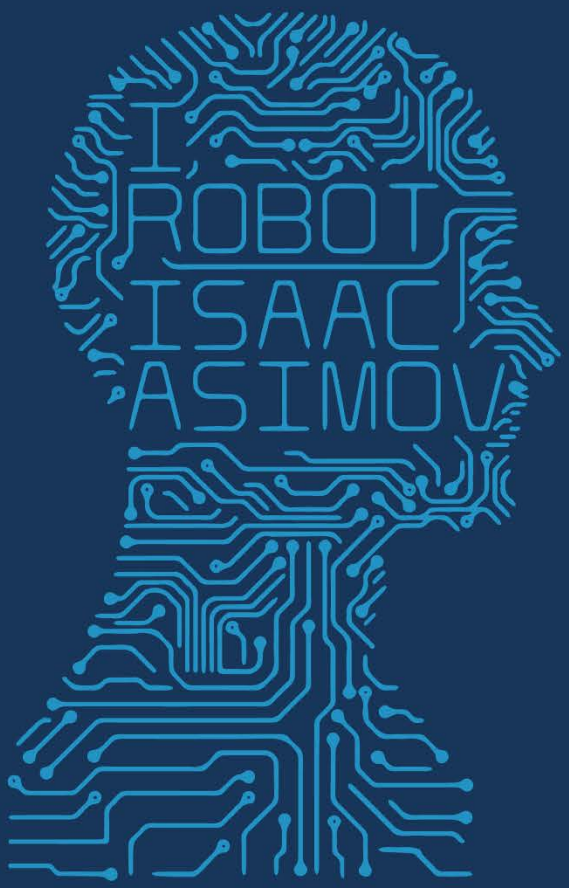
Pattern Recognition

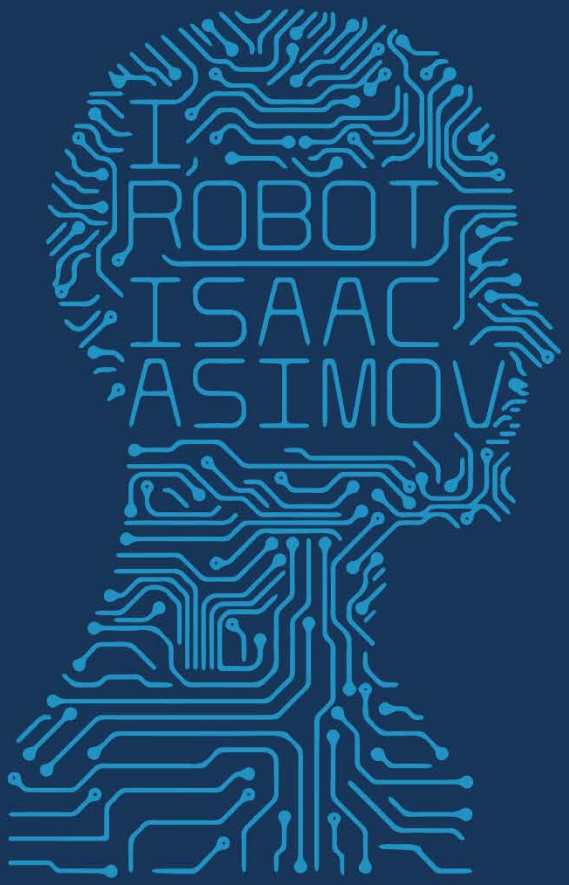
Dr.Ahmed Anter

Senior Lecture, Computer Science Dep.,
Faculty of Computer Science



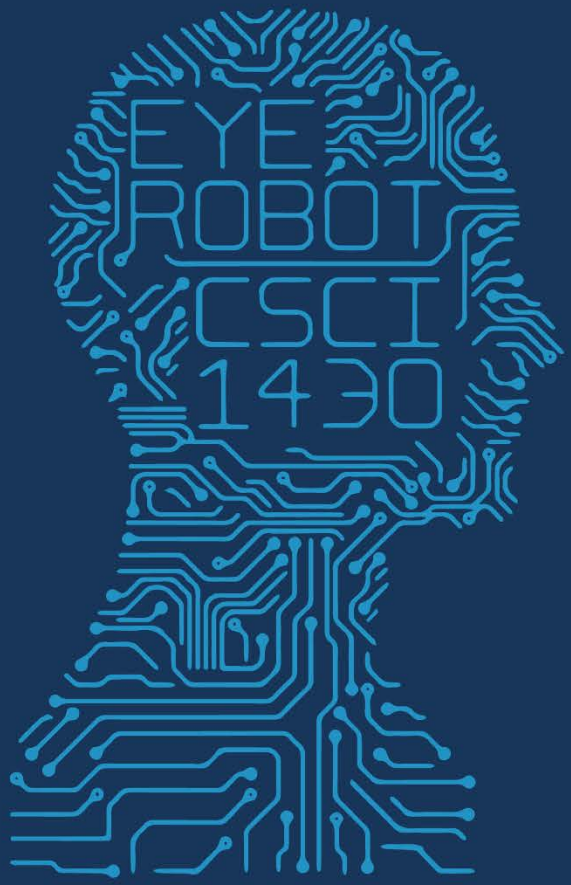
1950

FUTURE VISION



1950

FUTURE VISION



2017 MWF 1PM

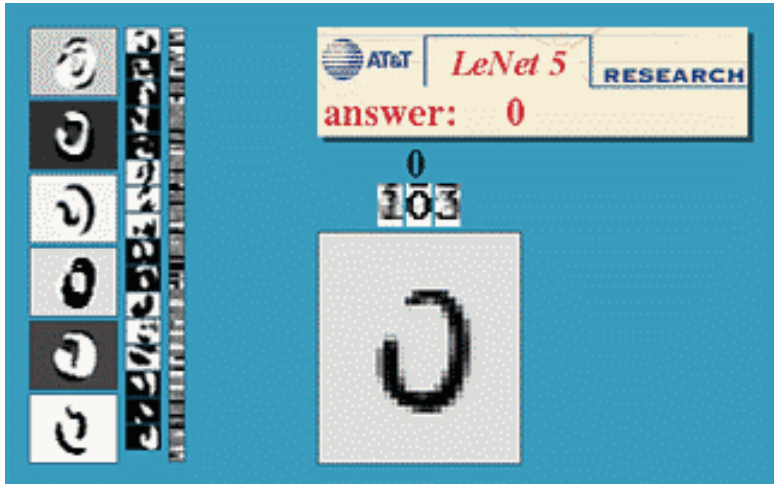
COMPUTER VISION

Projects

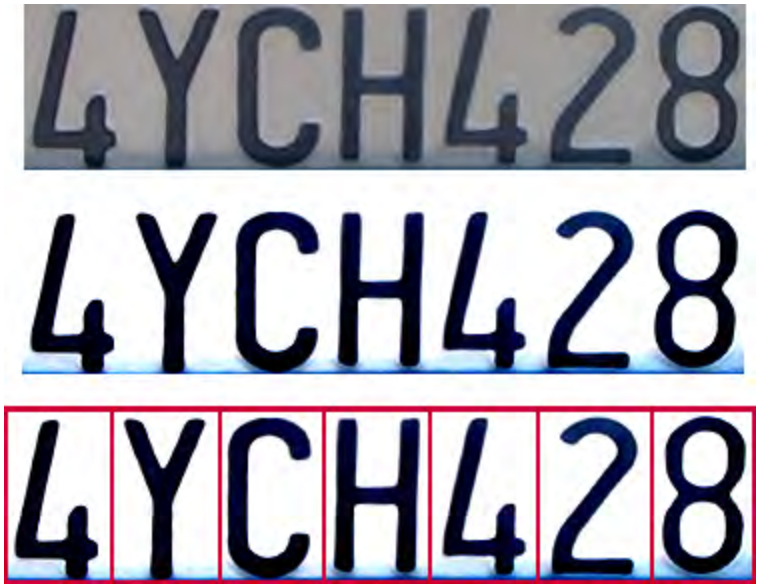
Optical character recognition (OCR)

