

Lecture 01: Introduction

Instructor: Dr. Hossam Zawbaa

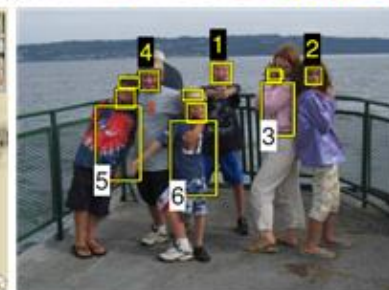
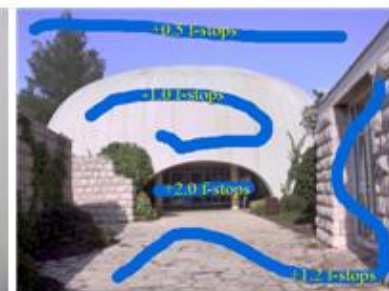
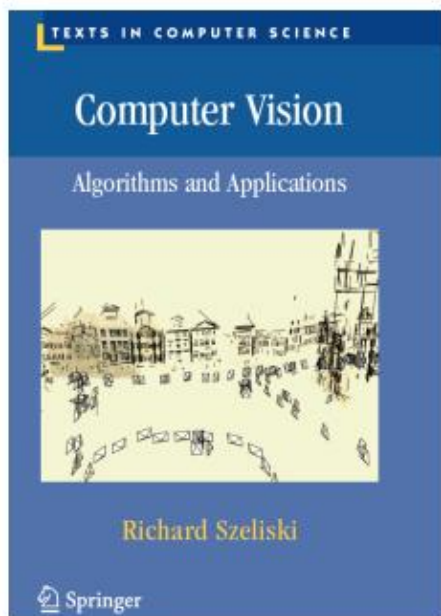
Course Syllabus

- Introduction.
- Image Morphology.
- Image Segmentation
- Image Color Spaces.
- Feature Detection.
- Feature Matching.
- Image Clustering.
- Image Classification.
- Face Detection & Recognition.
- Object Tracking.
- Image Stitching.
- Video Shot Detection.

Textbook

Computer Vision: Algorithms and Applications

© 2010 [Richard Szeliski](#), Microsoft Research



An electronic copy is also available free online:

http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf

Grading

- Lab activities and assignments: 10%
- Final project: 20%
- Mid-term exam: 20%
- Final exam: 50%
- Extra credit: 5% for students who participate actively on the lectures.
- Extra credit: 5% for students who obtain the best final project.

Prerequisites

- Good knowledge of image processing
- Good knowledge of pattern recognition
- Good knowledge of machine learning
- Basic knowledge of statistics and probability
- Experience with Matlab will help

Computer Vision

- What are examples of computer vision being used in the world?
 - Use in **security systems**.
 - Use in **law enforcement** such as matching face of person in criminal database.
 - **OCR recognition** which can be used in number plate recognition or you can scan any text from image.
 - Use in **robotics**.

Computer Vision

Make the computer understand images and videos.



What kind of scene?

What includes in the image?

Where are the cars?

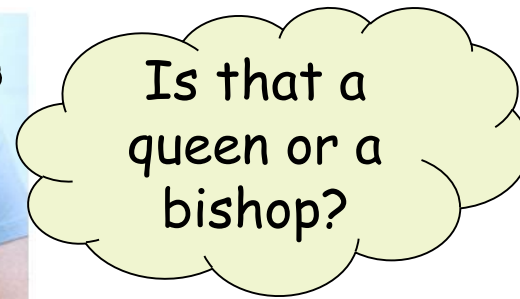
How far is the building?

...

Computer Vision

- The part of the human brain dedicated to the **vision operation** is bigger than any other operations.
- **Vision** is an amazing action of **natural intelligence**.

