- Textbook: S. Russell and P. Norvig *Artificial Intelligence: A Modern Approach* Prentice Hall, 2003, Second Edition

Outline

- Course overview
- What is AI?
- A brief history
- The state of the art

What is AI?

Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

The textbook advocates "acting rationally"

Acting humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" → "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game
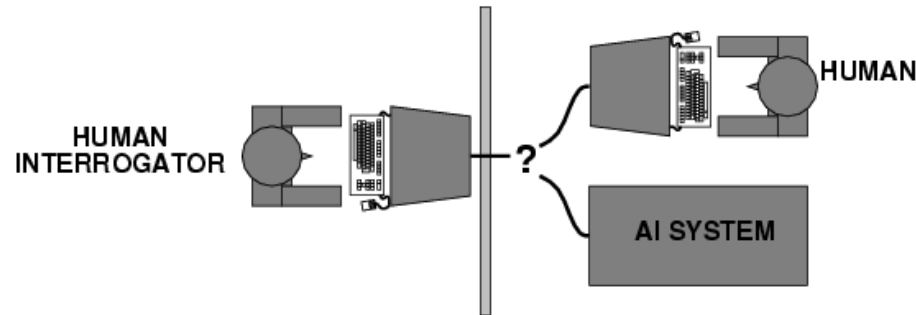
- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning

Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology

- Requires scientific theories of internal activities of the brain

- -- How to validate? Requires
    1) Predicting and testing behavior of human subjects (top-down)
    or 2) Direct identification from neurological data (bottom-up)

- Both approaches (roughly, Cognitive Science and Cognitive Neuroscience)
- are now distinct from AI

Thinking rationally: "laws of thought"

- Aristotle: what are correct arguments/thought processes?

- Several Greek schools developed various forms of *logic*: *notation* and *rules of derivation* for thoughts; may or may not have proceeded to the idea of mechanization

- Direct line through mathematics and philosophy to modern AI

- Problems:
  1. Not all intelligent behavior is mediated by logical deliberation
  2. What is the purpose of thinking? What thoughts should I have?

Acting rationally: rational agent

- Rational behavior: doing the right thing

- The right thing: that which is expected to maximize goal achievement, given the available information

- Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action

Rational agents

- An agent is an entity that perceives and acts

- This course is about designing rational agents

- Abstractly, an agent is a function from percept histories to actions:

$$[f: P* \rightarrow A]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance

- Caveat: computational limitations make perfect rationality unachievable

AI prehistory

- Philosophy   Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality

- Mathematics   Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability

- Economics   utility, decision theory

- Neuroscience   physical substrate for mental activity

- Psychology   phenomena of perception and motor control, experimental techniques

- Computer   building fast computers engineering

- Control theory   design systems that maximize an objective function over time

- Linguistics   knowledge representation, grammar

Abridged history of AI

- 1943   McCulloch & Pitts: Boolean circuit model of brain
- 1950   Turing's "Computing Machinery and Intelligence"
- 1956   Dartmouth meeting: "Artificial Intelligence" adopted
- 1952—69   Look, Ma, no hands!
- 1950s Early AI programs, including Samuel's checkers
  program, Newell & Simon's Logic Theorist,
  Gelernter's Geometry Engine
- 1965   Robinson's complete algorithm for logical reasoning
- 1966—73   AI discovers computational complexity
  Neural network research almost disappears
- 1969—79   Early development of knowledge-based systems
- 1980--   AI becomes an industry
- 1986--   Neural networks return to popularity
- 1987-- AI becomes a science
- 1995-- The emergence of intelligent agents

State of the art

- Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
- Proved a mathematical conjecture (Robbins conjecture) unsolved for decades
- No hands across America (driving autonomously 98% of the time from Pittsburgh to San Diego)
- During the 1991 Gulf War, US forces deployed an AI logistics planning and scheduling program that involved up to 50,000 vehicles, cargo, and people
- NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft
- Proverb solves crossword puzzles better than most humans