

## CS10 The Beauty and Joy of Computing

### Artificial Intelligence



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(Slides adapted from Dan Garcia)  
19 March 2012

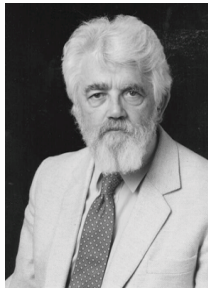
## Lecture Overview

- Definition
- Some AI history
- Tour of areas of AI
- Turing Test and the Chinese room



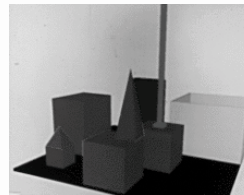
## AI Definition by John McCarthy

- “Getting a computer to do things which, when done by people, are said to involve intelligence”
- Finesses the idea of whether a computer has consciousness, whether they have rights, etc



## A little history...

- Early AI (1956-early 1970s): symbolic reasoning and lots of optimism
- Neural nets (but very simple)



Person: PICK UP A BIG RED BLOCK.  
Computer: OK. (does it)  
Person: GRASP THE PYRAMID.  
Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.  
Person: FIND A BLOCK WHICH IS TALLER THAN THE ONE YOU ARE HOLDING AND PUT IT INTO THE BOX.  
Computer: BY "IT", I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.  
Computer: OK. (does it)

<http://hci.stanford.edu/winograd/shrdlu/>

## Clicker Question

- Which of these rules is true for all dogs?
  - (A) Has four legs
  - (B) Has fur
  - (C) Barks
  - (D) None of the above



(Image from: [http://vision.stanford.edu/resources\\_links.html](http://vision.stanford.edu/resources_links.html))

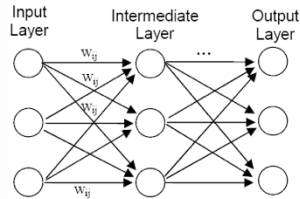
## Revival of AI

- Probability and uncertainty
- Rather than trying to specify a dog exactly, what is the probability that the thing we're seeing is a dog?



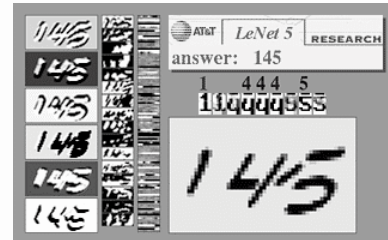
## Revival of AI

- Neural nets with layers (lots of local computations, like your brain)



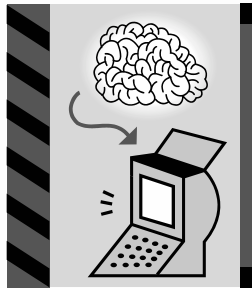
## Revival of AI

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## What intelligent things do people do?

- Planning
- (Machine) Learning
- Natural Language Processing
- Motion and manipulation
- Perception
- Creativity
- General Intelligence



[en.wikipedia.org/wiki/Artificial\\_intelligence](http://en.wikipedia.org/wiki/Artificial_intelligence)

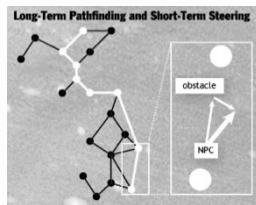
## Tour of AI Applications

- Questions to keep in mind:
  - How would you evaluate how well a machine performed on the tasks we talk about?
  - Where would you draw the line between intelligent/not intelligent behavior?



## Planning (from Video Games lecture)

- Range of intelligence
  - Low: simple heuristics
  - Medium: pathfinding
  - High: Learns from player
- Dynamic difficulty
  - Must hold interest
  - "Simple to learn, difficult to master is the holy grail of game design."
  - Adjust to player's skill



[www.businessweek.com/innovate/content/aug2008/id20080820\\_123140.htm](http://www.businessweek.com/innovate/content/aug2008/id20080820_123140.htm)  
[en.wikipedia.org/wiki/Dynamic\\_game\\_difficulty\\_balancing](http://en.wikipedia.org/wiki/Dynamic_game_difficulty_balancing)  
[en.wikipedia.org/wiki/Game\\_artificial\\_intelligence\\_queue.acm.org/detail.cfm?id=971593](http://en.wikipedia.org/wiki/Game_artificial_intelligence_queue.acm.org/detail.cfm?id=971593)

