Foundations of Artificial Intelligence

1. Introduction: What is Artificial Intelligence?

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1.1 What is AI?

1.2 Acting Humanly

1.3 Thinking Humanly

1.4 Thinking Rationally

1.5 Acting Rationally

1.6 Summary

Introduction: Overview

Chapter overview: introduction
- ▶ 1. What is Artificial Intelligence?
- ▶ 2. AI Past and Present
- ▶ 3. Rational Agents
- ▶ 4. Environments and Problem Solving Methods

1.1 What is AI?

What is AI?

What do we mean by artificial intelligence?

⤳ no generally accepted definition!

often pragmatic definitions:

▶ "AI is what AI researchers do."
▶ "AI is the solution of hard problems."

in the following: some common attempts at defining AI

What is AI: Humanly vs. Rationally; Thinking vs. Acting

"[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)

four typical categories:

| thinking humanly	thinking rationally
acting humanly	acting rationally

⤳ here (and most widespread these days): acting rationally


1.2 Acting Humanly

Acting Humanly: the Turing Test

Alan Turing, Computing Machinery and Intelligence (1950):

▶ from "can machines think?"
  to "can machines act intelligently?"
▶ operationalization: the imitation game
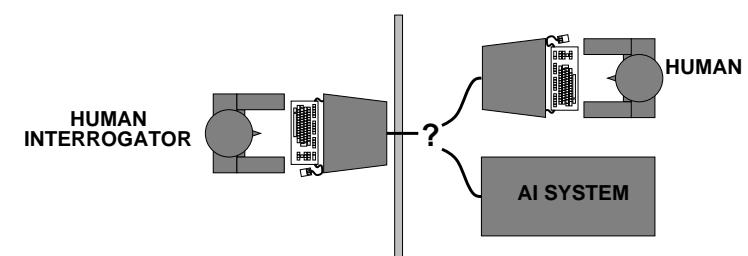
Cartoon
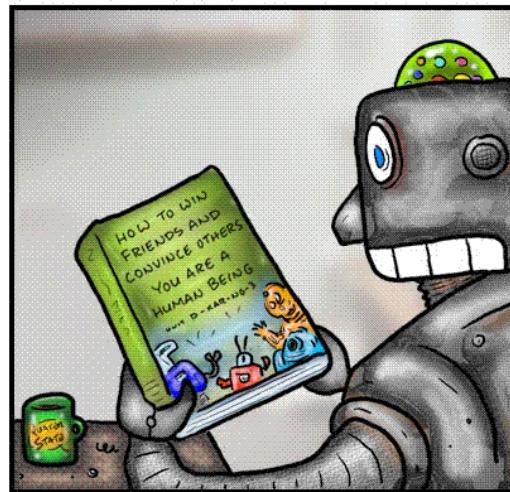
Unit Bob crams for his Turing Test.

How Useful is the Turing Test?

Turing Test:

- ► scientific usefulness is questionable
- ► not important in AI "mainstream"
- ► but: annual competitions (Loebner Prize):
  https://en.wikipedia.org/wiki/Loebner_Prize
- ► practical application: CAPTCHA ("Completely Automated Public Turing test to tell Computers and Humans Apart")
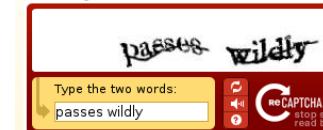
Turing and the Turing Test in Cinema

http://www.imdb.com/title/tt2084970/

More Turing Test in Cinema

http://www.imdb.com/title/tt0470752/

Turing's "Computing Machinery and Intelligence"

Turing's Computing Machinery and Intelligence:

▶ already discussed all important arguments
of the 20th century against possibility of AI

▶ suggested core aspects of AI: knowledge representation,
reasoning, language understanding, learning

▶ prediction: in the year 2000, a machine will be able to fool
a layperson for 5 minutes with 30% probability

▶ in the news: `http://www.engadget.com/2014/06/08/`
`supercomputer-passes-turing-test/`

1.3 Thinking Humanly

Thinking Humanly: Cognitive Science

▶ cognitive revolution of the 1960s: information processing
supplants dominant behaviorism in psychology

▶ Which cognitive abilities are necessary for intelligent behavior?

▶ requires scientific theory of brain activity
↝ which level of abstraction? "knowledge" or "circuits"?

▶ How to test? Requires
  ▶ prediction/test of human behavior (top-down) or
  ▶ identification from neurological data (bottom-up)

▶ roughly corresponds to cognitive science
and cognitive neuroscience
  ▶ today separate research areas from AI

1.4 Thinking Rationally

Thinking Rationally: Laws of Thought

- ▶ normative (prescriptive) rather than descriptive
- ▶ Aristotle: What are correct arguments/modes of thought?
- ▶ syllogisms: structures for arguments that always yield correct conclusions given correct premises:
  - ▶ Socrates is a human.
  - ▶ All humans are mortal.
  - ▶ Therefore Socrates is mortal.
- ▶ several Greek schools of thought developed various forms of logic:
  - ▶ notations (syntax) and
  - ▶ derivation rules (calculi) for "correct" thinking
- ▶ direct connection to modern AI via mathematical logic (early 20th century)

Problems of the Logical Approach

problems:

- ▶ not all intelligent behavior stems from logical thinking
- ▶ Which conclusions are relevant?
- ▶ How to deal with uncertainty?
- ▶ How to deal with contradictions?

1.5 Acting Rationally

Acting Rationally

acting rationally: "doing the right thing"

- ▶ the right thing: maximize utility given available information
- ▶ does not necessarily require "thought" (e.g., reflexes)

advantages of AI as design of rational agents:

- ▶ more general than "laws of thought":
  - ⤳ logical inference only one mechanism for obtaining rational behavior
- ▶ better suited for scientific method than approaches based on acting/thinking humanly

1.6 Summary

Summary

What is AI? ⤳ many possible definitions

- ▶ guided by humans vs. by utility (rationality)
- ▶ based on externally observable actions or inner thoughts?
- ⤳ four combinations:
    - ▶ acting humanly: e.g., Turing test
    - ▶ thinking humanly: cf. cognitive science
    - ▶ thinking rationally: logic
    - ▶ acting rationally: the most common view today
      ⤳ amenable to scientific method