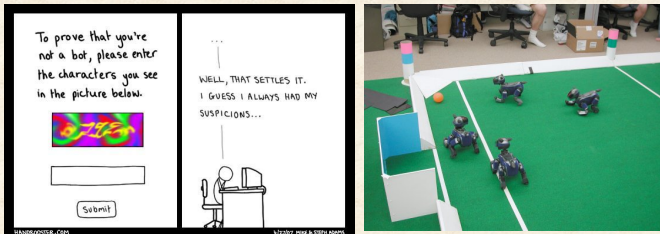


How to Solve Challenging Problems?



What do you want to do with computation?

Can you think of examples?

Solve interesting problems! (or entertain us!)

- Play games
- Recommend movies
- Find best priced items
- Connect us with our friends
- Find information for us
- Find best directions to destination
- Pick stocks
- Forecast the weather
- Recognize us to let us into our house
- Drive cars for us

Many Interesting Services Exist!

Popular, low-cost applications

- Song creation (Songify)
- Song recognition (Shazam)
- Itinerary planning (mTrip)
- Speech recognition (Dragon Dictation)
- Face recognition (Recognizr)
- Image recognition (SnapTell)
- Chatbot (AmyA.I.)

What is currently **challenging**?

Interesting + Challenging Apps

Interacting with human language

- Speech recognition, conversation, translation
- Answering questions for people

Understanding visual images

- Recognition (or "labeling")

Movement in human world

- Robotics

Today just examples

- Semester (+ more courses) to learn HOW

Natural language: Speech Recognition

First step: "Hear" words spoken by person

Why do you think this could be useful?

- Phone call routing (e.g., airline reservations)
 - "how can I help you?" with canned responses
 - "speak your card number"
- dictation (translate to written form)



IBM
ViaVoice



Dragon
NaturallySpeaking

- Hands-free commands to car

Not easy, but relatively "solved"

Goal: Interact w/ computer as if human (smart!)

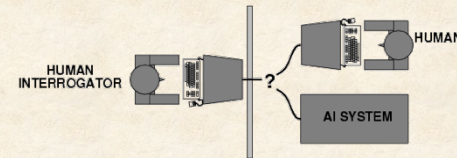
Acting Humanly: Turing Test

How to answer question: "Can machines think?"

- What does it mean to "think"???

A. Turing, Artificial Intelligence Pioneer, 1950

- "Can we tell it's a machine from conversation?"



Predicted by 2000, machine has 30% chance of fooling a lay person for 5 minutes

Natural Language: Chatbots



Valerie: CMU Robot
Receptionist in Newell-Simon
hall.

ALICE: 2004 Loebner Prize
winner

ELIZA: psychotherapist

Future homework: Experiment with chatbots

- How long before obvious not human?

Natural Language: Translation

Google translate.google.com

The spirit is willing but the flesh is weak.
[Bible, Matthew 26:41]

| | |
|--|---|
| Дух охотно готов но плоть слаба | Spirit is willingly ready but flesh it is weak |
| 精神是愿意的但骨肉是微弱的 | The spirit is wants but the flesh and blood is weak |
| 精神は喜んでであるが、肉は弱い | Mind is rejoicing,, but the meat is weak |
| El alcohol está dispuesto pero la carne es débil | The alcohol is arranged but the meat is weak |
| لكحول مستعدة غير أن اللحم ضعيف | The alcohol is ready nevertheless the meat is weak. |

Future homework: Experiment with translation

- Which phrases/words cause confusion?

Natural Language: Answering Questions

Ask Jeeves Web | Pictures | News | Local **NEW!** | Products | More »

who is the first US astronaut?