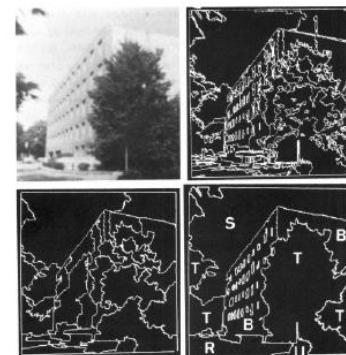
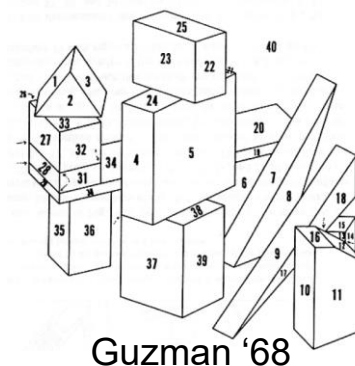
Vision is really hard



"One picture is worth more than ten thousand words"

Brief about Computer Vision

- 1960's: interpretation of **artificial worlds**.
- 1970's: some progress on **interpreting selected images**.
- 1980's: **artificial neural networks (ANNs)**; shift toward geometry and increased mathematical model
- 1990's: **face recognition**; statistical analysis
- 2000's: broader recognition; large annotated datasets available; **video processing** starts
- 2030's: **robot revolution**



Ohta Kanade '78

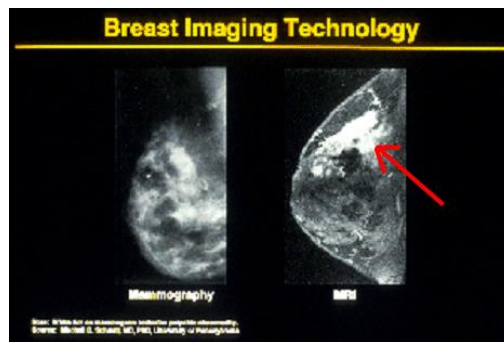


Turk and Pentland '91

Computer Vision Applications



Safety



Health



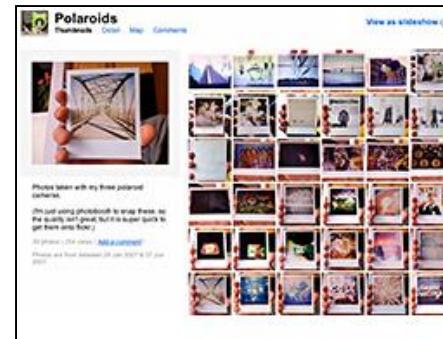
Security



Comfort



Fun



Access

Computer Vision

Image Processing
Pattern Recognition

Robotics

Human Computer
Interaction

Medical Imaging

Neuroscience

Optics

Computational
Photography

Graphics

Machine
Learning

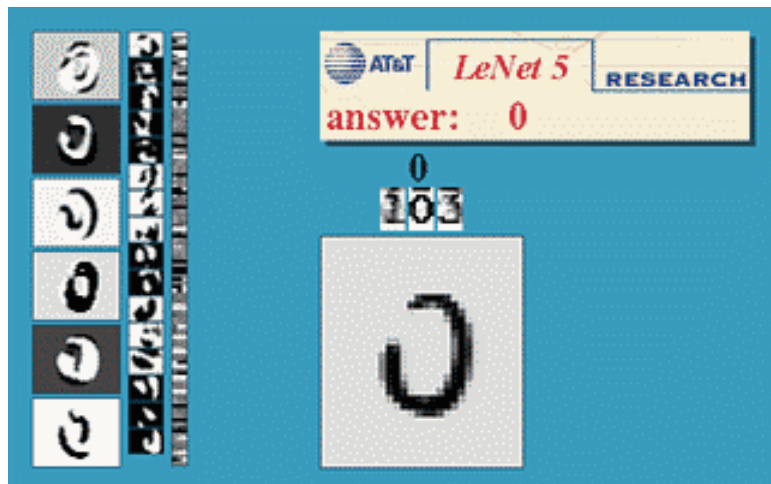
Computer Vision and Nearby Fields

- Computer Graphics: Models to Images
- Computer Photography: Images to Images
- Computer Vision: Images to Models

