

Chapter-1

Introduction to AI

What is Artificial Intelligence (AI)

The term Artificial Intelligence is composed of two words, artificial which means Manmade and intelligence, which means thinking power.

In Layman language AI is a branch of Computer Science which allows software and machines to act and behave as human beings.

Following are definitions of artificial Intelligence according to various text books.

(1) Systems that think like humans

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)

(2) Systems that think rationally

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)

(3) Systems that acts like humans

The art of creating machines that perform functions that require intelligence when performed by people.
(Kurzweil, 1990)

The study of how to make computers do things at which, at the moment people are better.
(Rich and Knight, 1991)

(4) Systems that act rationally

Computational Intelligence is the study of design of intelligent agents. (Poole et al., 1998)

AI... is concerned with intelligent behaviors in artifacts. (Nilsson, 1998)

From above definitions, it is clear that approaches to AI have been centered around humans and rationality.

A human centered approach must be an empirical science, involving hypothesis and experimental confirmation. A rationalist approach involves a combination of mathematics and engineering.

Let us look at the four approaches in more detail.

Acting humanly: The Turing test approach

The Turing test, proposed by Alan Turing (1950) was designed to provide a satisfactory operational definition of intelligence. The computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or not.

The computer would need to possess the following capabilities

1. Natural language processing: To enable it to communicate successfully in English.
2. Knowledge representation: To store what it knows or learns.
3. Automated reasoning: To use the stored information to answer questions and to draw new conclusions.
4. Machine learning: To adapt new circumstances and to detect and extrapolate patterns.

To pass the total turing test, the computer will ~~know~~ need

5. Computer Vision: To perceive objects.

6. Robotics: To manipulate objects and move about.

Thinking humanly: The Cognitive Modeling approach

If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get inside the actual workings of human minds. There are two ways to do this: - through introspection and through psychological experiments. Once we have a sufficiently precise theory of mind, it becomes possible to express the theory as a computer program.

The interdisciplinary field of cognitive science brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human beings.

Thinking rationally: The "Laws of Thought" approach

The Greek philosopher "Aristotle" was one of the first to attempt to codify "Right thinking", i.e., irrefutable reasoning process. His syllogisms provided patterns for argument structures that always yielded correct conclusions when given correct premises.

These laws of thought were supposed to govern the operation of the mind, which initiated the field called logic.

There are two main obstacles to this approach.

1. It is not easy to take informal knowledge and state it in the formal terms required by logical notation.

2. There is a big difference between being able to solve a problem "In Principle" and doing so in practice.

Acting Rationally: The Rational agent approach

An agent is just something that acts. But computer agents are expected to have other attributes that distinguish them from mere "programs", such as operating under autonomous control, perceiving their environment, persisting over a prolonged time period, adopting to change and being capable of taking on another's goals.

A rational agent is one that acts so as to achieve the best outcome or when there is uncertainty, the best expected outcome.

In the "laws of thought" approach to AI, the emphasis was on correct inference. Making correct inferences is sometimes part of being a rational agent. On the other hand, correct inference is not all of rationality because there are often situations where there is no provably correct thing to do, yet something must still be done.

The Foundations of AI

A brief history of disciplines that contributed ideas, viewpoints and techniques to AI are

1. Philosophy (428 BC - Present)

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

2. Mathematics (c 800 - Present)

- What are the formal rules to draw valid conclusions?
- What can be computed?
- How do we reason with uncertain information?

Philosophers staked out most of the important ideas of AI but the leap to a formal science required a label of mathematical formalization in three fundamental areas: Logic, computation and Probability.

3. Economics (1776 - Present)

- How should we make decisions so as to maximize Pay off?
- How should we do this when others may not go along?
- How should we do this when the payoff may be far in the future?

4. Neuroscience (1861 - Present)

- How do brains process information?

Neuroscience is the study of the nervous system, particularly the brain. The exact way in which the brain enables thought is one of the great mysteries of science. It has been appreciated for thousands of years that the brain is somehow involved in thought because of the evidence that strong blows to the head can lead to mental incapacitation.

5. Psychology (1879 - Present)

- How do humans and animals think and react?

6. Computer Engineering (1940 - Present)

- How can we build an efficient computer?

7. Control Theory and Cybernetics (1948 - Present)

→ How can artifacts operate under their own control?

8. Linguistics (1957 - Present)

→ How does language relate to thought?

History of AI

- i. The gestation of AI (1943-1955), W McCulloch & Walter Pitts.
- ii. The birth of AI (1956), John McCarthy.
- iii. Early enthusiasm, great expectations (1952-1969)
- iv. A dose of reality (1966-1973)
- v. Knowledge based system (1969- 1979)
- vi. AI becomes an industry. (1980 - Present)
- vii. The return of neural networks (1986 - Present)
- viii. AI becomes a science. (1987 - Present)
- ix. The emergence of intelligent agents (1995 - Present)

Application of AI (The state of the art)

Few applications of AI are

1. Autonomous Planning and Scheduling

A hundred millions miles from Earth, NASA's remote agent program became the first on-board autonomous planning program to control the scheduling of operations for a space-craft. Remote agent generated plans from high level goals specified from the ground and it monitored the operation of the space-craft as the plans were executed - detecting, diagnosing and recovering from problems.

2. Game Playing

IBM's Deep Blue became the first computer program to defeat the World Champion Garry Kasparov in a chess match. Kasparov said that he felt a "new kind of intelligence".

3. Autonomous Control

The ALVINN computer vision system was trained to steer a car to keep it following a lane.

4. Diagnosis

Medical diagnosis programs based on probabilistic analysis have been able to perform at the level of an expert physician in several areas of medicine.

5. Logistic Planning

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

6. Robotics

Many surgeons now use robot assistants in micro surgery.

7. Language understanding and problem solving

PROVERB is a computer program that solves cross-word puzzles better than most humans.