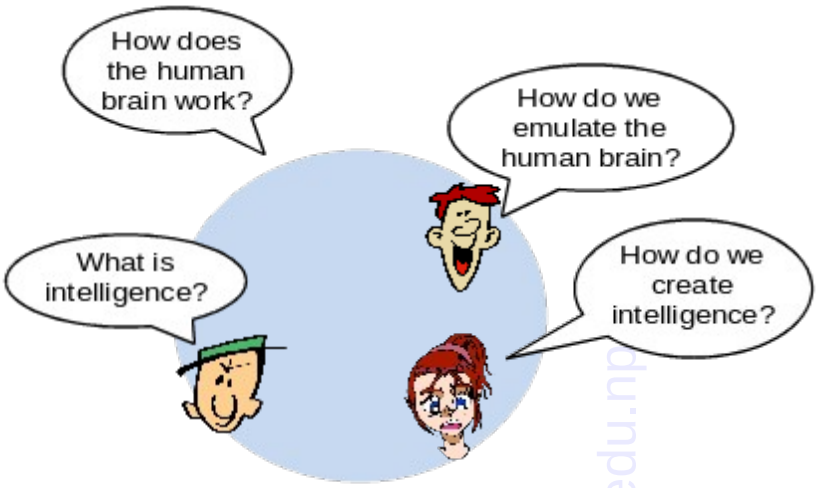
Chapter -1: Introduction to Artificial Intelligence



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 theinput (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**

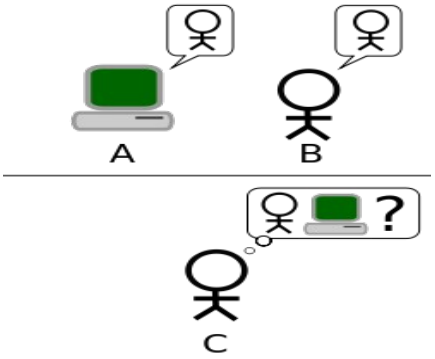
Note: Describe the application with few sentences:

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.



- 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.