Examples of state-of-the-art 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

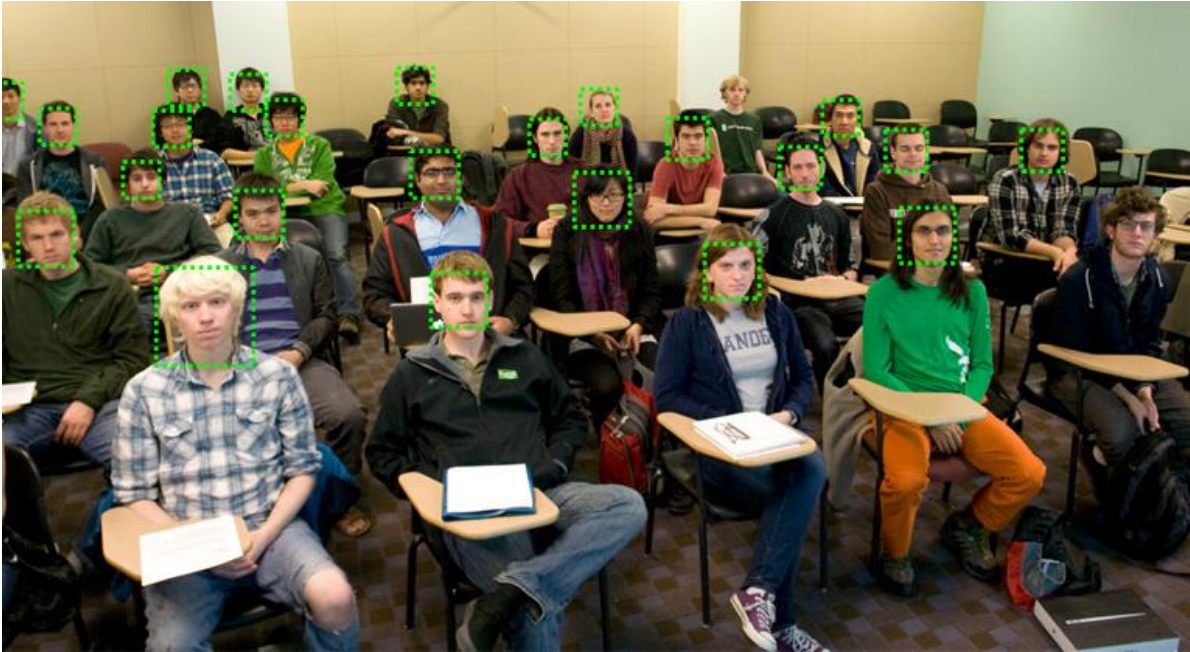
<http://www.research.att.com/~yann/>



License plate readers

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

Examples of state-of-the-art Face detection



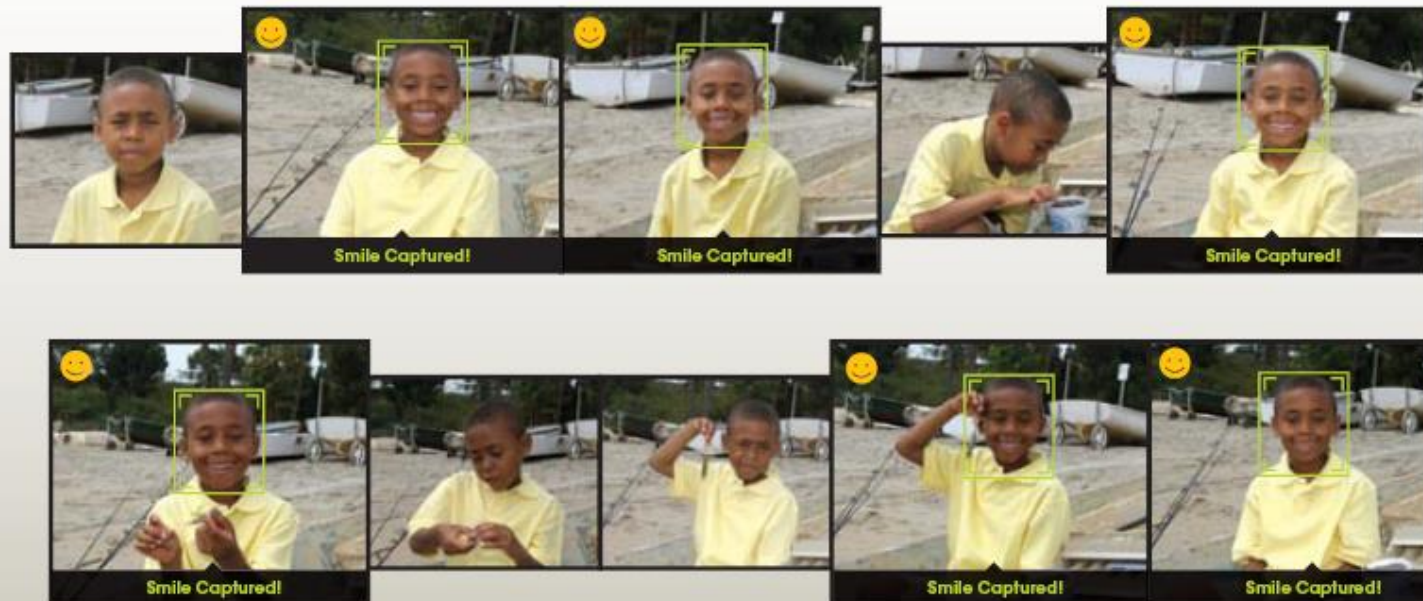
