



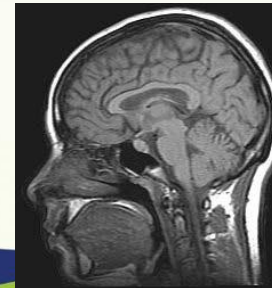
جامعة الجلالة
GALALA UNIVERSITY

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.



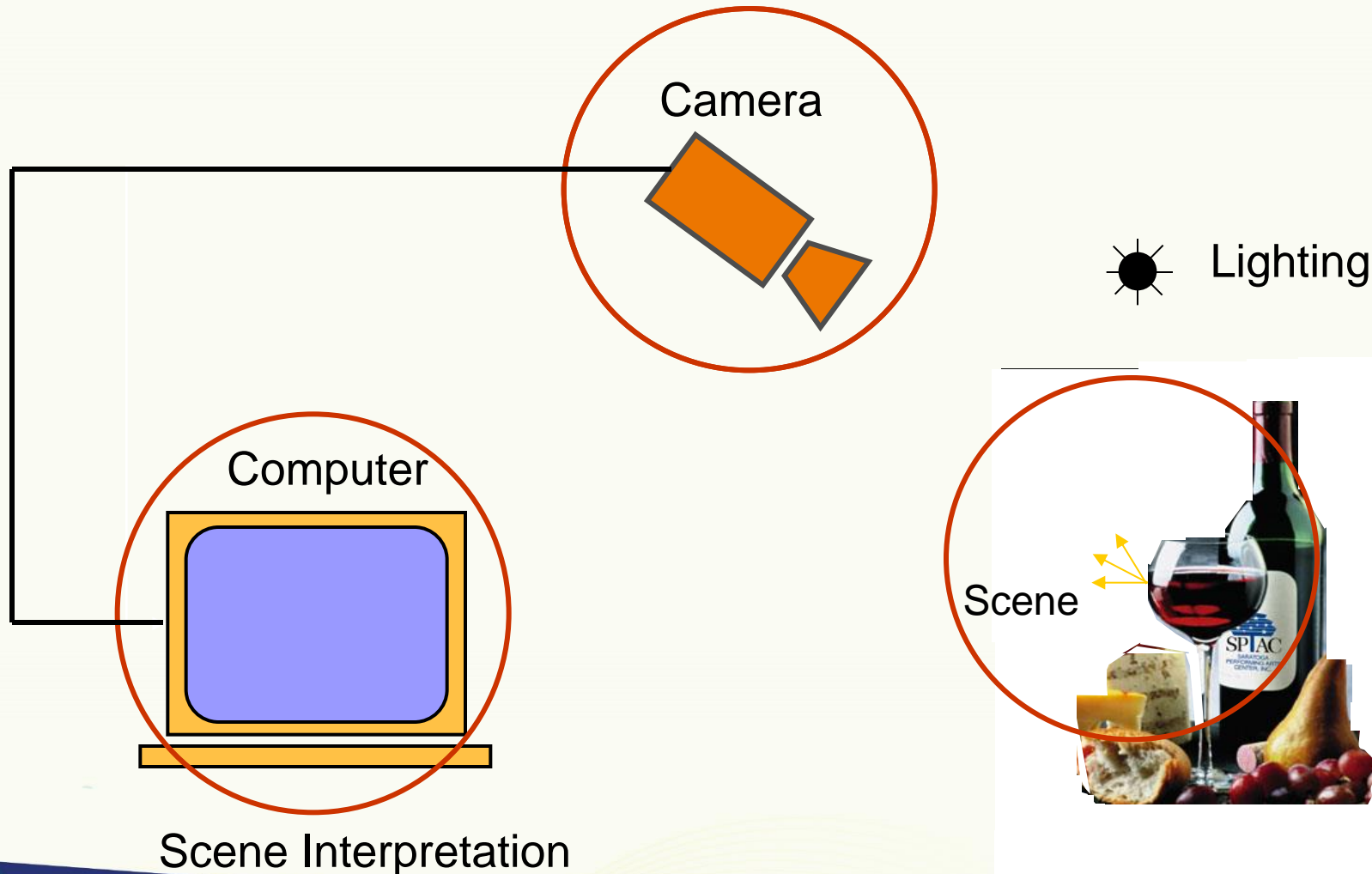
Where are the cars?

