Introduction

Vinay P. Namboodiri

Computer Vision

Goal

Provide vision to computers

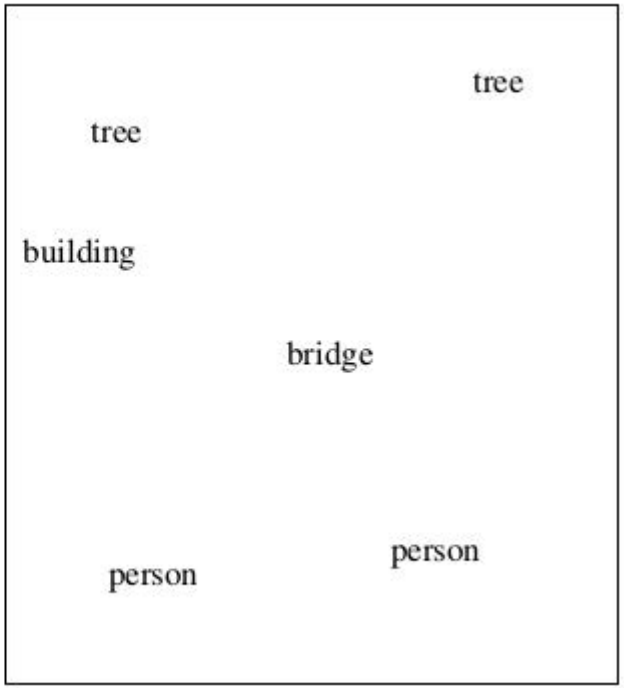
Reason

Enable various applications

Challenge

Its hard

Why is Computer Vision Hard?

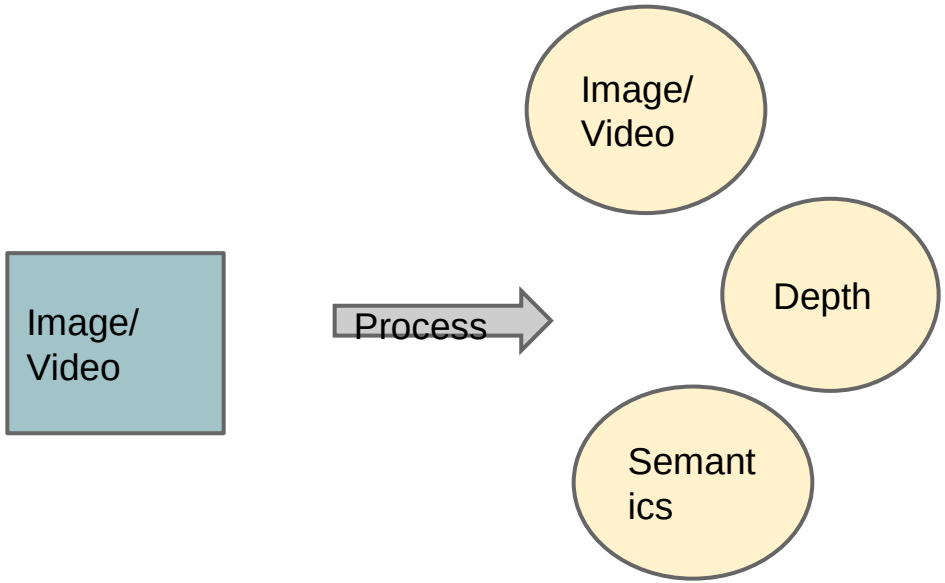


Giorgione's Tempest , courtesy Edelman's paper: *Constraints on the nature of the neural representation of the visual world*

