University of Colorado
Boulder

Deep Learning Applications for Computer Vision

Lecture 1: Introduction

What is Computer Vision?

- around since 1960s
- analyzing digital images
  - 1 image
  - sequence of images
    - ↳ video
  - multiple views of a scene
  - multi-dimensional data
    - ↳ 3D scanner
    - ↳ medical imaging system: CT, MRI
- interdisciplinary field

What is Computer Vision?

Extracting information from images

Methods for: acquiring, processing, analyzing and interpreting digital images.

Can we come up with algorithms that mimic the function of the human visual cortex?

Areas of interest: object/pattern recognition, segmentation, tracking, motion estimation, ...

“Machine vision” – giving “machines” the power to make decisions based on information from images

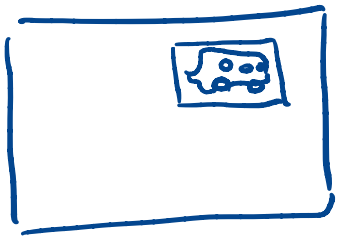
What problems is Computer Vision trying to solve?

1. Recognition
2. Tracking / segmentation
3. Motion estimation / analysis
4. Pose estimation
5. Scene reconstruction, 3D scene modeling
6. Visual servoing
7. Image restoration

1. Recognition

Does the image contain a certain object/ feature/ activity?

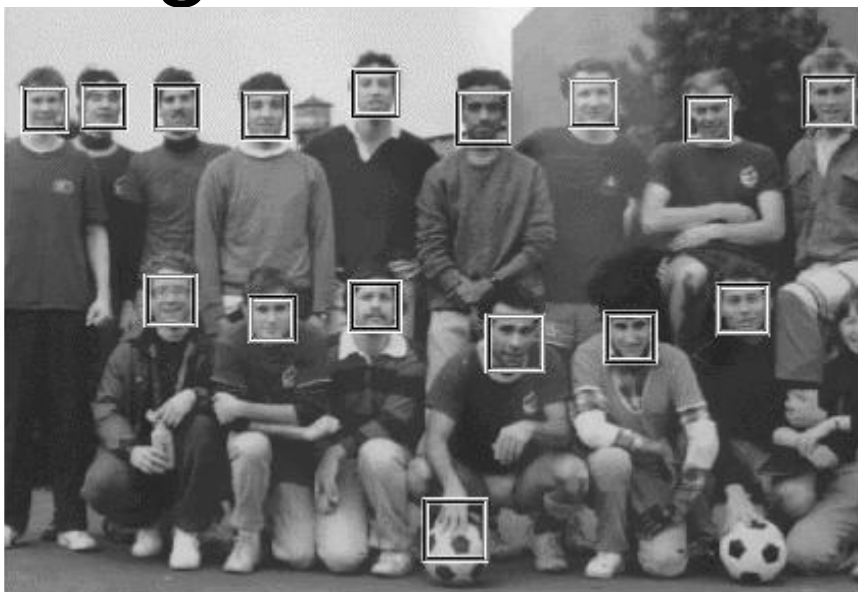
- **Recognize** and **classify** a certain given object or object class
- **Identify** and **localize**



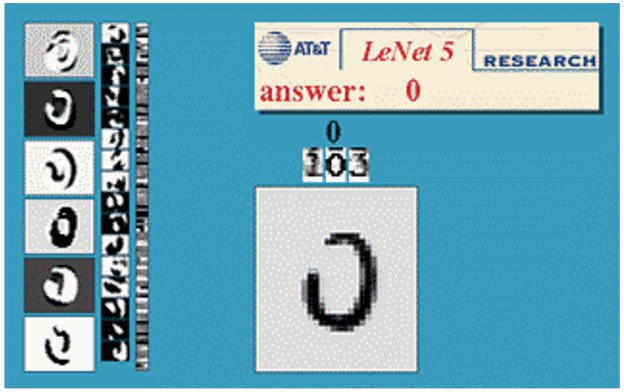
- **Detect** a certain specific condition, object

