Computer Vision (CS 482)

Professor

Zoran Duric

zduric@cs.gmu.edu

http://cs.gmu.edu/~zduric

Course Web Page

https://piazza.com/gmu/fall2013/cs482/home

Handouts

- signup sheet
- intro slides
- image filtering slides

Today

- Intros

- Computer vision overview

- Course overview

- Image processing

Readings

- Book: Richard Szeliski, Computer Vision: Algorithms and Applications
    - (please check course web site for updated drafts)
    - Intro: Ch 1.0

What is computer vision?

What is computer vision?

Terminator 2

Enemy of the State

Every picture tells a story

La Gare Montparnasse, 1895

Goal of computer vision is to write computer programs that can interpret images

Can computers match (or beat) human vision?
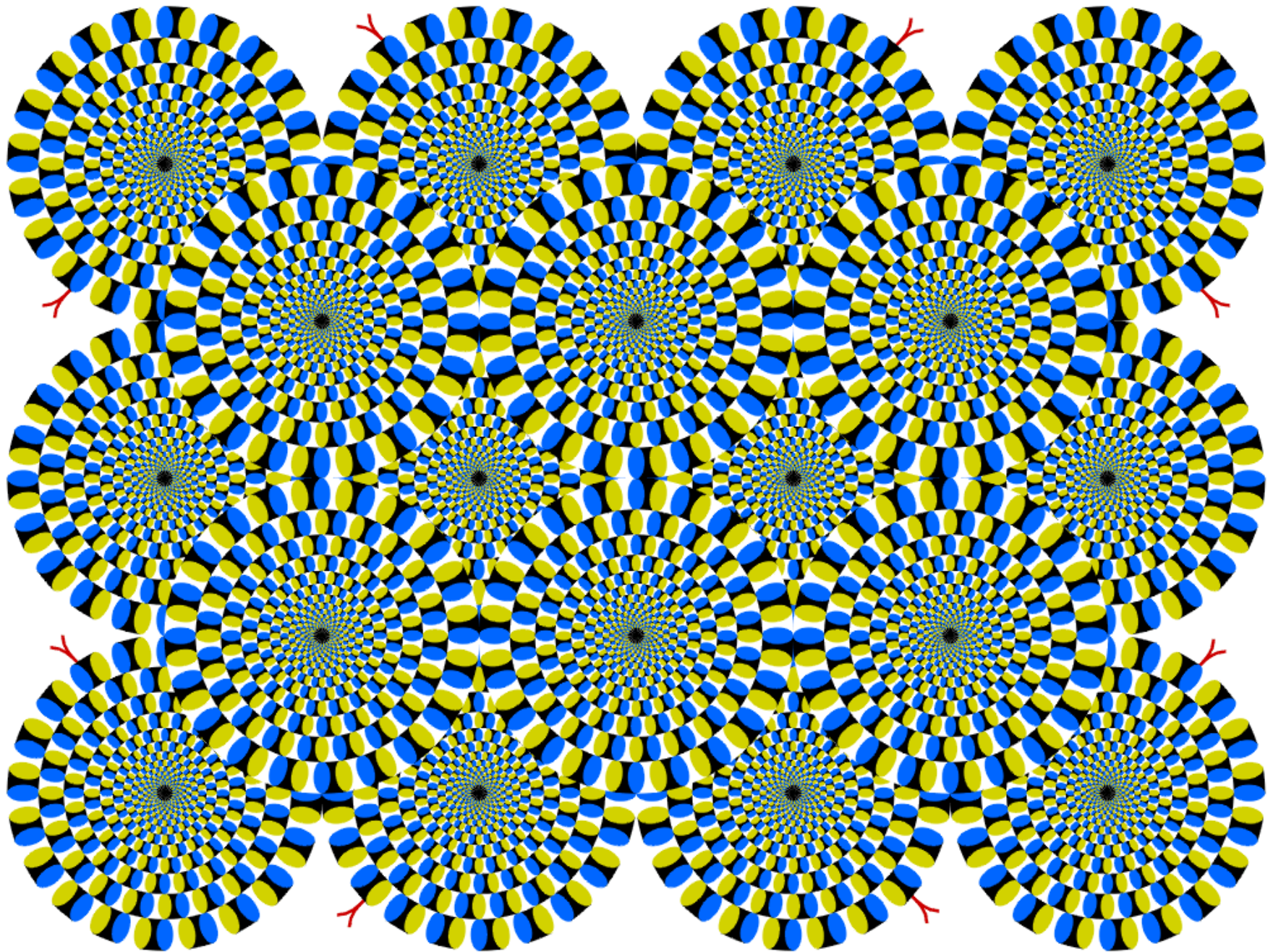