How far is the building?

...



Components of a computer vision system



Computer vision vs human vision



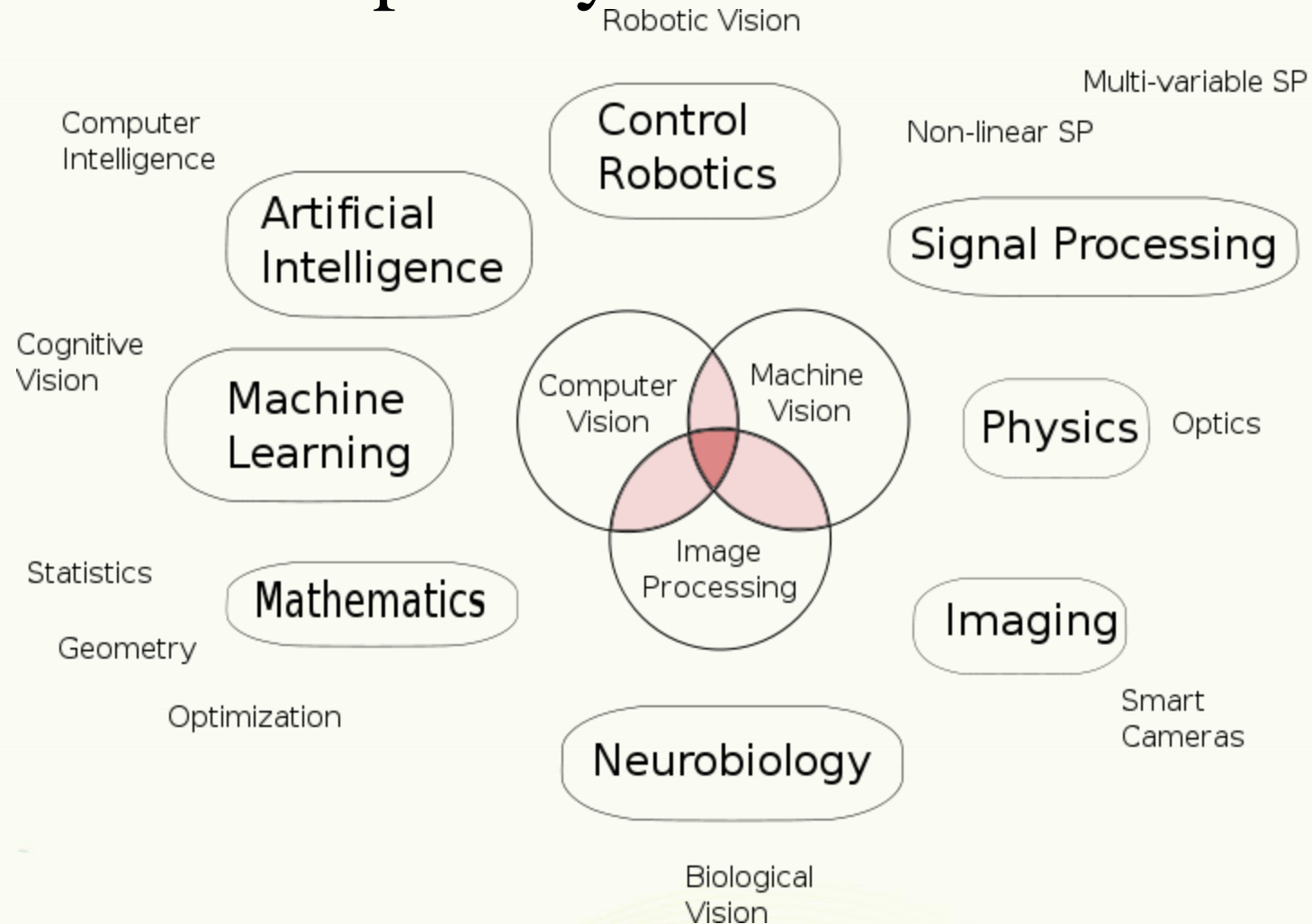
What we see

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



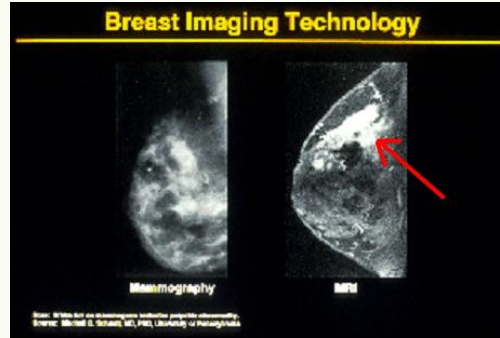
From wiki



Why computer vision matters



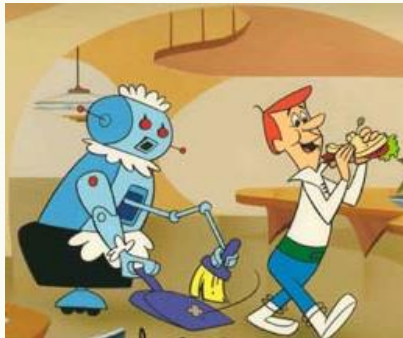
Safety



Health



Security



Comfort



Fun



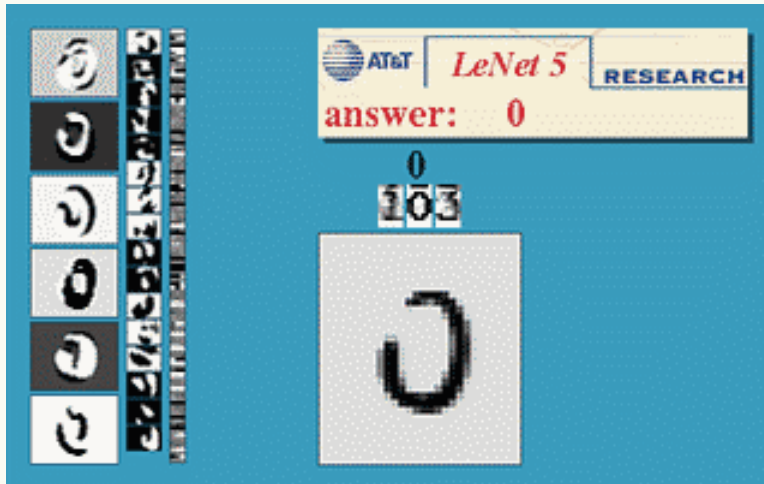
Access



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

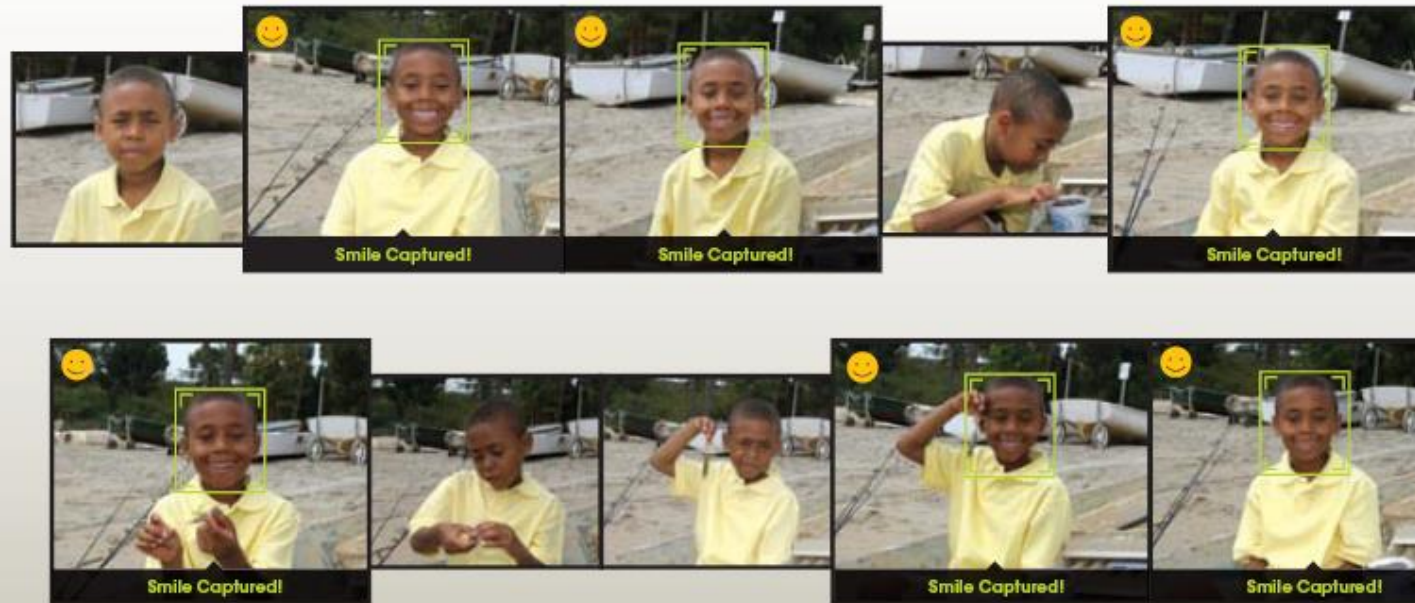


