Chapter 1 - Introduction

Russell, S., & Norvig, P. (2022). *Artificial Intelligence - A Modern Approach* (4th global ed.). Pearson.

Contents

- 1. What is Artificial Intelligence?
- 2. The History of Artificial Intelligence
- 3. The State of the Art

1. What is Artificial Intelligence?

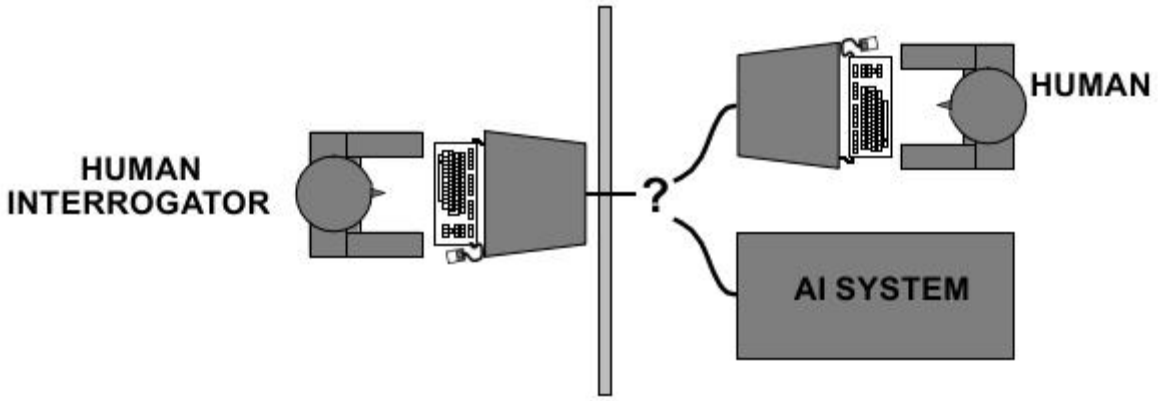
- Historically, researchers have pursued several different versions of AI.
  - *Human* vs. *Rational*
  - *Though* vs. *Behavior*

	Humans	**Rationality**
Though	Systems that think like humans	Systems that think rationally
Behavior	Systems that act like humans	Systems that act rationally

1. What is Artificial Intelligence?

Acting Humanly: The Turing Test Approach

- The **Turing test**, proposed by Alan Turing (1950), was designed as a thought experiment that would sidestep the philosophical vagueness of the question "Can a machine think?"



1. What is Artificial Intelligence?
Acting Humanly: The Turing Test Approach

- The computer would need the following capabilities:
  - **Natural language processing** to communicate successfully in a human language;
  - **Knowledge representation** to store what it knows or hears;
  - **Automated reasoning** to answer questions and to draw new conclusions;
  - **Machine learning** to adapt to new circumstances and to detect and extrapolate patterns.
- Turing viewed the *physical* simulation of a person as unnecessary to demonstrate intelligence.
- However, other researchers have proposed a **total Turing test**, which requires interaction with objects and people in the real world. To pass the total Turing test, a robot will need
  - **Computer vision** and speech recognition to perceive the world;
  - **Robotics** to manipulate objects and move about.

1. What is Artificial Intelligence?

Acting Humanly: The Turing Test Approach

- These six disciplines compose most of AI.
- Yet AI researchers have devoted little effort to passing the Turing test, **believing that it is more important to study the underlying principles of intelligence**.

1. What is Artificial Intelligence?

Thinking Humanly: The Cognitive Modeling Approach

- To say that a program thinks like a human, we must know how humans think.
- We can learn about human thought in three ways:
  - **Introspection**—trying to catch our own thoughts as they go by;
  - **Psychological experiments**—observing a person in action;
  - **Brain imaging**—observing the brain in action.
- Cognitive Science

1. What is Artificial Intelligence?

Thinking Rationally: The "Laws of Though" Approach

- In the "laws of thought" approach to AI, the emphasis was on correct inferences.
- **Syllogisms**
  - The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking"—that is, irrefutable reasoning processes.
  - His **syllogisms** provided patterns for argument structures that always yielded correct conclusions when given correct premises.
    - The canonical example starts with *Socrates is a man* and *all men are mortal* and concludes that *Socrates is mortal*.
  - These laws of thought were supposed to govern the operation of the mind; their study initiated the field called logic.

1. What is Artificial Intelligence?

Thinking Rationally: The "Laws of Though" Approach

- **Logicism**
  - Logicians in the 19th century developed a precise notation for statements about objects in the world and the relations among them.
  - By 1965, programs could, in principle, solve any solvable problem described in logical notation.
  - The so-called **logicist** tradition within artificial intelligence hopes to build on such programs to create intelligent systems.

1. What is Artificial Intelligence?
Thinking Rationally: The "Laws of Though" Approach

- **Probability**
  - Logic as conventionally understood requires knowledge of the world that is *certain*—a condition that, in reality, is seldom achieved.
    - We simply don't know the rules of, say, politics or warfare in the same way that we know the rules of chess or arithmetic.
  - The theory of probability fills this gap, allowing rigorous reasoning with uncertain information.
  - In principle, it allows the construction of a comprehensive model of rational thought, leading from raw perceptual information to an understanding of how the world works to predictions about the future.
  - What it does not do, is generate intelligent *behavior*. For that, we need a theory of rational action. Rational thought, by itself, is not enough.

1. What is Artificial Intelligence?

Acting Rationally: The Rational Agent Approach

- Agent
  - Just something that acts
  - All computer programs do something, but computer agents are expected to do more: operate autonomously, perceive their environment, persist over a prolonged time period, adapt to the change, and create and pursue goals.
- Rational Agent
  - A rational agent is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome.

1. What is Artificial Intelligence?

Acting Rationally: The Rational Agent Approach

- The rational-agent approach to AI has two advantages over the other approaches.
  - First, it is more general than the "laws of thought" approach because correct inference is just one of several possible mechanisms for achieving rationality.
  - Second, it is more amenable to scientific development. The standard of rationality is mathematically well defined and completely general. We can often work back from this specification to derive agent designs that provably achieve it—something that is largely impossible if the goal is to imitate human behavior or thought processes.

2. The History of Artificial Intelligence

- The inception of artificial intelligence (1943–1956)
  - The first work that is now generally recognized as AI was done by Warren McCulloch and Walter Pitts (1943).
  - They proposed a model of artificial neurons in which each neuron is characterized as being “on” or “off,” with a switch to “on” occurring in response to stimulation by a sufficient number of neighboring neurons.
  - The state of a neuron was conceived of as “factually equivalent to a proposition which proposed its adequate stimulus.”
- Early enthusiasm, great expectations (1952–1969)
- A dose of reality (1966–1973)

2. The History of Artificial Intelligence

- Expert systems (1969–1986)
- The return of neural networks (1986–present)
- Probabilistic reasoning and machine learning (1987–present)
- Big data (2001–present)
- Deep learning (2011–present)

3. The State of the Art

- Robotics vehicles
- Legged locomotion
- Autonomous planning and scheduling
- Machine translation
- Speech recognition
- Recommendations

3. The State of the Art

- Game playing
- Image understanding
- Medicine
- Climate science