

## Computer Vision (CSE/EE 576)

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### Web Page

- <http://www.cs.washington.edu/education/courses/cse576/09sp/>

### Handouts

- signup sheet
- intro slides
- image filtering slides

## Today

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- Intros
- Computer vision overview
- Course overview
- Image processing

### Readings

- Book: [Richard Szeliski, Computer Vision: Algorithms and Applications](#)
  - (please check [Web site](#) weekly for updated drafts)
  - Intro: Ch 1.0

## What is computer vision?

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## What is computer vision?

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*Terminator 2*

## Every picture tells a story



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

## Can computers match (or beat) human vision?



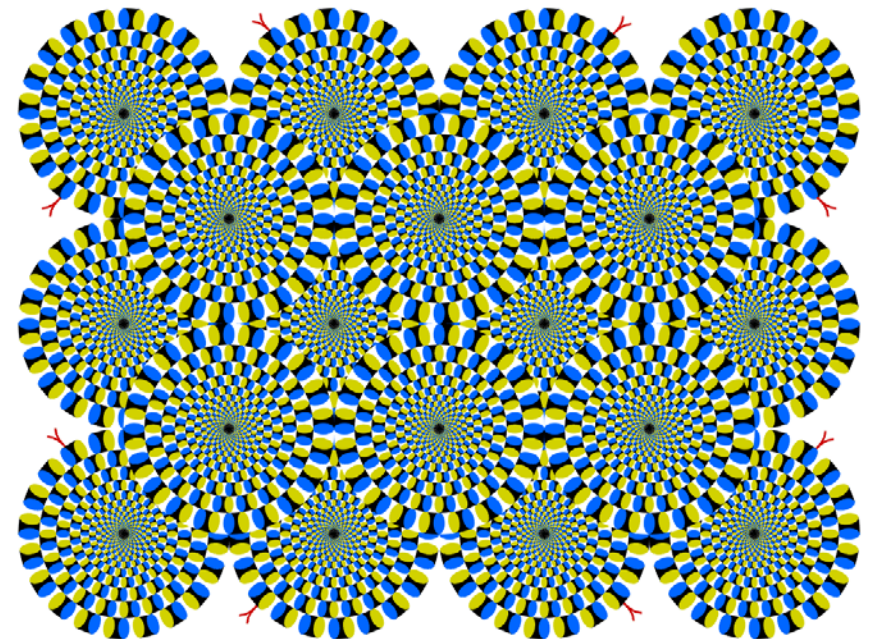
Yes and no (but mostly no!)

- 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)

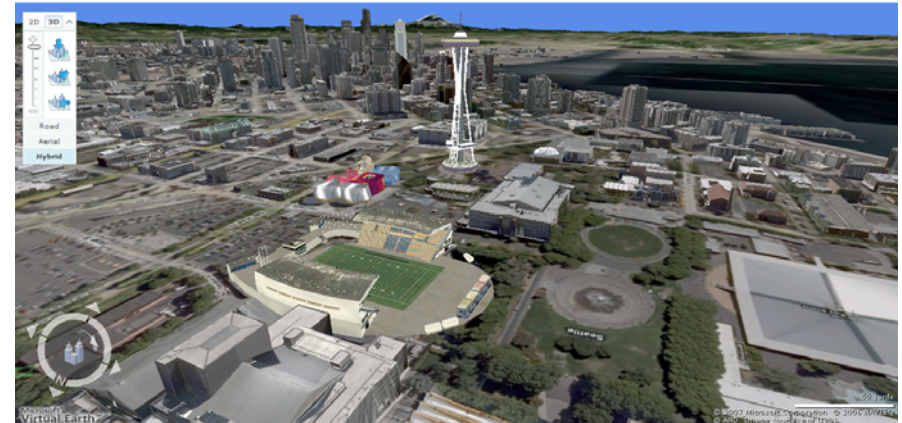


Image from Microsoft's [Virtual Earth](#)  
(see also: [Google Earth](#))

## Photosynth.net

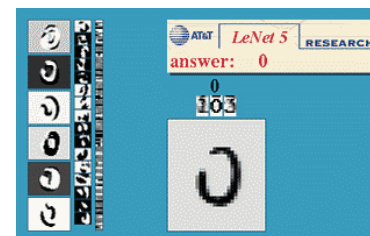


Based on [Photo Tourism](#) developed here in CSE!  
by Noah Snavely, Steve Seitz, and Rick Szeliski

## 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://www.research.att.com/~yann/>



License plate readers  
[http://en.wikipedia.org/wiki/Automatic\\_number\\_plate\\_recognition](http://en.wikipedia.org/wiki/Automatic_number_plate_recognition)



## Face detection



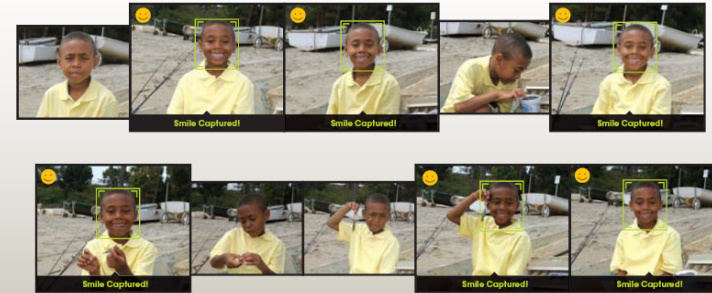
Many new digital cameras now detect faces

- 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](#)

