

Introduction

Introduction: What is AI, Foundations of AI, History of AI, The state of Art.

Intelligent Agents: Agents and Environments,

Good Behaviour: The concept of Rationality.

1. Artificial Intelligence:-

It is the science and engineering of making intelligent machines, especially intelligent computer programs.

Artificial : Man made

Intelligence : Thinking Power

→ It is a branch of computer science by which we create intelligent machine which can behave like a human, think like human and able to make decision.

→ You have to create a machine with programmed algorithm, which can work with own intelligence.

→ With the help of AI, we can create such software (or device) which can solve real world problems very easily and accurately such as health issues, marketing, traffic issues.

→ With the help of AI, you can create your personal virtual assistant such as Siri, Google assistant etc.

→ With the help of AI, we can build robots, which can work in environment and space, where survival of human can be rough.

Contributes to AI:-

AI is a science and technology based on computer science, Biology, Psychology, Linguistics, Mathematics, and Engineering.

AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving.

The following areas can contribute to build an intelligent system.

→ Computer Science → Maths

→ Psychology → Sociology

→ Neuron Science → Philosophy

→ Biology

2. Applications of AI:-

AI has been dominant in various fields such as

(i) Gaming:-

AI plays vital role in games such as chess, poker, tic-tac-toe, etc.

Where machine can think of large number of possible positions based on heuristic knowledge.

(iv) Natural Language Processing (NLP) :

It is possible to interact with the computer that understands natural language spoken by humans.

(v) Expert Systems :

They provide explanation and advice to the users.

(vi) Vision Systems :

These systems understand, interpret, and comprehend visual input on the computer.

→ A spying aeroplane takes photographs which are used to figure out the map of the areas.

→ Doctors use clinical expert system to diagnose the patient.

→ Police use computer software that can recognize the face of criminal.

(vii) Speech Recognition :

Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it.

(viii) Handwriting Recognition :

The handwriting recognition software reads the text written on paper by a pen.

It can recognize the shapes of the letters and convert into editable text.

(vii) Intelligent Robots:-

- Robots are able to perform the tasks given by a human.
- They have sensors to detect the physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure.
- They have efficient processors, multiple sensors and huge memory, to exhibit intelligence.
- They are capable of learning from their mistakes.

3. History of AI:-

- (i) 1943 - Foundations for neural networks laid.
- (ii) 1945 - Isaac Asimov, at Columbia University, coined the term Robotics.
- (iii) 1950 - Alan Turing introduced Turing Test for evaluation of intelligence and published Computing machinery and intelligence.
Claude Shannon published detailed analysis of chess playing.
- (iv) 1956 - John McCarthy coined the term AI.
Demonstration of the first running AI program at Carnegie Mellon University.
- (v) 1958 - John McCarthy invents LISP programming language for AI.

(vi) ¹⁹⁶⁴ Danny Bobrow's at MIT showed that computers can understand natural language to solve algebra word problems correctly.

(vii) 1965 - Joseph Weizenbaum built ELIZA at MIT.

(viii) 1969 - Scientists at Stanford Research Institute developed Shakey, a robot.

(ix) 1973 - The assembly robotics group at Edinburgh University built Freddy, the famous Scottish Robot, capable of using vision to locate and assemble models.

(x) 1979 - The first computer-controlled autonomous vehicle, Stanford Cart, was built.

(xi) 1985 - Harold Cohen created and demonstrated the drawing program, Aaron.

(xii) 1990 - Significant demonstrations in ML
Case based reasoning.

Multi Agent Planning, Scheduling,
Data Mining, Natural language
understanding and translation,
Vision, Virtual Reality, Games.

(xiii) 1997 - The deep blue chess program beats the world chess champion, Garry Kasparov.

(xiv) 2000 - Interactive robot pets become commercially available.

What is Intelligence:-

The ability of a system to calculate, reason, perceive relationships and analogies, learn from experience, store and retrieve information from memory, solve problems, comprehend complex ideas, use natural language fluently, classify, generalize, and adapt new situations.

Types of Intelligence:-

As described by Howard Gardner, an American development psychologist, .

- Linguistic Intelligence
- Musical Intelligence
- Logical - mathematical Intelligence
- Spatial Intelligence
- Bodily - Kinesthetic Intelligence
- Intra-personal Intelligence
- Inter-personal Intelligence.

Linguistic Intelligence:-

The ability to speak, recognize, and use mechanisms of phonology (speech sounds), syntax (grammar), and semantics (meaning).

