Introduction to AI

Outline

- What is AI?
- The Age of Intelligent Machine
- Definitions of AI
- Turing 's Test – Part 1 & 2
- History of AI
- The state of the art
- Example of AI systems

What is AI?

Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

The textbook advocates "acting rationally"

What 's AI: 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
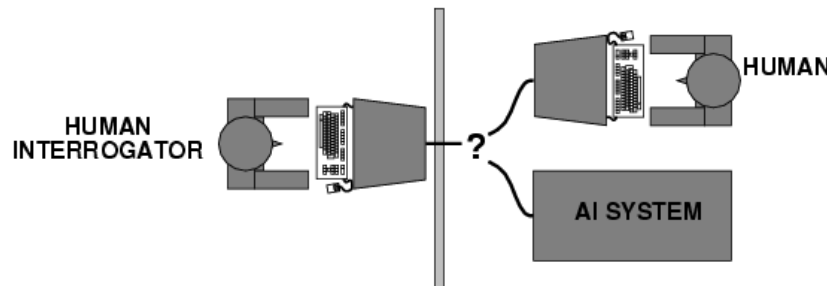
- • Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- • Anticipated all major arguments against AI in following 50 years
- • Suggested major components of AI: knowledge, reasoning, language understanding, learning

What 's AI: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

What 's 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 ?*

What 's AI: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:
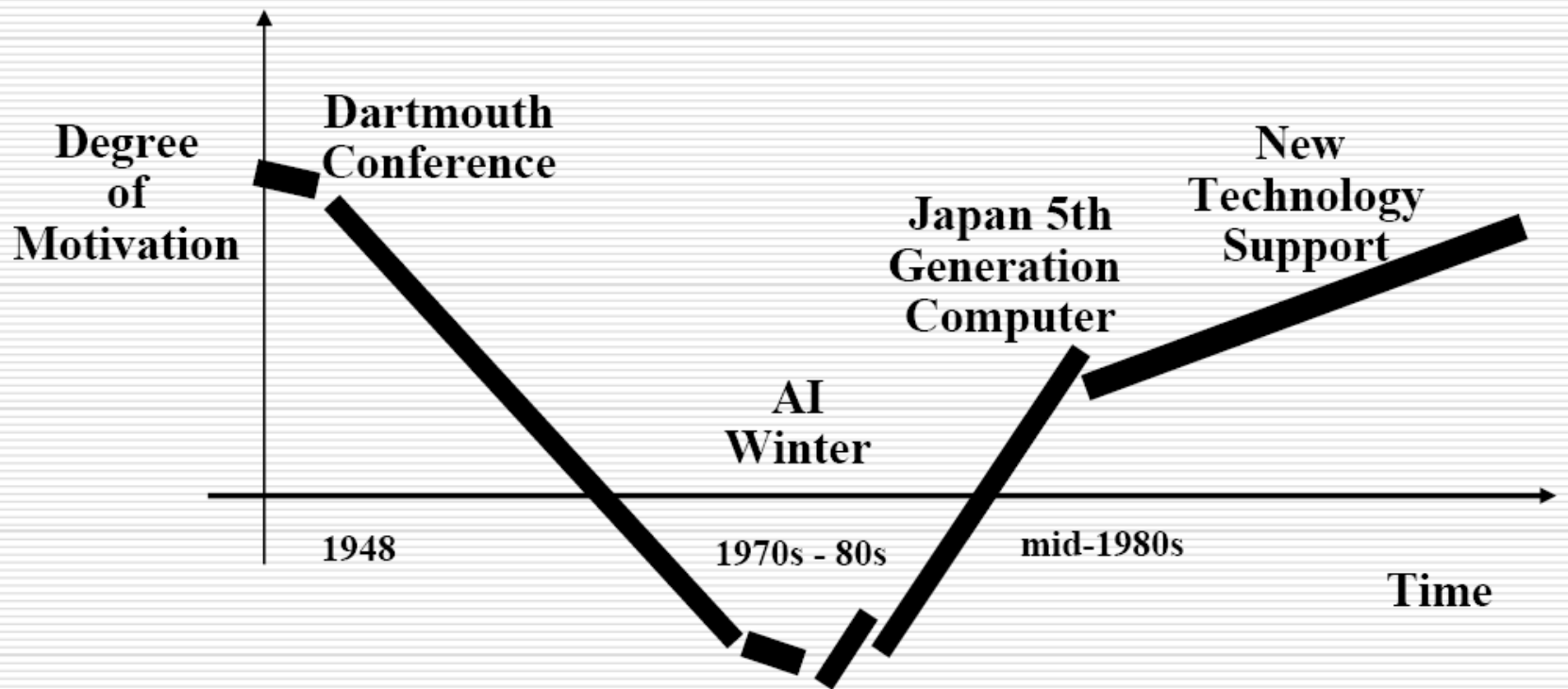
$$[f: P^* \rightarrow A]$$

- 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

  $\rightarrow$ design best program for given machine resources

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 engineering   building fast computers
- Control theory   design systems that maximize an objective function over time
- Linguistics   knowledge representation, grammar

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
- 2001--   The availability of very large data sets

Degree of Motivation / Time

Dartmouth Conference — 1948

AI Winter — 1970s - 80s

Japan 5th Generation Computer — mid-1980s

New Technology Support

Adapted from:
Joe Carter (Andersen Consulting, 1988)
Oliver Tian (Andersen Consulting, 1989)

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

Examples of AI systems

- Robots
- Chess-playing program
- Voice recognition system
- Speech recognition system
- Grammer checker
- Pattern recognition
- Medial diagnosis
- System malfunction rectifier

- Game Playing
- Machine Translation
- Resource Scheduling
- Expert systems (diagnosis, advisory, planning, etc)
- Intelligent interfaces