La Gare Montparnasse, 1895

Yes and no (but mostly no!)

- humans are much better at "hard" things
- computers can be better at "easy" things

Human perception has its shortcomings…

Sinha and Poggio, *Nature*, 1996

Copyright A.Kitaoka 2003

Current state of the art

The next slides show some examples of what current vision systems can do
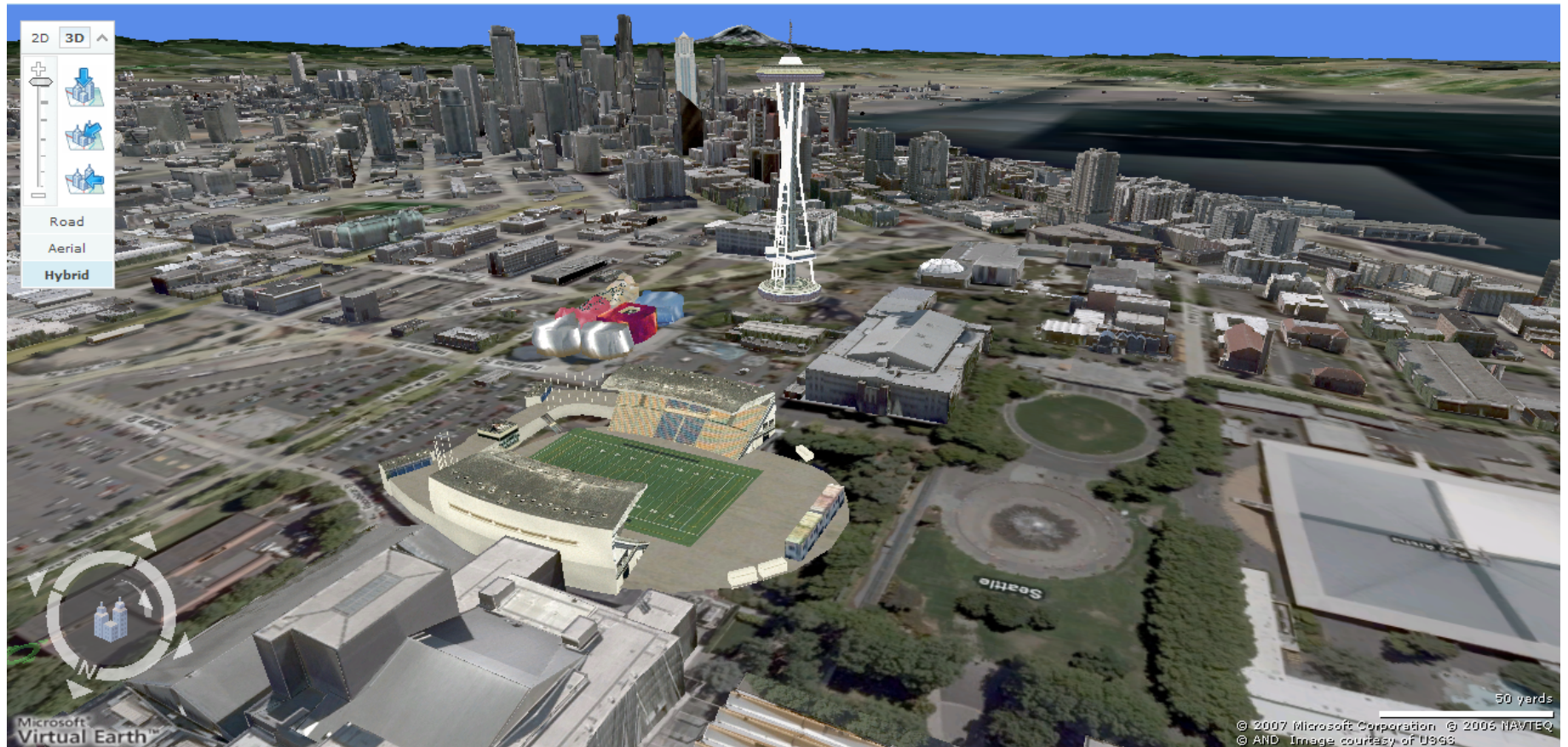
Earth viewers (3D modeling)

