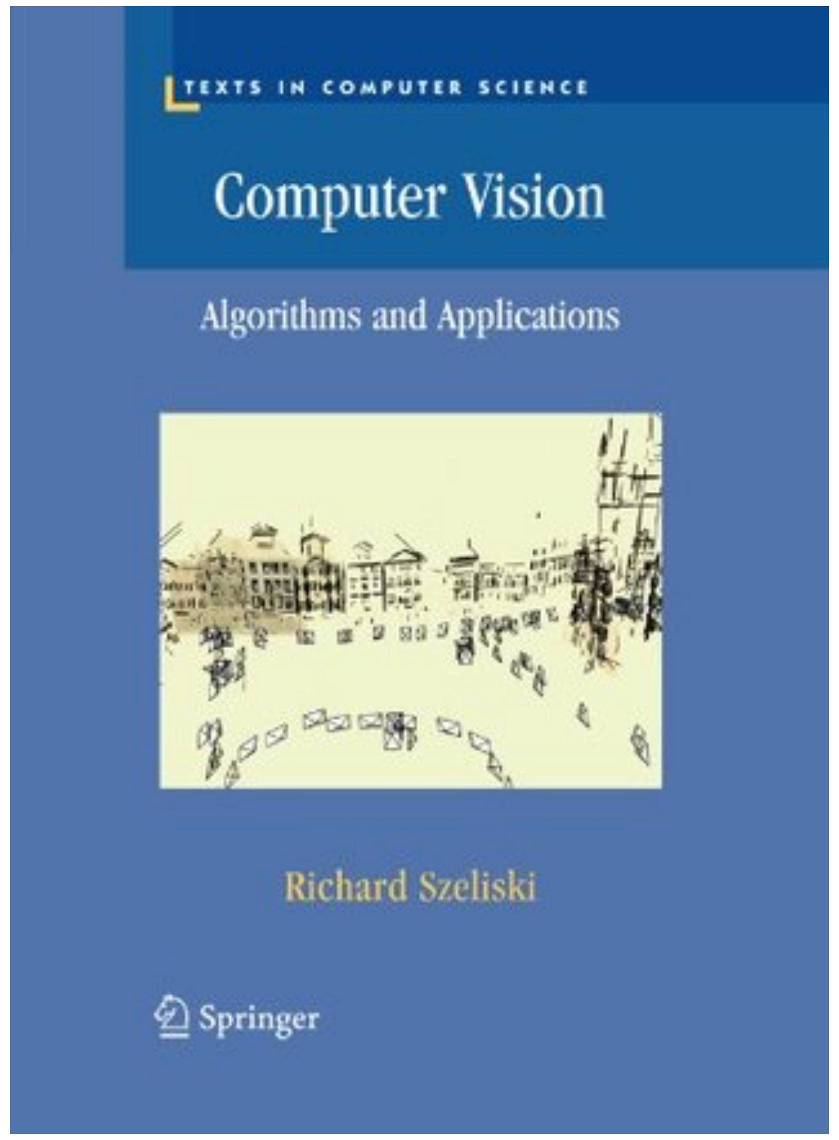
Textbooks

The course uses the following textbooks, which are recommended (but **not required**):



Computer Vision: A Modern Approach (2nd ed)