Computer Vision: For this course

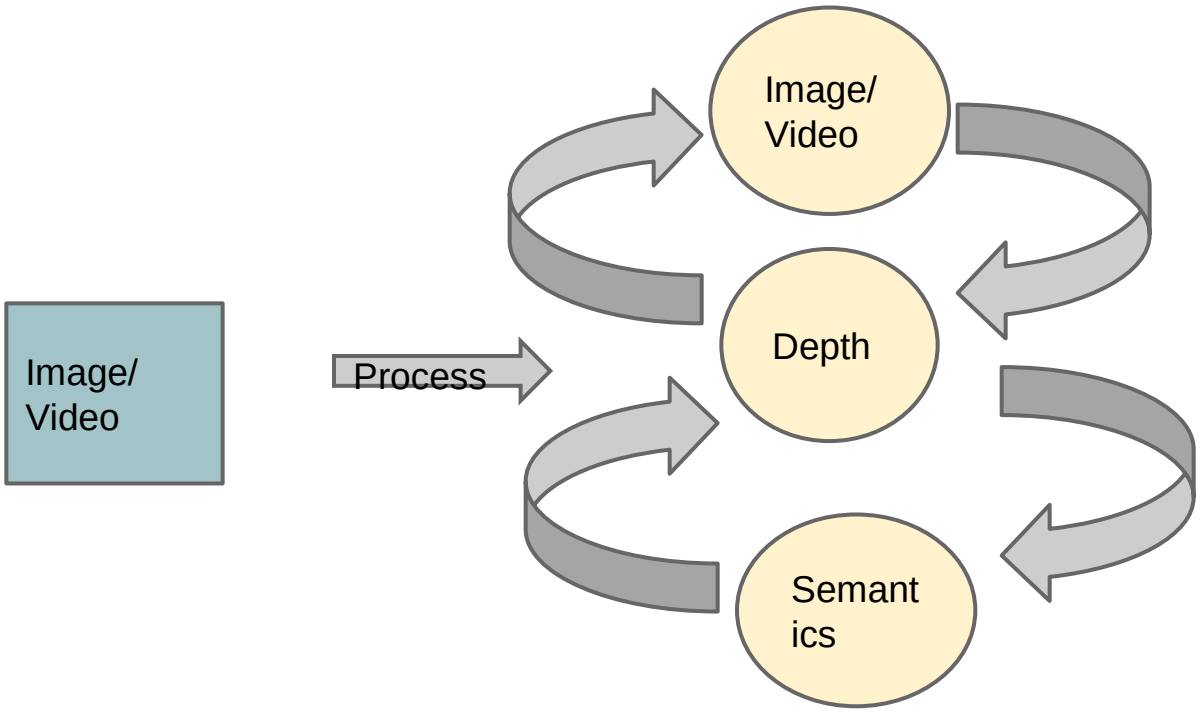
Goal

Convert visual data into information



An instance DIKW pyramid
by Randall Deutsch

Further



History

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PROJECT MAC

Artificial Intelligence Group — July 7, 1966
Vision Memo. No. 100.

THE SUMMER VISION PROJECT

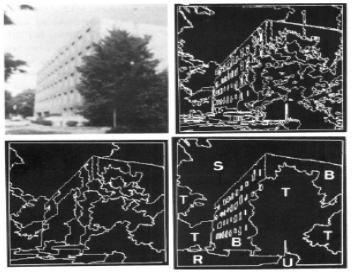
Seymour Papert

The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

Ridiculously brief history of computer vision

- 1966: Minsky assigns computer vision as an undergrad summer project
- 1960's: interpretation of synthetic worlds
- 1970's: some progress on interpreting selected images
- 1980's: ANNs come and go; shift toward geometry and increased mathematical rigor
- 1990's: face recognition; statistical analysis in vogue
- 2000's: broader recognition; large annotated datasets available; video processing starts
- 2030's: robot uprising?