Image from Microsoft's Virtual Earth
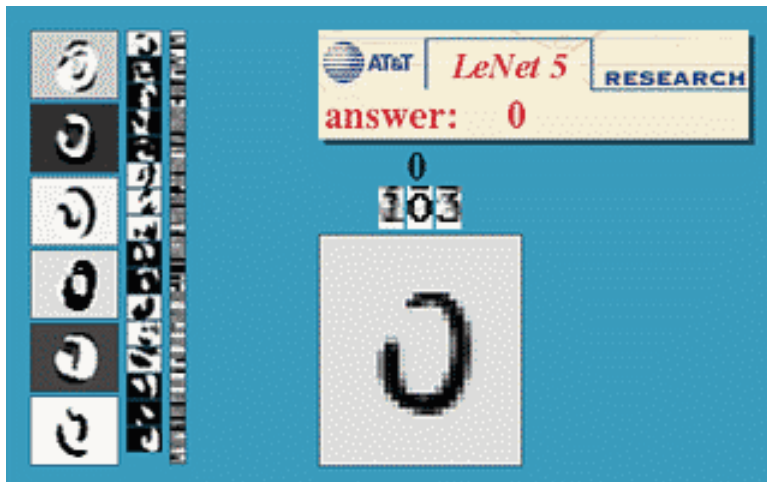(see also: Google Earth)

http://photosynth.net

Based on Photo Tourism technology developed
by Noah Snavely, Steve Seitz, and Rick Szeliski

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://yann.lecun.com/ex/research/index.html