Technology to convert scanned docs to text

- If you have a scanner, it probably came with OCR software

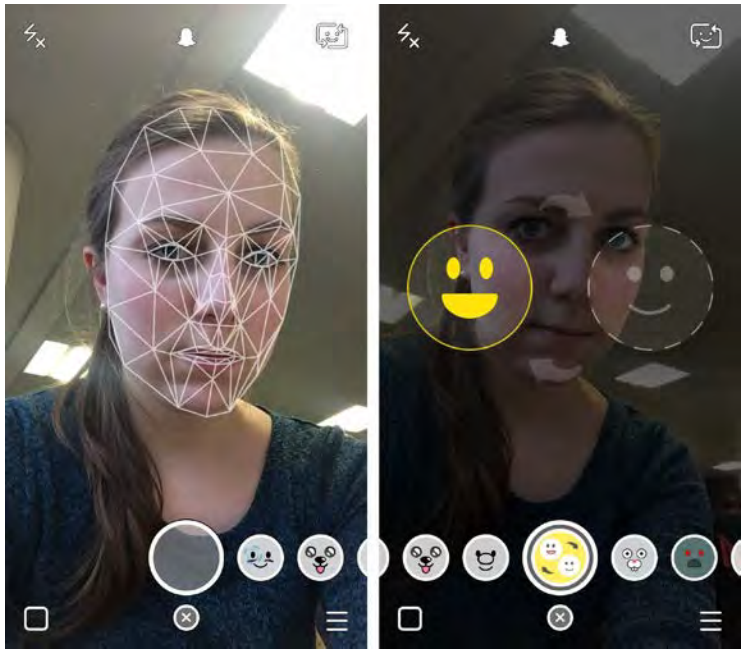


Digit recognition, AT&T labs
http://www.research.att.com/~yann/



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

Face detection

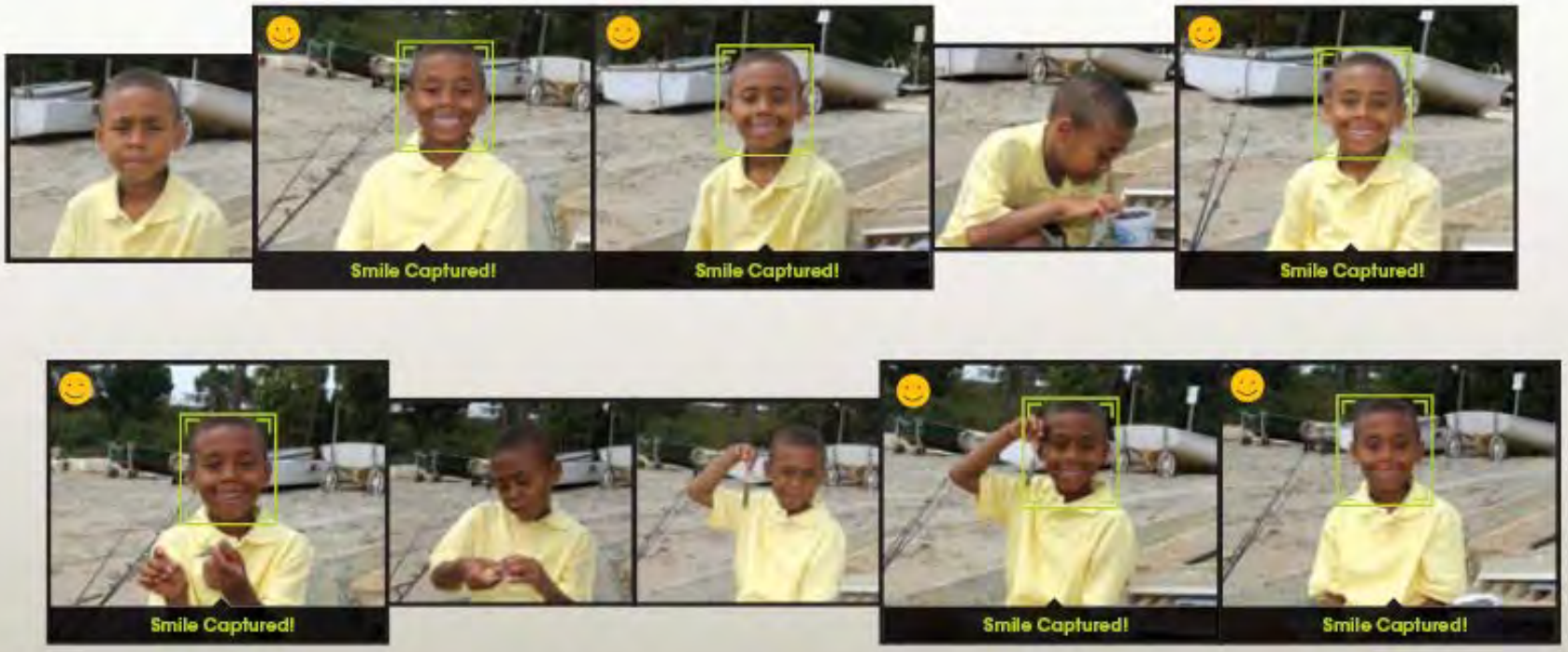


- Almost all digital cameras detect faces
- Snapchat face filters

Smile detection

The Smile Shutter flow

Imagine a camera smart enough to catch every smile! In Smile Shutter Mode, your Cyber-shot® camera can automatically trip the shutter at just the right instant to catch the perfect expression.



Sony Cyber-shot® T70 Digital Still Camera

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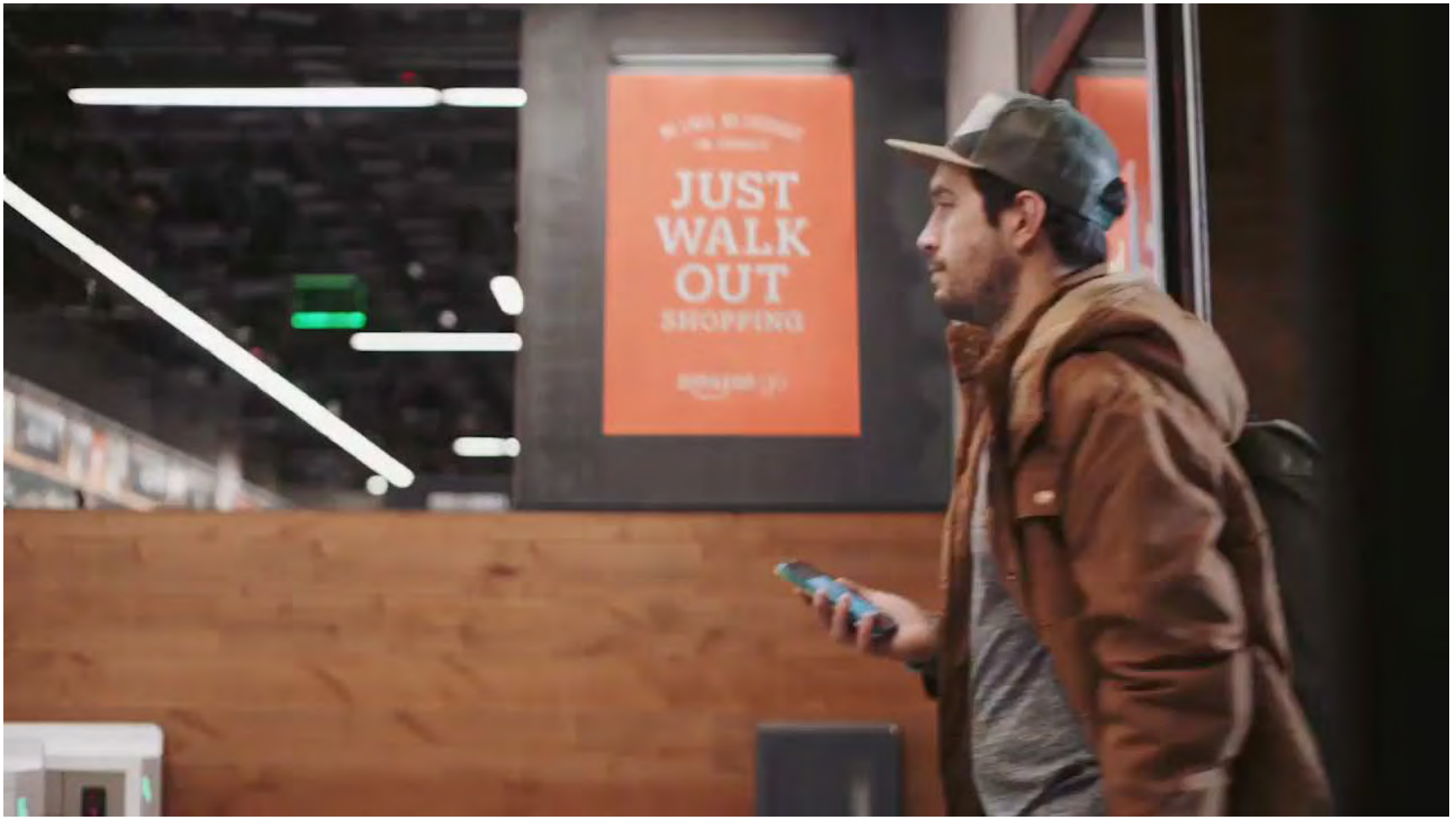
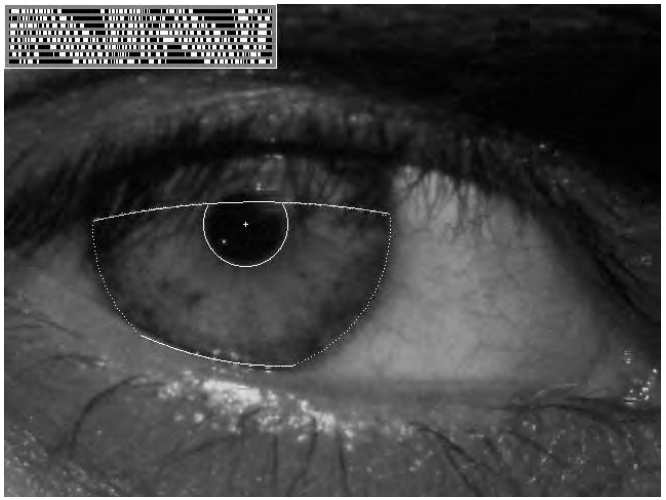
Object recognition (in supermarkets)