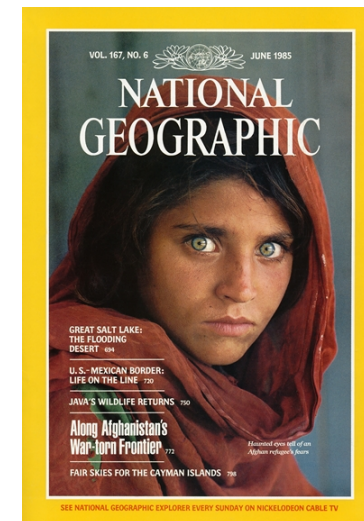
## Object recognition (in supermarkets)



[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

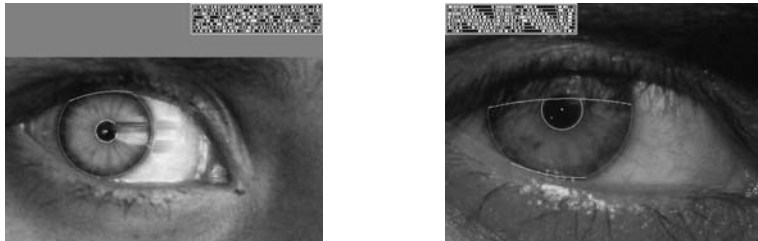


Who is she?

## Vision-based biometrics



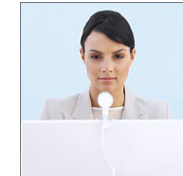
"How the Afghan Girl was Identified by Her Iris Patterns" Read the [story](#)



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

## Special effects: shape capture



## Special effects: motion capture



*Pirates of the Caribbean*, Industrial Light and Magic

[Click here for interactive demo](#)

## Sports



*Sportvision* first down line  
Nice [explanation](#) on [www.howstuffworks.com](http://www.howstuffworks.com)

## 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.
- [Video demo](#)

## Vision-based interaction (and games)



Nintendo Wii has camera-based IR tracking built in. See [Lee's work at CMU](#) on clever tricks on using it to create a [multi-touch display](#)!



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



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



## Vision in space

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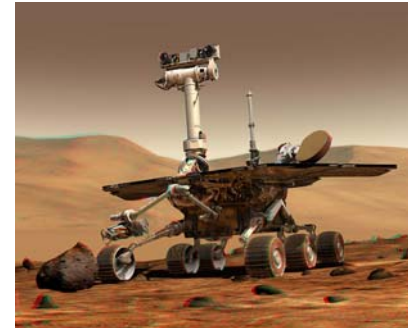
[NASA'S Mars Exploration Rover Spirit](#) captured this westward view from atop a low plateau where Spirit spent the closing months of 2007.

### 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

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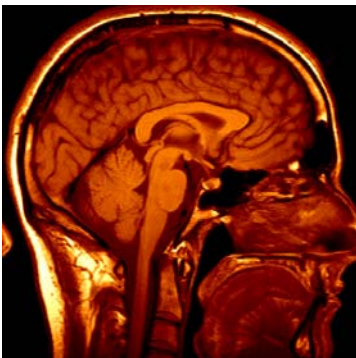
NASA's Mars Spirit Rover  
[http://en.wikipedia.org/wiki/Spirit\\_rover](http://en.wikipedia.org/wiki/Spirit_rover)



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

## Medical imaging

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3D imaging  
MRI, CT



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

## Current state of the art

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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

<http://www.cs.washington.edu/education/courses/cse576/09sp/>

## Project 1: features

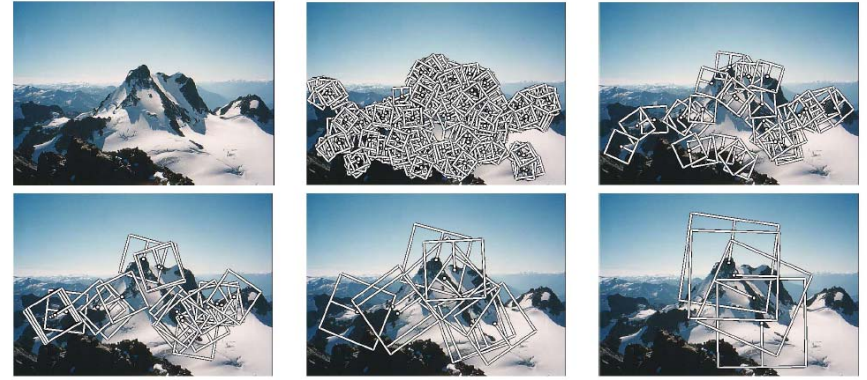


Figure 1. Multi-scale Oriented Patches (MOPS) extracted at five pyramid levels from one of the Matier images. The boxes show the feature orientation and the region from which the descriptor vector is sampled.

## Project 2: panorama stitching

<http://www.cs.washington.edu/education/courses/cse576/05sp/projects/proj2/artifacts/winners.html>



Indri Atmosukarto, 576 08sp

## Project 3: Face Recognition





## Final Project

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TBA

- either an open-ended team “research project”
- or a build-a-vision-system challenge

## Grading

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Based on projects

No midterm or final

## General Comments

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Prerequisites—*these are essential!*

- Data structures
- A good working knowledge of C and C++ programming
  - (or willingness/time to pick it up quickly!)
- Linear algebra
- Vector calculus

Course does ***not*** assume prior imaging experience

- computer vision, image processing, graphics, etc.