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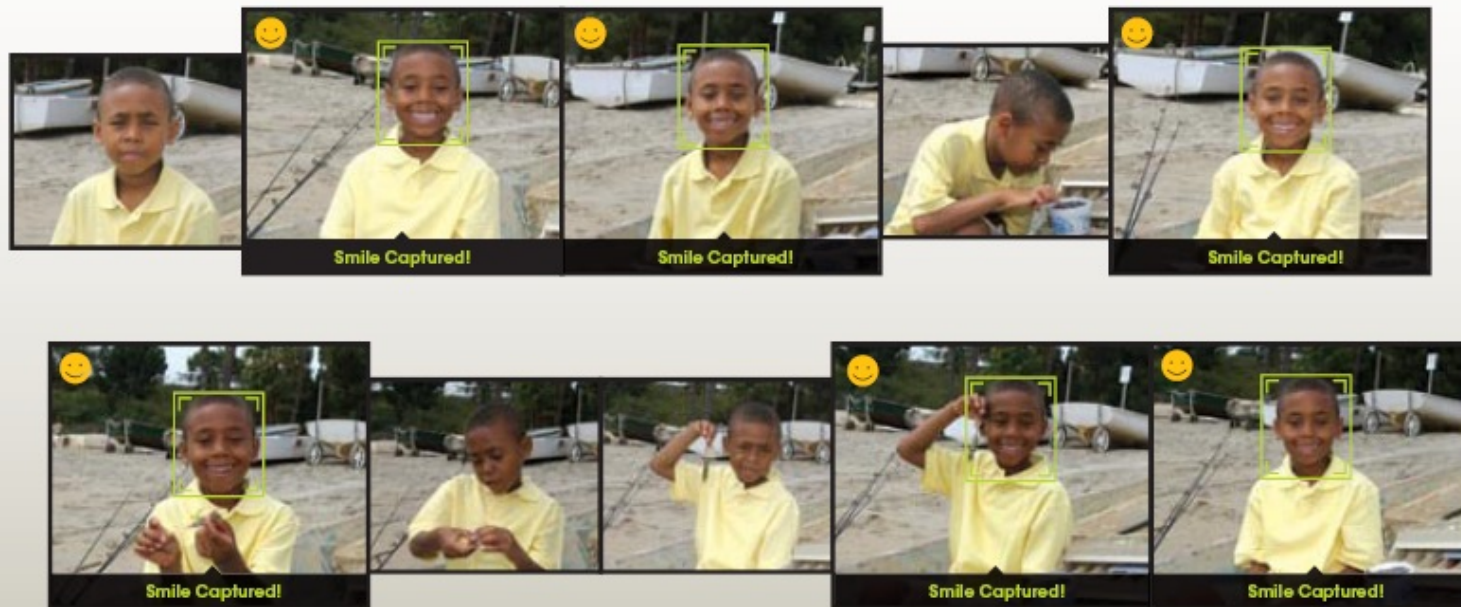
Face detection

Many new digital cameras now detect faces

- Canon, Sony, Fuji, …

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

Object recognition (in supermarkets)