1. Recognition

Faces



Face recognition, MIT+CMU test set
Reading: Viola and Jones 2001 Paper

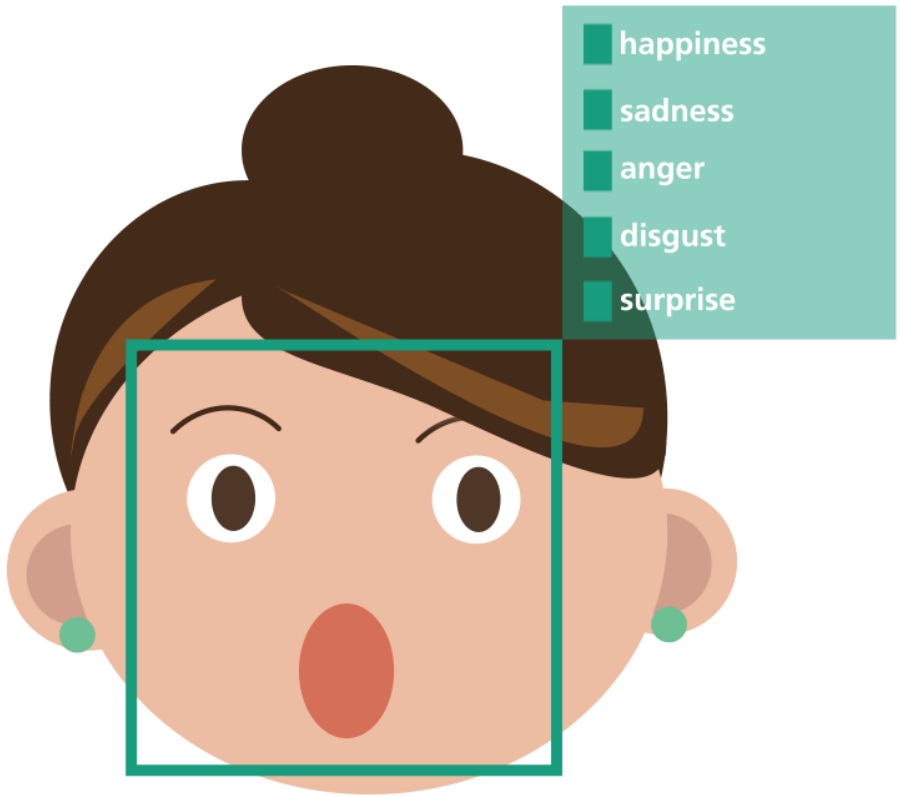


Digit recognition, AT&T labs
http://www.research.att.com/~yann/

Optical Character Recognition (**OCR**)

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

Smile detection?



- photo selection
- analyzing user experience
- patient monitoring

[Reading: Can artificial intelligence recognize facial human emotions?]

