Introduction to Artificial Intelligence (AI)

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Objectives

- You should
  - be able to evaluate the various definitions of AI.
  - be able to summarize the history of AI.

What is AI?

"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning…" (Bellman, 1978)	"The study of mental faculties through the use of computational models" (Charniak+McDermott, 1985)
"The study of how to make computers do things at which, at the moment, people are better" (Rich+Knight, 1991)	"The branch of computer science that is concerned with the automation of intelligent behavior" (Luger +Stubblefield, 1993)

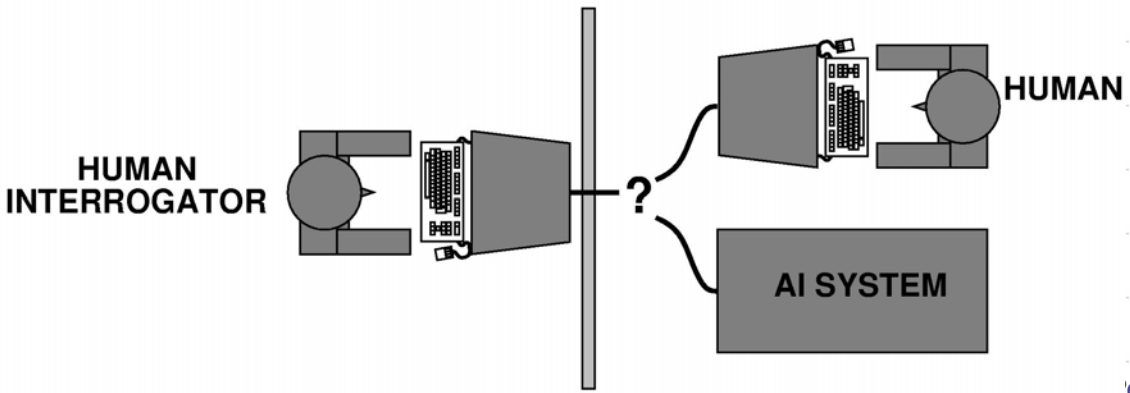
- Views of AI fall into four categories

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

- Book generally goes for acting rationally

Acting humanly: The Turing test

- Turing (1950) "Computing machinery and intelligence"
  - "Can machines think?->"Can machines behave intelligently?"
  - 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
- Problem: Turing test is not reproducible, constructive, or amenable to mathematical analysis
- Ask the opponent to summarize your discussion?



AI: A Slides © Stuart Russell and Peter Norvig, 1998 Chapter 1

Thinking humanly: Cognitive Science

- 1960s "cognitive revolution": information- processing psychology replaced prevailing orthodoxy of behaviorism
- Requires scientific theories of internal activities of the brain
  - What level of abstraction? "Knowledge" or "circuits"?
  - 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
- Both share with AI the following characteristic:
  - the available theories do not explain (or engender) anything resembling human-level general intelligence
- Hence, all three fields share one principal direction!

Thinking rationally: Laws of Thought

- Normative (or prescriptive) rather than descriptive
- 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

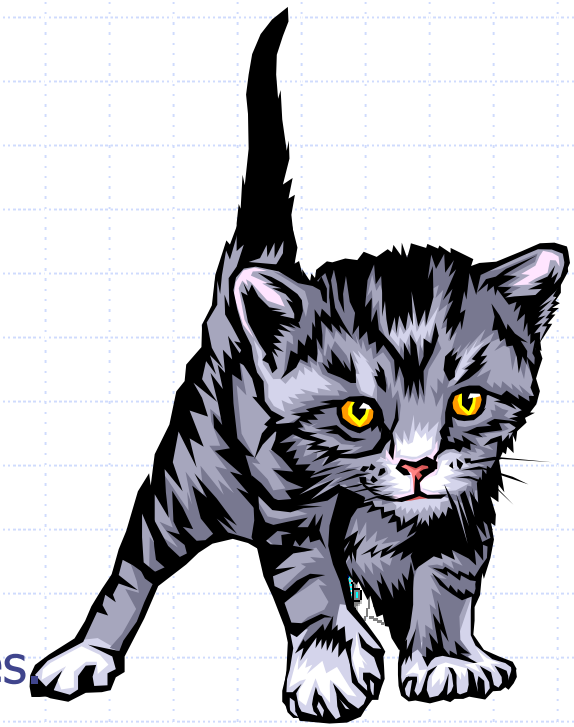
- Rational behavior: doing the right thing
- The right thing: that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking---e.g., blinking reflex---but thinking should be in the service of rational action
- Aristotle (Nicomachean Ethics):
  - *Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good*

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 -> design best program for given machine resources

CAT – What do the movies say?

