# Chapter 1 Introduction

CS4811 - Artificial Intelligence

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# Outline

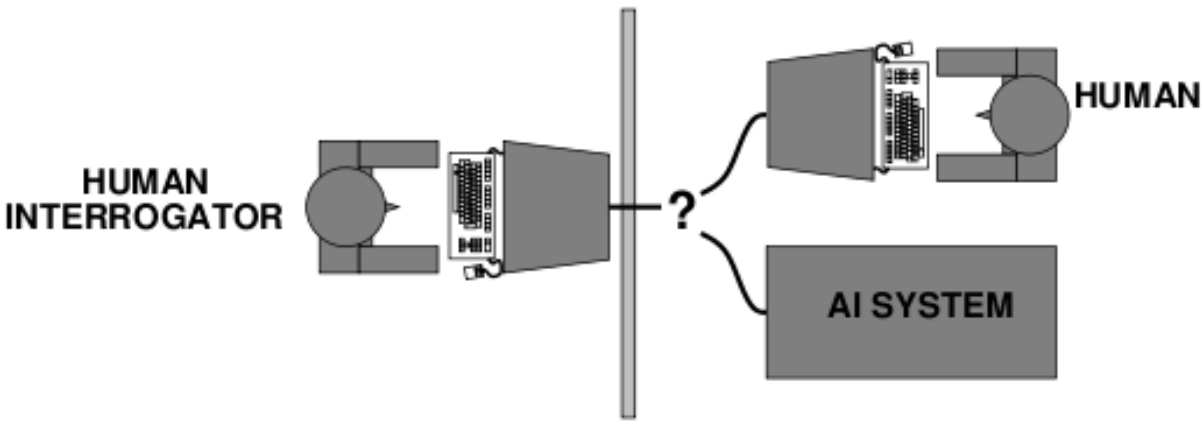
# What is AI?

Systems that:

| think like humans | think rationally |
|---|---|
| act like humans | act rationally |

# Acting humanly: The Turing test

- British mathematician and computer scientist Alan Turing's paper:
  "Computing Machinery and Intelligence", *Mind*, 1950.
- Operational test for intelligent behavior: the Imitation Game



# Acting humanly: The Turing test (cont'd)

- "Can machines think?" $\rightarrow$ "Can machines behave intelligently?"
- 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
- Problem: The Turing test is not reproducible, constructive or amenable to mathematical analysis

# Thinking humanly: Cognitive Science

- 1960s "cognitive revolution": information-processing psychology replaced prevailing orthodoxy of behaviorism
- Requires scientific theories of internal activities of the brain
- What level of abstraction?
  - Knowledge?
  - Circuits?

# Thinking humanly: Cognitive Science (cont'd)

- How to validate?
  - Predict and test behavior of human subjects (top-down)
  - Identify directly from neurological data (bottom-up)
- Interdisciplinary fields: Cognitive Science and Cognitive Neuroscience
- Problem: The available theories do not explain (or engender) human-level general intelligence

# Thinking rationally: Laws of Thought

- Normative (or prescriptive) rather than descriptive
- Aristotle: what are correct arguments or thought processes?
- Several Greek schools developed various forms of logic: notation and rules of derivation for thoughts;
- Problem: not all intelligent behavior is mediated by logical deliberation

# Acting rationally: Rational Agents

- Agent: an entity that perceives and acts
- Rational behavior: doing the right thing
- The right thing: the action that is expected to maximize goal achievement given the available information
- Does not necessarily involve thinking, e.g., blinking reflex, but thinking should be in the service of a rational agent

# Rational Agents

- This course is about designing rational agents
- Abtractly, 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
- Design the 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, probability |
| | (un)decidability, (in)tractability |
| Psychology | adaptation |
| | phenomena of perception and motor control |
| | experimental techniques (psychophysics, etc.) |
| Economics | formal theory of rational decisions |
| Linguistics | knowledge representation |
| | grammar |
| Neuroscience | plastic physical substrate for mental activity |
| Control theory | homeostatic systems, stability |
| | simple optimal agent designs |

# Which of the following can be done at present?

Play a decent game of table tennis
Drive safely along a curving mountain road
Drive safely along College Avenue
Buy a weeks worth of groceries on the web
Buy a weeks worth of groceries at the Tori Market
Play a decent game of bridge
Discover and prove a new mathematical theorem
Design and execute a research program in molecular biology
Write an intentionally funny story
Give competent legal advice in a specialized area of law
Translate spoken English into spoken Swedish in real time
Converse successfully with another person for an hour
Perform a complex surgical operation

# Which of the following can be done at present?

| | |
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| Play a decent game of bridge | yes |
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| Design and execute a research program in molecular biology | |
| Write an intentionally funny story | |
| Give competent legal advice in a specialized area of law | yes |
| Translate spoken English into spoken Swedish in real time | yes |
| Converse successfully with another person for an hour | |
| Perform a complex surgical operation | |

# Sources for the slides

- AIMA textbook ($3^{rd}$ edition)
- AIMA slides (http://aima.cs.berkeley.edu/)