UNIT-1
Introduction

⊛ **Intelligence:** It is the capacity to learn and solve problems. It is the to solve novel problems, act rationally and act like humans.

It is the part of computer science concerned with designing intelligence computer systems that is, systems exhibit the characteristics we associate with intelligence in human behaviour.

⊛ **Artificial Intelligence (AI):** In short we can say that artificial intelligence is giving machines ability to perform tasks normally associated with human intelligence. With AI issues like deduction, reasoning, problem solving, knowledge representation, planning, learning, natural language processing came into existence.

But there are four main different approaches for defining artificial intelligence in eight different ways by different people with different methods based on thinking humanly, acting humanly, thinking rationally and acting rationally as follows:-

a) Thinking Humanly →

1). "The exciting new effort to make computers think... machines with minds, in the full and literal sense." (Haugeland, 1985)

2). "The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning..." (Bellman, 1978).

b) Acting Humanly

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

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

c) Thinking Rationally:

5). "The study of mental faculties through the use of computational methods." (Charniak and Mc Dermott, 1985).

6). "The study of computations that make it possible to preceive, reason and act." (Winston, 1992).

d) Acting Rationally:

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

8). "AI... is concerned with intelligent behaviour in artifacts." (Nilsson, 1998).

⇒ These 4 different approaches in more detail are as follows:- [Imp]

Thinking Humanly: (The Cognitive modeling approach)

If we are going to say that a given program thinks like a human, then we must have some way of determining how humans think. We need to go inside the actual workings of human minds. There are three ways to do this:

i) Through introspection (i.e, trying to catch our own thoughts as they go by).

ii) Through psychological experiments (i.e, observing a person in action).

iii). Through Brain imaging (i.e, observing the brain in action).

Once we have a sufficiently precise theory of mind, it becomes possible to express the theory as computer program. If the programs input-output behaviour matches corresponding human-behaviour that is evidence that some of the programs mechanism could also be operating in humans.

Acting Humanly: (The turning test approach) [V. Imp]

A computer could be called intelligent if it passes the test of a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer. The computer would need to possess the following capabilities:

i) natural language processing → to enable it to communicate successfully in English.

ii) knowledge representation → to store what it knows or hears.

iii) automated reasoning → to use the stored information to answer questions and to draw new conclusions.

iv) machine learning → to adopt new circumstances and to detect and extrapolate patterns.

Thinking rationally: (The "laws of thought" approach)

Aristotle was one of the first to attempt to codify "right thinking", that is irrefutable reasoning process. He gave syllogisms that always yielded correct conclusion when correct premises are given.

For example:- If Roshan is man.
All men are mortal.
Then ⇒ Roshan is mortal.

These law of thought were supposed to govern the operation of mind: this study initiated the field of logic. The logicist tradition in AI hopes to create intelligent systems using logic programming. However there are two obstacles to this approach.

i) First it is not easy to take informal knowledge and state in the formal terms required by logical notation, particularly when knowledge is not 100% certain.

ii) Second is solving problem "in principle" is different from doing it in practice.

Acting rationally: (The rational agent approach)

An agent is just something that acts but a rational agent is one that acts so as to achieve the best outcome. Computer agent is expected to have autonomous control, preceiving their environment, persisting over a prolonged period of time, adopting to change and capable of taking on another's goal.

In the "laws of thought" approach to AI, the emphasis

was given to correct inferences. Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion and act on that conclusion.

Advantages:-

less imp
- → It is more general than laws of thought approach because correct inference is just one of several mechanisms for achieving rationality.
- → It is more amenable to scientific development than other approaches based on human behaviour or human thought.

⊛. History of AI:

Warren Mc Culloch and Walter Pitts (1943): a model of artificial boolean neurons to perform computations was first step toward computation and learning. Marvin Minsky and Dann Edmonds (1951) constructed the first neural network computer. In 1950: Alan Turing's "Computing Machinery and Intelligence" was the first complete vision of AI.

i) The birth of AI (1956): Dartmouth workshop bringing together top minds on automata, neural nets and the study of intelligence organized a two-month workshop at Dartmouth in the summer of 1956.

ii) Great expectations (1952-1969):
- → Newell and Simon introduced the general problem solver which was imitation of human problem solving.
- → John McCarthy (1958) was the inventer of Lisp (second-oldest high-level language).
- → Marvin Minsky (1958) introduced microworlds that appear to require intelligence to solve, anti-logic orientation and society of mind.

iii) Collapse in AI research (1966-1973):
- → Progress was slower than expected.
- → ~~Unrel~~ Unrealistic predictions.
- → Some systems lacked scalability.
- → Fundamental limitations on techniques and representations.

iv) AI revival through knowledge-based systems (1969-1970).