Guzman '68



Ohta Kanade '78

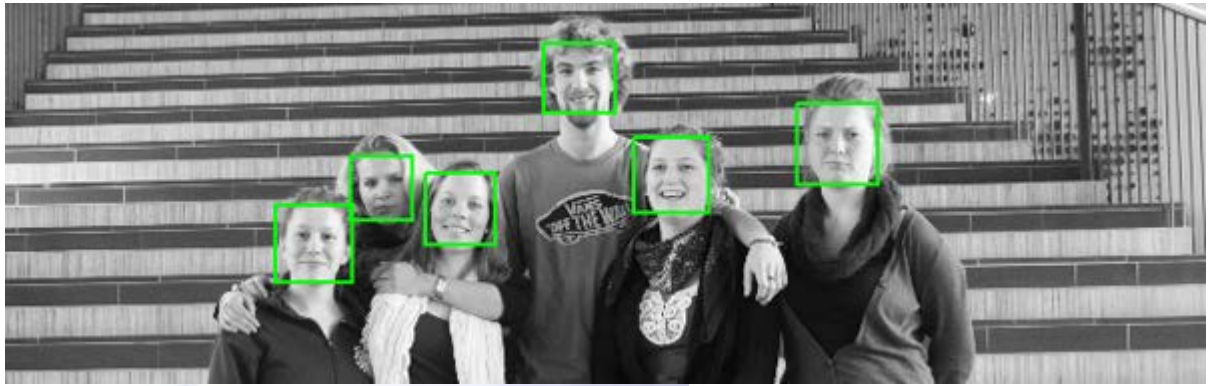
Turk and Pentland '91

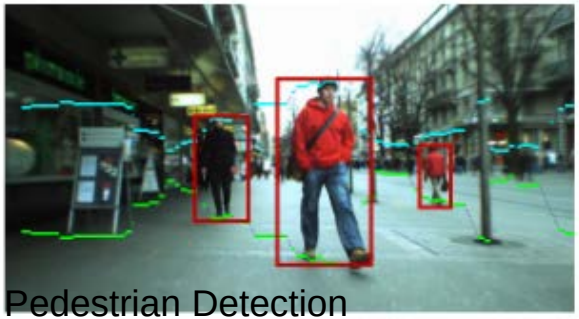
Slide by James Hays

Some successes

Viola Jones Face Detection

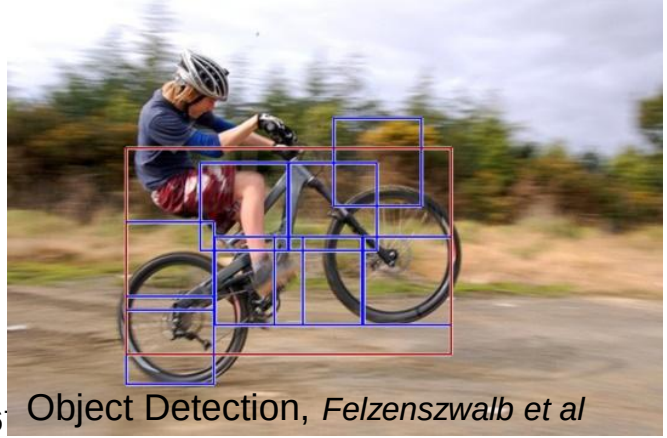
http://www.noio.nl/2011/03/stitching-smiles/





Pedestrian Detection

Benenson et al CVPR 2012



Object Detection, *Felzenszwalb et al*

Reconstruction,

Furukawa et al. CVPR 2012

How vision is used now

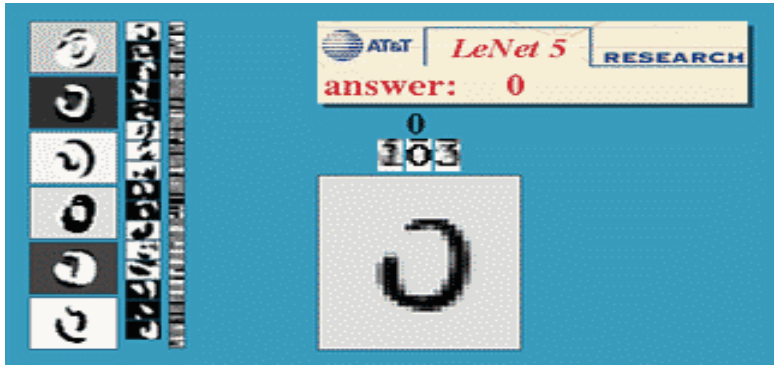
- Examples of state-of-the-art

This and following application slides courtesy Steve Seitz and James Hays

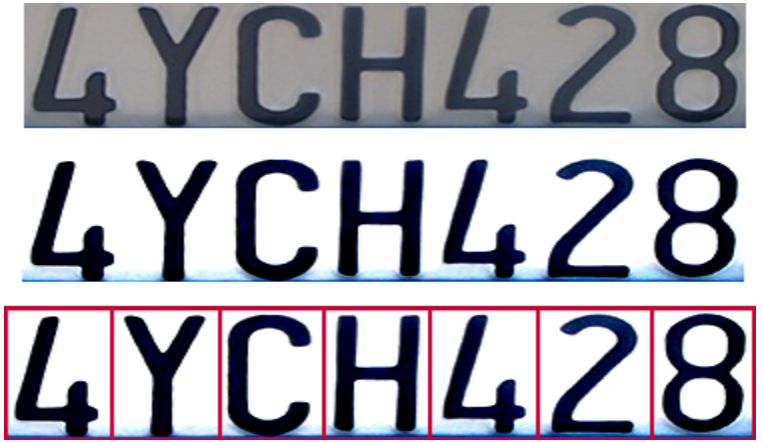
Optical character recognition (OCR)

