

Artificial Intelligence

Introduction

- AI is one of the newest fields in science and engineering. Work started in earnest soon after World War II, and the name itself was coined in 1956
- Along with molecular biology, AI is regularly cited as the “field I would most like to be in” by scientists in other disciplines
- AI currently encompasses a huge variety of subfields, ranging from the general (learning and perception) to the specific, such as playing chess, proving mathematical theorems, writing poetry, driving a car on a crowded street, and diagnosing diseases
- AI is relevant to any intellectual task; it is truly a universal field

Some definitions of AI

- “The exciting new effort to make computers think ... machines with minds, in the full and literal sense.” (Haugeland, 1985)
- “[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 and McDermott, 1985)
- “The study of the computations that make it possible to perceive, reason, and act.” (Winston, 1992)

- “The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)
- “AI . . . is concerned with intelligent behavior in artifacts.” (Nilsson, 1998)

The four approaches

- **Acting humanly: The Turing Test approach**
- To act humanly computer would need to possess the following capabilities
 - **natural language processing** to enable it to communicate successfully in English
 - **knowledge representation** to store what it knows or hears
 - **automated reasoning** to use the stored information to answer questions and to draw new conclusions
 - **machine learning** to adapt to new circumstances and to detect and extrapolate patterns
 - **computer vision** to perceive objects, and
 - **robotics** to manipulate objects and move about

- **Thinking humanly: The cognitive modeling approach**
- The interdisciplinary field of cognitive science brings together computer models from AI and experimental techniques from psychology to construct precise and testable theories of the human mind
- Modern authors separate the two kinds of claims; this distinction has allowed both AI and cognitive science to develop more rapidly
- The two fields continue to fertilize each other, most notably in computer vision, which incorporates neurophysiological evidence into computational models

- **Thinking rationally: The “laws of thought” approach**
- There are two main obstacles to this approach
- First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain
- Second, there is a big difference between solving a problem “in principle” and solving it in practice

- **Acting rationally: The rational agent approach**
- Making correct inferences is sometimes part of being a rational agent
- On the other hand, correct inference is not all of rationality; in some situations, there is no provably correct thing to do, but something must still be done
- Knowledge representation and reasoning enable agents to reach good decisions

Foundations of Artificial Intelligence

- **Philosophy**

- Can formal rules be used to draw valid conclusions?
- How does the mind arise from a physical brain?
- Where does knowledge come from?
- How does knowledge lead to action?

- **Mathematics** probability

- **Economics** how to maximize the profit

- **Neuroscience** how do brain process information

- **Psychology** how do humans and animals think and act
- **Computer engineering** how can we build an efficient computer
- **Linguistics** how does language relate to thought

Few Applications

- Robotic vehicles
- Speech recognition: A traveler calling United Airlines to book a flight can have the entire conversation guided by an automated speech recognition and dialog man
- Autonomous planning and scheduling
- Game playing: IBM's DEEP BLUE became the first computer program to defeat the world champion in a chess match when it bested Garry Kasparov by a score of 3.5 to 2.5 in an exhibition match (Goodman and Keene, 1997)

- Spam fighting
- Logistics planning
- Robotics
- Machine Translation

Major AI Conferences

- The most recent work appears in the proceedings of the major AI conferences
- biennial International Joint Conference on AI (IJCAI),
- annual European Conference on AI (ECAI),
- National Conference on AI, more often known as AAAI

Major Journals

- Artificial Intelligence
- Computational Intelligence
- the IEEE Transactions on Pattern Analysis and Machine Intelligence
- IEEE Intelligent Systems
- Electronic Journal of Artificial Intelligence Research

Professional Societies

- American Association for Artificial Intelligence (AAAI), the ACM Special Interest Group in Artificial Intelligence (SIGART)
- Society for Artificial Intelligence and Simulation of Behaviour (AISB)