CSE 473:
Artificial Intelligence

Hanna Hajishirzi

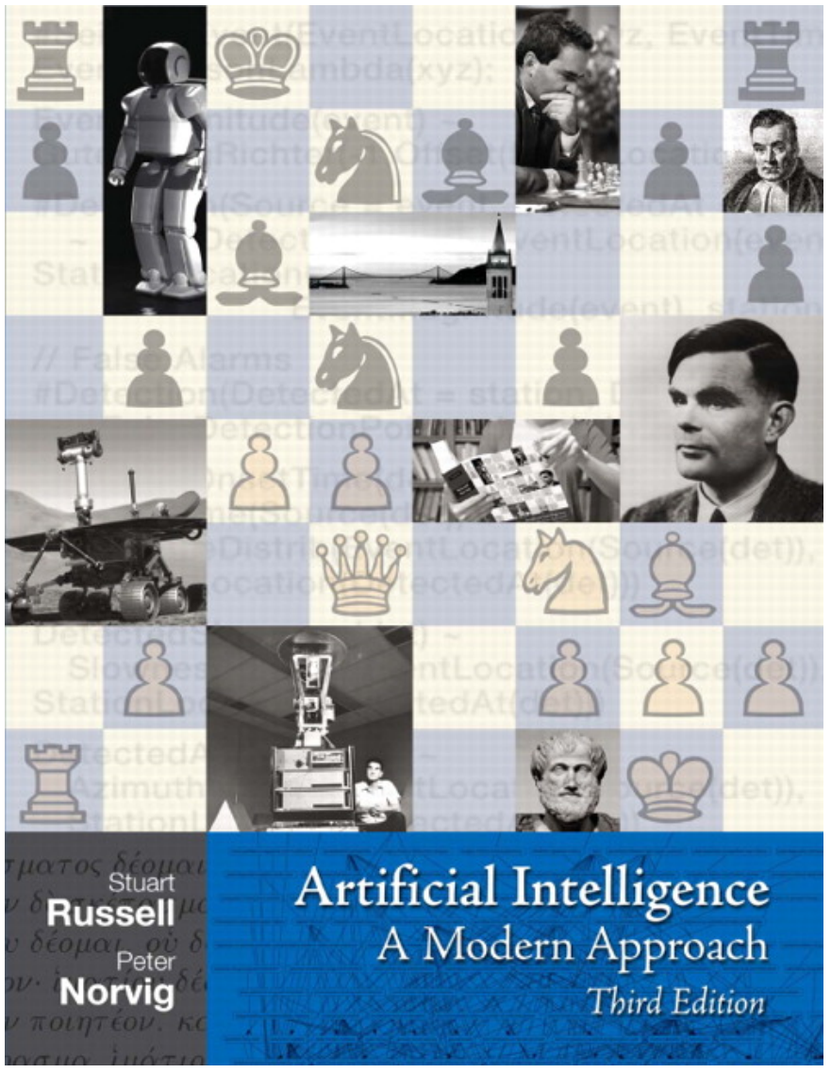
http://www.cs.washington.edu/cse473/14sp/

Several slides from Luke Zettlemoyer, Dan Klein, Dan Weld, Stuart Russell, Andrew Moore

What is CSE 473?

Textbook:

- Artificial Intelligence: A Modern Approach, Russell and Norvig (3rd ed)



Prerequisites:

- Data Structures (CSE 326 or CSE 322) or equivalent
- Basic exposure to probability, data structures, and logic

Work:

- Readings,
- Programming assignment (50%),
- Written assignments (20%),
- Final Exam (25%),
- Class participation (5%)

Course Staff

- Instructor:
  - Hanna Hajishirzi
    Research: AI, NLP, ML, Reasoning

- TAs:
  - Svetoslav Kolev
  - Yunyi Song
  - Johnson Goh

- Course Overload:
  - Write your name on the overload request form if you are not registered

Today

- What is artificial intelligence (AI)?
- What can AI do?
- What is this course?

What is AI?

Science of making intelligent machines or computer programs

What Is AI?

The science of making machines that:

Think like humans
Act like humans

Rational Decisions

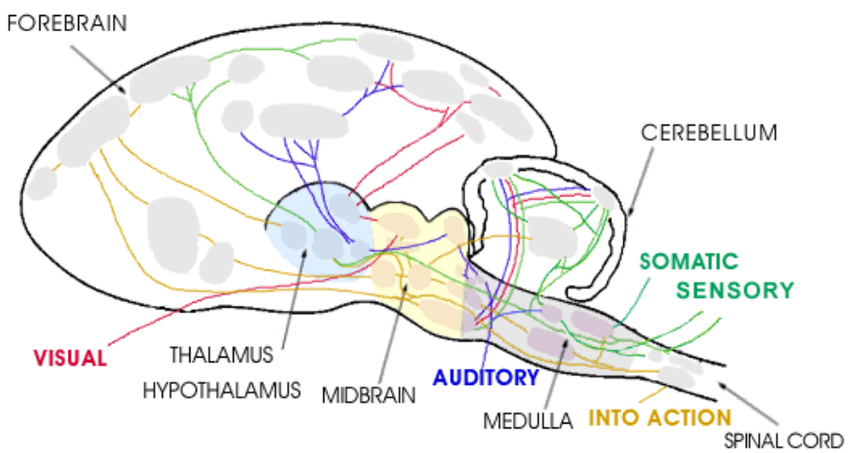
We'll use the term **rational** in a particular way:

- Rational: maximally achieving pre-defined goals
- Rational only concerns what decisions are made (not the thought process behind them)
- Goals are expressed in terms of the utility of outcomes
- Being rational means maximizing your expected utility

A better title for this course would be:

Computational Rationality

Can We Build It?