Vision-based biometrics

"*How the Afghan Girl was Identified by Her Iris Patterns*"
Read the story (Wikipedia)



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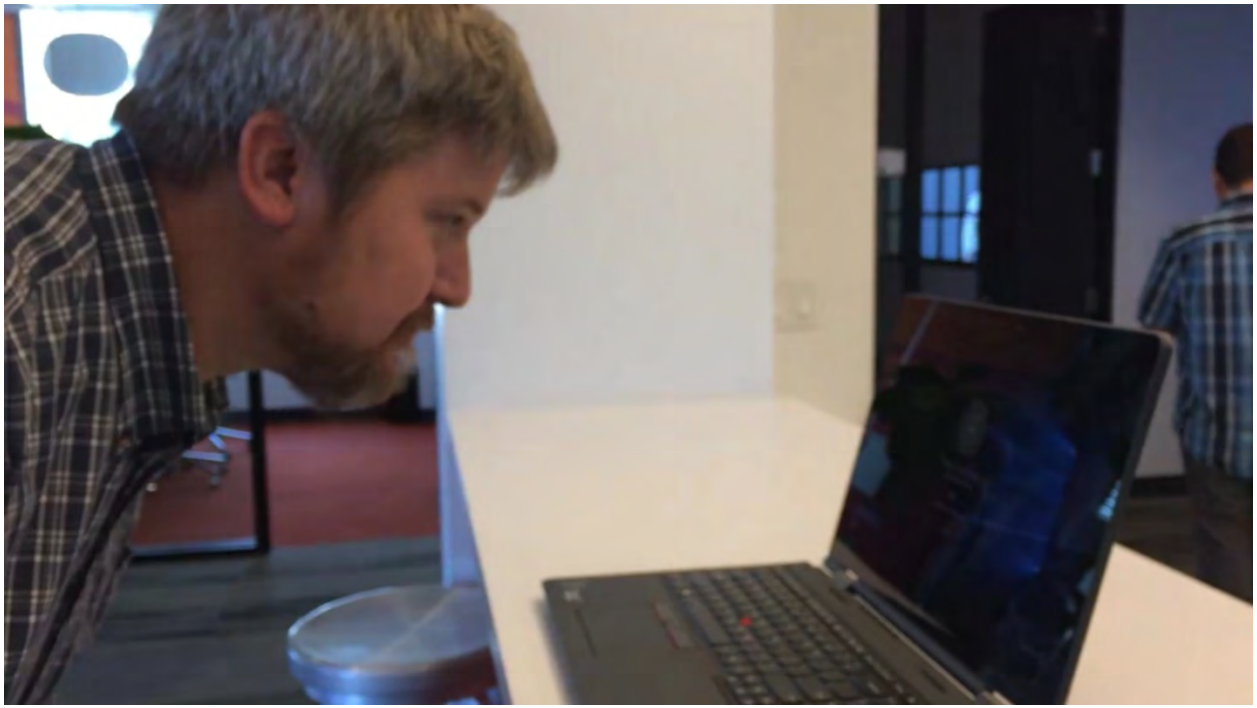
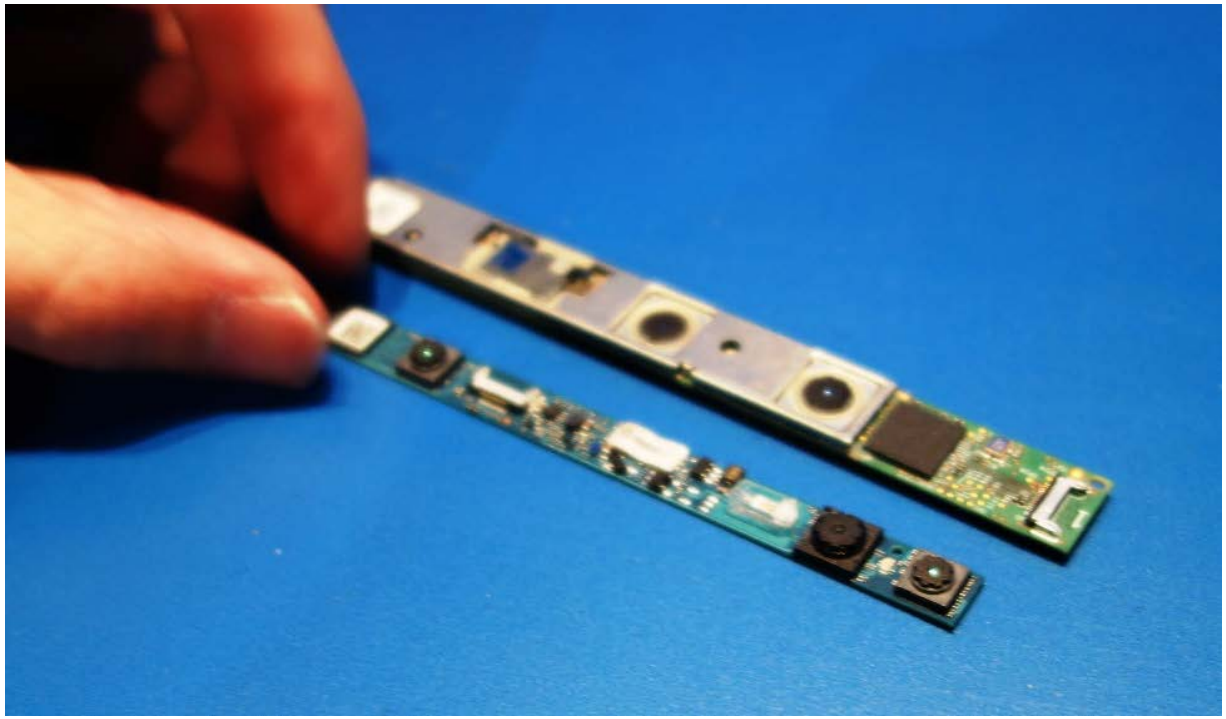
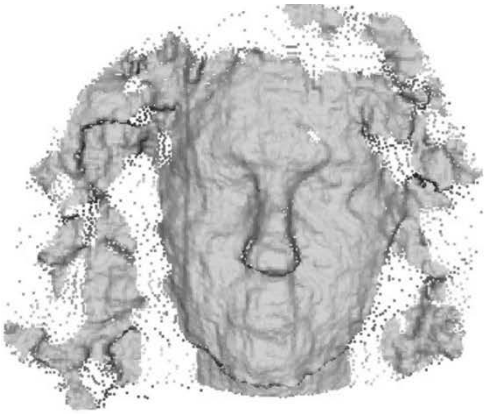
Login without a password…