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/

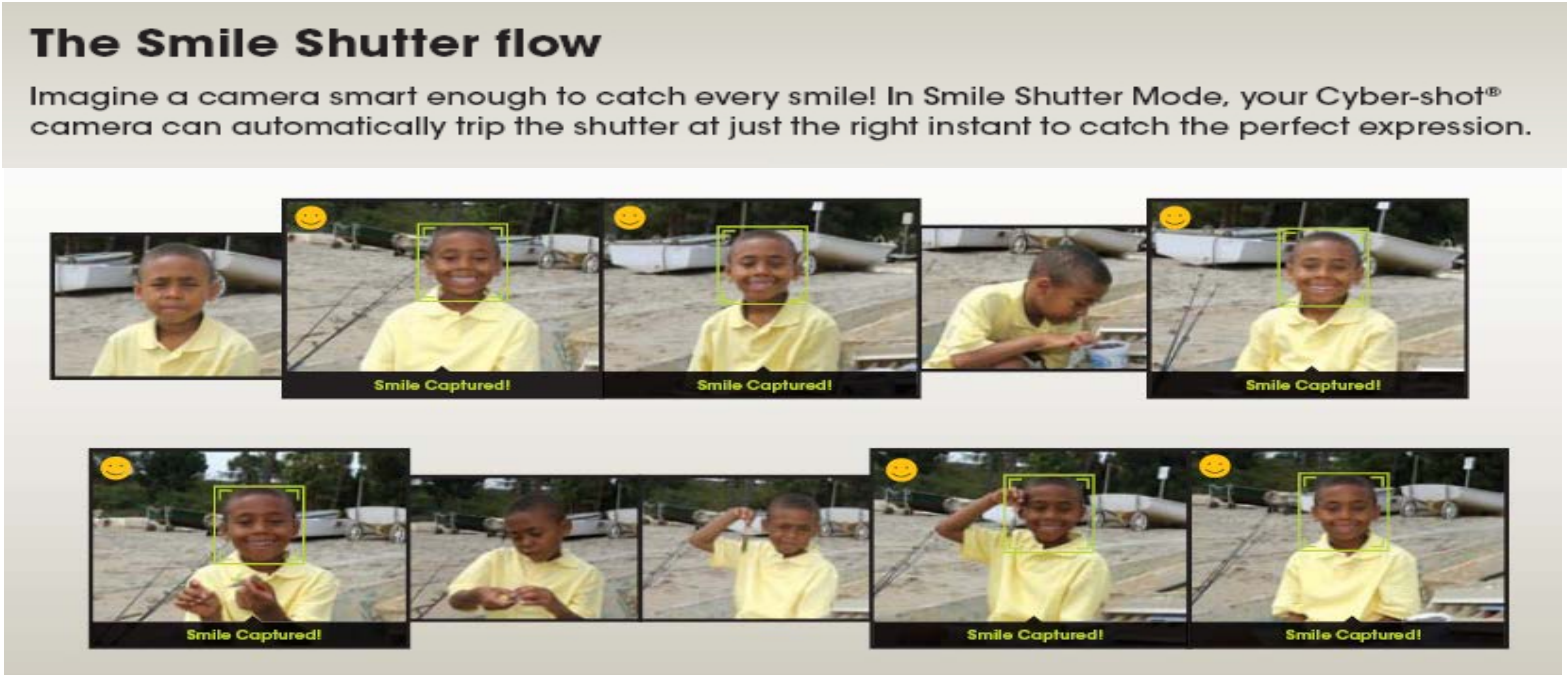


License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Face detection

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

Smile detection



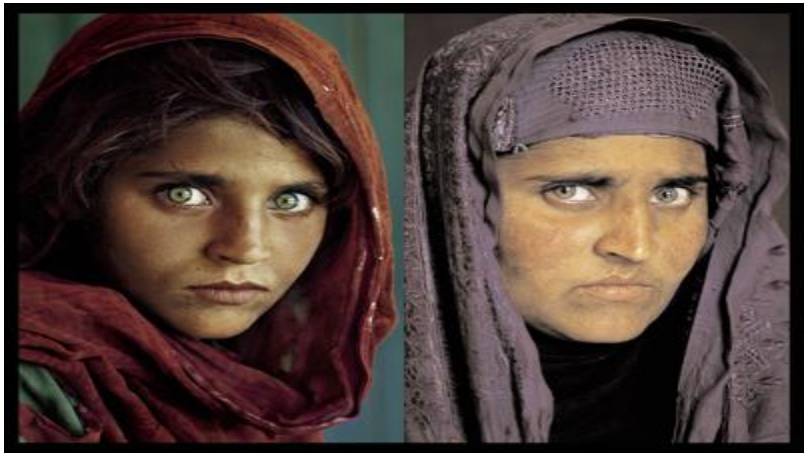
[Sony Cyber-shot® T70 Digital Still Camera]

Object recognition (in supermarkets)

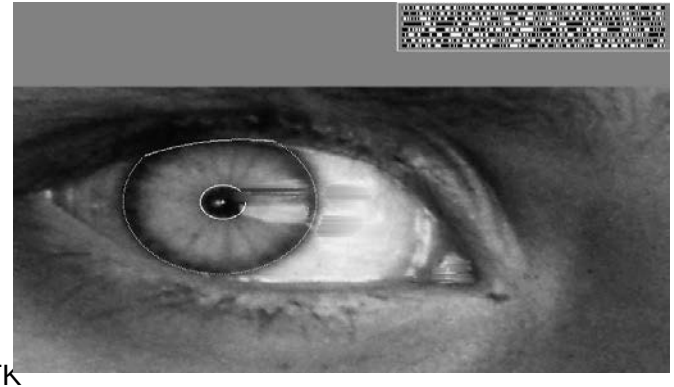
LaneHawk by EvolutionRobotics

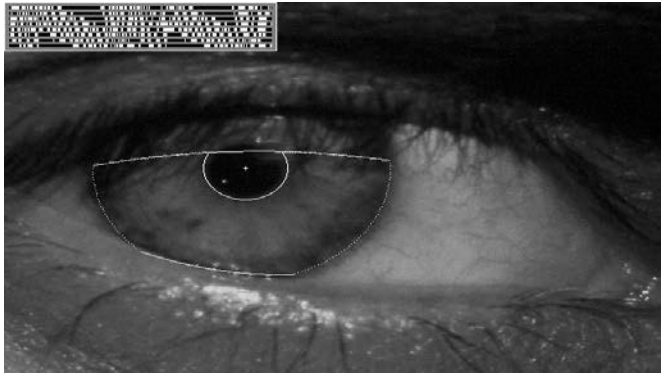
“A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk,you are assured to get paid for it… “

