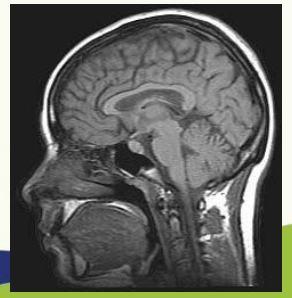
جامعة الجلالة
GALALA UNIVERSITY

Artificial Intelligence Science Program

Computer Vision

What is Computer Vision?

- Vision is **a perceptual channel** that accepts impulse and reports some representation of the world.
- Most agents that use vision use **passive sensing**—they do not need to send out light to see.
- In contrast, **active sensing** involves sending out a signal such as radar or ultrasound, and sensing a reflection.
  - Bats (ultrasound), dolphins (sound), and some robots (light, sound, radar).
- **Computer vision** is the science and technology of machines that see.
  - Concerned with the theory for building artificial systems that obtain information from images.
- The image data can take many forms, such as a video sequence, depth images, views from multiple cameras, or multi-dimensional data from a medical scanner



Computer Vision

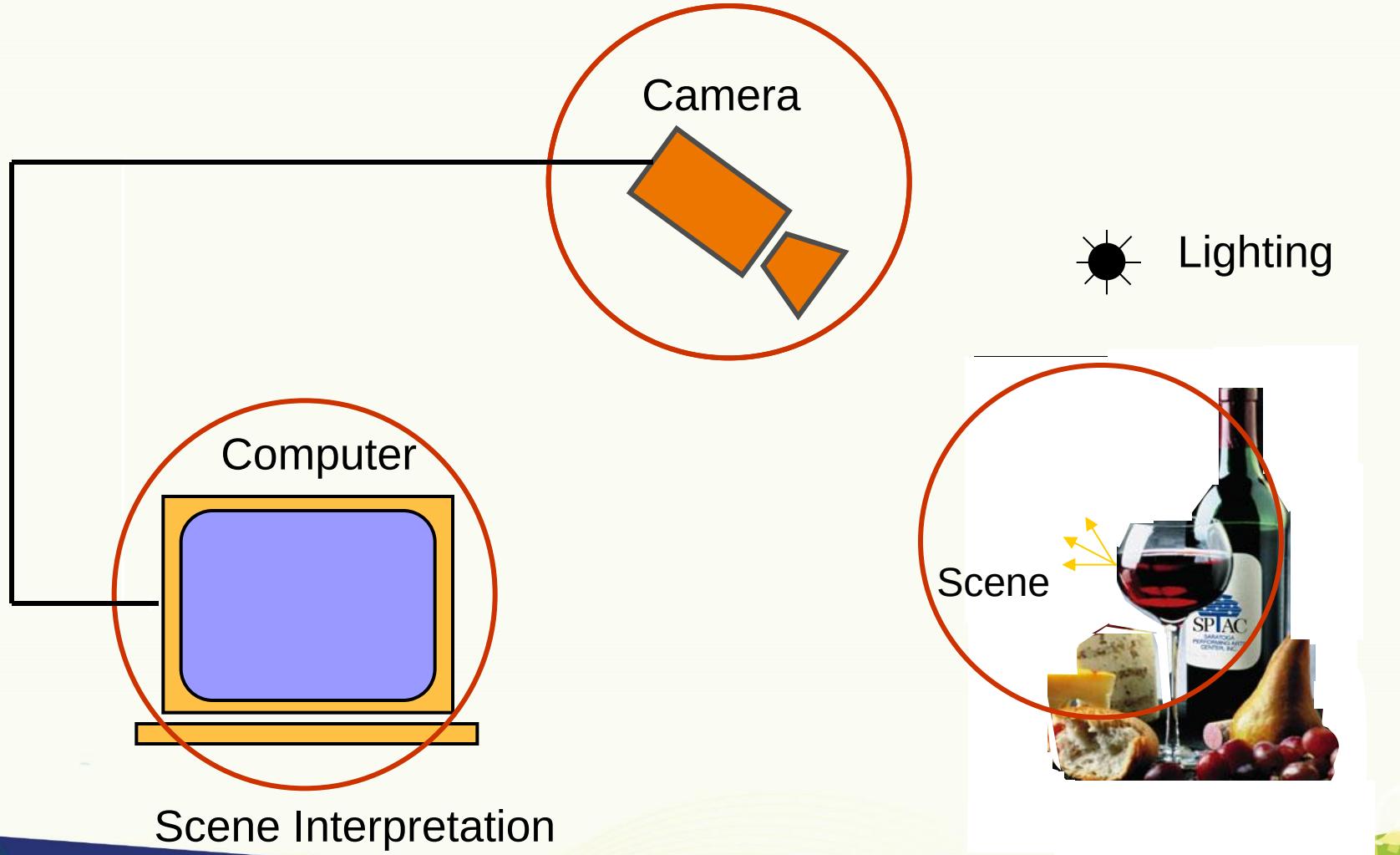
Make computers understand images and videos.