Web Search: who is the first US astronaut? 1-10 results

who is the first US astronaut? [Web Answer]
The flight of **Alan Shepard, first US astronaut**, lasted only 15 minutes, 22 seconds. Email: myalmanac@angelfire.com...
www.angelfire.com/az/myalmanac/page4.htm... | Save | See 5 more Web Answers »

Web Search: who is the first astronaut? 1-10 results

who is the first astronaut? [Web Answer]
Rabbi Harold Robinson of the Navy Chaplain Corps recited prayers and poetry in English and Hebrew, mindful that the crew included Israeli Air Force Col. **Ilan Ramon, the first astronaut** from that country.
www.chron.com/cs/CDA/story.hts/space/sts... | Save

Natural Language: Recommendation Systems

Recommendation based on other users' behavior
(e.g., Amazon, Netflix)

Availability: Usually ships within 24 hours. Ships from and so
Want it delivered Friday, July 17? Order it in the next 8 hours
choose **One-Day Shipping** at checkout. See details
Z6.usd.8.new available from \$14.99

Share your own customer images
Look inside another edition of this book

Customers who bought this book also bought

Introduction to Algorithms, Second Edition by Thomas H. Cormen
Machine Learning by Tom M. Mitchell
ANSI Common Lisp by Paul Graham
Principles of Artificial Intelligence Programming : Case Studies in Common Lisp by Peter J.
Operating System Concepts (Windows XP Update) by Abraham Silberschatz
AI Application Programming (Programming Series) by M. Tim Jones

Explore Similar Items: in Books



Future Homework: Explore recommendation systems

- How well do you think they work?

Future Lecture: How Natural Language Processing works

Interesting + Challenging Apps

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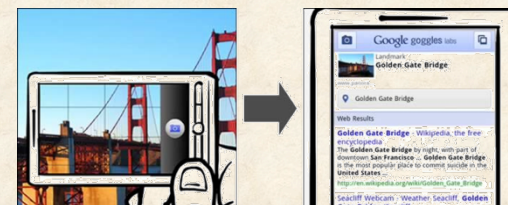
Movement in human world

- Robotics

Today just examples

- Semester (+ more courses) to learn HOW

Visual Images: Recognition



Images: Face Recognition

What makes recognizing faces difficult (or, identifying that two images are of same face)?

Many things can differ...

- Angle (front, left side, right side)
- Expressions
- Hairstyle
- Lighting (shadows, coloring)

Images: Face Recognition



Are these all the same people?

Images: Face Recognition



Context is important!

Images: Hard Problems

Face and image recognition is very hard

What should we do?

- Give up?
- Bang your head really hard?
- Learn an important lesson!
 - turn challenge into something useful

Not hard problem for humans!

What is useful about a problem that is very hard for machines, but trivial for humans?

Images: CAPTCHA

Completely Automated Public Turing test to tell Computers and Humans Apart

The "Anti-Turing test"

Tell human and machines apart, **automatically**

- Deny spam-bots free email registration
- Protect online poll from vote-bots



Many different distortion techniques

Also audio Captcha

Images: Labeling

Task: label all images on the web with words



→ car, boy, hat, ...

Why useful?

Image search engines

- Do not really understand the image
- Use image filename and surrounding text

How can we label?

Visual Images: ESP Game

Use real human intelligence!



How can we trick humans into doing this labeling work for computers?

Make it into a game!

- Two separate players find common label for image
- Benefits: Fun and hard to give bad labels

Explore in HW 1: Games with a purpose

Visual Images: ESP Game

PLAYER 1



GUESSING: **CAR**

GUESSING: **HAT**

GUESSING: **KID**

SUCCESS!

YOU AGREE ON CAR

PLAYER 2



GUESSING: **BOY**

GUESSING: **SMILE**

GUESSING: **CAR**

SUCCESS!

YOU AGREE ON CAR

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Robotics: Cars

DARPA Grand Challenges

DARPA Grand Challenge I
Barstow to Primm
March 13, 2004



142 miles
10 hours

DARPA Grand Challenge II
Desert Classic
October 8, 2005



132 miles
10 hours

DARPA Grand Challenge III
Urban Challenge
November 8, 2007



60 miles
6 hours

Robotics: Cars

DARPA Grand Challenge

- <http://video.google.com/videoplay?docid=-4948445106261731330&hl=en>
- <http://video.google.com/videoplay?docid=-8274817955695344576&hl=en>



Automatic car parking

- http://www.youtube.com/watch?v=_piO849uRdI&feature=player_embedded

Other vehicle control systems

- Mercedes semi-automatic braking system
- iRobot Roomba automated vacuum cleaner