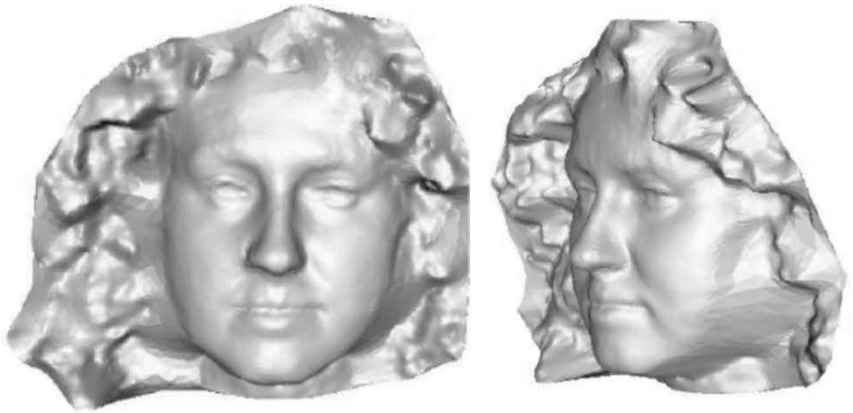
Login without a password…

Login without a password…





Single depth frame

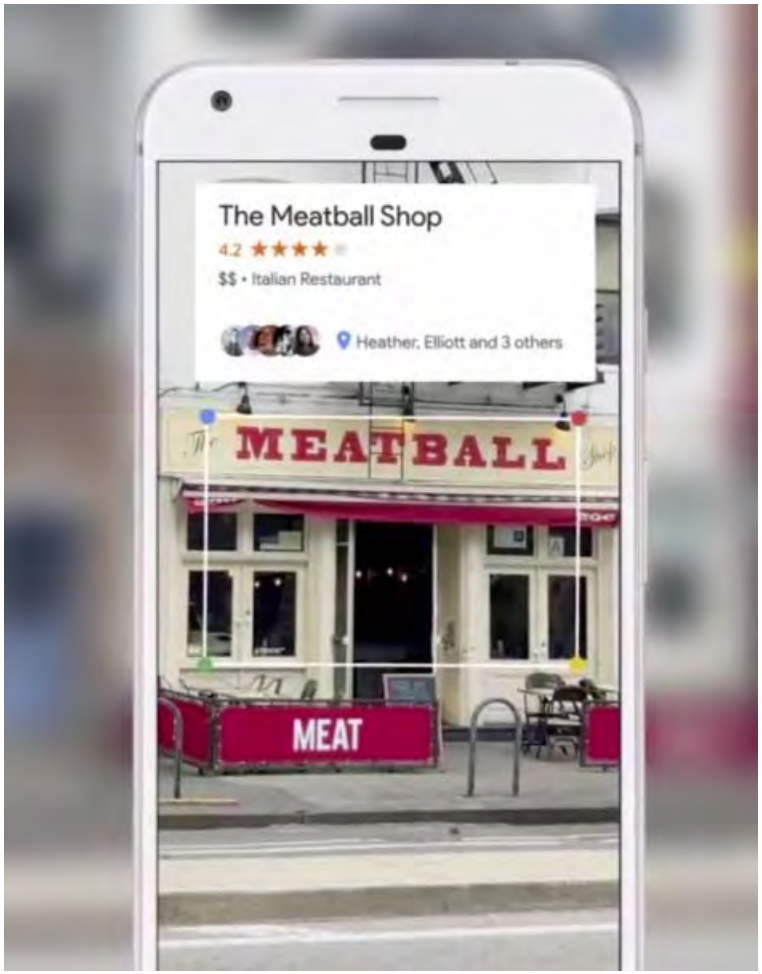


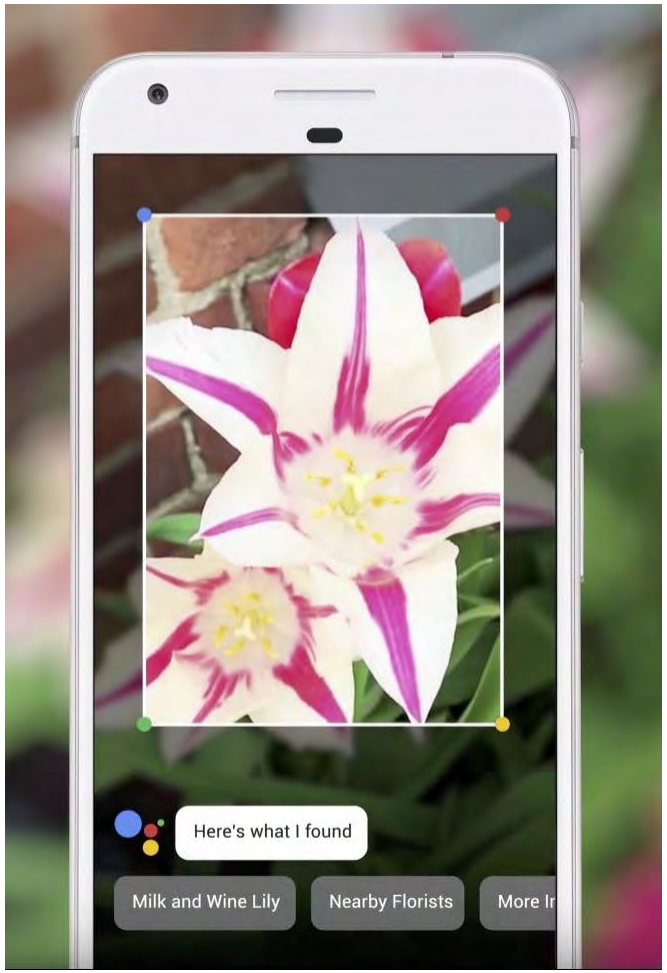
Reconstructed 3D mesh

Liang et al. 2014

Object recognition (in mobile phones)