Where are the cars?

How far is the building?

…

Components of a computer vision system



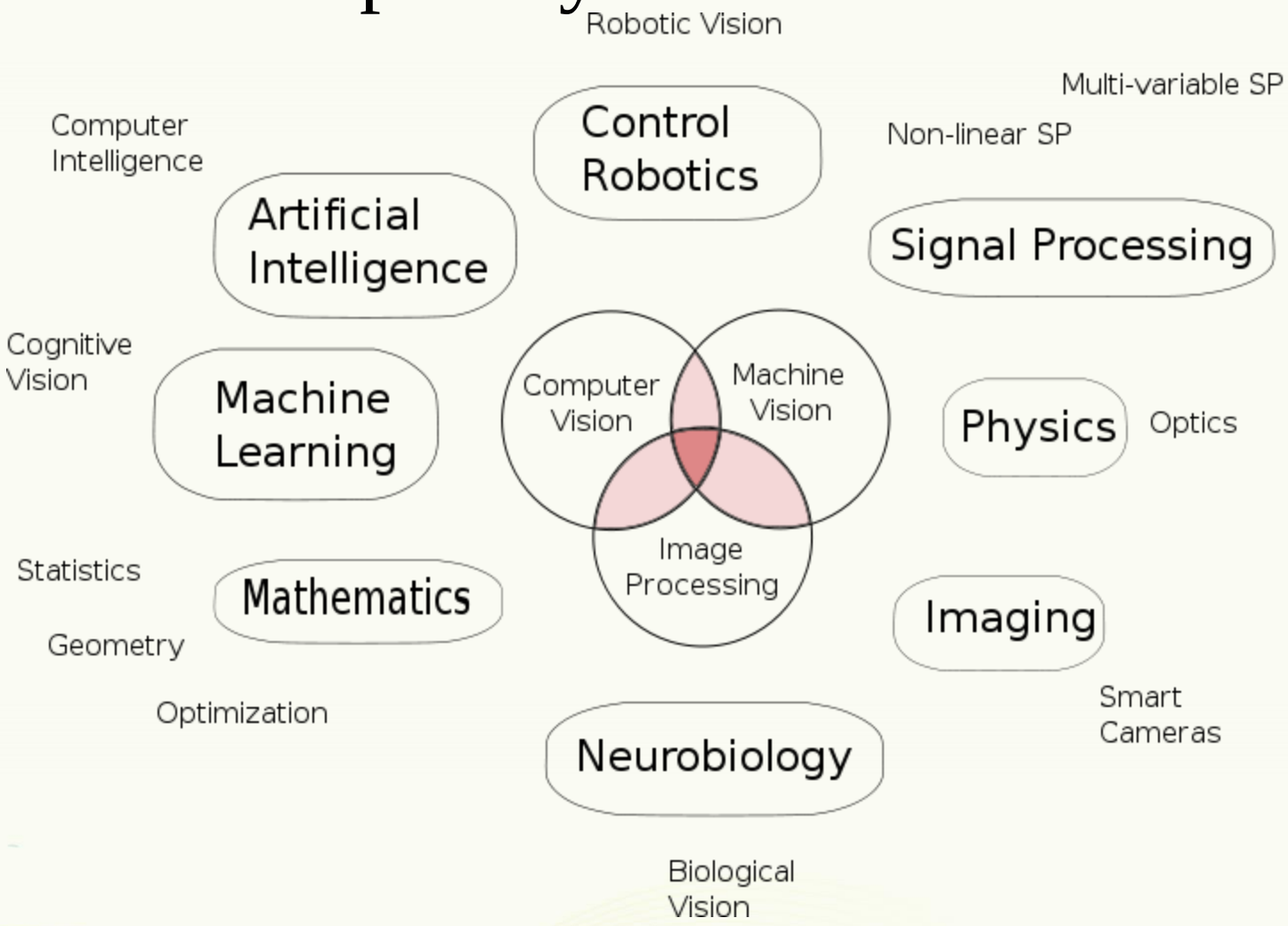
Computer vision vs human vision

What we see

0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0

What a computer sees