- Many new digital cameras now detect faces
 - Canon, Sony, Fuji, ...

Smile detection

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.



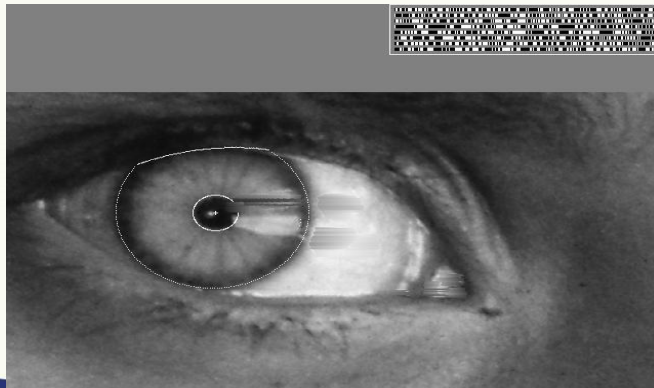
[Sony Cyber-shot® T70 Digital Still Camera](#)



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

The screenshot displays the Mobileye website with a top navigation bar for 'manufacturer products' and 'consumer products'. The main banner features a car with three camera fields of view: 'rear looking camera', 'forward looking camera', and 'side looking camera', under the slogan 'Our Vision. Your Safety.' Below this, three product highlights are shown: 'EyeQ Vision on a Chip' with an image of the chip, 'Vision Applications' showing a pedestrian on a crosswalk, and 'AWS Advance Warning System' with a dashboard display showing a car icon and a distance of 0.8. A right sidebar contains 'News' and 'Events' sections with links to various press releases and events.

manufacturer products consumer products

Our Vision. Your Safety.