- Many new digital cameras now detect faces
 - Canon, Sony, Fuji, ...



Examples of state-of-the-art 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](#)

Examples of state-of-the-art Object recognition (in supermarkets)



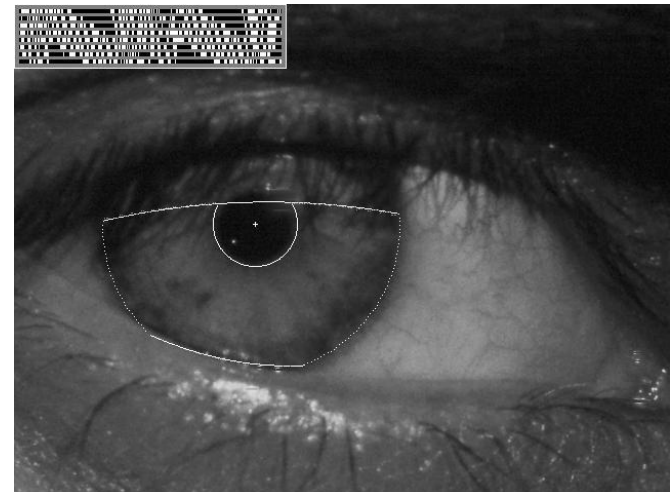
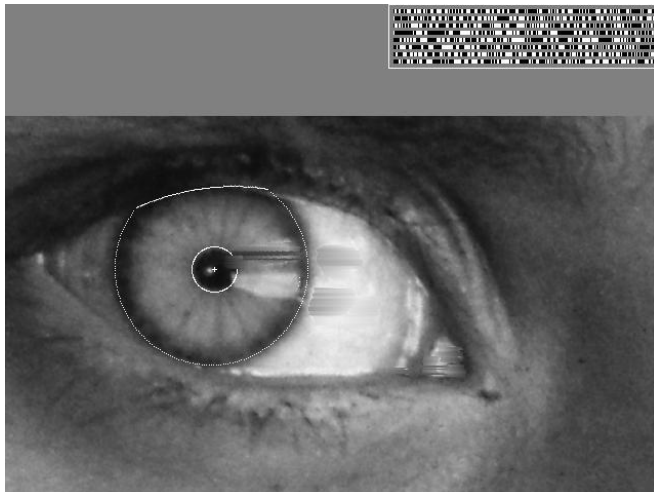
Lane Hawk by Evolution Robotics

