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CS 106A

Handout #63
June 4, 2012

Frontiers of Computer Science

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Artificial Intelligence and the Turing Test

- In 1950, Alan Turing posed a thought experiment to address a question that underlies the field of Artificial Intelligence.

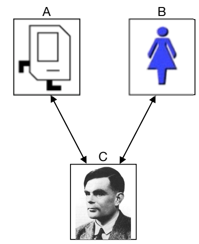
Computing Machinery and Intelligence
A. M. Turing

1 The Imitation Game

I propose to consider the question, 'Can machines think?' . . .

[A revised form of the question] can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. . . .

We now ask the question, 'What will happen when a machine takes the part of A in this game?'



A Dialogue in the Imitation Game

In his paper, Turing suggests the following as a possible dialogue between the interrogator and the unknown subject:

```
TuringGame
Please write me a sonnet on the subject of the Forth Bridge.
Count me out on this one. I never could write poetry.
Add 34957 to 70764.
105621.
Do you play chess?
Yes.
I have K at my K1, and no other pieces. You have only K at K6 and R at
R1. It is your move. What do you play?
R-R8 mate.
```

Turing notes that a computer trying to fool the interrogator might wait several seconds before answering the arithmetic problem, but does not point out that the answer is incorrect.

Eliza

In the mid-1960s, MIT Professor Joe Weizenbaum write a now famous program called *Eliza*, which would mimic—at least in minor formulaic ways—the style of a Rogerian psychotherapist.

```
Eliza
I am the psychotherapist. Please, describe your problems.
Each time you finish talking, type RET twice.
I am depressed.
Are you depressed often?
No, just during Dead Week.
This is not a healthy way of thinking.
Maybe not.
Earlier you said you felt depressed?
```

Note: The Eliza program is built into GNU Emacs; to run it, type ESC-X Doctor RET.

Recursion and Games

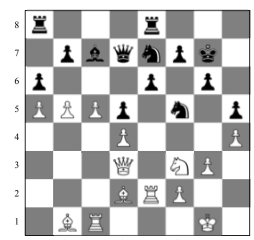
- In 1950, Claude Shannon wrote an article for *Scientific American* in which he described how to write a chess-playing computer program.
- Shannon's strategy was to have the computer try every possible move for white, followed by all of black's responses, and then all of white's responses to those moves, and so on.
- Even with modern computers, it is impossible to use this strategy for an entire game, because there are too many possibilities.

Deep Blue Beats Gary Kasparov

In 1997, IBM's Deep Blue program beat Gary Kasparov, who was then the world's human champion. In 1996, Kasparov had won in play that is in some ways more instructive.

Game 6

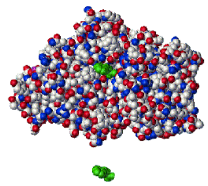
Kasparov	Deep Blue
30. b6	30. Bb8 ??

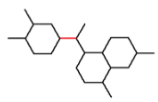


Computer-Assisted Pharmaceutical Design

—Professors Jean-Claude Latombe and Lydia Kavraki

- Designing new therapeutic drugs is an expensive, time-comsuming process, in which computation can be of tremendous value.
- Most proteins are large molecules with a rigid, complex structure.
- Many drugs operate by blocking a reaction site in a protein. Such inhibitor drugs tend to be small and flexible.
- Understanding whether a drug molecule can fit into a reaction site is analogous to determining whether a robot arm can move in a particular way.

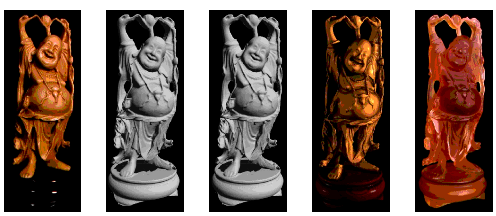




Marc Levoy's Graphics Projects

http://graphics.stanford.edu/projects/mich/

The 3-D Fax Machine

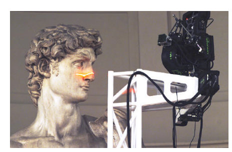


1. Start with a statue of the Happy Buddha.
2. Use laser range scanning to produce a triangle mesh from a single perspective.
3. Merge scans from different perspectives.
4. Construct a digital model using shaded rendering.
5. Use stereolithography to construct a lucite copy.

http://graphics.stanford.edu/projects/faxing/

Scanning Michelangelo's David

In 1999, Professor Marc Levoy spent a year at Stanford's Overseas Studies campus in Florence, at which he and the approximately 30 students who spent at least part of their year there used the technology developed for the 3-D fax machine project to scan the Michelangelo sculptures open to the public.



The laser range-scanning technology allowed Marc to construct a model of each statue with sub-millimeter accuracy — accurate enough to tell when the sculptor changed chisels. This data makes it possible to view statues from any perspective and to analyze them mathematically.

The *Forma Urbis Romae* Project

While in Italy, Professor Levoy and his students also scanned fragments of the *Forma Urbis Romae,* a huge marble map from the 3rd century AD that is now a jigsaw puzzle with 1,186 pieces.

Scanning the fragments makes it possible to use computational techniques to reassemble the pieces of the puzzle. The first match found by Levoy's team is shown at the left. Since that time, the Stanford group has been able to determine the placement of missing pieces at a far faster rate than was previously possible.

http://graphics.stanford.edu/projects/forma-urbis/

Other Options for Continuing CS

- Computer Science minor
- Electrical Engineering
- Mathematics and Computational Sciences
- Science, Technology, and Society
- Symbolic Systems