e.g., Google Lens

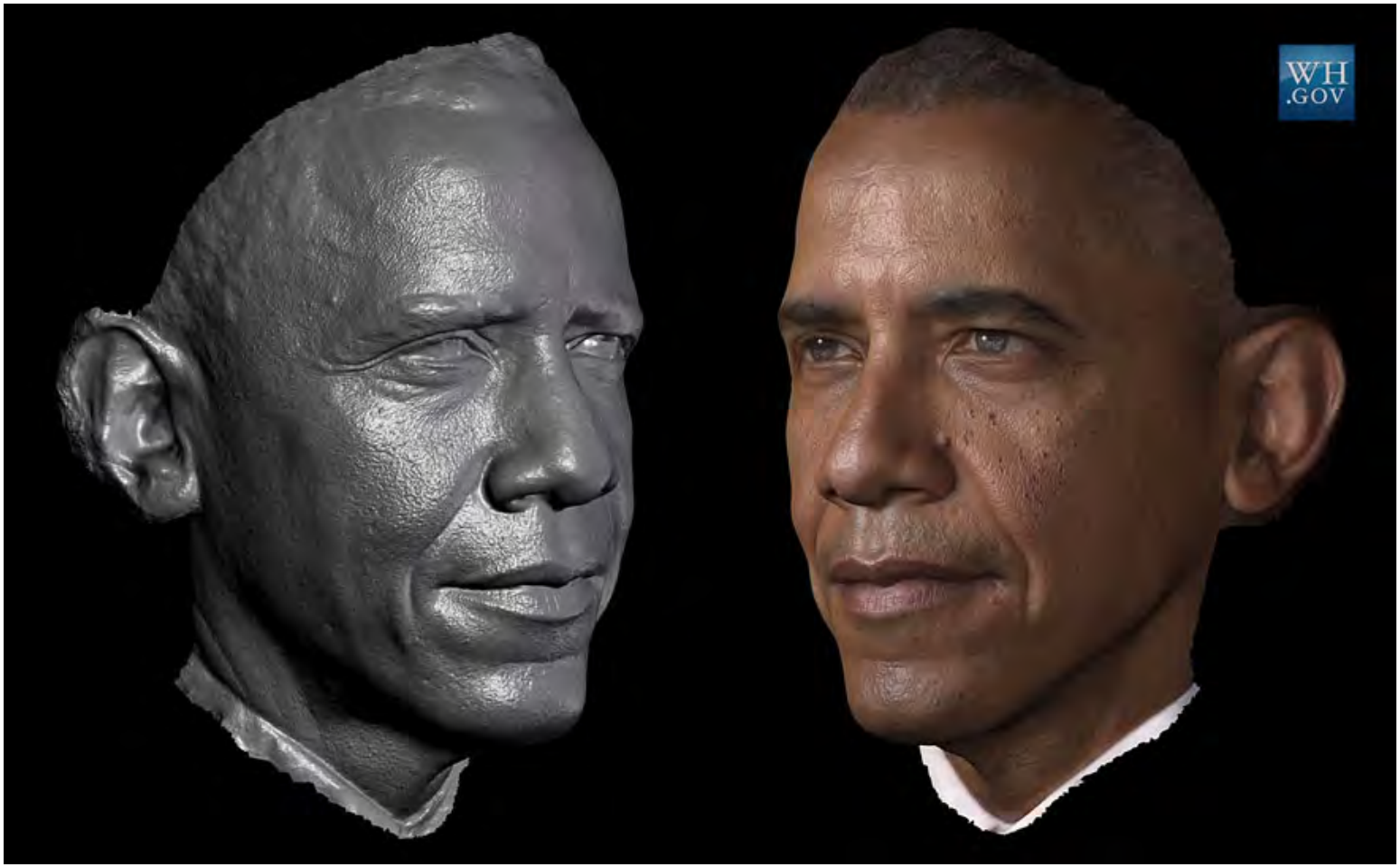




Human shape capture

Human shape capture

Human shape capture



Human shape capture

Special effects: shape capture

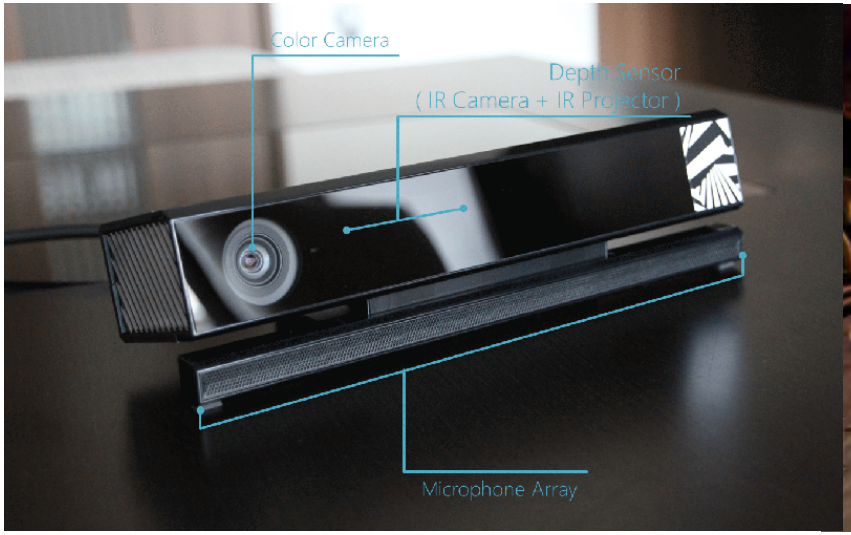
Star Wars: Rogue One – Peter Cushing / Admiral Tarkin

Special effects: shape capture

Special effects: motion capture

Interactive Games: Kinect

- Object Recognition: http://www.youtube.com/watch?feature=iv&v=fQ59dXOo63o
- Mario: http://www.youtube.com/watch?v=8CTJL5lUjHg
- 3D: http://www.youtube.com/watch?v=7QrnwoO1-8A
- Robot: http://www.youtube.com/watch?v=w8BmgtMKFbY



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Sports

Sportvision first down line
Nice explanation on www.howstuffworks.com

http://www.sportvision.com/video.html

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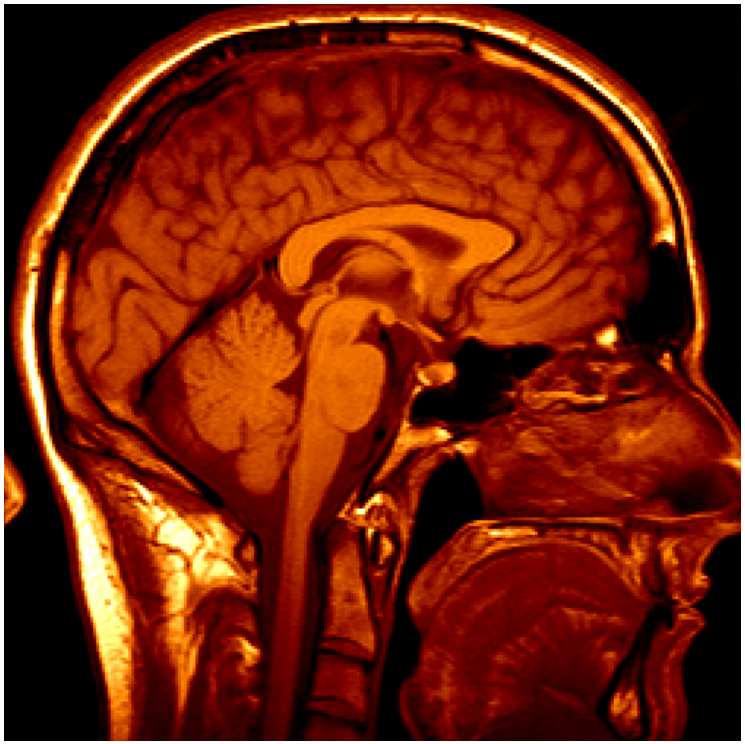
Medical imaging



3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT

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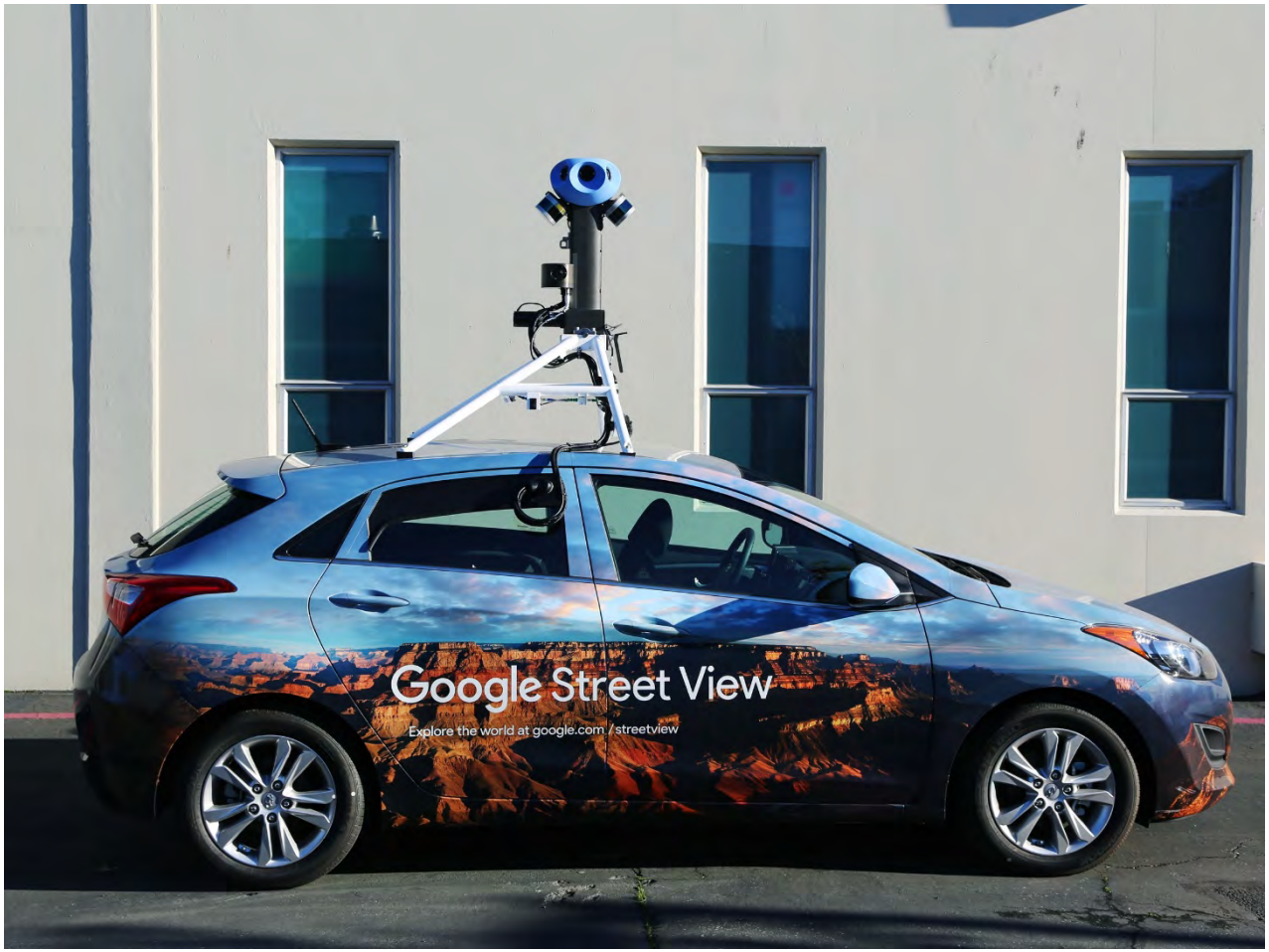
AutoCars - Uber bought CMU's lab


Google Street View
Explore the world at google.com/streetview

Industrial robots

Vision-guided robots position nut runners on wheels

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Vision in space

NASA'S Mars Exploration Rover Spirit captured this westward view from atop a low plateau where Spirit spent the closing months of 2007.

