Artificial Intelligence

School of EECS
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Course Information

- Webpage with prof. Larry Holder's lecture notes: www.eecs.wsu.edu/~holder/courses/AI

- These notes are (mildly) edited version of professor Holder's standard AIMA-based lecture notes

- Instructor's Email: predrag.tosic@wsu.edu

Some resources:

- Blackboard Learn (learn.wsu.edu)
- myWSU (portal.wsu.edu)

Introduction

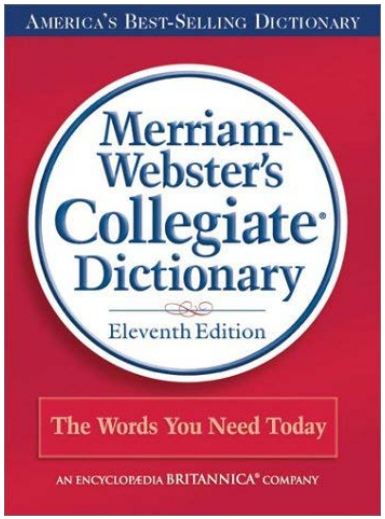
- Readings: Chapter 1 in AIMA

What Is AI?

- John McCarthy, Dartmouth (1956)
  - "The science and engineering of making intelligent machines."
- Intelligent?
- What makes humans intelligent?
- Can you imagine an intelligent biological creature whose intelligence is radically different from human intelligence?

Definition(s) of Intelligence

- Ability to learn or understand or to deal with new or trying situations
- Ability to apply knowledge to manipulate one's environment
- Ability to think abstractly as measured by objective criteria (e.g., tests)



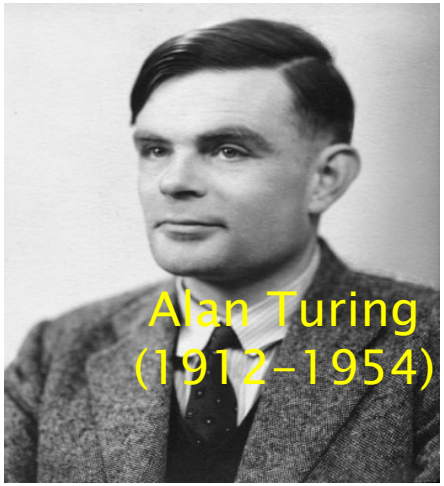
Four (Philosophical) Approaches to AI

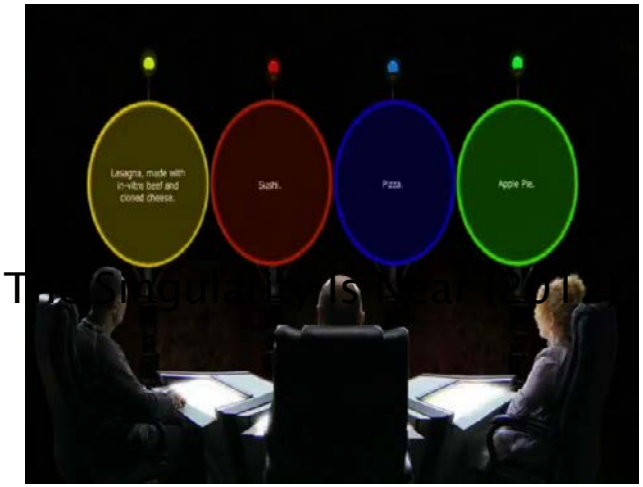
- Acting humanly
- Thinking humanly
- Thinking rationally
- **Acting rationally**

- There really are more, but these four are dominant; AIMA adopts the last one

AI = Acting Humanly

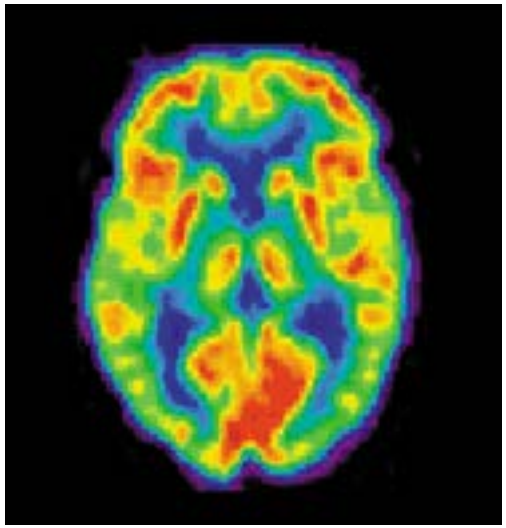
- Turing Test
  - Can the machine convince a human that it is human via written English
- Machine abilities
  - Natural language
  - Knowledge representation
  - Reasoning
  - Learning
- Loebner Prize
  - www.loebner.net/Prizef/loebner-prize.html