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

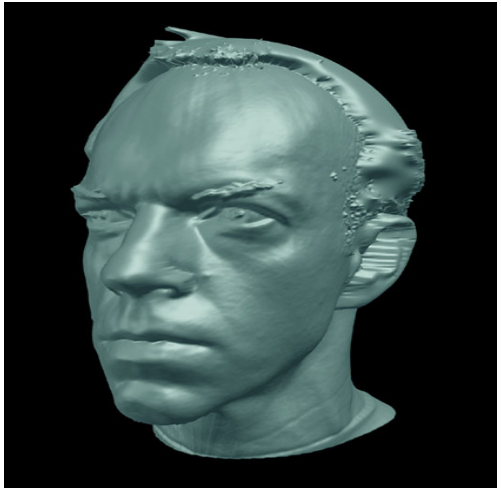
Face recognition systems now beginning to appear more widely
http://www.sensiblevision.com/

Object recognition (in mobile phones)

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

[Google Goggles]()

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

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

Smart cars

Slide content courtesy of Amnon Shashua

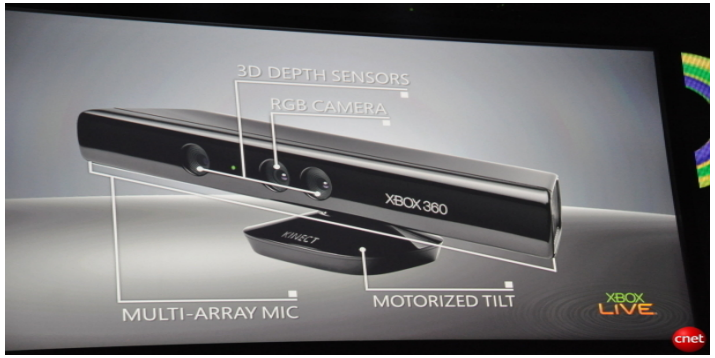
- Mobileye
  - –Vision systems currently in high-end BMW, GM, Volvo models
  - –By 2010: 70% of car manufacturers.

Google cars

Oct 9, 2010. "Google Cars Drive Themselves, in Traffic". *The New York Times*. John Markoff
June 24, 2011. "Nevada state law paves the way for driverless cars". *Financial Post*. Christine Dobby
Aug 9, 2011, "Human error blamed after Google's driverless car sparks five-vehicle crash". *The Star* (Toronto)

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



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.

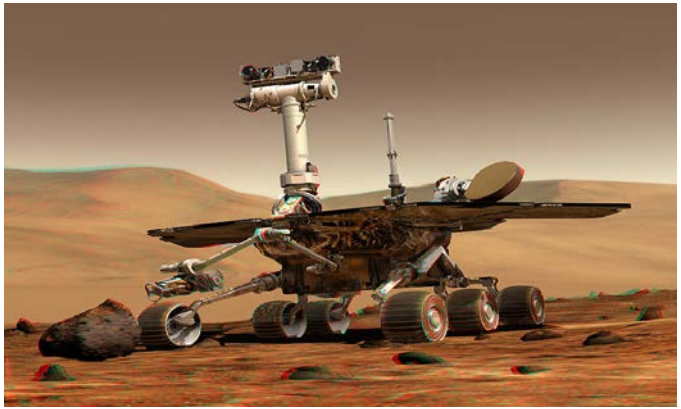
Vision systems (JPL) used for several tasks