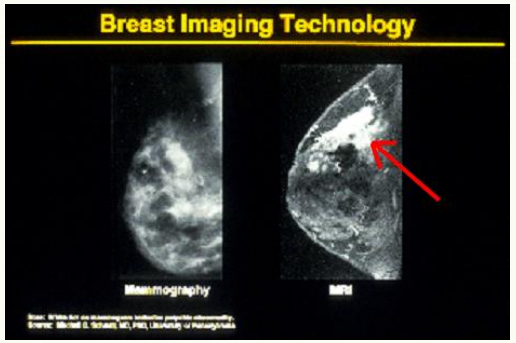
Vision is multidisciplinary



From wiki

Why computer vision matters

Safety

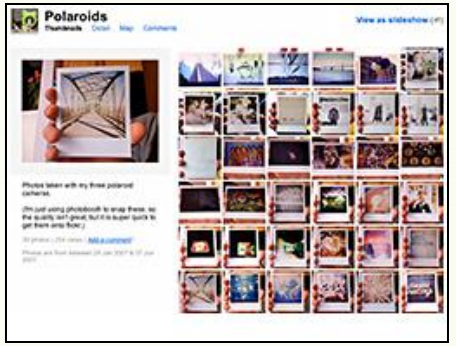


Health

Security

Comfort

Fun

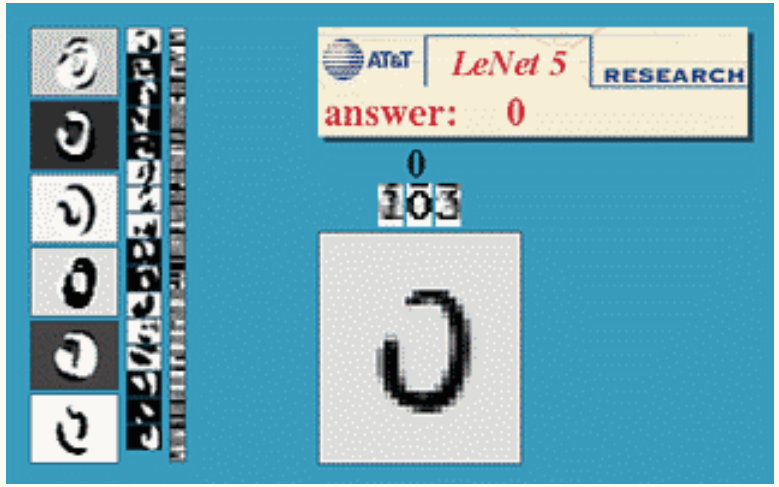


Access

Optical character recognition (OCR)