10^{11} neurons
10^{14} synapses
cycle time: 10^{-3} sec

vs.

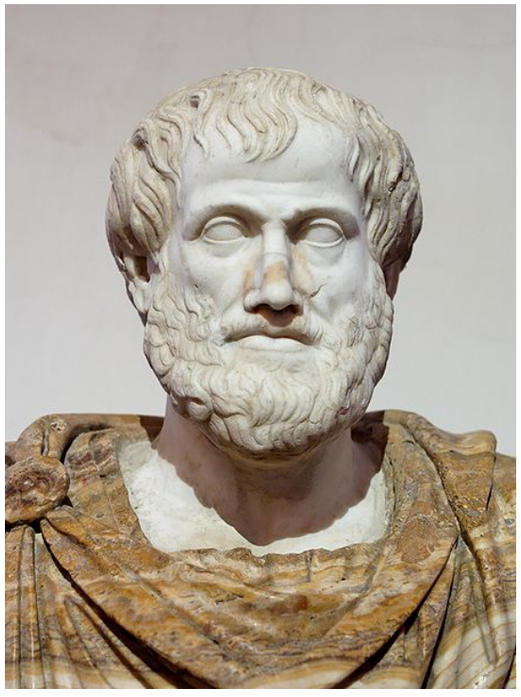
10^{9} transistors
10^{12} bits of RAM
cycle time: 10^{-9} sec

A (Short) History of AI

- Prehistory
- 1940-1950: Early days
- 1950—70: Excitement: Look, Ma, no hands!
- 1970—88: Knowledge-based approaches
- 1988—: Statistical approaches
- 2000—: Where are we now?

Prehistory

- Logical Reasoning: (4th C BC+) Aristotle, George Boole, Gottlob Frege, Alfred Tarski
- Probabilistic Reasoning: (16th C+) Gerolamo Cardano, Pierre Fermat, James Bernoulli, Thomas Bayes



and

1940-1950: Early Days

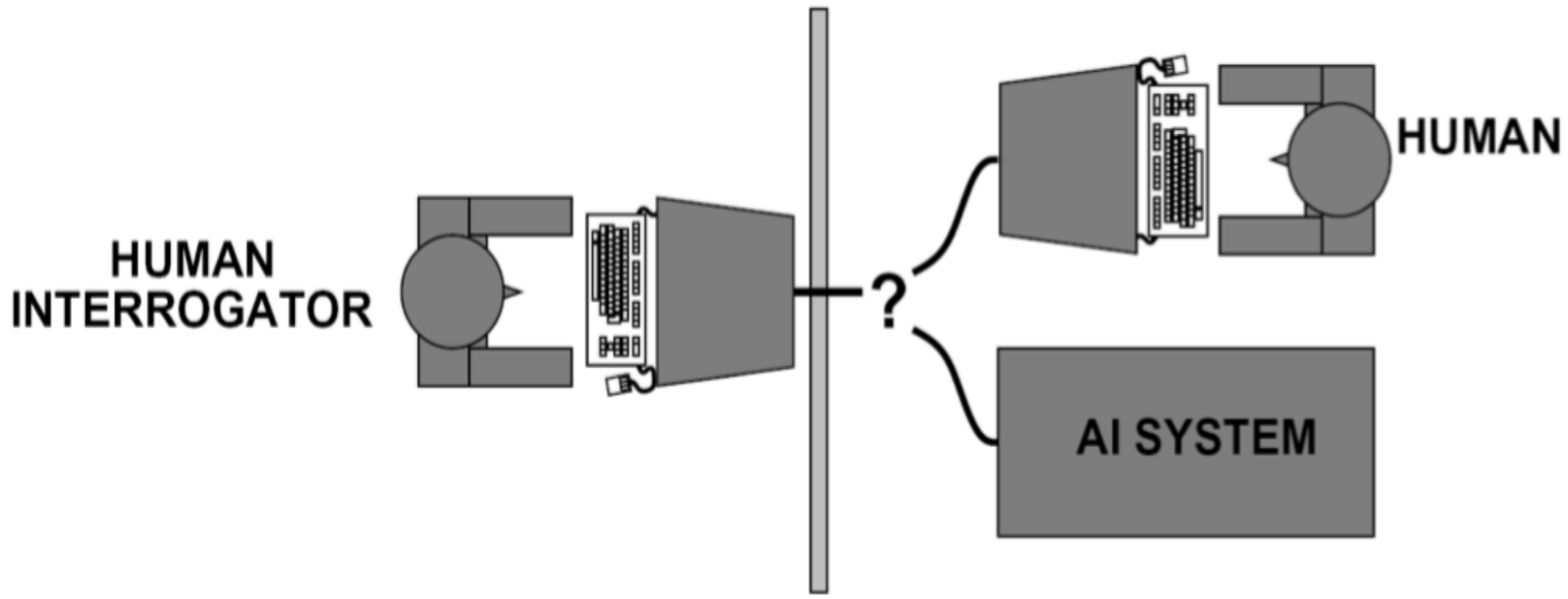
- 1943: McCulloch & Pitts: Boolean circuit model of brain
- 1950: Turing's "Computing Machinery and Intelligence"

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed...

