Introduction: Chapter 1
CS3243

- IVLE for schedule, lecture notes, tutorials, assignment, grading, office hours, etc.
- Lecturer: Min-Yen Kan (S15 05-05)
- Grading: Class participation (10%), Programming assignment (15%),
  Midterm test (20%), Final exam (55%)
- Class participation includes participation in both lectures and tutorials (attendance, asking and answering questions, presenting solutions to tutorial questions).
- Note that attendance at every lecture and tutorial will be taken and constitutes part of the class participation grade.
- Midterm test (in class, 1 hr) and final exam (2 hrs) are both open-book
Outline

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

• Introduction and Agents (chapters 1,2)
• Search (chapters 3,4,5,6)
• Logic (chapters 7,8,9)
• Planning (chapters 11,12)
• Uncertainty (chapters 13,14)
• Learning (chapters 18,20)
• Natural Language Processing (chapter 22,23)
What is AI?

Views of AI fall into four categories:

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<th>Thinking humanly</th>
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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
  \( \rightarrow \) 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
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