Chapter -1: Introduction to Artificial Intelligence

Intelligent behaviors

- **Everyday tasks**: recognize a friend, recognize who is calling, translate from one language to another, interpret a photograph, talk, cook a dinner
- **Formal tasks**: prove a logic theorem, geometry, calculus, play chess, checkers, or Go
- **Expert tasks**: engineering design, medical designers, financial analysis

**Intelligence** is:

- The ability to reason
- The ability to understand
- The ability to create...

Can we produce a machine with all these abilities? The answer is no, so then what is AI?

**Artificial Intelligence**

“The art of creating machines that perform functions that require intelligence when performed by people” – Kurzwell,1990

“The science of making computers, do things that require intelligence like humans”- Minskey

“AI is the study of how to make computers do things at which, at the moment, people are better”- Elaine Rich

**AI Today**

- Diagnose lymph-node diseases
- Monitor space shuttle missions
- Automatic vehicle control
- Large-scale scheduling
- Detection of money laundering
- Classify astronomical objects
• Speech understanding systems
• Beat world’s best players in chess, checkers, and backgammon.

**AI Topics**
- Robotics
- Search
- Planning
- Machine learning
- Image processing
- Expert systems
- Natural Language Processing

**Example Eliza**
- **ELIZA:** A program that simulated a psychotherapist interacting with a patient and successfully passed the Turing Test.
- **Coded at MIT during 1964-1966 by Joel Weizenbaum.**
  - First script was DOCTOR.
  - The script was a simple collection of syntactic patterns not unlike regular expressions
  - each pattern had an associated reply which might include bits of the input (after simple transformations (my -> your)
  - Weizenbaum was shocked at reactions:
    - Psychiatrists thought it had potential.
    - People unequivocally anthropomorphised.

**Is AI Ethical**
- Joseph Weizenbaum (1976) in *Computer Power and Human Reason* argues:
  - A real AI would indeed be an autonomous, intelligent agent
    - Hence, out of our control
  - It will not share our: motives, constraints, ethics
  - There is no obvious upper bound on intelligence. And perhaps there is no upper bound at all.
    - When our interests and AI’s interests conflict, guess who loses
    - Therefore, AI research is unethical.

**Asimov’s laws of Robotics**
- A method to insert ethics into AI
- The three laws of robots are:
  - A robot may not injure a human being or, through inaction, allow a human being to come to harm.
• A robot must obey the orders given it by human beings.
• A robot must protect its own existence.
• **Meta-law:** Precedence order is lower to higher

**Brief history**

- 1943 McCulloch & Pitts: Boolean circuit model of brain
- 1950 Turing's "Computing Machinery and Intelligence"
- 1956 Dartmouth meeting: "Artificial Intelligence" adopted
- 1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1965 Robinson's complete algorithm for logical reasoning
- 1966—73 AI discovers computational complexity, 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 becomes a science
- 1995-- The emergence of intelligent agents

**Applications of AI**

- **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 in 1997.
- **Autonomous control:** The Alvinn computer vision system was trained to steer a car to keep it following a lane. It was placed in CMU's NavLab computer-controlled minivan and used to navigate across the United States—for 2850 miles it was in control of steering the vehicle 98% of the time. A human took over the other 2%, mostly at exit ramps. NavLab has video cameras that transmit road images to Alvinn, which then computes the best direction to steer, based on experience from previous training runs.
- **Language understanding and problem solving:**
  - **Business Intelligence**
  - **Medical Diagnosis**
  - **Scientific Analysis**
  - **Weather forecasting**
  - And many more

*Note: Describe the application with few sentences:*
**Approaches of AI**

- Acting humanly
- Thinking humanly
- Acting rationally
- Thinking rationally

**Acting humanly**

- Machine is required to act as humans do.
- **Turing Test**, proposed by Alan Turing (1950). Turing's definition of intelligent behavior as the ability to achieve human-level performance in all cognitive tasks.
- The test involves an interrogator who interacts with one human and one machine. Within a given time the interrogator has to find out which of the two the human is, and which one the machine.

![Diagram](image)

- Issue to solve in order to pass the test using a terminal: natural language processing, knowledge representation automated reasoning, machine learning.
- Additional requirements for the “total Turing test”: computer vision, speech recognition, speech synthesis, robotics.

**Critics of Turing test**

- Test is not reproducible, amenable or constructive to mathematical analysis as it is more important to study the underlined principles of intelligence than to duplicate example
- Trying to evaluate machine intelligence in terms of human intelligence is fundamental mistake. It focuses too much on the behavior of conversation

**Factors required to pass Turing Test**

- **Natural Language Processing**: To communicate easily.
- **Knowledge Representation**: To store facts and rules.
- **Automated Reasoning**: To draw conclusion from stored knowledge.
- **Machine Learning**: To adopt new circumstances and detect pattern.

**Thinking humanly**
• It is the action or process of acquiring knowledge and understanding thought, experience or the sense. Machine needs to understand how humans think.

• It is mainly concerned with the investigation, development of human behavior and the working of human mind in the computer.

• **Example: General Problem Solver (GPS)** developed by Newell & Simon in 1961 attempted to synthesize the human solving process. Compares the steps of the problem with the reasoning of human subjects solving the same problem.

• **Critics:** Lacks scientific theories of internal activities of brain. Level of abstractin of the approach is vague too.

**Thinking rationally**

• Aristotle made first attempt to harness “right thinking”. Famous example: “Socrates is a man; all men are mortal; therefore Socrates is mortal.”

• Formal logic (late nineteenth, early twentieth century’s) provides a precise notation of statements of all kinds of things and relations between them.

• Programs that can find the solution to a logical problem if one exists have been around since 1965. Given enough memory and time, they should be able to solve everything.

• **Critics:** It is not easy to take informal knowledge and state in the formal terms required by logical notation specially when knowledge is less than 100% certain

• There is big difference between being able to solve a problem in principle and doing so in practice

**Acting rationally (Rational agent approach)**

• Rational agent: acts to achieve the best outcome on when there is uncertainty of the best expected outcome
  • Rational agent does not necessarily involve thinking. Example, reflex action

• **Advantages**
  • More general than laws of thought approach
  • More amenable to scientific development then approach based on human behaviors.