Vision systems (JPL) used for several tasks

- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking
- For more, read "Computer Vision on Mars" by Matthies et al.

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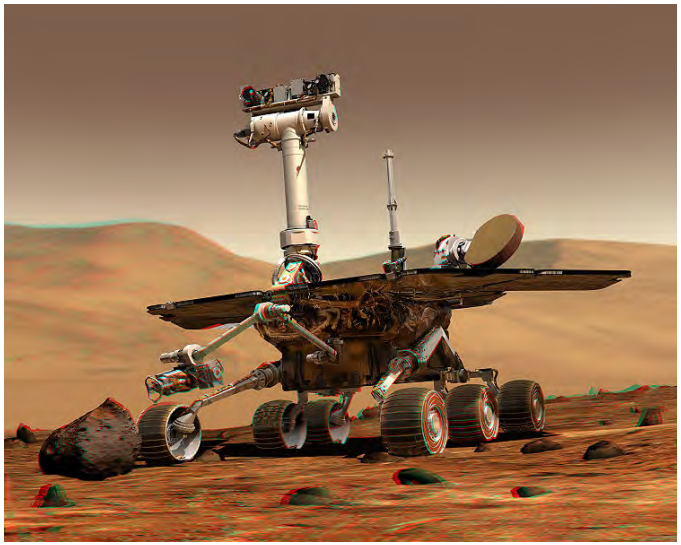
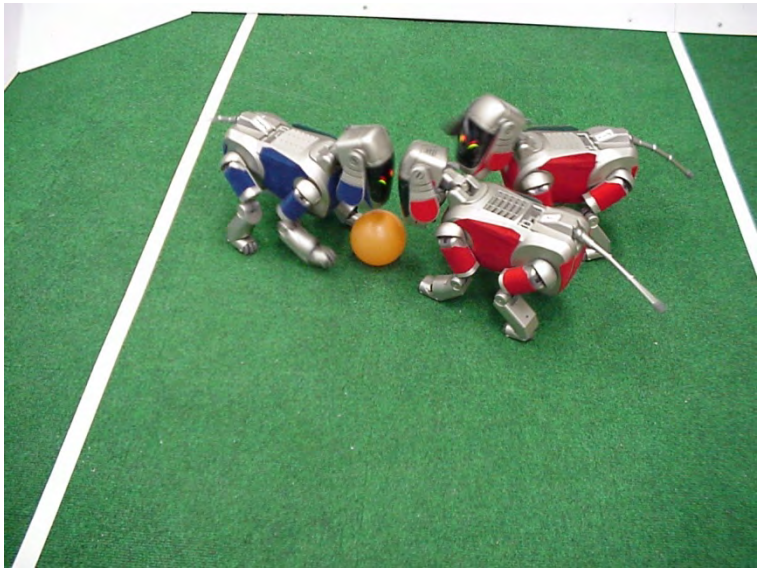
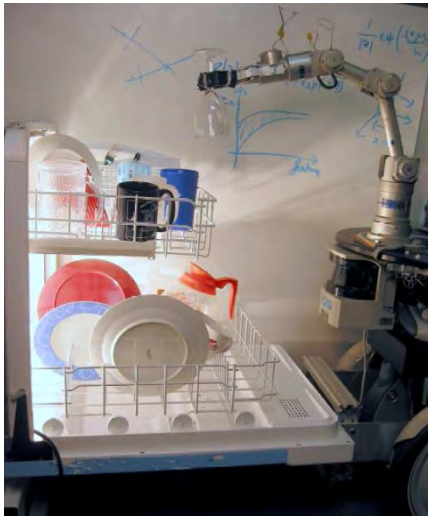
Mobile robots



NASA's Mars Spirit Rover
http://en.wikipedia.org/wiki/Spirit_rover



http://www.robocup.org/



Saxena et al. 2008
STAIR at Stanford

amazon Prime Air

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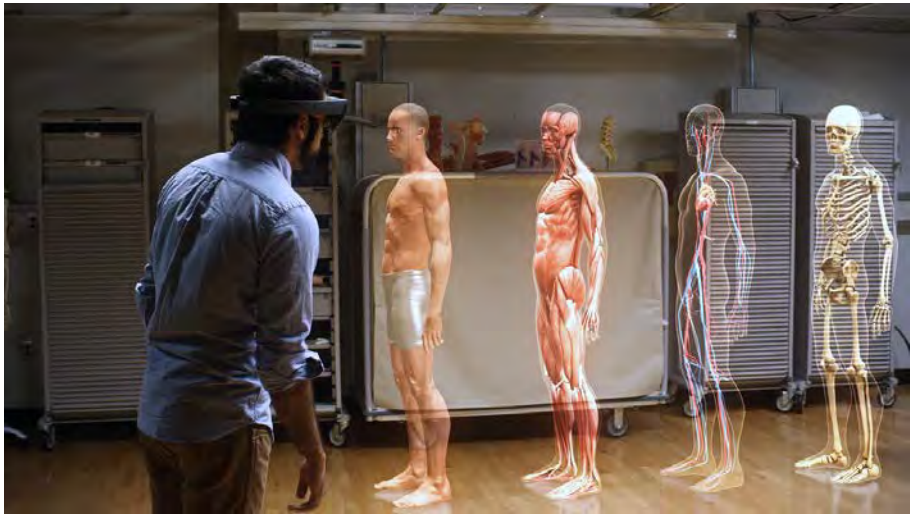
Augmented Reality and Virtual Reality



MS HoloLens, Oculus, Magic Leap,
ARCore / ARKit

State of the art today?

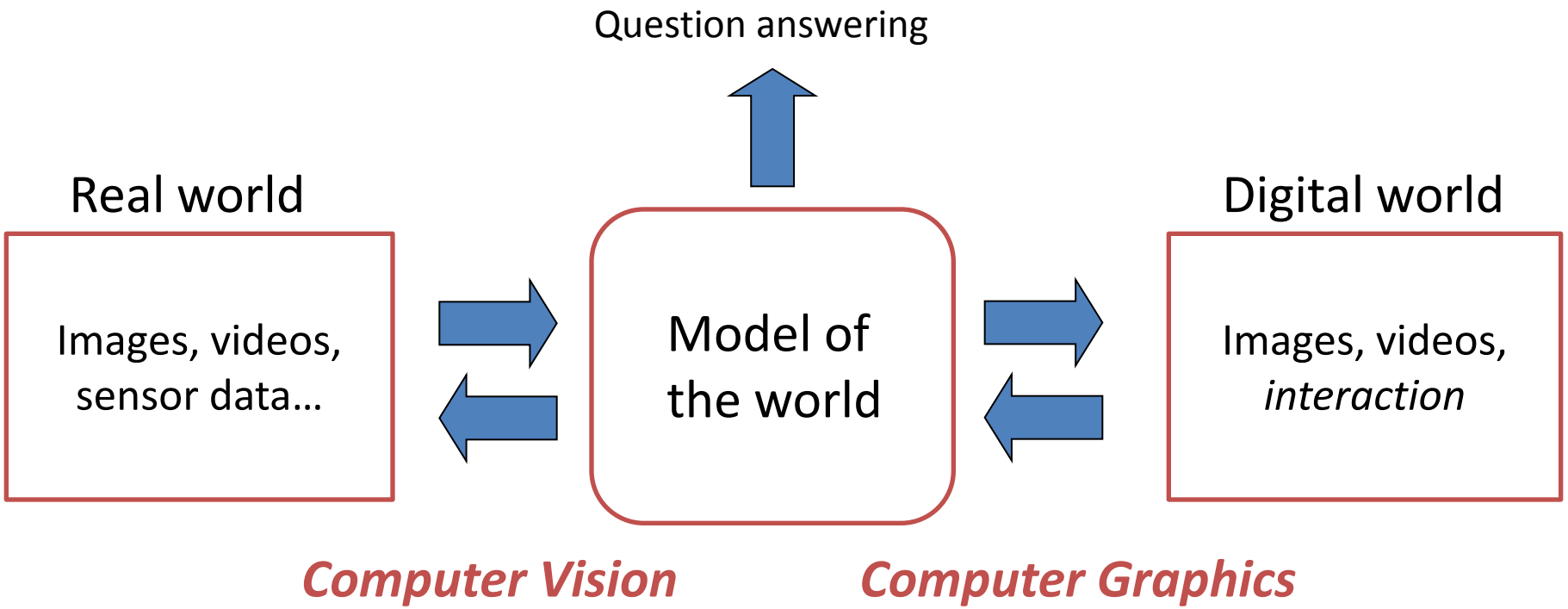
With enough training data, computer vision nearly matches human vision at most recognition tasks

Deep learning has been an enormous disruption to the field. Many techniques are being “deepified”.