Technology to convert scanned docs to text

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



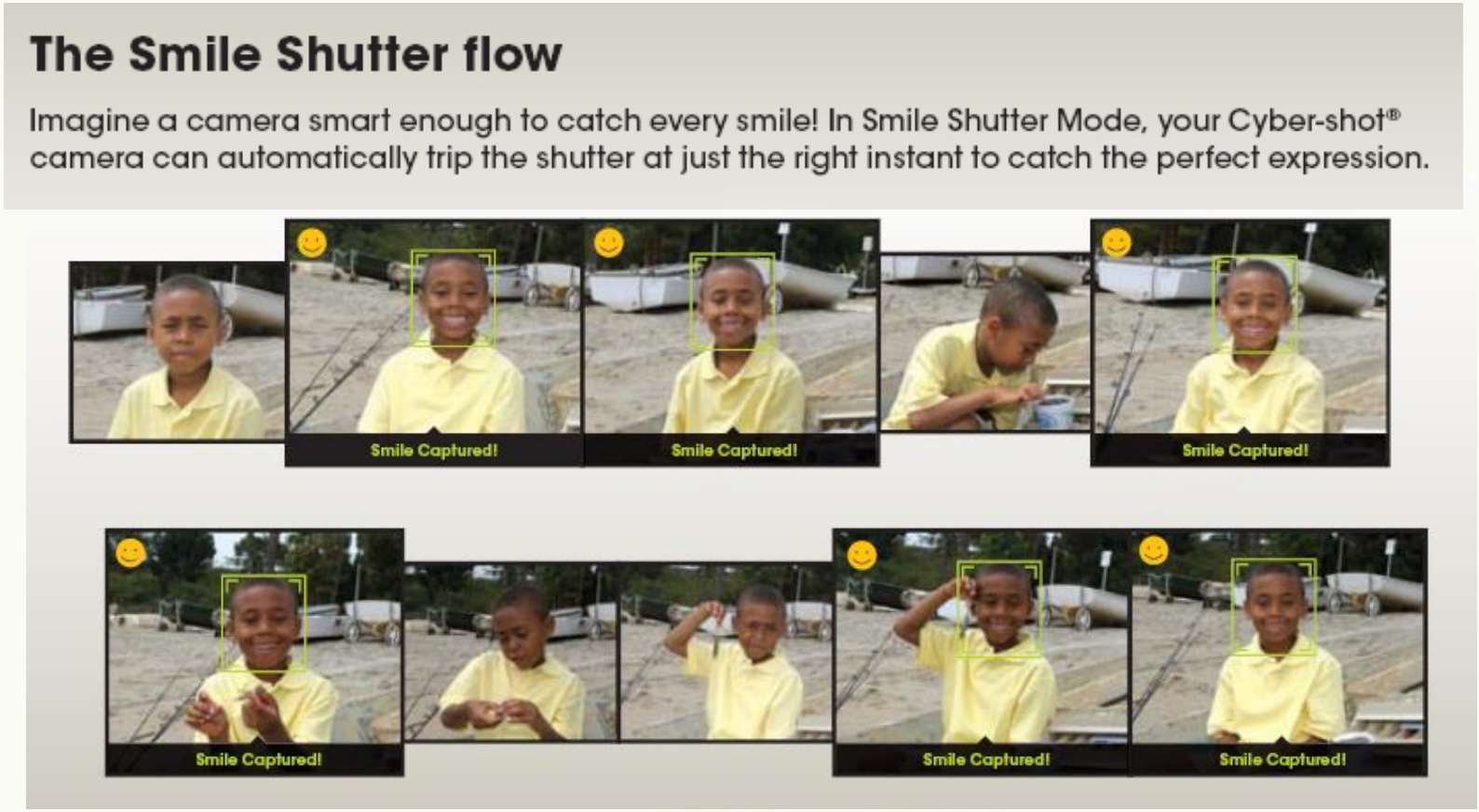
Digit recognition, AT&T labs
http://www.research.att.com/~yann/