-Alan Turing

The Turing Test

- Turing (1950) "Computing machinery and intelligence"
  - "Can machines think?" → "Can machines behave intelligently?"
  - The Imitation Game:



- Suggested major components of AI: knowledge, reasoning, language understanding, learning

1950-1970: Excitement

- 1950s: Early AI programs including
  - Samuel's checkers program,
  - Newell & Simon's Logic Theorist,
  - Gelernter's Geometry Engine

- 1956: Dartmouth meeting: “Artificial Intelligence” adopted

- 1965: Robinson's complete algorithm for logical reasoning

> “Over Christmas, Allen Newell and I created a thinking machine.”
>
> *-Herbert Simon*

1970-1980: Knowledge Based Systems

- 1969-79: Early development of knowledge-based systems
- 1980-88: Expert systems industry booms
- 1988-93: Expert systems industry busts
  - "AI Winter"

    The knowledge engineer practices the art of bringing the principles and tools of AI research to bear on difficult applications problems requiring experts' knowledge for their solution.

    - *Edward Felgenbaum* in "The Art of Artificial Intelligence"

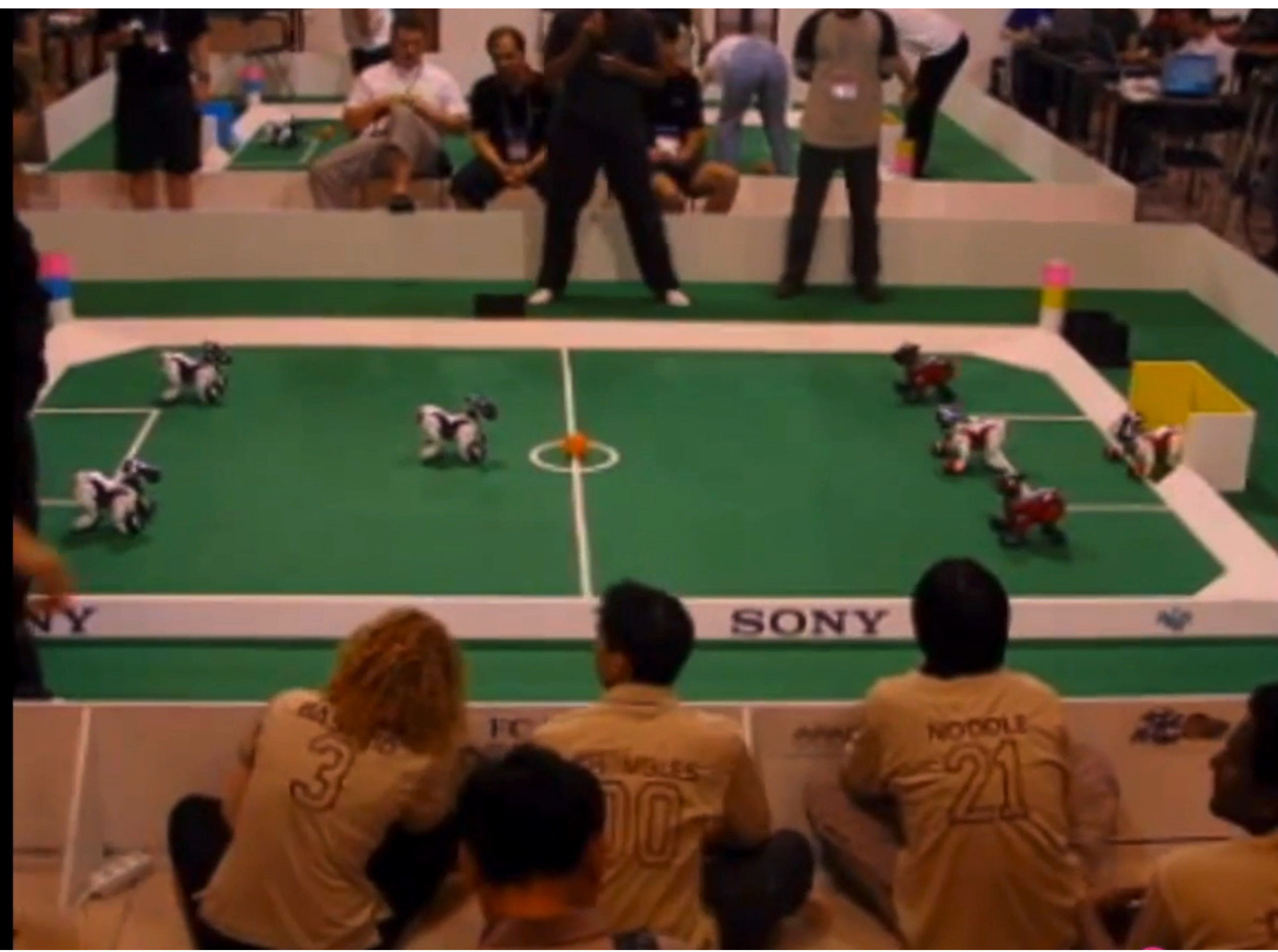
1988--: Statistical Approaches

- 1985-1990: Probability and Decision Theory win
  - Pearl, Bayes Nets
- 1990-2000: Machine learning takes over subfields: Vision, Natural Language, etc.
- Agents, uncertainty, and learning systems…
  - "AI Spring"?

What Can AI Do?

Quiz: Which of the following can be done at present?

- Play a decent game of Soccer?
- Play a winning game of Chess? Go? Jeopardy?
- Drive safely along a curving mountain road? University Way?
- Buy a week's worth of groceries on the Web? At QFC?
- Make a car? Make a cake?
- Discover and prove a new mathematical theorem?
- Perform a complex surgical operation?
- Translate Chinese into English in real time?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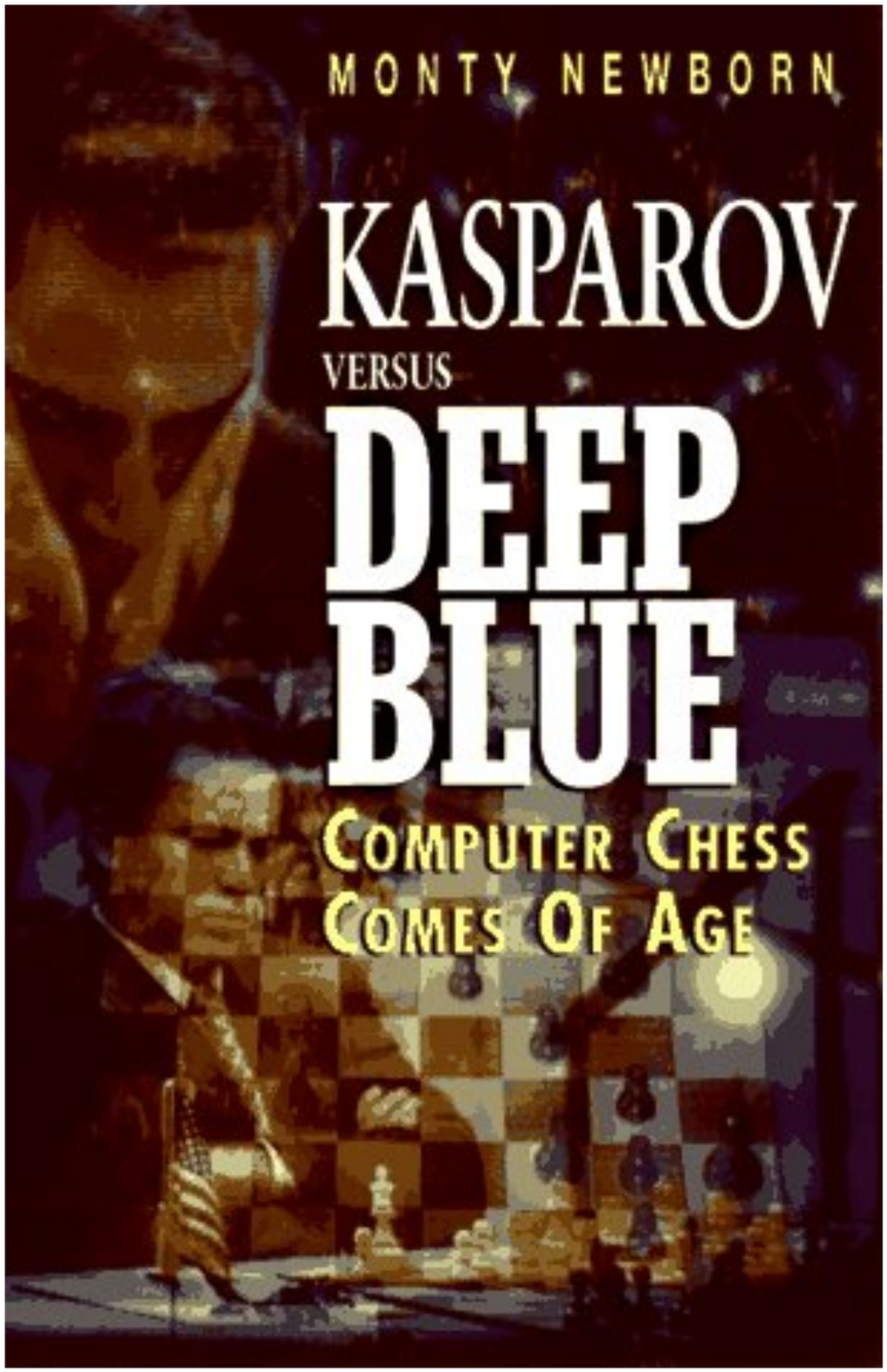
State of the Art