AI = Thinking Humanly

- Building machines that mimic human cognition
- "Cognitive Science"
- How to capture human thought
  - Introspection
  - Psychological experiments
  - Brain imaging

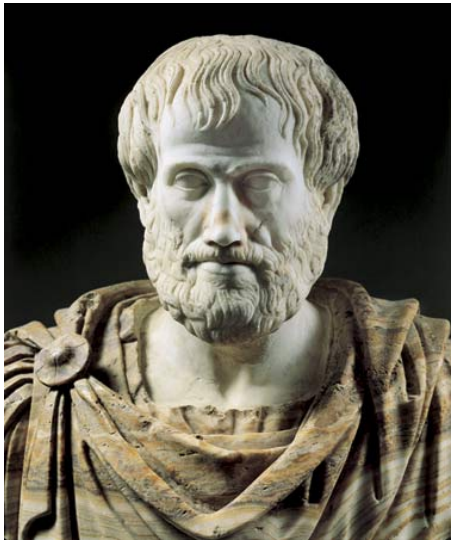


AI = Thinking Rationally

- Laws of thought
- (Formal, Mathematical) Logic
- Difficulties
  - Expressing knowledge as logical formulae
    - A chair is something designed to support a person in a sitting position, *usually* having four legs for support and a rest for the back and *sometimes* having rests for the arms.

    If A is true, and A→B, then is B true?

  - Logical reasoning is in general NP-Hard (for Propositional Logic) or even worse for more expressive Logics
  - Certain core inference problems in First Order Logic are formally undecidable

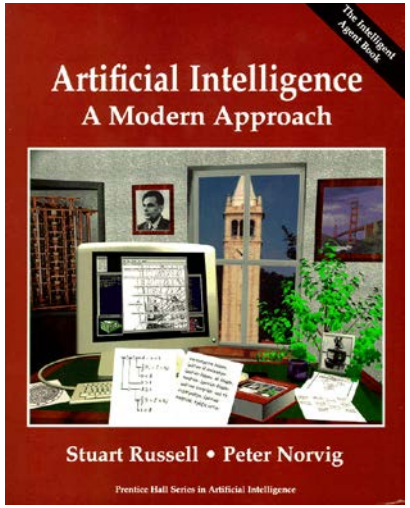


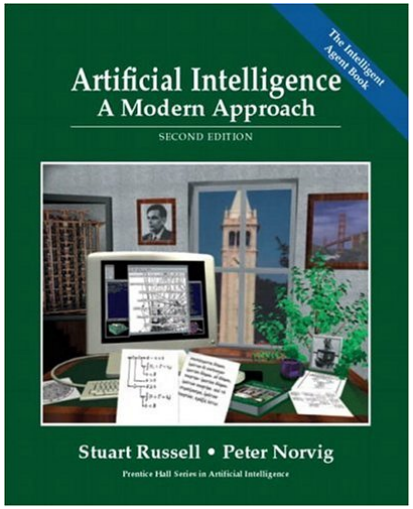
Aristotle
384-322 BC

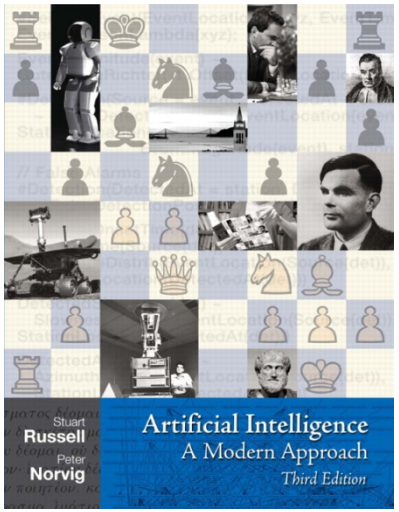
AI = Acting Rationally

- Rational agent
  - Acts to achieve the best outcome
  - Encompasses other approaches

- Focus of textbook ("a modern approach")







Computer Wins Jeopardy!