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

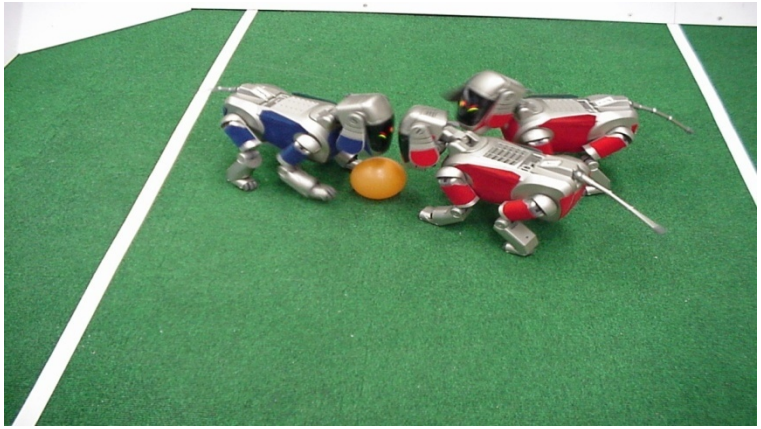
Industrial robots

Vision-guided robots position nut runners on wheels

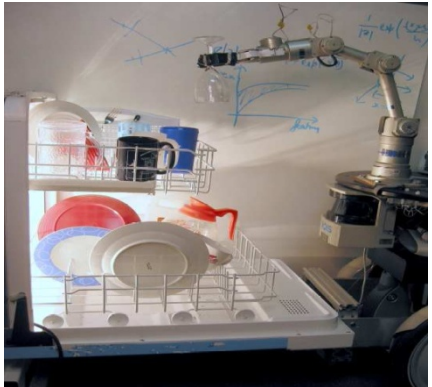
Mobile robots



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

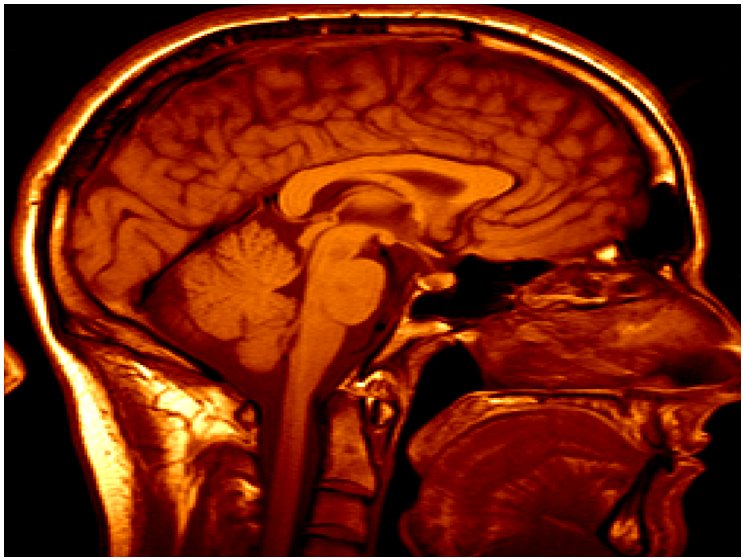


http://www.robocup.org/



Saxena et al. 2008
STAIR at Stanford

Medical imaging



3D imaging
MRI, CT

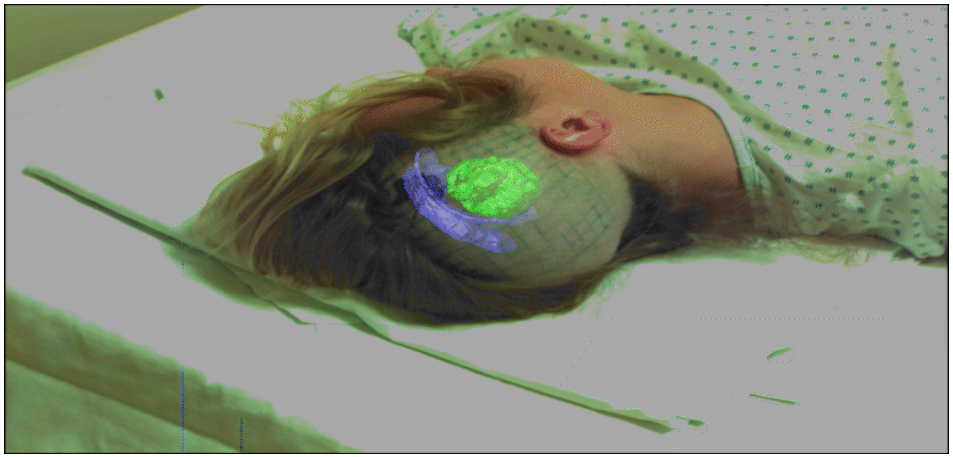
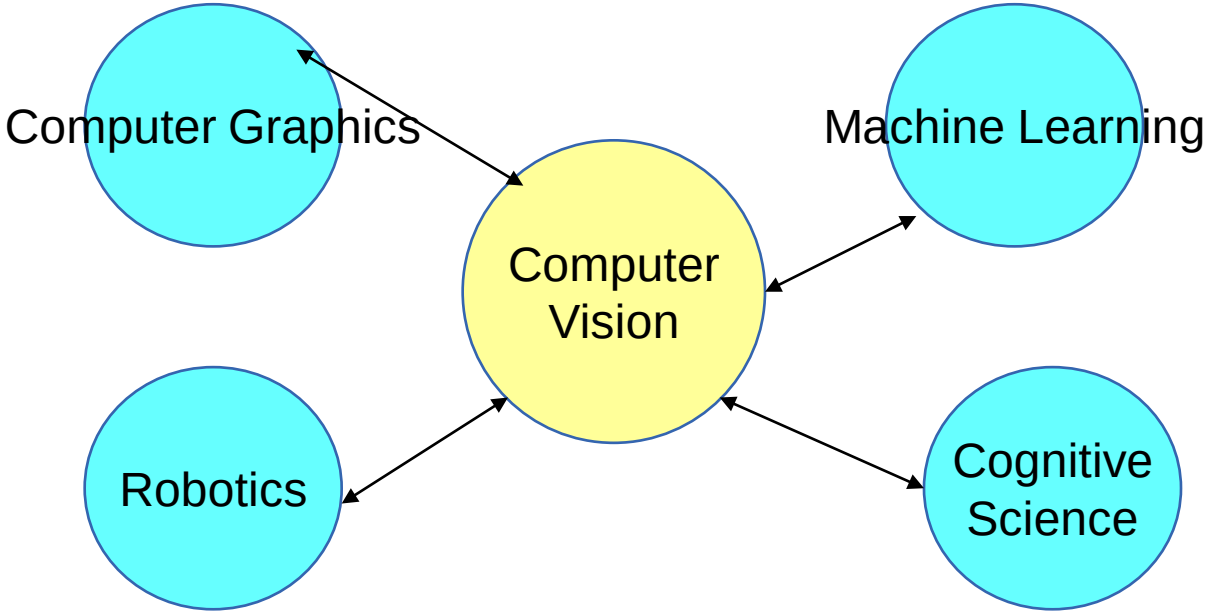