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

Face detection

- Many new digital cameras now detect faces
  - Canon, Sony, Fuji, …

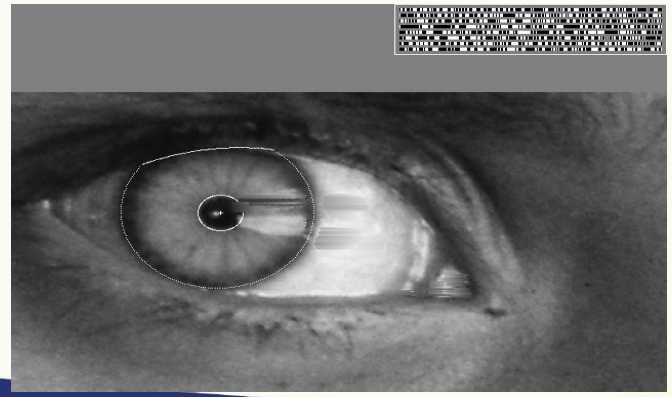
Smile detection

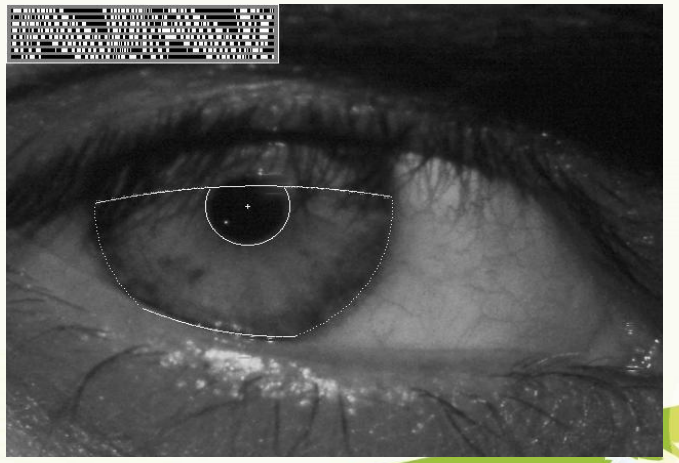


Sony Cyber-shot® T70 Digital Still Camera

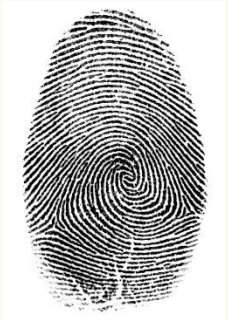
Vision-based biometrics

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





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)

[Point & Find](), [Nokia]()

[Google Goggles]()

Smart cars

Slide content courtesy of Amnon Shashua

- Mobileye [wiki article]
  - Vision systems currently in many car models

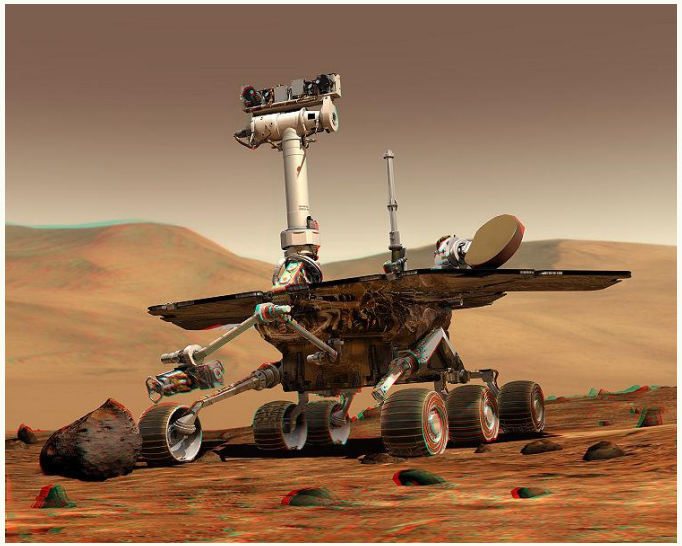
Google cars

http://www.nytimes.com/2010/10/10/science/10google.html?ref=artificialintelligence