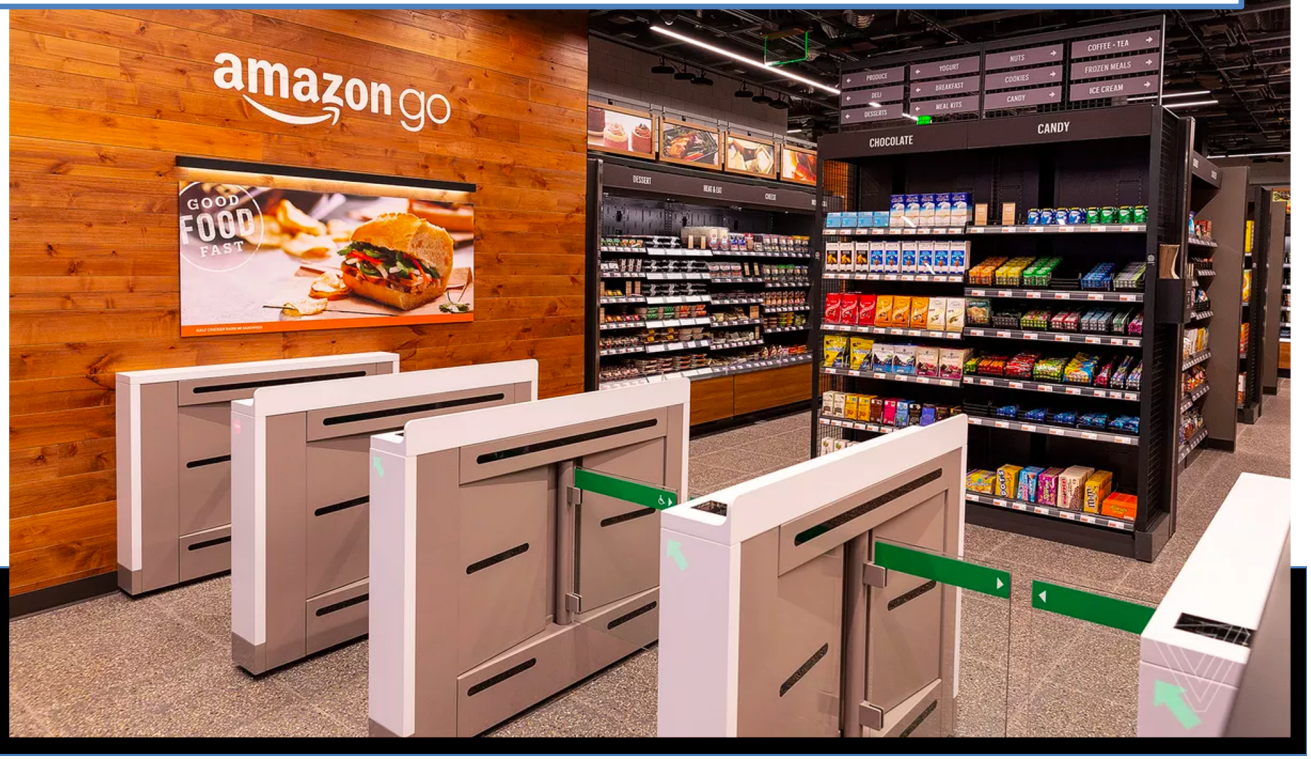
Object recognition (in supermarkets)

Amazon Go: Cashier-less stores

In 2016, Amazon introduced Go, a store where you could walk in, pick up items you wanted to buy, and walk out. There was no need for cashiers.

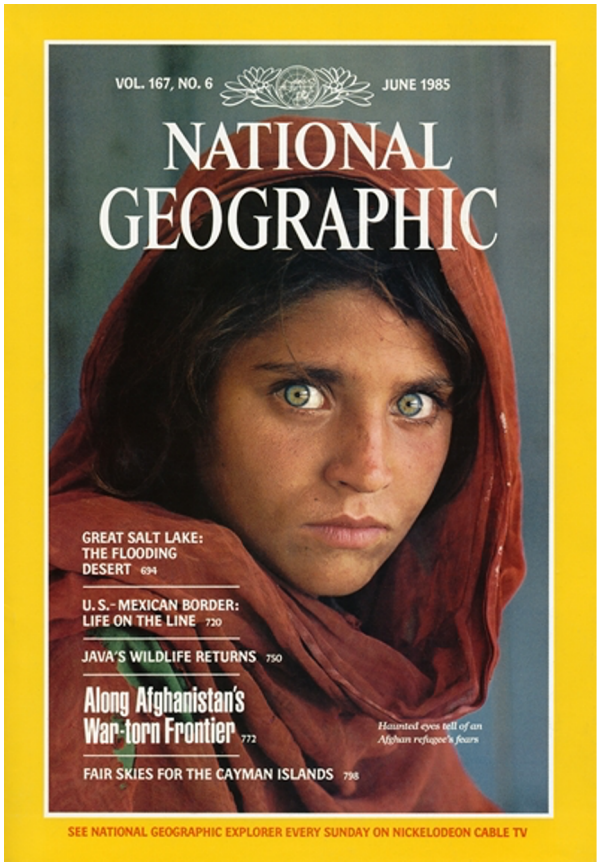
"As customers move about the store, cameras equipped with advanced computer vision algorithms monitor their behavior and keep track of the items they pick up or return to shelves. When they leave the store, their shopping cart is automatically charged to their Amazon account. Three years after the announcement, Amazon has opened 18 Go stores and it's still a work in progress."