Computer Vision and Nearby Fields

Derogatory summary of computer vision:

"Machine learning applied to visual data."



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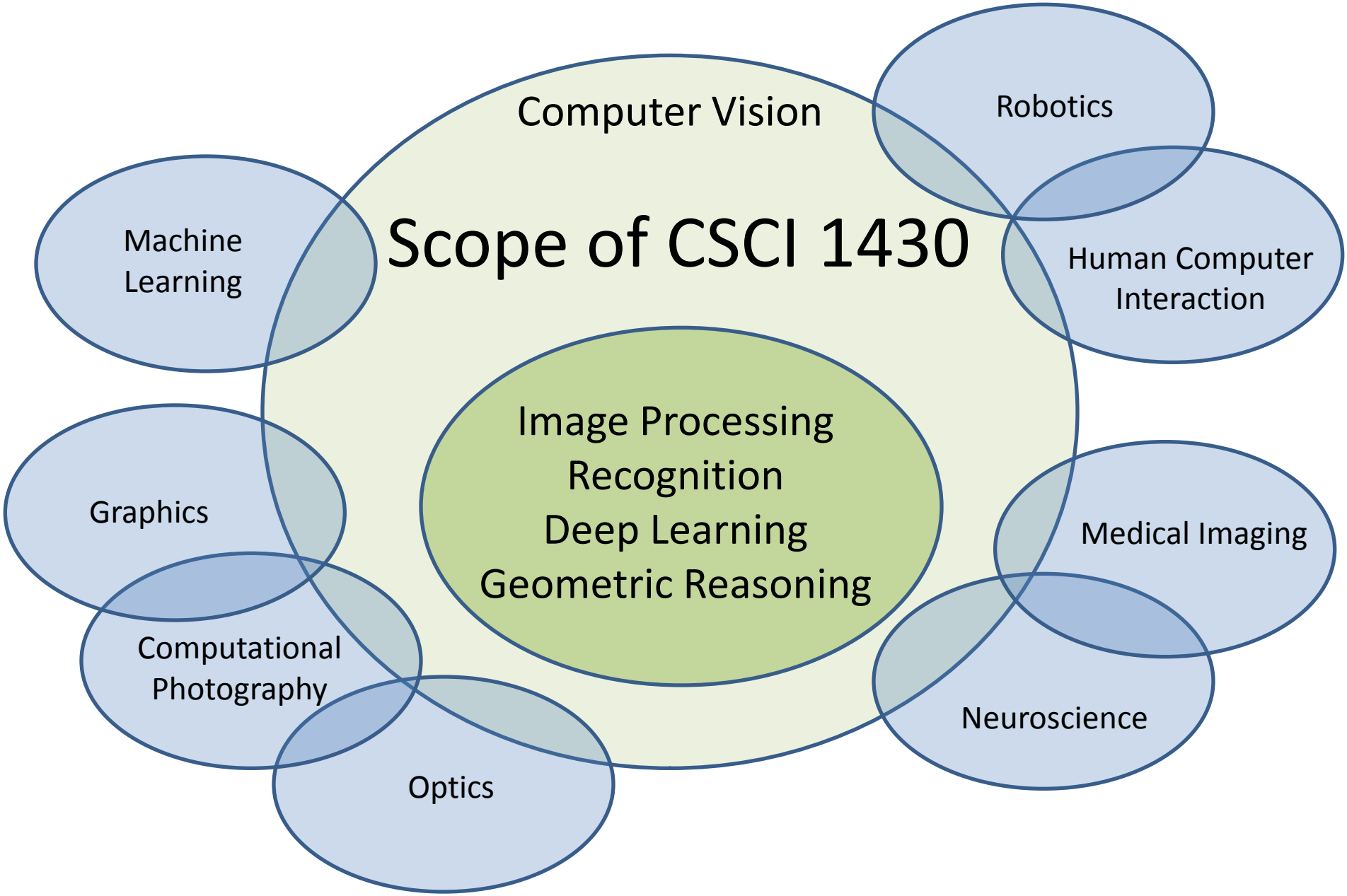
Computer Vision
Robotics
Scope of CSCI 1430
Machine Learning
Human Computer Interaction
Image Processing
Recognition
Deep Learning
Geometric Reasoning
Graphics
Medical Imaging
Computational Photography
Neuroscience
Optics

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Proj 1: Image Filtering and Hybrid Images

- Implement image filtering to separate high and low frequencies.
- Combine high frequencies and low frequencies from different images to create a scale-dependent image.

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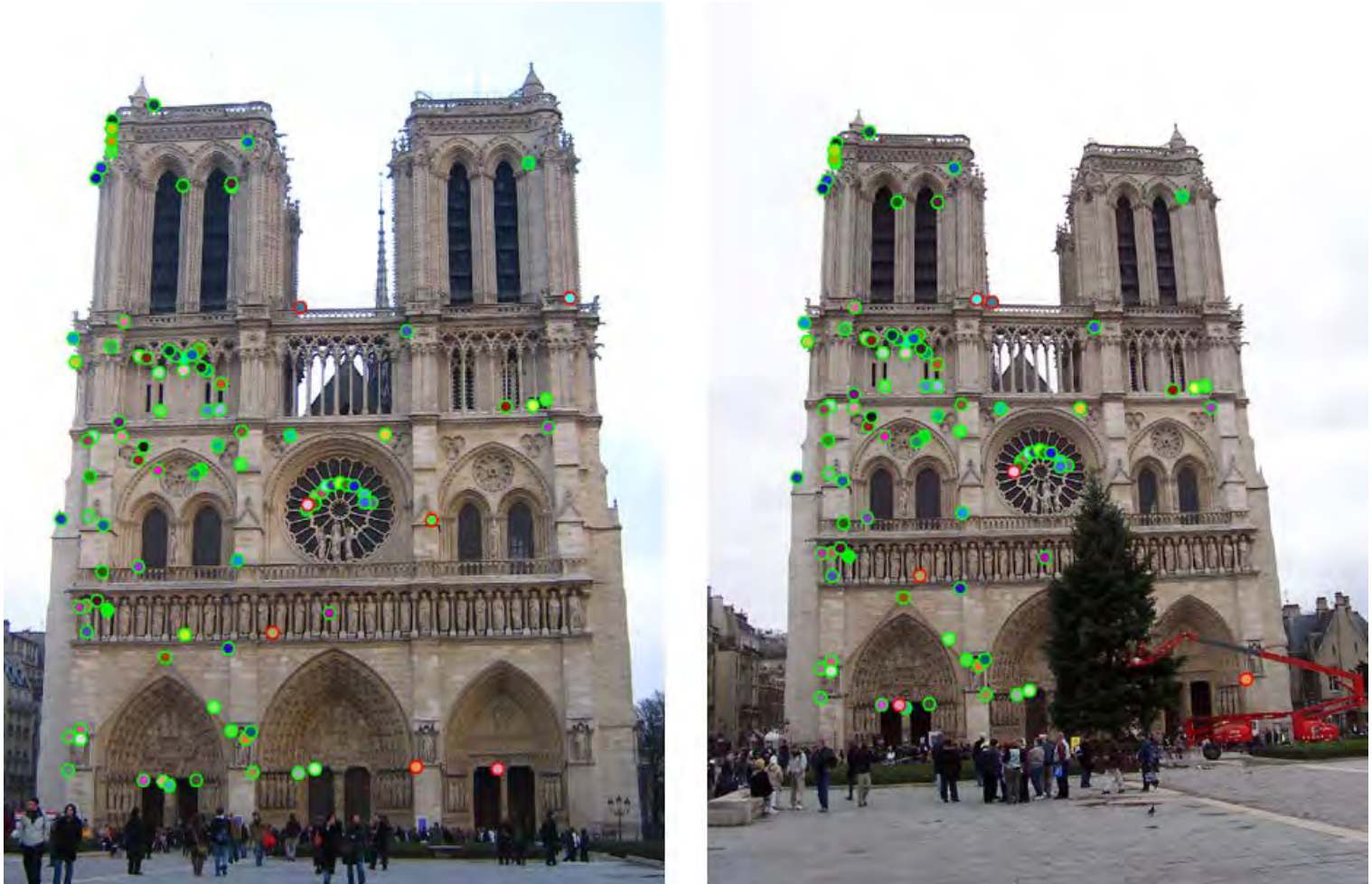
Proj 2: Local Feature Matching

- Implement interest point detector, SIFT-like local feature descriptor, and simple matching algorithm.