- IBM's Watson competes against humans in Jeopardy! Game

- Is Watson
  - Thinking humanly?
  - Acting humanly?
  - Thinking rationally?
  - Acting rationally?

Which one is more impressive? Beating the human champion at chess/go, or beating (pretty good) human competitors at Jeopardy?

- Which one is closer to "general purpose intelligence"?

Foundations of AI

- Philosophy: Logic, knowledge and rationality
- Mathematics: Algorithms, computability, probability
- Economics: Utility and decision theory, (formal strategic) games, mechanism design
- Neuroscience: Neurons, (A)NNs
- Psychology: Human cognition
- Control Theory
- Linguistics and NLP
- Computer Engineering
- Computer Science (as in, “traditional” CS)

History of AI

- Gestation of AI (1943-1955)
  - Turing's seminal paper "Computing Machinery and Intelligence" [1950]
  - Artificial neuron (McCullough & Pitts)
- Birth of AI (1956)
  - John McCarthy and the Dartmouth Workshop
  - Newell and Simon's "Logic Theorist"
- Early enthusiasm, great expectations (1952-1969)
  - Newell and Simon's "General Problem Solver"
  - Symbolic programming languages (LISP)
  - ANNs made of interconnected perceptrons

History of AI (cont.)

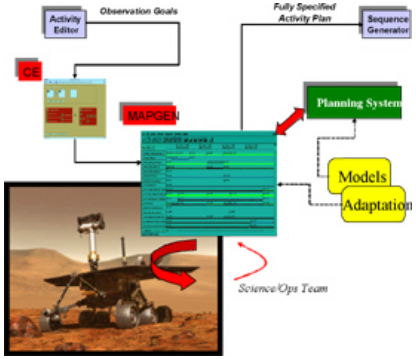
- Dose of reality (1966–1973)
  - Systems lacked knowledge; made simple mistakes
  - Systems provably unable to generate intelligent behavior
  - Most AI problems found to be intractable
- Knowledge-based systems (1969–1979)
  - Knowledge and uncertainty representation
  - Expert systems
- AI industry (1980–present)
- Return of neural networks (1986–present)
  - Multi-layer perceptrons, back-propagation, self-organizing maps
  - Most recent “big thing”: deep learning

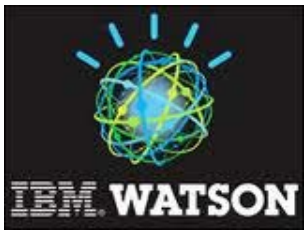
History of AI (cont.)

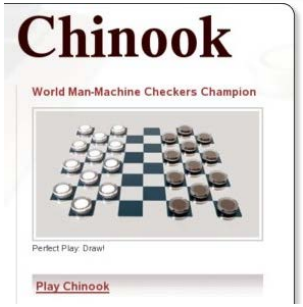
- AI adopts scientific method (1987–present)
  - Empirical validation and theory
- Emergence of intelligent agents as the dominant AI paradigm (1995–present)
  - Human-level AI
  - Artificial *general-purpose* intelligence
- Availability of "big data" (2001–present)
  - Amazon Web Services Public Datasets (http://aws.amazon.com/datasets)
  - Semantic Web (http://linkeddata.org)

Achievements

- Robotics
- Speech recognition
- Planning and scheduling
- Game playing
- Spam filtering
- Machine translation
- Web search/crawling
- “Big data”







Caution

- January 2015: “Top scientists call for caution over artificial intelligence”
  - http://www.telegraph.co.uk/technology/news/11342200/Top-scientists-call-for-caution-over-artificial-intelligence.html
  - http://futureoflife.org/AI/open_letter
- July 2015: “Musk, Wozniak and Hawking urge ban on warfare AI and autonomous weapons”
  - http://www.theguardian.com/technology/2015/jul/27/musk-wozniak-hawking-ban-ai-autonomous-weapons
  - http://futureoflife.org/AI/open_letter_autonomous_weapons

Summary

- AI is the science and engineering of building intelligent machines
  - i.e., machines that act rationally
- Rich history

  that builds on a variety of scientific, philosophical and engineering paradigms, principles and theories
- Impressive achievements
- Promising, challenging future