[LaneHawk by EvolutionRobotics](#)
"A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk,you are assured to get paid for it… "
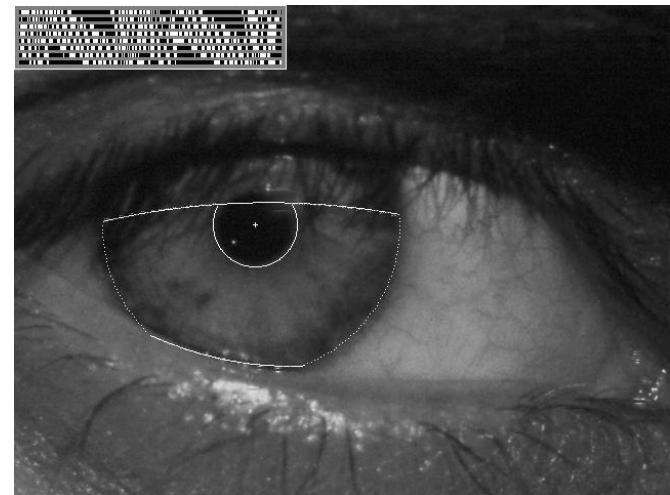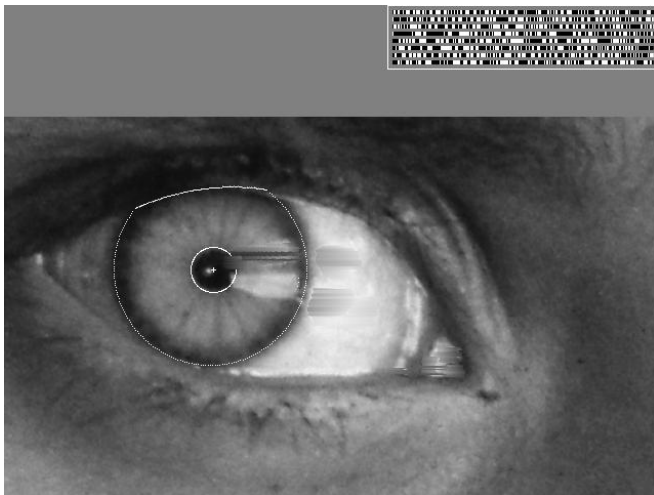
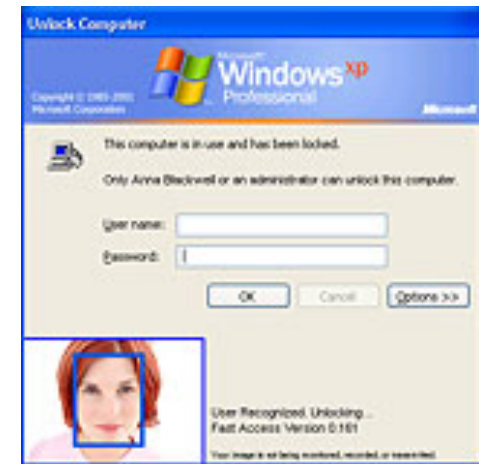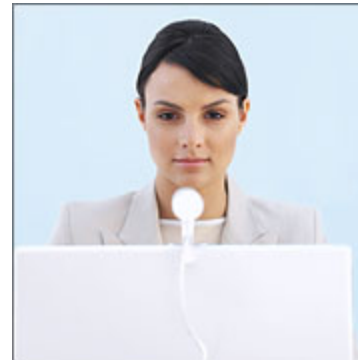# Face recognition
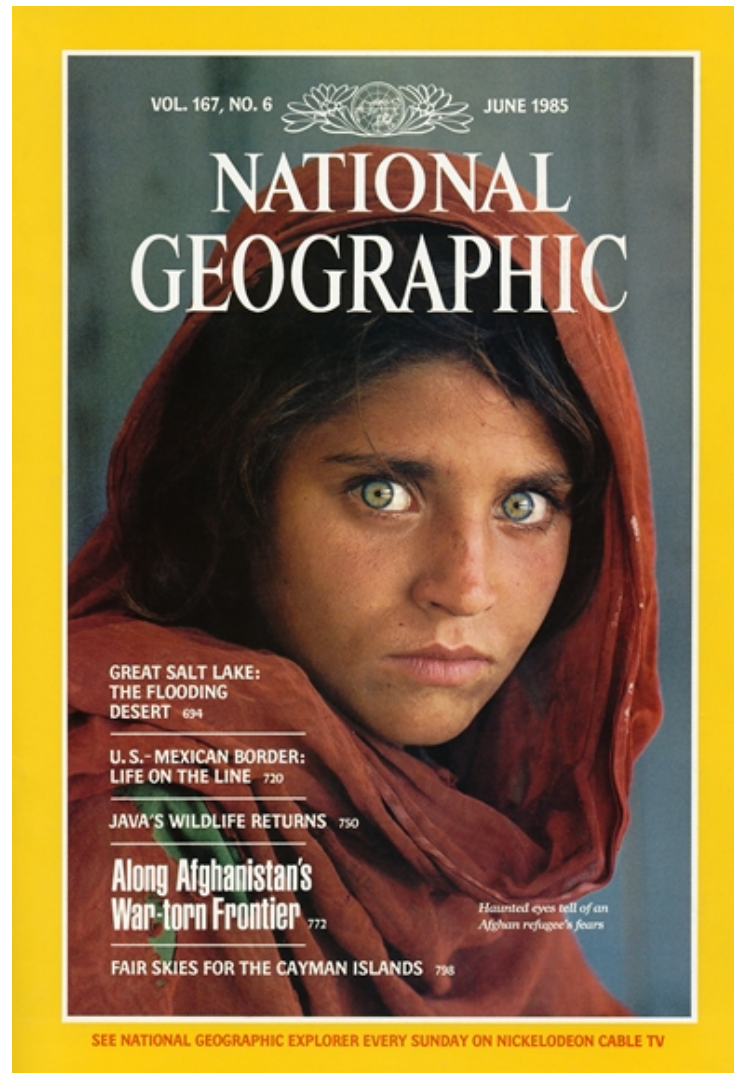
Who is she?