- Various movies been about AI
  - 2001: Space Odyssey
  - Star Trek
  - Star Wars
  - Terminator
  - AI
  - http://scifimovies.about.com/library/weekly/aa013000a.htm
- What perspective do they take?
    - Acting humanly
    - Thinking humanly
    - Thinking rationally
    - Acting rationally
  - Which one do you take?
- Discuss this with your neighbor for 5 minutes



AI prehistory I

- 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
- Psychology
  - adaptation; phenomena of perception and motor control; experimental techniques (psychophysics, etc.)

AI prehistory II

- Linguistics
  - knowledge representation
  - grammar
- Neuroscience
  - physical substrate for mental activity
- Control theory
  - homeostatic systems, stability
  - simple optimal agent designs

Brief history of AI I

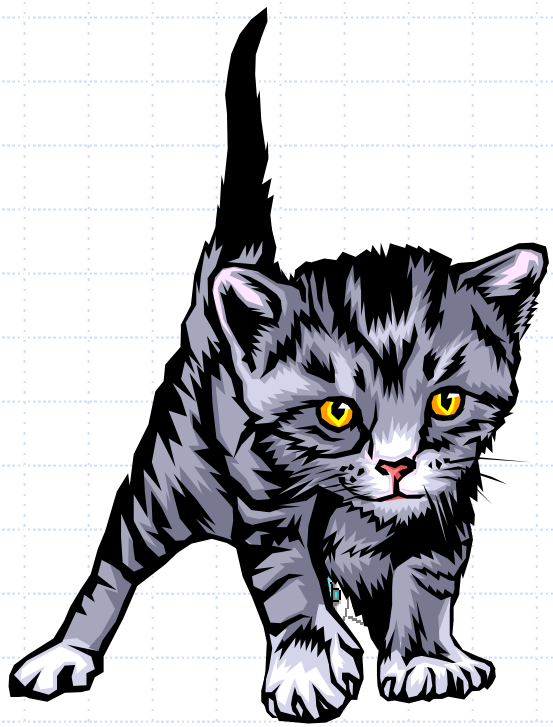
- 1943 McCulloch & Pitts: Boolean circuit model of brain
- 1950 Turing's "Computing Machinery and Intelligence"
- 1952-69 Look, Ma, no hands!
- 1950s Early AI programs, including
  - Samuel's checkers program
  - Newell & Simon's Logic Theorist
  - Gelernter's Geometry Engine
- 1956 Dartmouth meeting:
  - "Artificial Intelligence" adopted
- 1965 Robinson's complete algorithm for logical reasoning

Brief history of AI II

- 1966-74
  - AI discovers computational complexity
  - Neural network research almost disappears
- 1969-79 Early development of knowledge-based systems
- 1980-88 Expert systems industry booms
- 1988-93 Expert systems industry busts: "AI Winter"
- 1985-95 Neural networks return to popularity
- 1988-
  - Resurgence of probabilistic and decision-theoretic methods
  - Rapid increase in technical depth of mainstream AI
  - "Nouvelle AI": ALife, GAs, soft computing
- 1995- Agents agents everywhere ...

CAT – State of the Art?

- Surf the web for 5 minutes to find out which of the items on the next page are state of the art.
- Document where you find the answers.



State of the art

- Which of the following can be done at present?
  - Play a decent game of table tennis
  - Drive along a curving mountain road
  - Drive in the center of Cairo
  - Buy a week's worth of groceries at Pick n' Save
  - Buy a week's worth of groceries on the web
  - Play a decent game of bridge
  - Discover and prove a new mathematical theorem
  - Write an intentionally funny story
  - Give competent legal advice in a specialized area of law
  - Translate spoken English into spoken Swedish in real time
  - Perform a complex surgical operation