INTRODUCTION

Chapter 1

Outline

- **What is AI?**
- A brief history
- The state of the art

What is AI?

Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

The textbook advocates "acting rationally"

- Ideally, an **intelligent agent** takes the best possible action in a situation
- We study the problem of **building** intelligent agents

Acting humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines <u>behave intelligently</u>?"
- Operational test for intelligent behavior
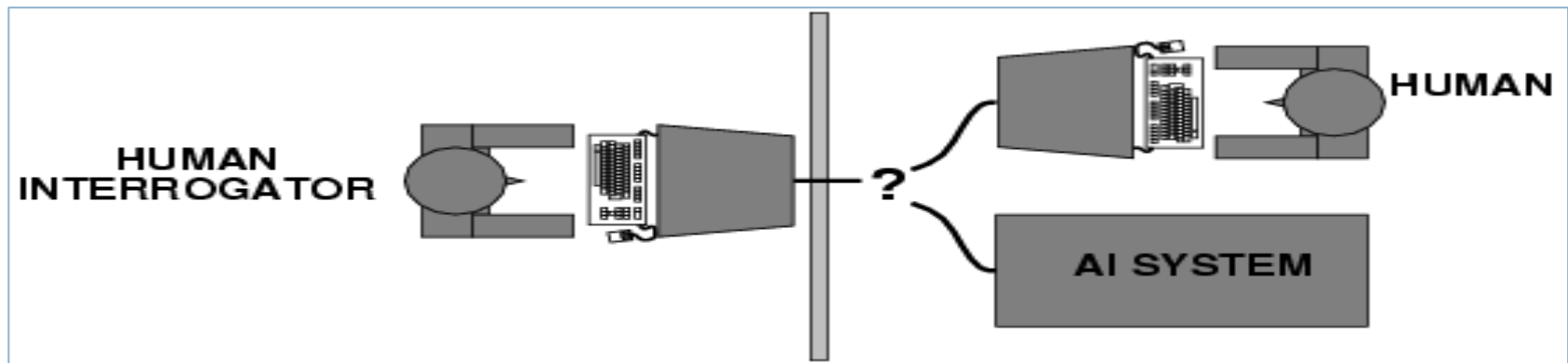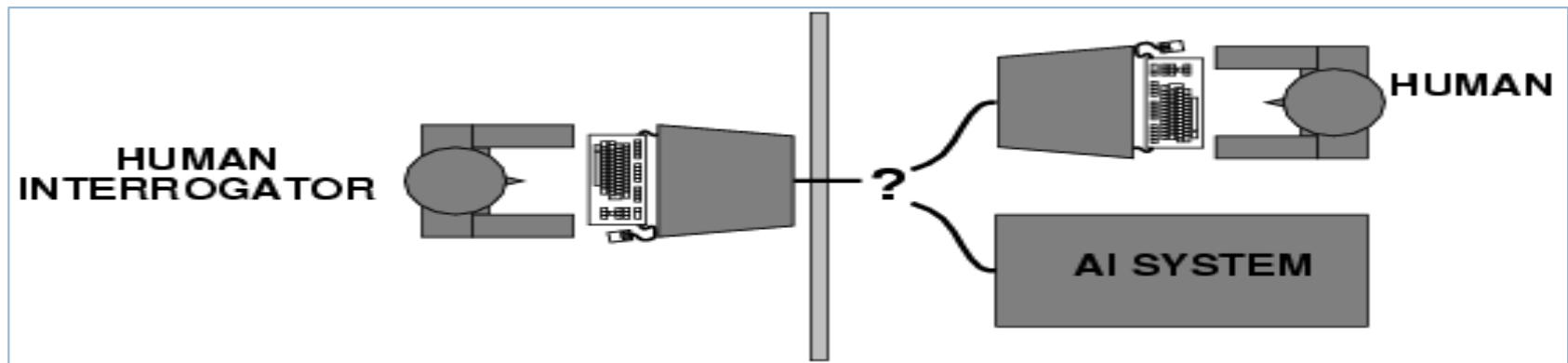
Acting humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines <u>behave intelligently</u>?"
- Operational test for intelligent behavior