By: D. Forsyth & J. Ponce
Publisher: Pearson 2012



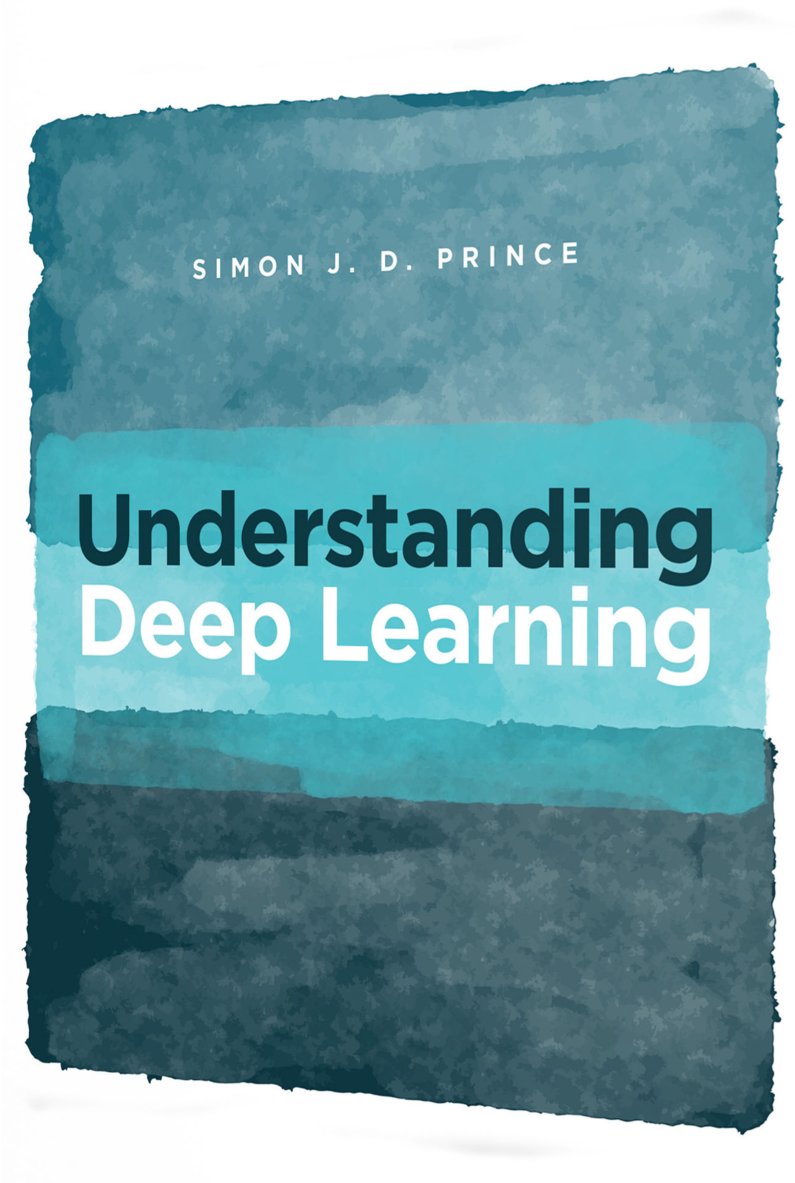
Computer Vision: Algorithms and Applications (2nd ed)

By: R. Szeliski
Publisher: Springer 2022

https://szeliski.org/Book/

Text**books**

The course uses the following textbooks, which are recommended (but **not required**):



Understanding Deep Learning

By: Simon J.D. Prince
Publisher: MIT Press 2023

https://udlbook.github.io/udlbook/

Readings

You will be assigned **readings**.

— Sometimes you will be assigned readings from other sources

Do the reading **after coming** to the lecture

— Reading assignments will be posted on course webpage

— They will also be mentioned in class

Borealis AI's Let's SOLVE it **undergraduate program**

Borealis AI's Let's SOLVE it, AI undergrad student mentorship program, now is open for applications for our upcoming fall cycle. It would be a great help if you could spread the news among the undergrad students at your department, and/or courses! We are looking for undergrad students from diverse backgrounds to support kickstart their career in A, while helping them solve a problem from their communities. Your help with this can go a long way!

For application guidelines, please visit our Let's SOLVE it webpage.
Application deadline: **Sept. 7, 2025** (@11.59pm ET)
Program dates: October-November 2025 (2 months)
Additional info here: University Students Harness the Power of AI for Social Good

For questions, please email us at: mi.research@borealisai.com
Use subject line: Let's SOLVE it