Robotics: Mars Rovers

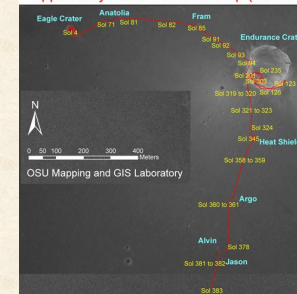
Autonomous (part time) driving on Mars by Sojourner, Spirit, and Opportunity rovers

Robot motion planning



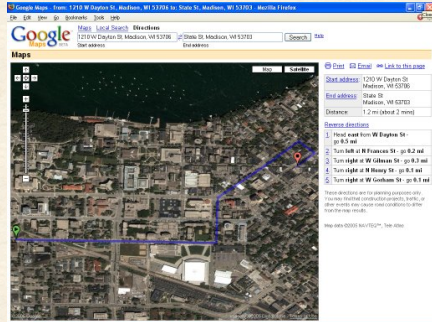
not always autonomously...

Opportunity Rover Traverse Map (Sol 383)



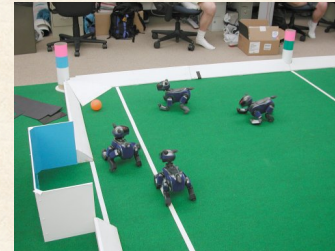
Robotics: Navigation at Home

From UW CS to State street



Robotics: Soccer

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



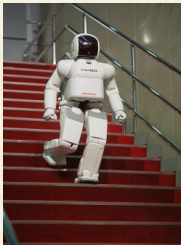
<http://www.youtube.com/watch?v=a9r4bvChWfc>

2006: <http://video.google.com/videoplay?docid=-464425065095495806&hl=en>

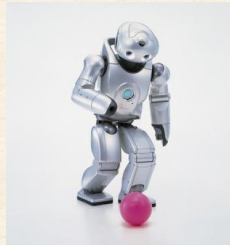
2010: <http://www.youtube.com/watch?v=4wMSiKHPKX4>

Robotics: Humanoid

Bipedal, human-like walking



Asimo (Honda)



QRIO (Sony)

Later lecture: Social Robotics

Is solving these problems Artificial Intelligence (AI)?

"AI is the study of complex information processing problems that often have their roots in some aspect of biological information processing. The goal of the subject is to identify solvable and interesting information processing problems, and solve them."

-- David Marr (1945-1980)

Focus of most all of computer science!

Part 1: How do we win strategy games against humans?

| How do computers...? | Answer |
|-----------------------------|-------------------------------------|
| Interact with humans? | Artificial intelligence |
| Solve problems? | Algorithms |
| Know what to do? | Programming languages |
| Make art? | Control flow: Sequential and Repeat |
| Show animated stories? | Flowcharts and Abstraction |
| Make decisions? | Decision Trees and If statements |
| Remember what has happened? | Variables |
| Avoid race conditions? | Critical sections |
| Create educational games? | Private vs. shared variables |
| Understand human language? | Natural language processing |
| Interact with humans? | Social robots |
| Guess what may happen? | Probability trials |
| Win games against you? | Game trees |

Homework 1

Homework 1 Due Friday at 5:00 pm

- A) Investigate on-line Scratch projects
- How to hand in? Friend TWO TA Scratch accounts
- B) Explore Games with a Purpose
- Help humanity by playing 3 on-line games
 - How to hand in? Upload screenshot to Learn@UW dropbox

See www.cs.wisc.edu/~cs202-1 for details

Need Help?

Send email to cs202-tas@cs.wisc.edu

Come to office and lab hours

| Day | Time | Instructor or TA | Room |
|-----|-------------|-------------------|---------------|
| Tue | 10:45-11:45 | A. Arpaci-Dusseau | CS 7375 |
| Wed | 2:00-4:00 | Ben Bramble | CS 1370 (Lab) |
| Thu | 10:45-11:45 | A. Arpaci-Dusseau | CS 7375 |
| Thu | 1:30-3:30 | Sharad Punuganti | CS 1370 (Lab) |