rear looking camera forward looking camera side looking camera

› **EyeQ** Vision on a Chip

› **Vision Applications**
Road, Vehicle, Pedestrian Protection and more

› **AWS** Advance Warning System

› **News**

› Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System

› Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end

› all news

› **Events**

› Mobileye at Equip Auto, Paris, France

› Mobileye at SEMA, Las Vegas, NV

› read more

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



Google cars

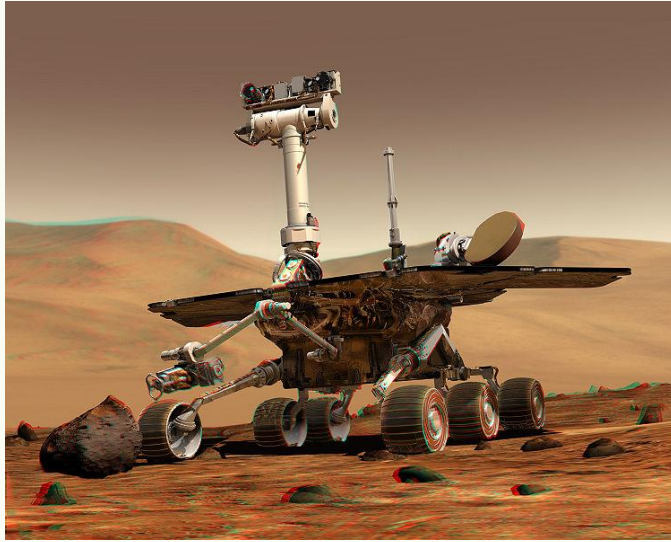


Industrial robots



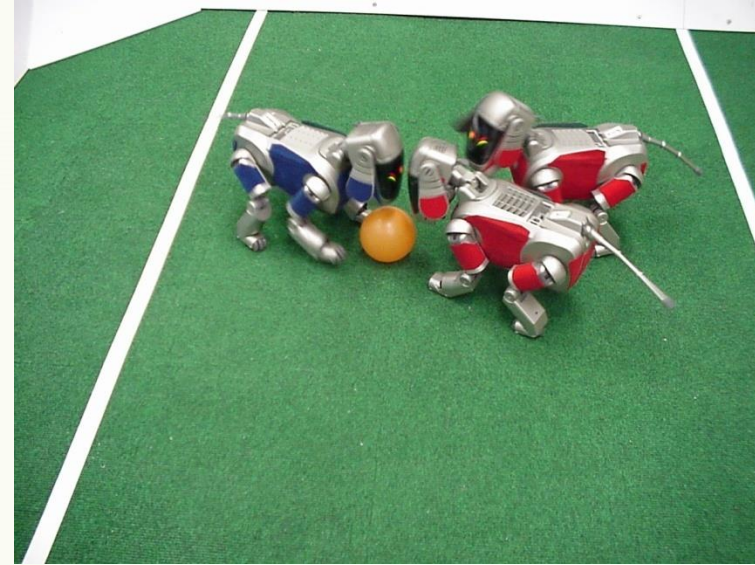
Vision-guided robots position nut runners on wheels