May 1997

"I could feel – I could smell – a new kind of intelligence across the table"

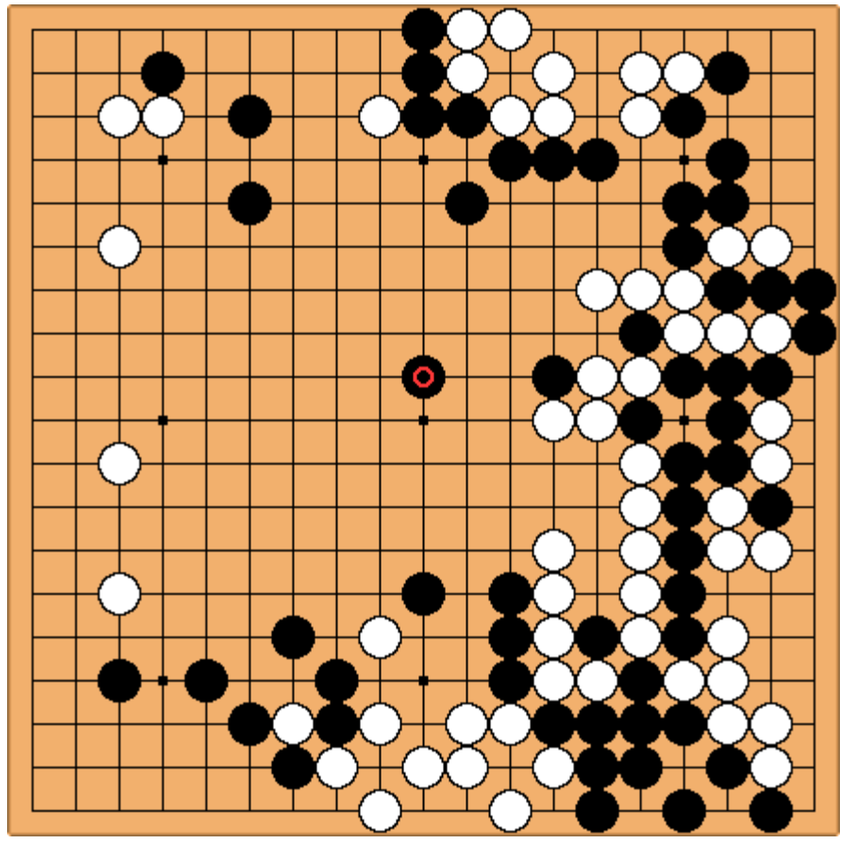
-*Gary Kasparov*



Saying Deep Blue doesn't really think about chess is like saying an airplane doesn't really fly because it doesn't flap its wings.

– *Drew McDermott*

Other Games?



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BakeBot:
Motion Planning for Cooking

Mario Bollini and Daniela Rus
CSAIL, MIT

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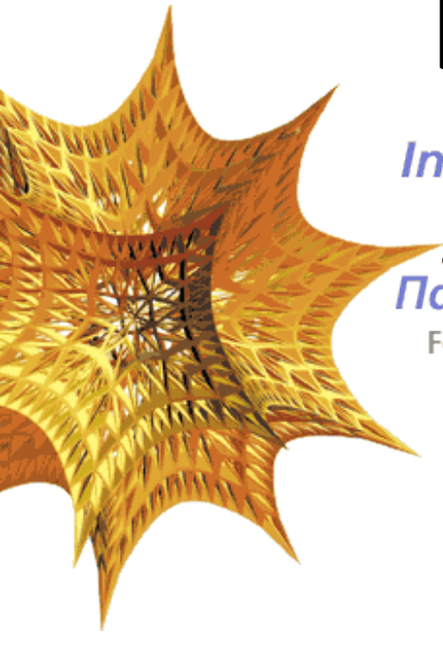
Mathematical Calculation



Introducing
MATHEMATICA 5
Παρουσιάζουμε το
Featuring a new generation of
advanced algorithms with unparalleled
speed, scope, and scalability

$$\partial_r^2 u = -\left[E' - \frac{l(l+1)}{r^2} - r^2\right] u(r)$$

$$e^{-2s}\left(\partial_s^2 - \partial_s\right) u(s) = -\left[E' - l(l+1)e^{-2s} - e^{2s}\right] u(s)$$

$$e^{-2s}\left[e^{\frac{1}{2}s}\left(e^{-\frac{1}{2}s}u(s)\right)'' - \frac{1}{4}u\right] = -\left[E' - l(l+1)e^{-2s} - e^{2s}\right] u(s)$$

$$e^{-2s}\left[e^{\frac{1}{2}s}\left(e^{-\frac{1}{2}s}u(s)\right)''\right] = -\left[E' - \left(l+\frac{1}{2}\right)^2 e^{-2s} - e^{2s}\right] u(s)$$

$$v'' = -e^{2s}\left[E' - \left(l+\frac{1}{2}\right)^2 e^{-2s} - e^{2s}\right] v$$