## Clicker Question

The WORLD'S BEST AI StarCraft player is from:



- Google
- IBM (folks who did Watson)
- Stanford
- Berkeley
- MIT

## Machine Learning

- “A program learns if, after an experience, it performs better”
- Algorithm Types
  - Supervised learning
    - Give a system input & output training data, and it produces a classifier
  - Unsupervised learning
    - Goal: determine how data is organized, or clustered
  - Reinforcement learning
    - No training data, real-time corrections adjust behavior



[en.wikipedia.org/wiki/Machine\\_learning](http://en.wikipedia.org/wiki/Machine_learning)

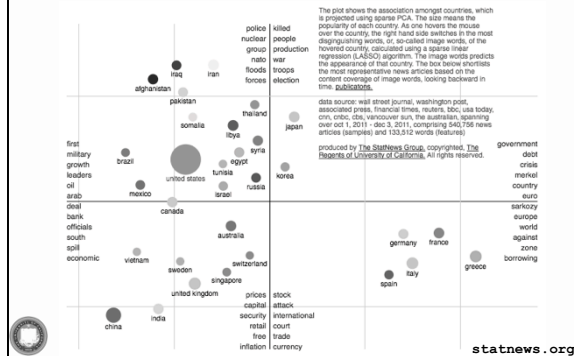
## Natural Language Processing

- Known as “AI-complete” problem
  - Requires extensive knowledge of world
- Statistical NLP
  - Imagine a supervised learning system trained on all text of Web
  - It could easily correct your text (and guess what you'd say) by seeing what's common



[en.wikipedia.org/wiki/Natural\\_language\\_processing](http://en.wikipedia.org/wiki/Natural_language_processing)

## Unsupervised Learning Example



## Robotics

- For many, the coolest and scariest part of AI
- Involves HCI
- Combines fields of AI
  - Speech recognition
  - Synthetic voice
  - Machine vision
  - Planning



TOPIO, the ping-pong playing robot



UC Berkeley's towel-folder



Autonomous helicopter

[en.wikipedia.org/wiki/Robotics](http://en.wikipedia.org/wiki/Robotics)

## Recap

- All of these applications are tough because they require:
  - Knowing about context
  - Uncertainty about input
  - Intensive computations
- But AI has been relatively successful at making progress (and in some cases like certain games, better than people!)

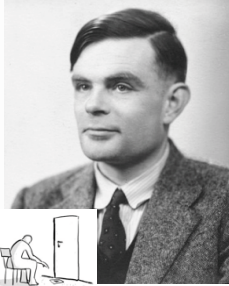


## Clicker Question

- What would a “truly intelligent” AI system look like?
  - (A) Behaves in an optimal or rational manner
  - (B) Can do the same things people do (and makes the same kinds of mistakes people make)
  - (C) Carries out the same type of processing (mental representations) people do – i.e., thinks like people

## Turing Test for Intelligence

- In 1950, Turing defined a test of whether a machine could “think”
- “A human judge engages in a natural language conversation with one human and one machine, each of which tries to appear human. If judge can’t tell, machine passes the Turing test”
- John Searle argued against the test via the Chinese room experiment, in which someone carries on a conversation by looking up phrases in a book. Does that person understand Chinese?



[en.wikipedia.org/wiki/Turing\\_test](https://en.wikipedia.org/wiki/Turing_test)



## Summary

- AI systems excel in things computers are good at
  - big data (using web to parse language)
  - constrained worlds (chess, math)
- It's getting better at...
  - Language understanding
  - Real-time robotics
- Lots more applications that I didn't have time to talk about!
- CS188: Artificial Intelligence
  - One of the most popular courses on campus!
- CogSci131: Computational Models of Cognition



Thanks! Feel free to email me with questions at [rafferty@cs.berkeley.edu](mailto:rafferty@cs.berkeley.edu)