“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 Lane Hawk, you are assured to get paid for it... “

Examples of state-of-the-art Vision-based biometrics



“How the Afghan Girl was Identified by Her Iris Patterns” Read the [story wikipedia](#)



Examples of state-of-the-art Login with your biometrics



Fingerprint scanners on
many new laptops,
other devices



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

Examples of state-of-the-art Object recognition



Examples of state-of-the-art Special effects: shape capture



The Matrix movies, ESC Entertainment, XYZRGB, NRC

Examples of state-of-the-art Sports



Sports vision [explanation](#)

Examples of state-of-the-art Smart cars

▶ manufacturer products consumer products ◀◀

Our Vision. Your Safety.

rear looking camera side looking camera forward looking camera

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](#)

- Vision systems currently in high-end BMW, GM, Volvo models

Examples of state-of-the-art Self-driving cars



Oct 9, 2010. ["Google Cars Drive Themselves, in Traffic"](#). [The New York Times](#). John Markoff

Aug 9, 2011, ["Human error blamed after Google's driverless car sparks five-vehicle crash"](#). [The Star \(Toronto\)](#)

Examples of state-of-the-art Interactive Games: Kinect

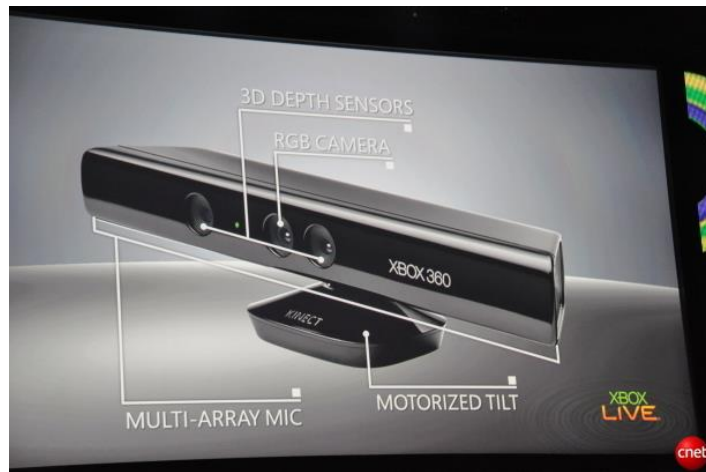
- Object Recognition:

<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>



Examples of state-of-the-art Vision in space

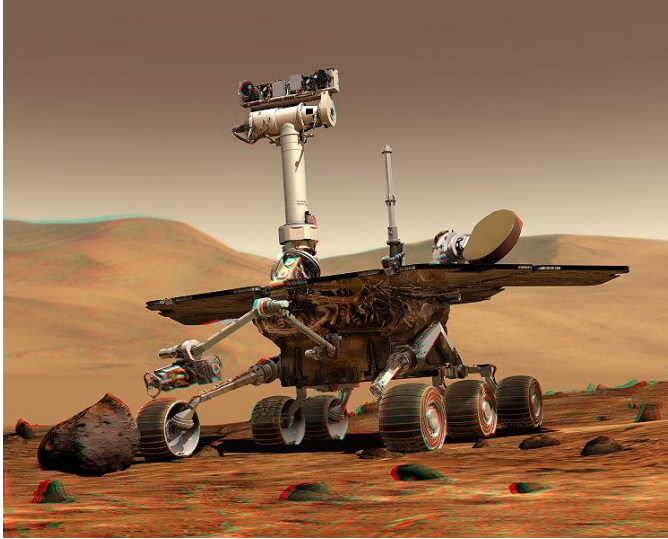


NASA'S Mars Exploration Rover Spirit

Vision systems used for several tasks

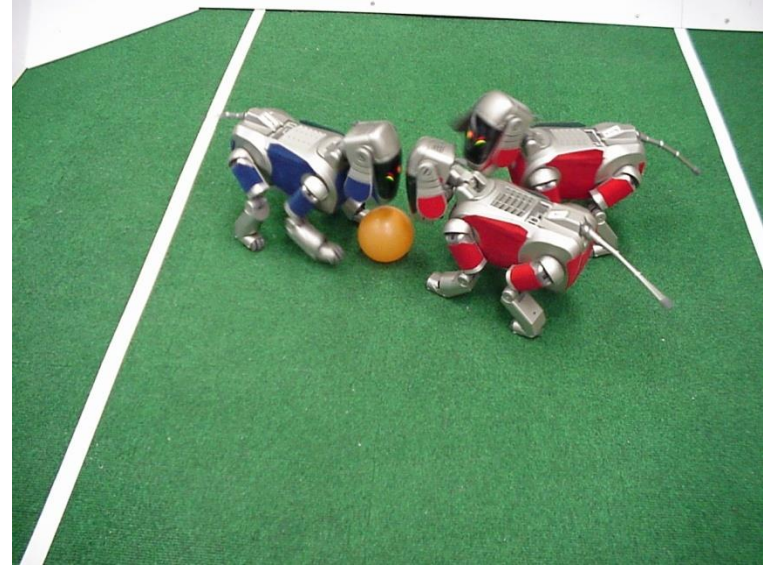
- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking
- For more, read "Computer Vision on Mars" by Matthies et al.

Examples of state-of-the-art Robots



NASA's Mars Spirit Rover

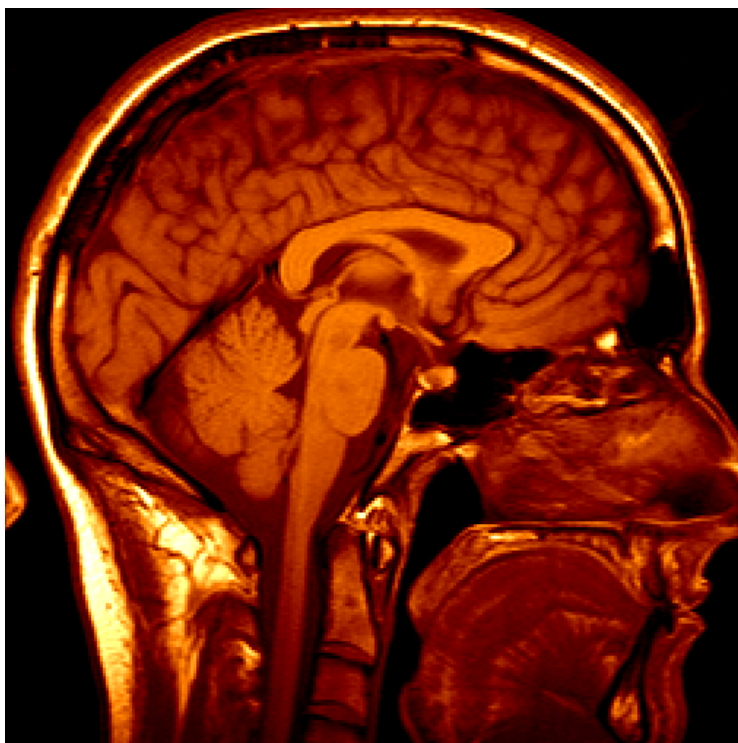
http://en.wikipedia.org/wiki/Spirit_rover