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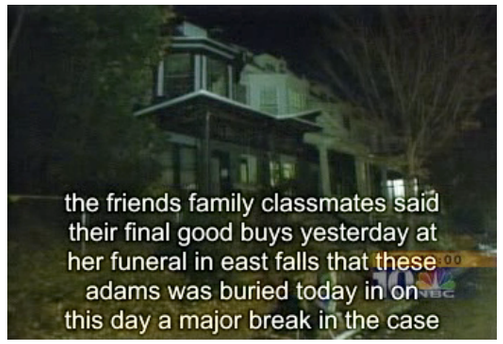
Different Research Areas in AI

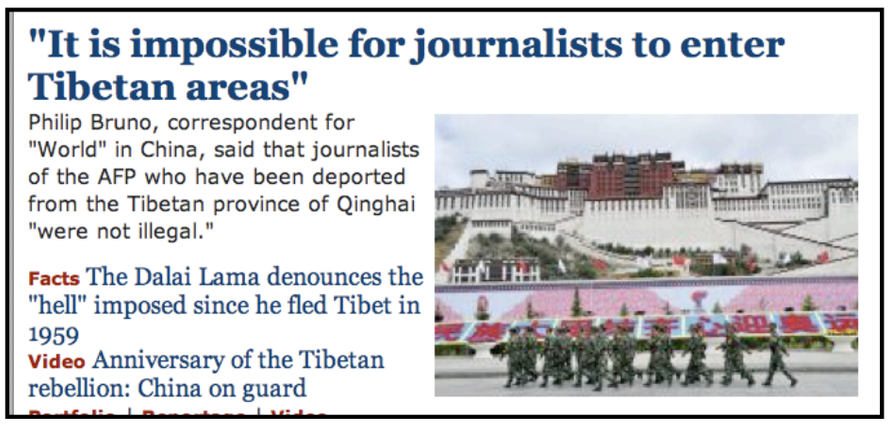
- Natural Language Processing
- Computer Vision
- Robotics
- Logic
- Decision Making
- Game Playing

Natural Language Processing

- Speech Technologies (e.g., Siri):
  - Automatic Speech Recognition (ASR)
  - Text-to-speech synthesis
  - Dialog Systems



- Language Technologies:
  - Question answering
  - Machine translation



- Text classification; spam filtering; etc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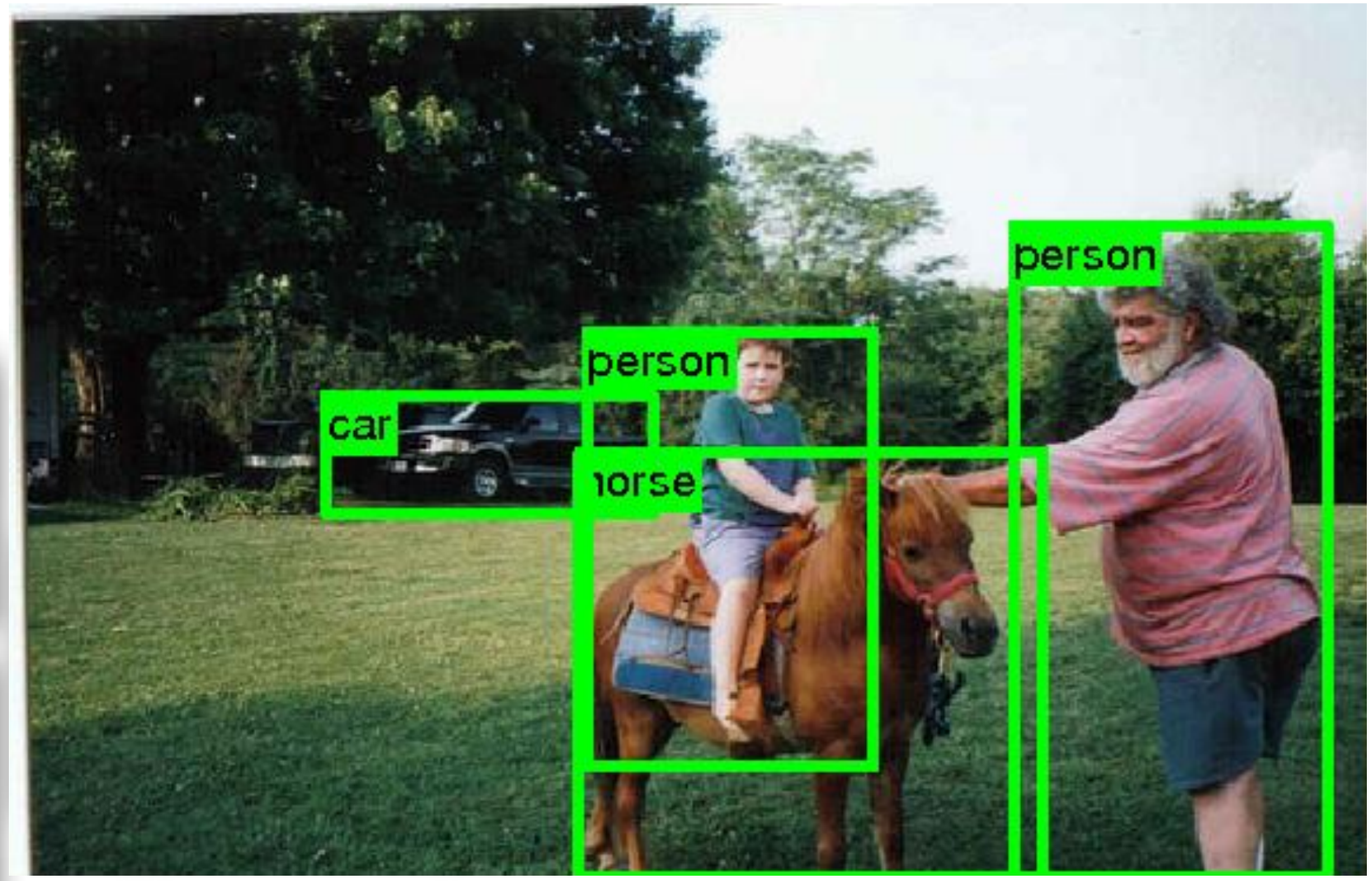
Vision