Vision-based biometrics

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

Login without a password…

Fingerprint scanners on
many new laptops,
other devices

Face recognition systems now
beginning to appear more widely
http://www.sensiblevision.com/

Object recognition (in mobile phones)

This is becoming real:
- Lincoln Microsoft Research

Special effects: shape capture

The Matrix movies, ESC Entertainment, XYZRGB, NRC

Special effects: motion capture

Pirates of the Carribean, Industrial Light and Magic

Sports

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

Smart cars

Mobileye

- Vision systems currently in high-end BMW, GM, Volvo models
- By 2010: 70% of car manufacturers.
- Video demos

Vision-based interaction (and games)

[Digimask](#): put your face on a 3D avatar.

Nintendo Wii has camera-based IR tracking built in. See [Lee's work at CMU](#).

"Game turns moviegoers into Human Joysticks", CNET
Camera tracking a crowd, based on [this work](#).

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.
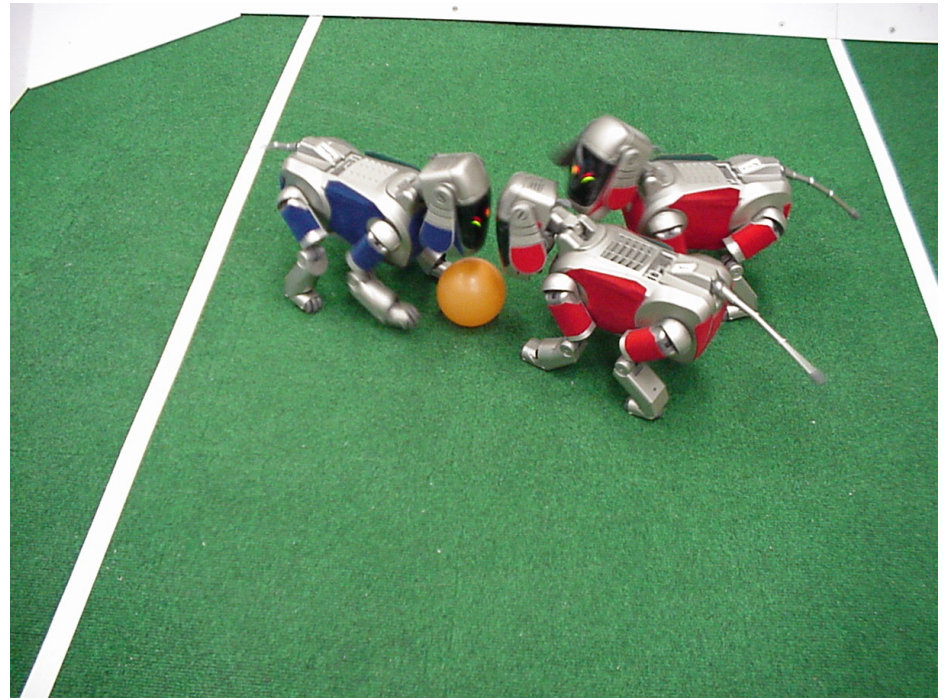
Vision systems (JPL) used for several tasks

