

CmpE 540 Principles of Artificial Intelligence

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Course Information

- Topics
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- Academic Integrity

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Chapter 1 Introduction

(Based mostly on the course slides
from <http://aima.cs.berkeley.edu/> and
<http://www.cmpe.boun.edu.tr/~akin/>)

Course overview

- Introduction and Agents (chapters 1,2)
- Search (chapters 3,4,5,6)
- Logic (chapters 7,8,9,10)
- Uncertainty (chapters 13,14)
- Learning (chapters 18,20,21)

What is AI?

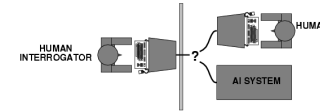
Views of AI fall into four categories:

- 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:
 $[f: \mathcal{P}^* \rightarrow \mathcal{A}]$
- 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

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** adopted
Dartmouth meeting: "Artificial 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
- 1965 reasoning
Robinson's complete algorithm for logical
- 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