Image guided surgery
Grimson et al., MIT

Interdisciplinary nature of Computer Vision



Logistics

Prerequisites
Linear Algebra, probability, calculus etc

Lectures
M 11-12, Tues, Thurs 10-11

Course Outline

Image Processing
Geometric computer vision
Computational Photography
Videos (optical flow, tracking)
Face detection, tracking by detection
Object Classification
Object Detection, Action recognition

Grading

Mid-sem 20%
End-sem 30%
Term Paper 10%
Assignment 10%
Project 30% (In group)

Reference Book

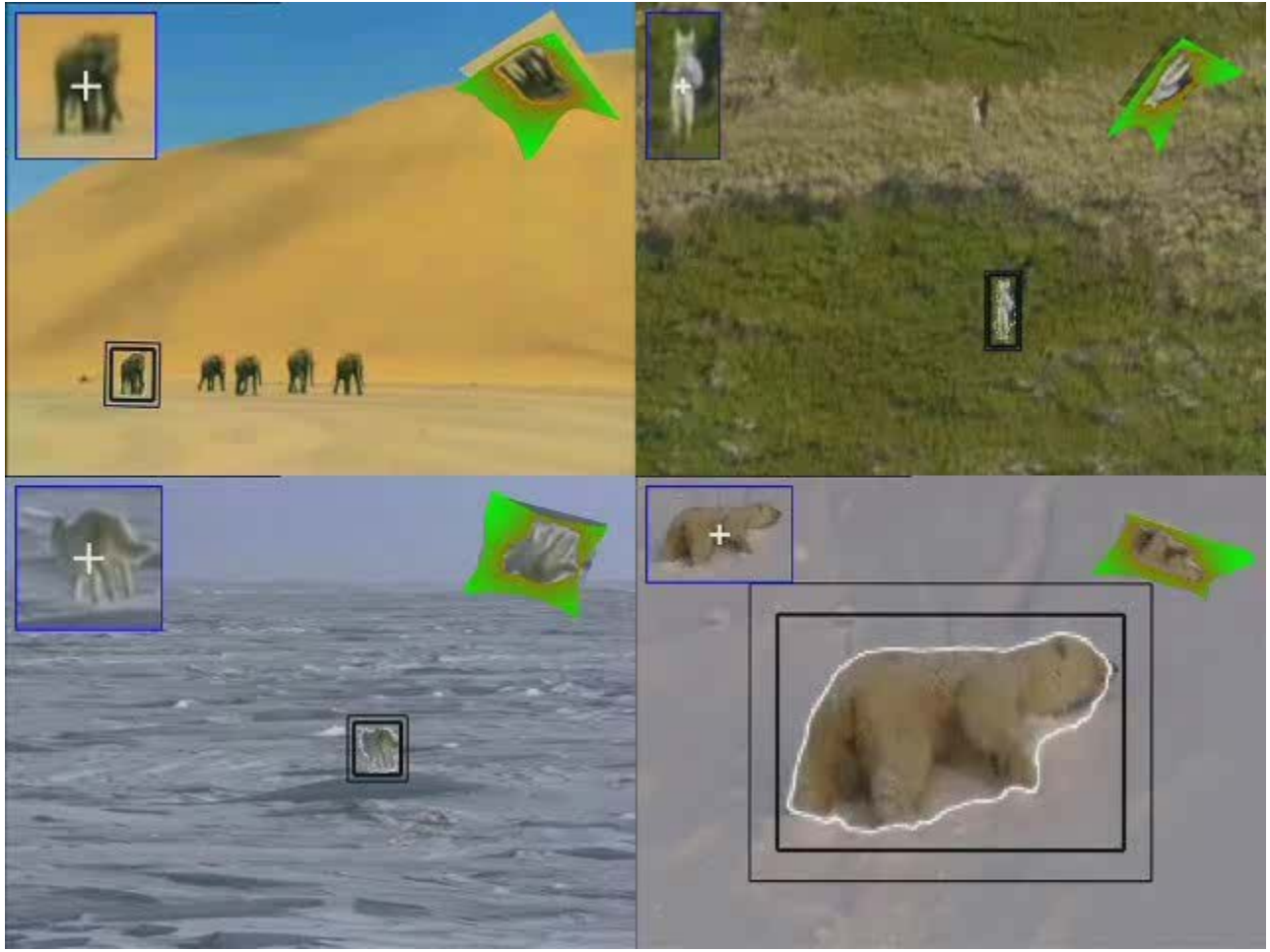
Computer Vision: Algorithms and Applications