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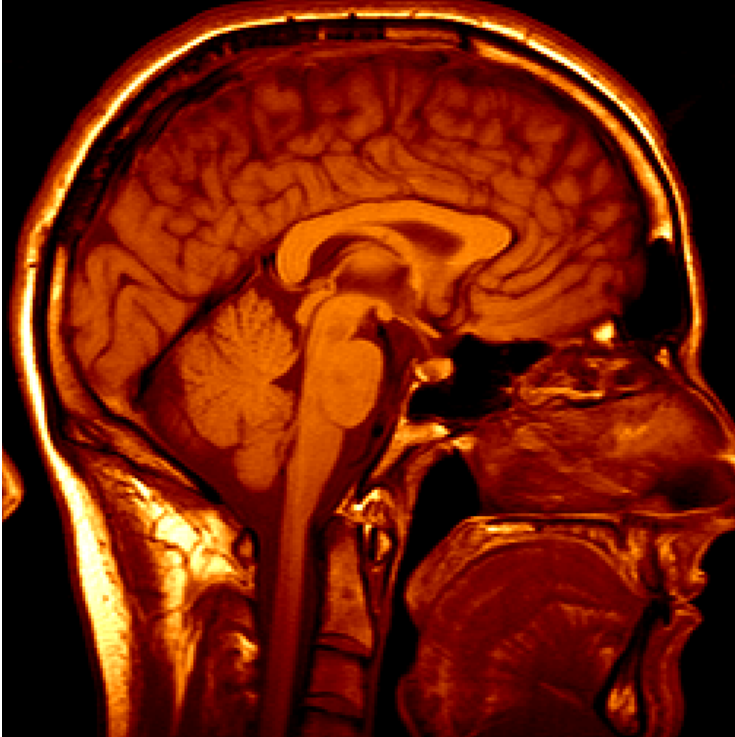- For more, read "Computer Vision on Mars" by Matthies et al.

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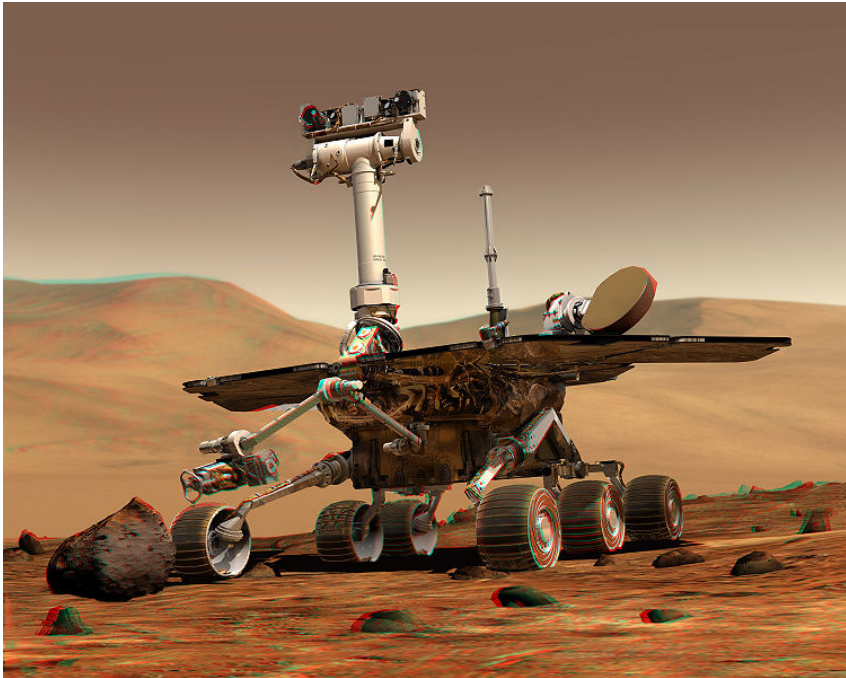
NASA's Mars Spirit Rover
http://en.wikipedia.org/wiki/Spirit_rover

http://www.robocup.org/

Medical imaging

3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT

Current state of the art

You just saw examples of current systems.

- Many of these are less than 5 years old

This is a very active research area, and rapidly changing

- Many new apps in the next 5 years

To learn more about vision applications and companies

- David Lowe maintains an excellent overview of vision companies
  - http://www.cs.ubc.ca/spider/lowe/vision.html

This course

https://piazza.com/gmu/fall2013/cs482/home

Grading

- Class attendance and participation 10%.
- Homeworks and projects 50% (about every 2 weeks).
- A midterm 20%.
- A final 20%.

General Comments

Prerequisites—*these are essential*!

- Data structures
- A good working knowledge of Python, Java, or C and C++ programming
  - We will use OpenCV and Matlab
- Linear algebra
- Vector calculus

Course does **not** assume prior imaging experience

- computer vision, image processing, graphics, etc.

You need to install OpenCV on your computer