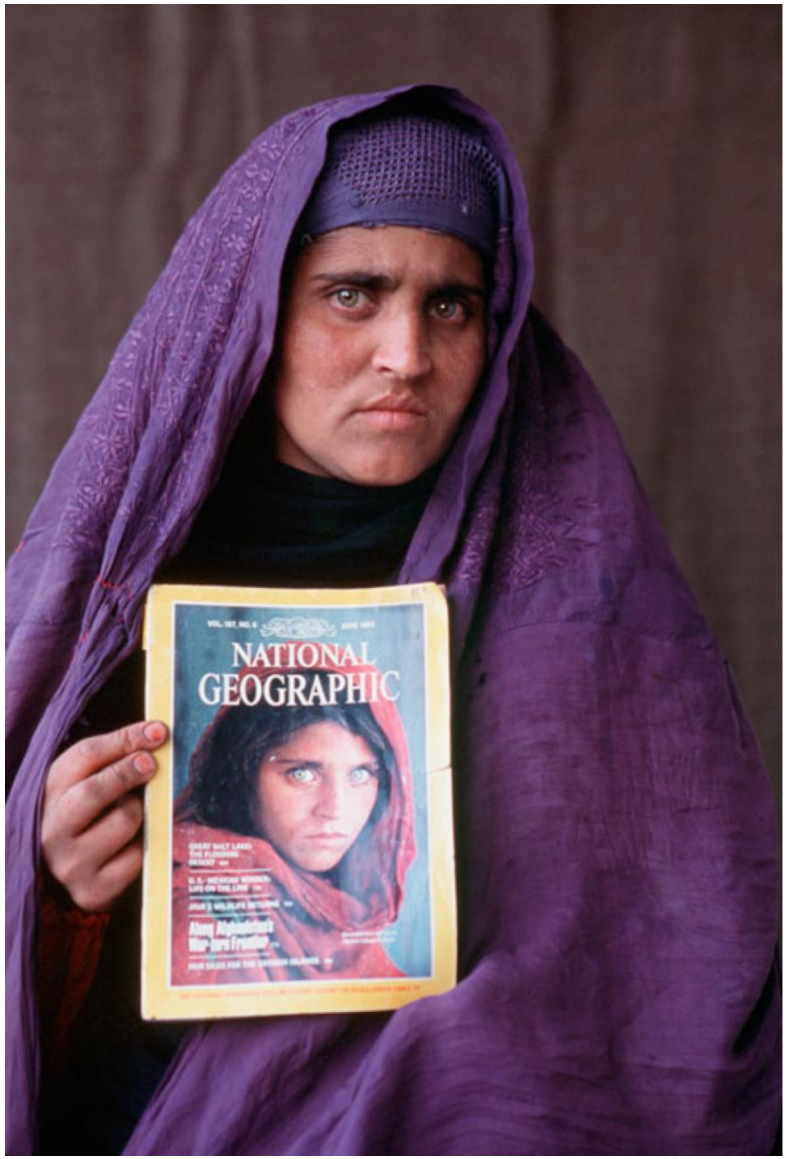
Computer vision applications: The power and limits of deep learning https://bdtechtalks.com/2019/12/30/computer-vision-applications-deep-learning/



Who is she?