Ex: Narrators, Operators.

Musical Intelligence:-

The ability to create, communicate with, and understand meanings made of sound, understanding of pitch, rhythm.

Ex: Musicians, singers, Composers.

Logical-Mathematical Intelligence

The ability to use and understand relationships in the absence of action on objects.

Understanding complex and abstract ideas.
Ex: Mathematicians, scientists.

Spatial Intelligence

The ability to perceive visual & spatial information, and re-create visual images without reference to the object, construct 3D images.

Ex: Map Readers, Astronauts, Physicists.

Bodily-Kinesthetic Intelligence

The ability to use complete & part of the body to solve problems and manipulate the objects.

Ex: Players, Dancers.

Intra-personal Intelligence

The ability to distinguish among one's own feelings, intentions, and motivations.

Ex: Gautam Buddha.

Inter-personal Intelligence

The ability to recognize other people feelings, beliefs and intentions.

Ex: Mass communicators, interviewers.

5. The intelligence composed of:-

- Reasoning
- Learning
- Problem Solving
- Perception
- Linguistic Intelligence.

Reasoning:-

It is the set of processes that enables us to provide basis for making decisions, and prediction.

Reasoning 2 types

- Inductive Reasoning
- Deductive Reasoning.

Learning:-

It is the activity of gaining knowledge or skill by studying, practicing, being taught or experiencing something.

Learning categorized as

- Auditory Learning : Learning by listening and hearing.
- Episodic Learning : by remembering sequence of events
- Motor Learning : by precise movement of muscles.
- Observational Learning : by watching and imitating others.
- Perceptual Learning :

→ Relational Learning

→ Spatial Learning

Problem Solving:-

Problem solving includes decision making, which is the process of selecting the best suitable alternative out of multiple alternatives to reach the desired goal are available.

Perception:-

It is the process of acquiring, interpreting, selecting, and organizing sensory information. In humans, perception ~~mechanism~~ ~~puts the~~ is aided by sensory organs.

Linguistic Intelligence:-

It is the ability to use, comprehend, speak and write the verbal and written language. It is important in interpersonal communication.

Real life applications of AI in Research Areas:-

The domain of AI is huge in breadth and width.

→ Expert Systems

→ Neural Networks

→ Robotics

→ Fuzzy Logic

→ NLP - Natural Language Processing

→ Speech and voice Recognition.

Expert Systems :-

Ex: Flight tracking systems, clinical systems.

NLP :-

Ex: Google Assistant, Siri, Speech Recognition, Automatic voice output.

Neural Networks :-

Ex: Pattern recognition systems such as face recognition, character recognition, hand writing recognition.

Robotics :-

Ex: SoRa robot, Industrial robots doing moving, spraying, painting, drilling, cleaning, coating etc.

Fuzzy logic Systems :-

Ex: Consumer electronics, automobiles, Microwave-oven

Speech and Voice Recognition :-

These both terms are common in robotics, expert systems and NLP.

The speech recognition aims to understand and comprehending WHAT was spoken.

The voice recognition aims to recognize WHO is speaking.

4. Task Classification of AI:

The domain of AI is classified into

- Formal Tasks
- Mundane Tasks and
- Expert Tasks.

Formal Tasks:

- Mathematics : Geometry, Logic, Integration and Differentiation.
- Games : Go, Chess (Deep Blue), Checkers.
- Verification
- Theorem proving.

Mundane (Ordinary) Tasks:

- Perception : Computer vision, Speech and Voice.
- NLP : understanding, Language generation and translation.
- Common sense
- Reasoning → Locomotive.
- Planning
- Robotics.

Expert Systems:

- Financial Analysis
- Engineering → Creativity.
- Scientific Analysis
- Medical Diagnosis
- Manufacturing
- Fault Finding
- Monitoring

Humans learn mundane (ordinary) tasks since their birth. They learn by perception, speaking using language, and locomotives. They learn formal and expert tasks later.

Applications of AI:

- Finance
- Music
- Transportation
- Toys & Games
- Hospitals
- Expert Systems.

8. Agents and Environments:-

AI agent can have mental properties like knowledge, belief, intention etc.