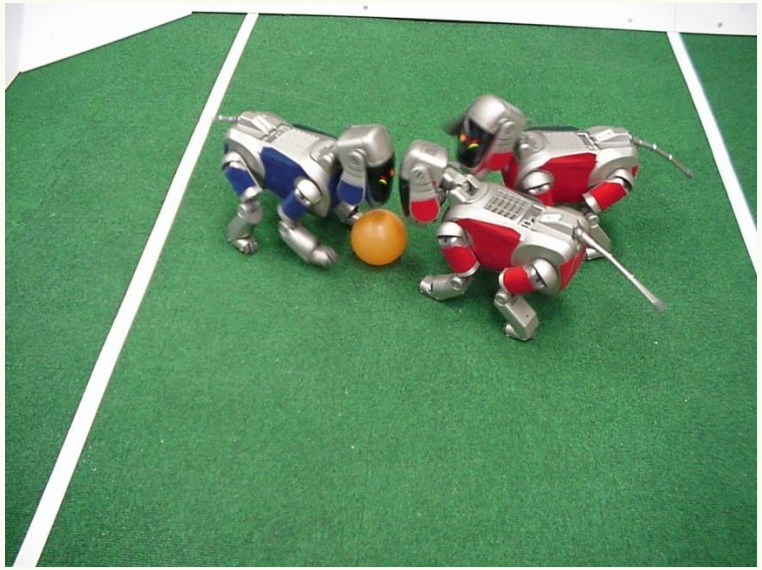
Industrial robots

Vision-guided robots position nut runners on wheels

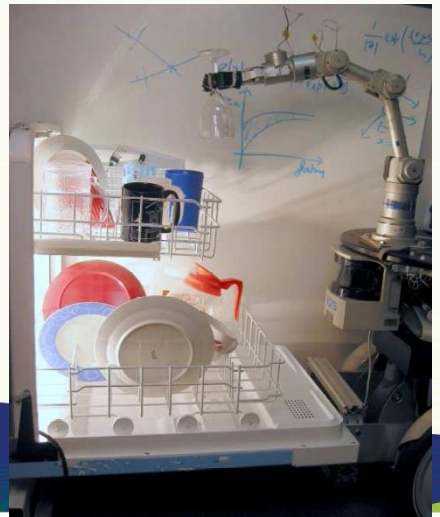
Mobile robots



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

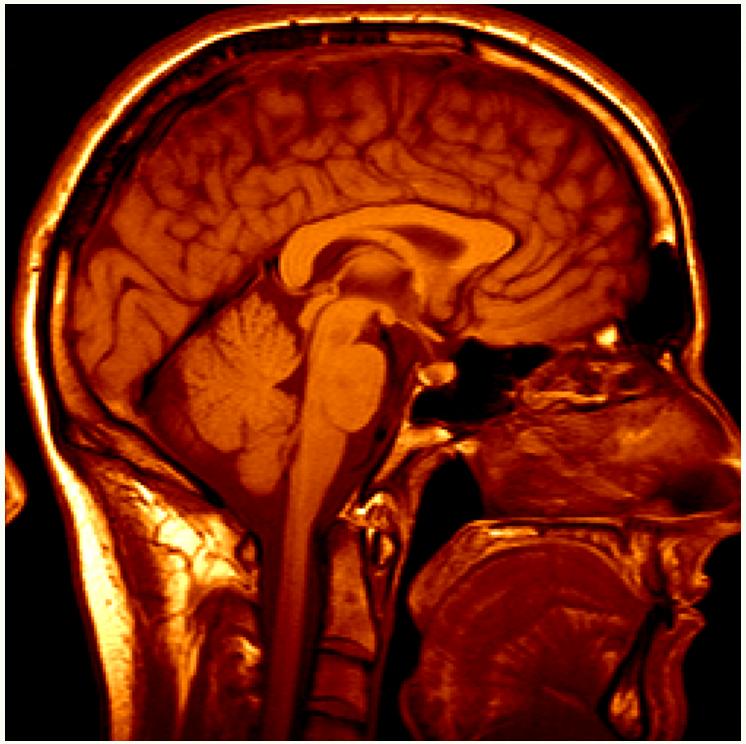


http://www.robocup.org/



Saxena et al. 2008
STAIR at Stanford

Medical imaging



3D imaging
MRI, CT

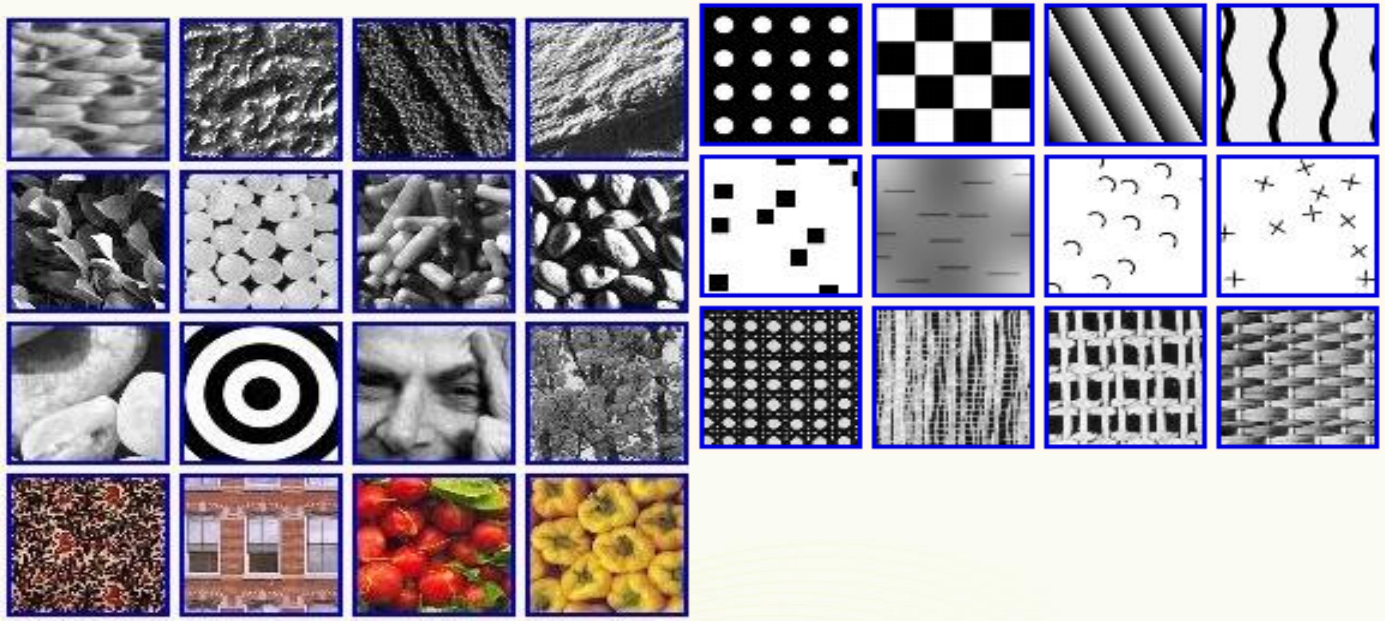
Image guided surgery
Grimson et al., MIT

Main Problems

- The two core problems of computer vision are:
  - **Reconstruction**, where an agent builds a model of the world from an image or a set of images, and
  - **Recognition**, where an agent draws distinctions among the objects it encounters based on visual and other information.
- Image plane is subdivided into a grid of a few million pixels.

Image Feature

- A feature is a number obtained by applying simple computations to an image. Very useful information can be obtained directly from features.
- **Edges** are straight lines or curves in the image plane across which there is a “significant” change in image brightness.
- **Texture** In computational vision, texture refers to a pattern on a surface that can be sensed visually.



Region Segmentation

Segmentation is the process of breaking an image into groups of similar pixels. The basic idea is that each image pixel can be associated with certain visual properties, such as brightness, color, and texture.