18 years

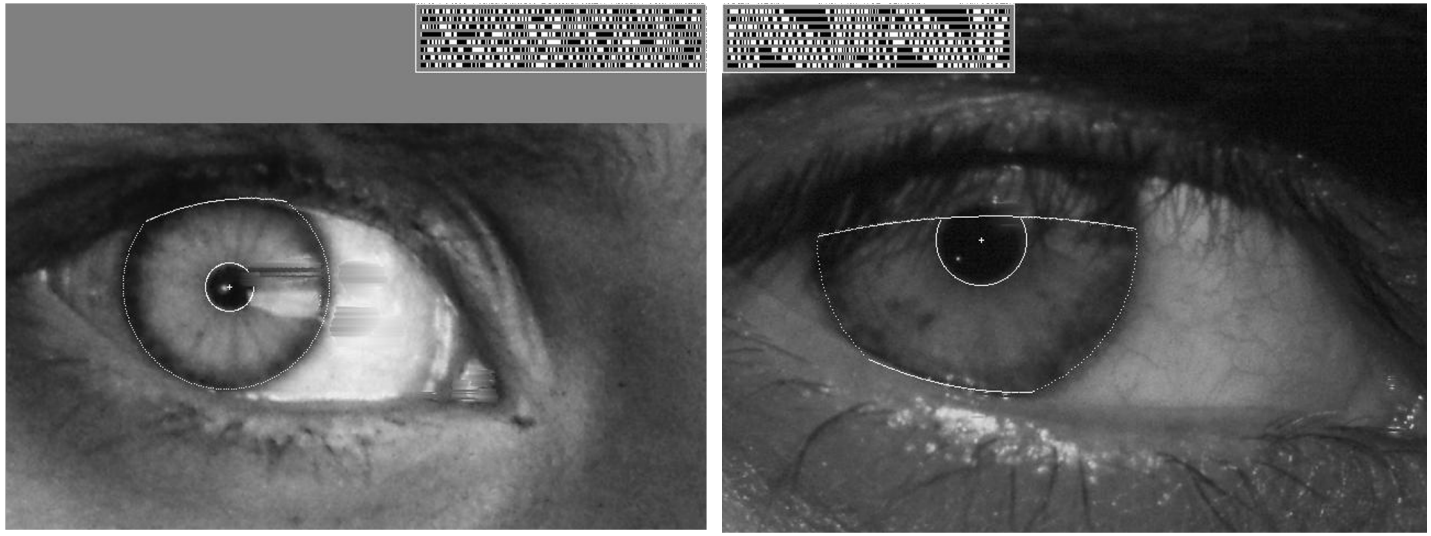




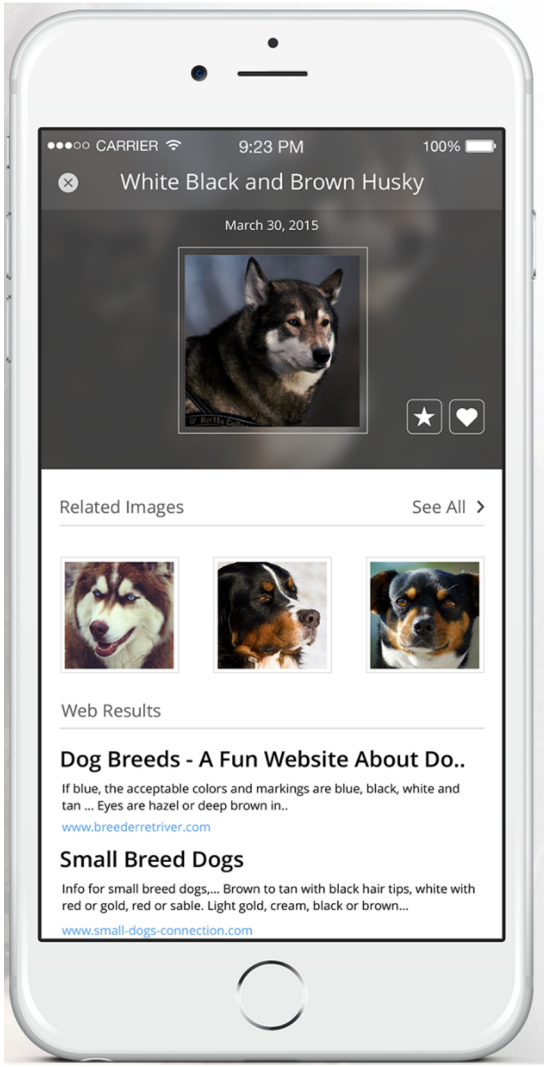
Vision-based biometrics

Automatic Iris Recognition

http://www.cl.cam.ac.uk/~jgd1000/afghan.html
John Daugman (Univeristy of Cambridge, England)



Object recognition in mobile apps



Google Lens app:

- Text → translation
- Identify plants and animals

Find out what plant is in your friend's apartment, or what kind of dog you saw in the park.