Who Are You All?

Most everyone has a laptop
- Windows is still OS of choice

Very few have previous programming experience
- In past, programmers do learn lots from 202 as well

Half freshman
- 25% Sophomores
- 25% Juniors + Seniors

What might you major in?

- Actuarial Science
- African Languages
- Anthropology
- Atmospheric and Ocean Science
- Biochemistry – 2
- Biology – 2
- Business – 2
- Chemistry – 2
- Communication Arts
- Communicative disorders
- Computer Engineering
- Computer Science - 16
- Economics – 4
- Education
- Engineering – 3
- English – 4
- Environmental Studies
- Finance
- French
- Geography – 3
- History
- Industrial Engineering
- Information Systems
- International studies – 3
- Journalism – 3
- Languages and Cultures of Asia
- Linguistics
- Marketing
- Math – 5
- Meteorology
- Nursing
- Pre-Pharmacy
- Pre-Med
- Physics
- Political Science – 3
- Psychology – 4
- Social Studies
- Sociology
- Undecided – 11

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?”
  - “speak your card number”
- dictation (translate to written form)
- 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
The spirit is willingly ready but flesh it is weak

مIND 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

الcohol es dispuesto pero la carne es débil.
The alcohol is ready nevertheless the meat is weak.

Future homework: Experiment with translation
• Which phrases/words cause confusion?

**Natural Language: Answering Questions**

Web Search: who is the first US astronaut?

who is the first US astronaut? [Web Answer]
The flight of Alan Shepard, first US astronaut, lasted only 15 minutes, 22 seconds. Email: ralshermi@angelfish.com.

Web Search: who is the first astronaut? [Web Answer]

who is the first astronaut? [Web Answer]

Rabbi Harold Robinson of the Haver Chalifin Corps recited prayers and poetry in English and Hebrew, mindful that the law included Israeli Air Force Col. Ilan Ramon, the first astronaut from that country.
www.chron.com/lap/DB/story.html?sec=270... | Site

**Natural Language: Recommendation Systems**

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

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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• 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)

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

Random string oamg → Distorted image → What do you see?

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

Interesting + Challenging Apps
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Robotics: Cars
DARPA Grand Challenges
- 142 miles 10 hours
DARPA Grand Challenge II Desert Classic October 8, 2005
- 132 miles 10 hours
DARPA Grand Challenge II Urban Challenge November 3, 2007
- 60 miles 6 hours
Robotics: Cars

DARPA Grand Challenge
- \texttt{http://video.google.com/videoplay?docid=-4948445106261731330&hl=en}
- \texttt{http://video.google.com/videoplay?docid=-8274817955695344576&hl=en}

Automatic car parking
- \texttt{http://www.youtube.com/watch?v=_pi0849uRdI&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

Robotics: Navigation at Home

From UW CS to State street

Robotics: Soccer

Robocup
- \texttt{http://www.robocup.org/}

\texttt{http://www.youtube.com/watch?v=a9r4bvChWFc}
2006: \texttt{http://video.google.com/videoplay?docid=-4444250650954958066&hl=en}
2010: \texttt{http://www.youtube.com/watch?v=swMSkHPKX4}
Robotics: Humanoid

Bipedal, human-like walking

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

Focus of most all of computer science!

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

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

Homework 1

Homework 1 Due Friday at 5:00 pm

A) Investigate on-line Scratch projects
   - How to hand in? Friend TA Scratch account

B) Explore Games with a Purpose
   - Help humanity by playing 3 on-line games
   - How to hand in? Upload screenshot to Learn@UW dropbox

C) Help CS Education with on-line survey
   - How to hand in? Upload screenshot to Learn@UW dropbox

See [www.cs.wisc.edu/~cs202-1](http://www.cs.wisc.edu/~cs202-1) for details
**Need Help?**

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

**Come to office and lab hours**

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Instructor or TA</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>11:00 - 12:00</td>
<td>Prof. A Arpaci-Dusseau</td>
<td>CS 7375 (office)</td>
</tr>
<tr>
<td>Wed</td>
<td>11:00 - 12:00</td>
<td>Prof. A Arpaci-Dusseau</td>
<td>CS 7375 (office)</td>
</tr>
<tr>
<td>Wed</td>
<td>12:00 - 2:00</td>
<td>Victor Bittorf</td>
<td>CS 1370 (lab)</td>
</tr>
<tr>
<td>Thurs</td>
<td>12:00 - 2:00</td>
<td>Thea Hinkle</td>
<td>CS 1370 (lab)</td>
</tr>
<tr>
<td>Thurs</td>
<td>4:15 - 6:15</td>
<td>Thea Hinkle</td>
<td>CS 1370 (lab)</td>
</tr>
<tr>
<td>Friday</td>
<td>11:00 - 1:00</td>
<td>Victor Bittorf</td>
<td>CS 1370 (lab)</td>
</tr>
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