→ General purpose vs. domain specific.
→ Expert systems.
→ Increase in knowledge representation research.

v) AI becomes an industry (1980-present):

→ The first successful commercial expert system R1 began operation at the Digital Equipment Corporation (Mc Dermott, 1982).
→ Nearly every major U.S. corporation had its own AI group and was either using or investing expert systems saving millions of dollar per year.
→ The AI industry boomed from a few million dollars in 1988, including hundreds of companies building expert systems, vision systems, robots etc.

vi) The return of neural networks (1986-Present):

→ Back-propagation learning algorithm was applied that resulted Parallel Distributed Processing (Rumelhart and Mc Clelland, 1986) caused great excitment.
→ Seperation of AI and cognitive science in two fields, one concerned with creating effective network architectures and algorithms and understanding their mathematical properties, the other concerned with careful modeling of the empirical properties of actual neurons.

vii) AI becomes a science (1987-Present):

→ In speech recognization.
→ In neural networks.
→ In uncertain reasoning and expert systems.

viii) The emergence of intelligent agents (1995-Present):

→ One of the most important environments for intelligent agents is the Internet.
→ AI systems have become so common in web-based applications.
→ AI technologies underlie many internet tools, such as search engines, recommender systems and website aggregators.

⊛ Foundations of AI:

Foundations are the disciplines that contributed ideas, viewpoints and techniques to AI. Following are some of the foundations of AI.

i) Philosophy: It includes logic, methods of reasoning, mind as physical system, foundations of learning language, rationality etc. It leads to following type of questions:
   → Where does knowledge come from?
   → How does knowledge lead to action?
   → Can formal rules be used to draw valid conclusions?

ii) Mathematics: It includes formal representation and proof algorithms, computation, probability etc. It leads to following type of questions:
   → What can be computed?
   → How do we reason with uncertain information?
   → What are the formal rules to draw valid conclusions?

iii) Psychology: It includes adaption, phenomena of perception and motor control. It leads to following question.
   → How humans and animals think and act?

iv) Economics: It includes formal theory of rational decisions, game theory, operation research etc. It leads to following questions:
   → How should we make decisions so as to maximize pay off?
   → How should we do this when the pay off may be far in future?

v) Linguistics: It includes knowledge representation and grammer. It leads to question
   → How does language relate to thought?

vi) Neuroscience: It includes physical substrate for mental activities. → How do brains process information?

vii) Control theory: It includes homeostatic systems, stability, optimal agent ~~decision.~~ design.
   → How can artifacts operate under their own control?

⊛ Applications of AI:

AI is making our daily life more comfortable and fast because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education etc. Following are some sectors which have applications of AI.

i) **AI in Healthcare:** Healthcare industries are applying AI to make better and faster diagnosis than humans. AI can help doctors with diagnosis and can inform when patients are worsening so that medical help can reach to the patient before hospitalization.

ii) **AI in Finance:** AI and finance industries are the best matches for eachother. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading and machine learning into financial processes.

iii) **AI in Gaming:** AI can be used for gaming purposes. The AI machines can play strategic games like chess, where the machine needs to think of large number of possible places.

iv) **AI in Social Media:** Social Medias such as facebook, twitter, and snapchat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amount of data. AI can analyze lots of data to identify the latest trends, hashtag and requirement of different users.

v) **AI in data security:** AI can be used to make data more safe and secure since cyber attacks are rapidly growing in the digital world. Some examples such as AFG bot, AI2 platform are used to determine software bugs and cyber attacks in a better way.

vi) AI in education: AI chatbot can communicate with students as a teaching assistant. AI in the future can work as a personal virtual tutor for students which will be accessible easily at any time and any place.

vii) AI in entertainment: We are currently using some AI based applications in our daily life with some entertainment services such as Netflix or Amazon. With the help of ML/AI algorithms, these services show the recomendations for programs or shows.