- The test suggested <u>major components</u> of AI:
  - Natural language understanding
  - Knowledge representation
  - Automatic reasoning
  - Learning
  - Computer vision and robotics, if we consider the "**total Turing test**"

Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology

- Requires <u>scientific theories</u> (e.g. computational models) of <u>internal activities of the brain</u>

- <u>How to validate?</u> Requires
  - For ex, predicting and testing behavior of human subjects

- This approach (roughly, Cognitive Science) is now <u>distinct from AI</u>

Thinking rationally: "laws of thought"

- Aristotele: what are **correct** reasoning processes?

- **Syllogisms**: patterns that lead from correct premises to correct conclusions

  Example:

  - Premises:

    - Socrates is a man;

    - All men are mortal

  - Conclusion:

    - Socrates is mortal

- The study of these laws of thought initiated the field called **logic**

- Some problem:

  Casting informal knowledge into the formal structure required by the logic (e.g. uncertainty)

Acting rationally: rational agent

- An **agent** is an entity that **perceives** and **acts**

- A **rational agent**: **agent** that acts so as to achieve
  - the best outcome or
  - the best expected outcome when there is uncertainty

- Doesn't necessarily involve thinking – e.g., reflex action – but thinking should be in the service of rational action

- This course is about designing rational agents

Rational agents

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance

- This course is about designing rational agents

- Computational limitations make **perfect rationality unachievable**
  - → design best program for given machine resources

# INTRODUCTION – PART II

Chapter 1

Outline

- What is AI?
- A brief history
- The state of the art

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   How does the brain process information, neural models

Psychology   Phenomena of perception, action, experimental techniques

Computer engineering   Building fast computers

Control theory   Design systems that maximize an objective function over time

Linguistics   Knowledge representation, grammar
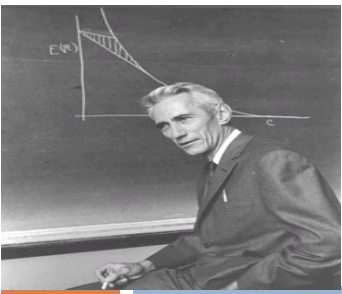
A brief history of AI

- 1943   McCulloch & Pitts: Boolean <u>circuit model of brain</u>
- 1950   Turing's "Computing Machinery and Intelligence"
- 1956   Dartmouth meeting: "Artificial Intelligence" adopted
- 1952—69   Early enthusiasm, great expectations
- 1950s   <u>Early AI programs</u>, Newell & Simon's <u>Logic Theorist</u>, Gelernter's Geometry Theorem Prover
- 1965   Robinson's complete algorithm for logical reasoning
- 1966—73   AI discovers <u>computational complexity</u> 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 <u>adopts the scientific method</u>
- 1995--   The emergence of intelligent agents
- 2001--   Big data

State of the art

- Logistic planning: 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
    - had to account for starting points, destinations, routes, and conflict resolution among all parameters

    The AI planning techniques generated in hours a plan that would have taken weeks with older methods

    DARPA (The Defense Advanced Research Project Agency) stated that this single application more than **paid back DARPA's 30 year** investment in AI

State of the art

- **Autonomus planning and scheduling**: NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft

- **Robotics**: iRobot Corporation has sold over two million Roomba robotic vacuum cleaners for home use

- **Speech recognition**: A traveler calling United Airlines to book a flight can have the entire conversation guided by an automated speech recognition and dialog management system

State of the art

- **Games:** An **AI** beats the world best human player at GO

  https://www.youtube.com/watch?v=g-dKXOlsf98

- Self Driving Cars

  https://www.youtube.com/watch?v=7oCe0aLye-U

- Wigdog entertains conversations with patients with Alzheimer

  http://www.youtube.com/watch?v=-Xx5hgjD-Mw

- …