- Object Recognition
- Scene Classification
- Image Segmentation
- Human Activity Recognition

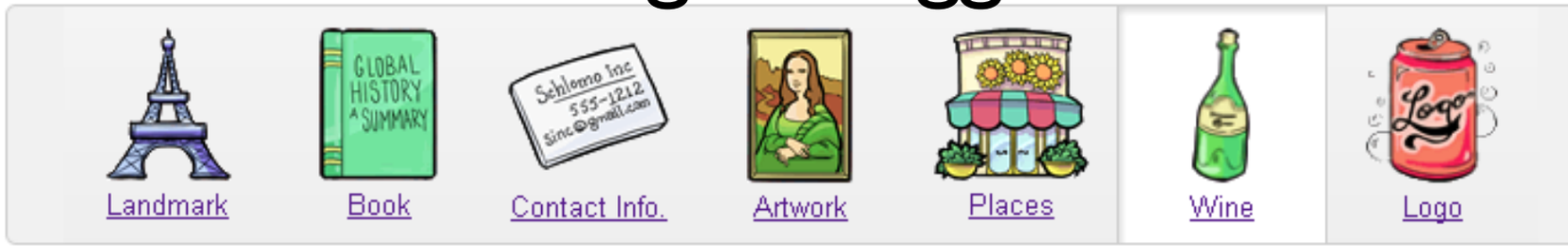
Object Recognition

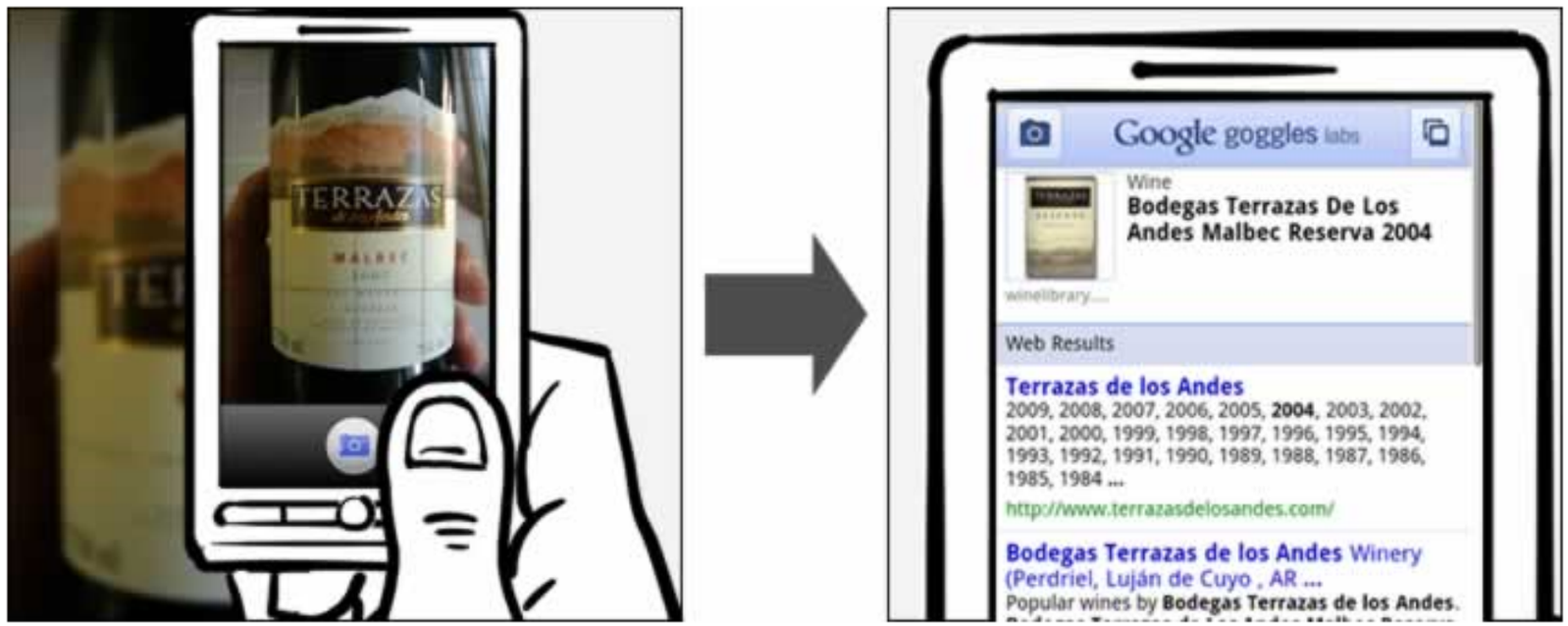


Scene Segmentation