Mobile robots

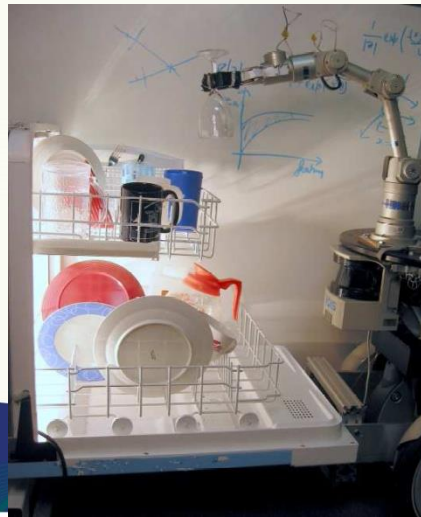


NASA's Mars Spirit Rover

http://en.wikipedia.org/wiki/Spirit_rover



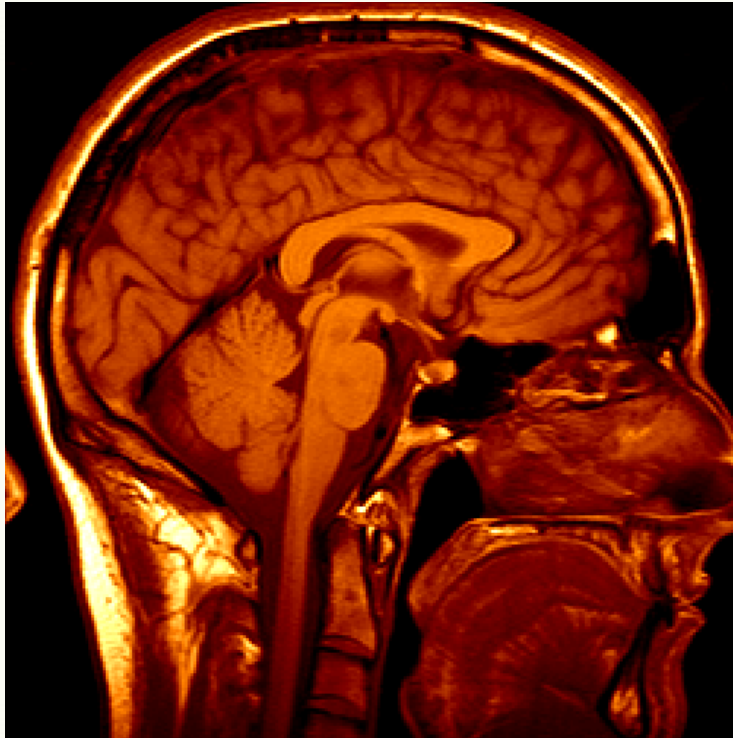
<http://www.robocup.org/>



Saxena et al. 2008
[STAIR](#) at Stanford



Medical imaging



3D imaging
MRI, CT



Image guided surgery
[Grimson et al., MIT](#)



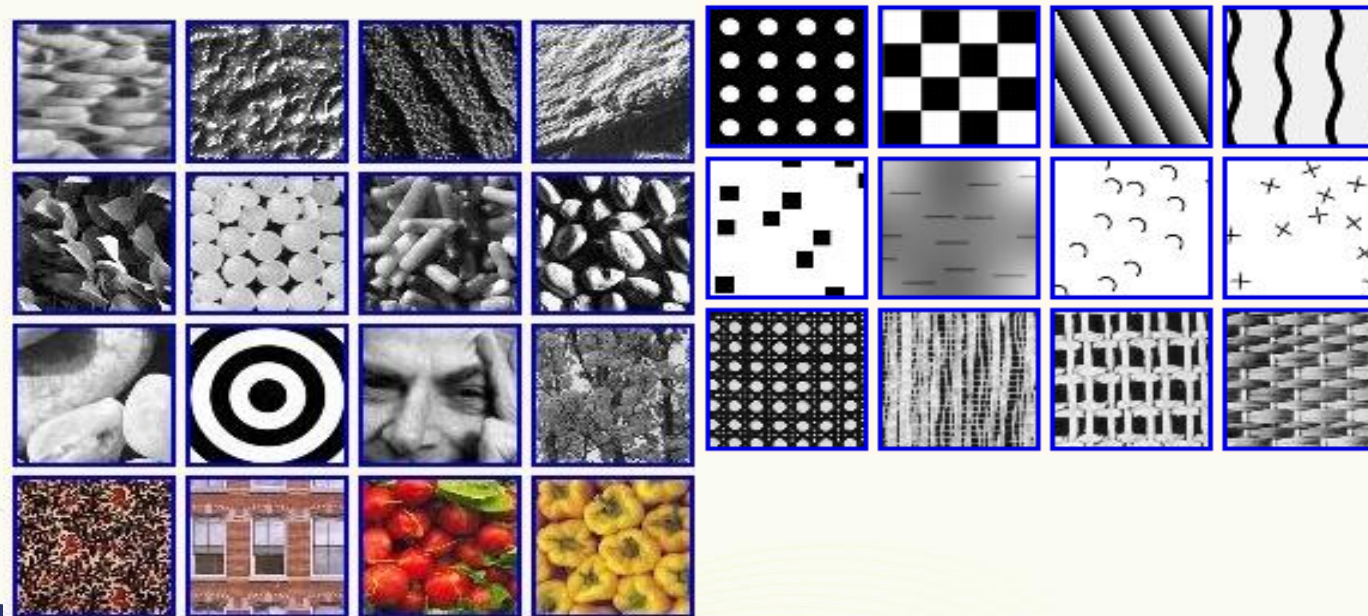
Main Problems

- 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.