© 2010 Richard Szeliski, Microsoft Research

For more details please refer to
http://web.cse.iitk.ac.in/users/cs676/

Dot Templates detection


DIANE LADD



Photobios

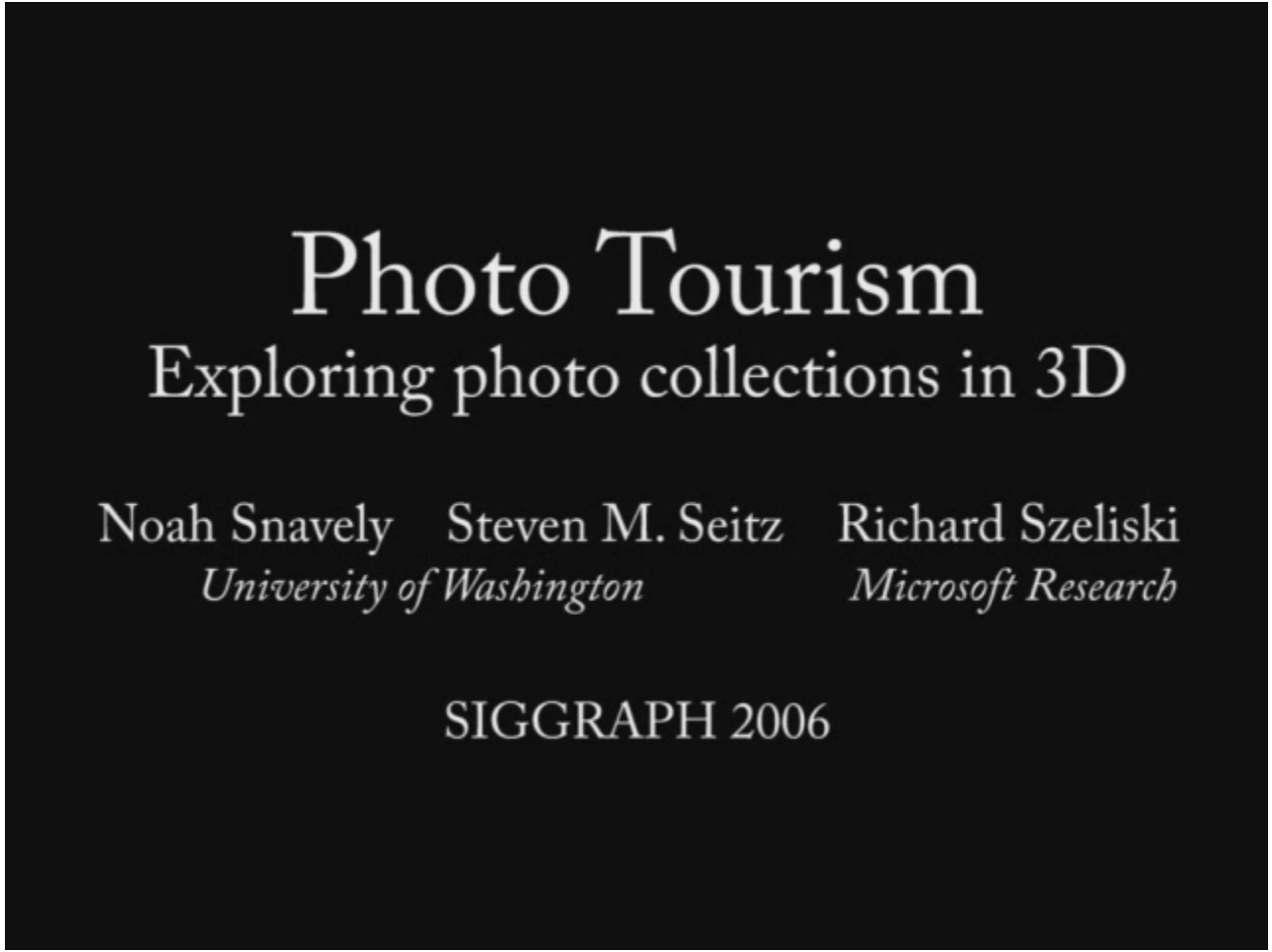


Photo Tourism
Exploring photo collections in 3D
Noah Snavely
Steven M. Seitz
Richard Szeliski
University of Washington
Microsoft Research
SIGGRAPH 2006

Visual Turing Test

Unwrap Mosaics

Snap Image Composition


Rigging a Swimming
Competition


Demolition