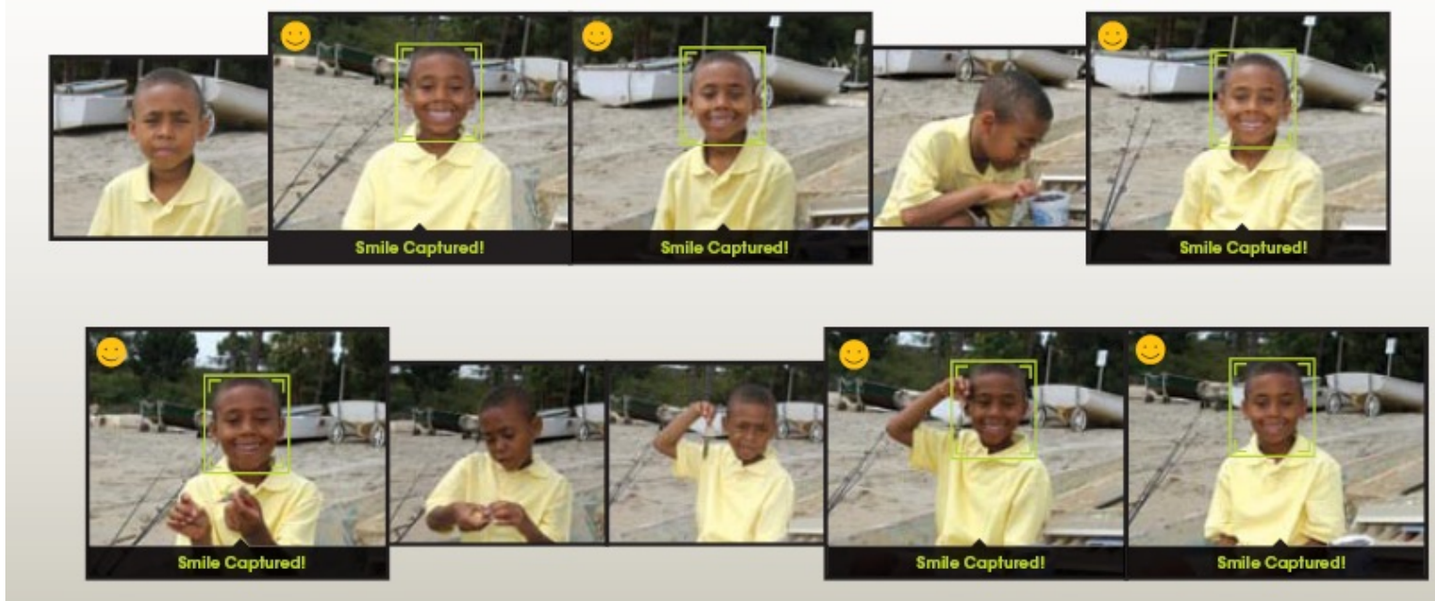
(b) (c)

Google Goggles

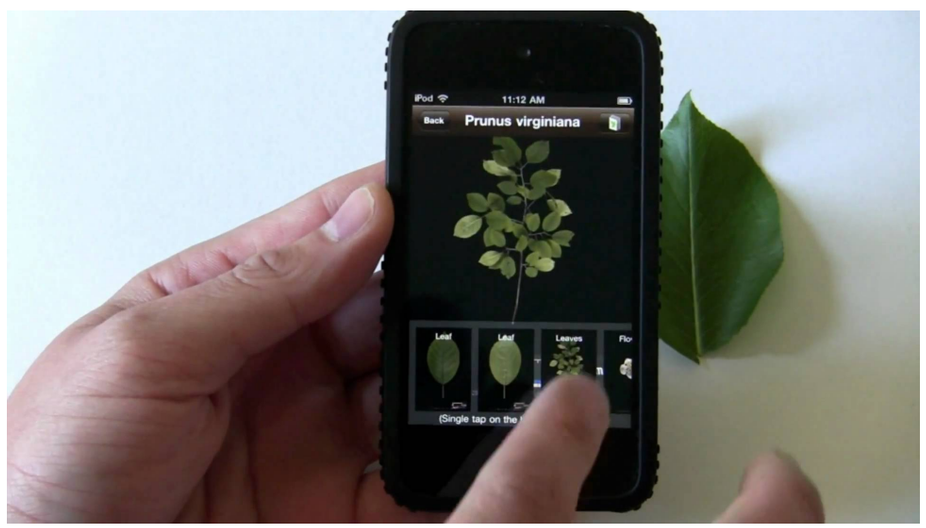




Smile Detection



Leaf Snap



To Do:

- Look at the course website: http://www.cs.washington.edu/cse473/14sp/
- Do the python tutorial