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



Examples of state-of-the-art Medical imaging



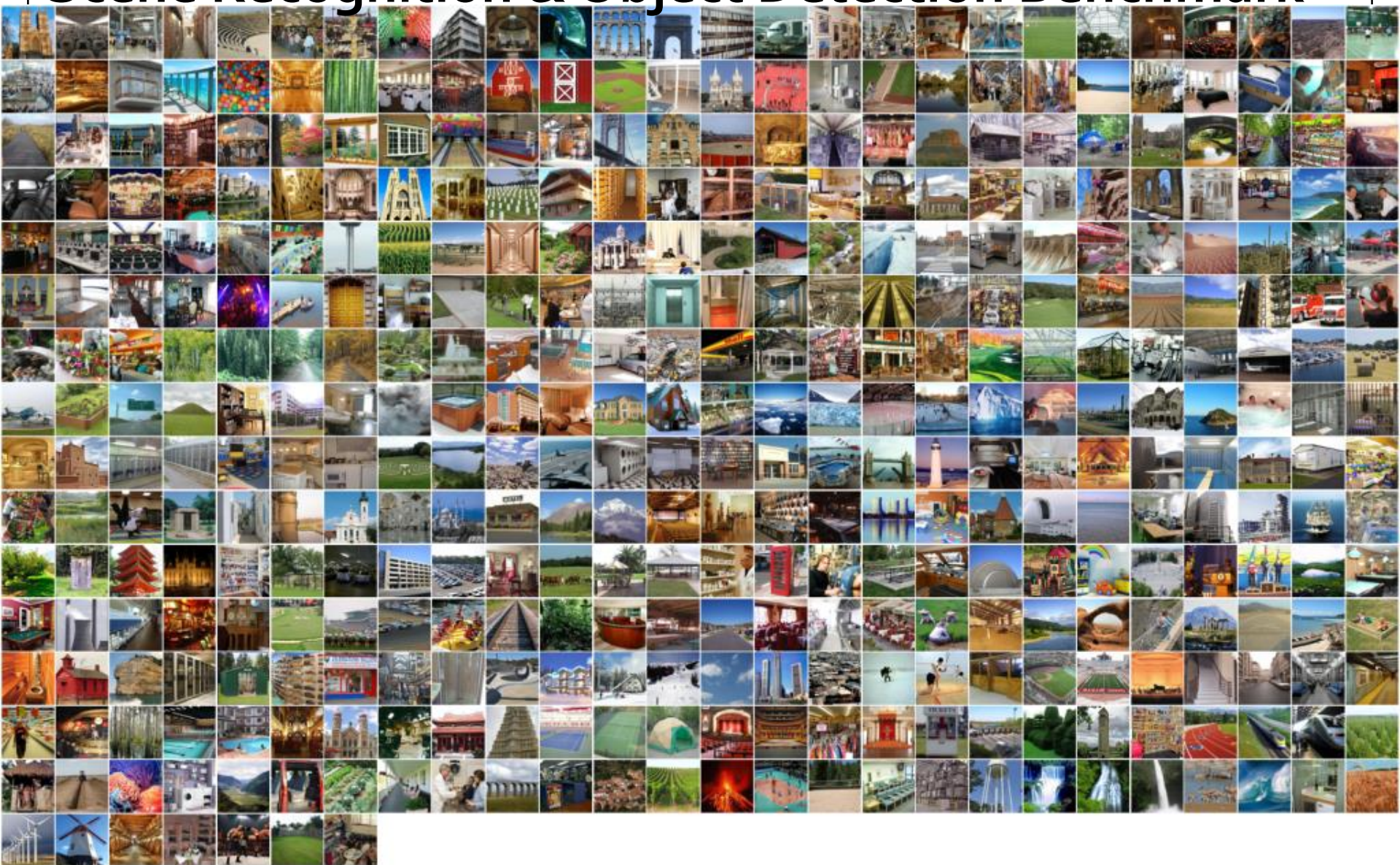
3D imaging
MRI, CT



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

SUN database

Scene Recognition & Object Detection Benchmark



Computer Vision & Image processing software

- **CVIPtools** (Computer Vision and Image Processing tools)
- Intel Open Computer Vision Library (**OpenCV**)
- **Microsoft Vision SDL Library**
- **Matlab**

- For more information, see
 - <http://www.cs.unr.edu/~bebis/CS791E>
 - http://www.cs.unr.edu/CRCO/ComputerVision/cv_resources.html