Foundations of Artificial Intelligence

1. Introduction: What is Artificial Intelligence?

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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

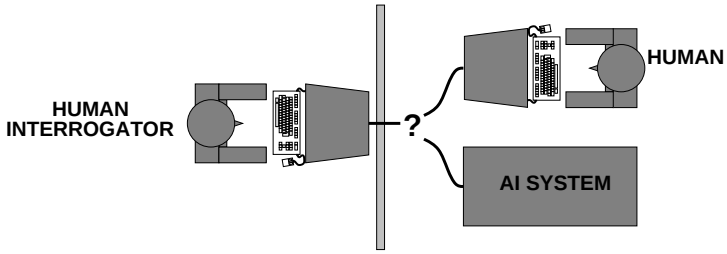
⇝ here (and most widespread these days): acting rationally

1.2 Acting Humanly

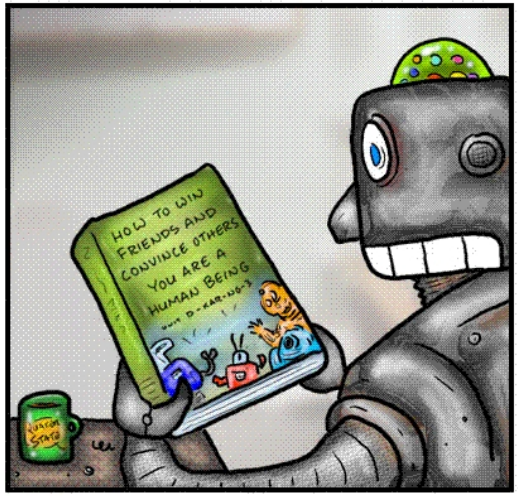
Acting Humanly: the Turing Test

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): `http://www.loebner.net/Prizef/loebner-prize.html`
- 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":
  - $\rightsquigarrow$ 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? $\rightsquigarrow$ many possible definitions

- guided by humans vs. by utility (rationality)
- based on externally observable actions or inner thoughts?

$\rightsquigarrow$ four combinations:

- acting humanly: e.g., Turing test
- thinking humanly: cf. cognitive science
- thinking rationally: logic
- acting rationally: the most common view today
  $\rightsquigarrow$ amenable to scientific method