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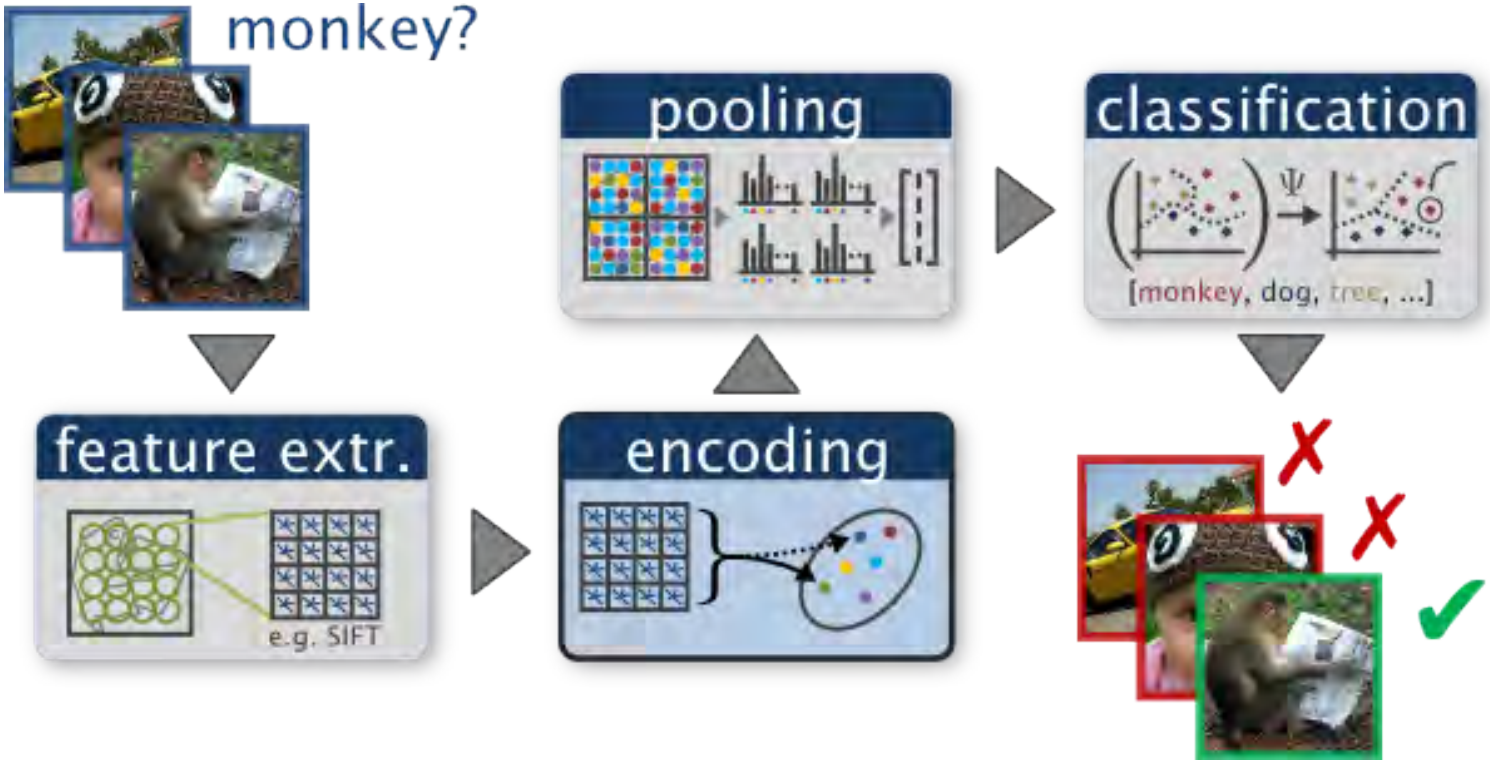
Proj 3: Scene Recognition with Bag of Words

- Quantize local features into a “vocabulary”, describe images as histograms of “visual words”, train classifiers to recognize scenes based on these histograms.



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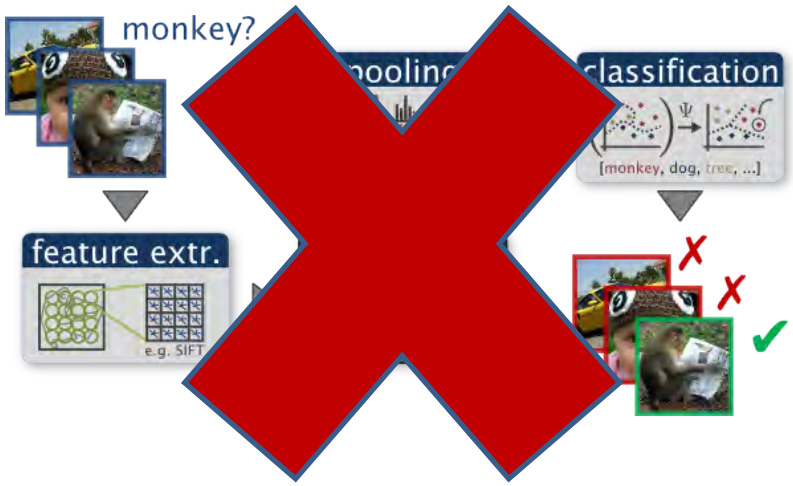
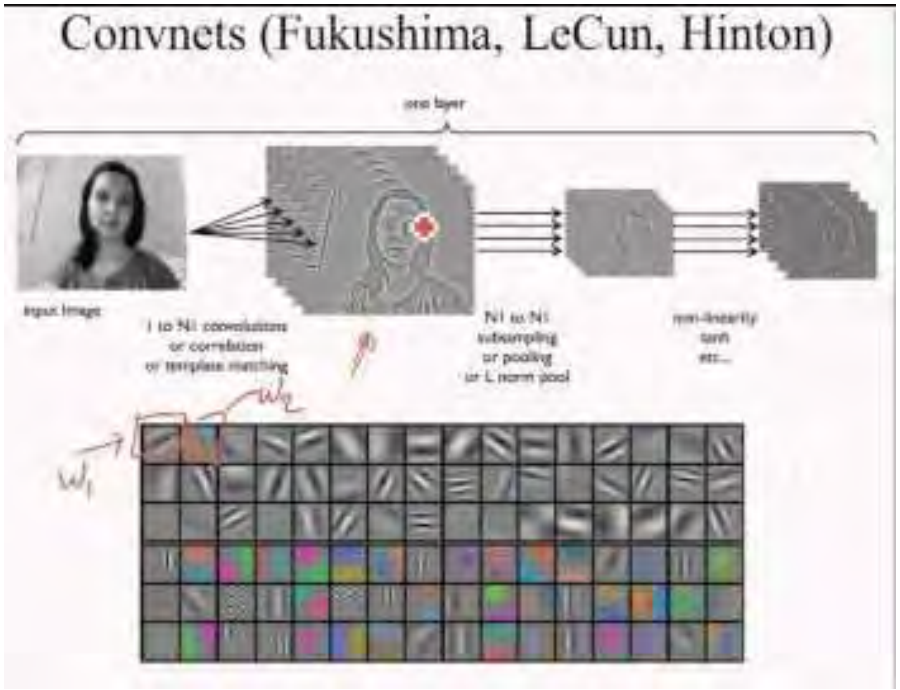
Proj 4: Convolutional Neural Nets

- Proj 3 again, but state of the art.





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Proj 5: Multi-view Geometry

- Recover camera calibration from feature point matches.
- Foundation for almost all measurement in computer vision.

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Proj 6: Group challenge

- Improve WebGazer:
  A real-time Web-based eye tracker.