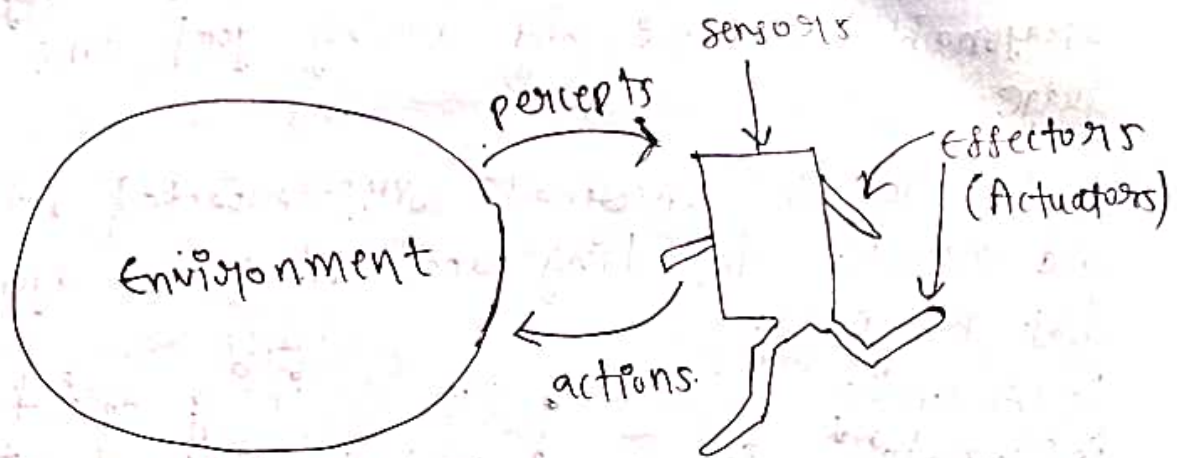
An AI system is composed of an agent and its environment. The agents act in their environment. The environment may contain other agents.

Agent:-

An agent is anything that can perceive its environment through sensors and acts upon that environment through effectors.

- A human agent has sensory organs such as eyes, ears, nose, tongue and other organs such as hands, legs, mouth, for effectors.
- A robotic agent replaces cameras and IR range finders for the sensors, and various motors and actuators for effectors.

→ A software agent has encoded bit strings as its programs and actions.



Agent Terminology:

Performance Measure of Agent:

It determines how successful an agent is.

Behavior of Agent:

It is an action that agent performs after any given sequence of percepts.

Percept:

It is agent's perceptual inputs at a given instance.

Percept sequence:

It is the history of all perceived information by an agent in a sequence.

Agent Function:

It is a map from the percept sequence to an action.

Rationality:-

Rationality is nothing but status of being reasonable, sensible, and having good sense of judgement.

Rationality is concerned with expected actions and results depending upon what the agent has perceived.

Performing actions with obtaining useful information is an important part of rationality.

Ideal Rational Agent:-

It is capable of doing expected actions to maximize its performance measure, on the basis of

- Its percept sequence
- Its built in knowledge base.

Rationality of an agent depends on the following

- (i) The performance measure, which determines the degree of success.
- (ii) Agent's percept sequence.
- (iii) Agent's prior knowledge about the environment.
- (iv) The actions that the agent can carry out.

The problem the agent solves is ~~category~~ characterized by Performance Measure, Environment, Actuators, and Sensors (PEAS).

The structure of Intelligent Agents:

Agent = Architecture + Agent Program.

where, Architecture = The ~~what~~ machinery that an agent executes on

Agent Program = An implementation of an agent function.

There are different types of agents.

- Simple Reflex Agents
- Model Based Reflex Agents
- Goal Based Agents
- Utility Based Agents

Simple Reflex Agents:

- They choose actions only based on the current percept.
- They are rational only if a correct decision is made on the basis of current percept.
- Their environment is completely observable.
- Condition-Action Rule maps a condition to an action.

Model Based Reflex Agents:

They use a model of the world to choose their actions. They maintain an internal state.

Model: Knowledge about, "How the things happen in the world."

Internal State:

It is a representation of unobserved aspects of current state depending on percepts history. Updating the state requires the information about

- How the world evolves
- How the agent actions affect the world

Goal Based Agents:

- They choose their actions in order to achieve their goals.
- It is more flexible than reflex agent, since the knowledge supporting a decision is explicitly modeled.
- Goal: It is the description of desirable situations.

Utility Based Agents:

- They choose actions based on preference (utility) for each state.
- Goals are inadequate when, there are conflicting goals, out of which only few can be achieved.

9. Nature of Environments:

Some programs operate in the entirely artificial environment confined to keyboard input, database, computer file systems and character output on a screen.

The most famous artificial environment is the Turing Test Environment, in which one real and other artificial agents are tested on equal ground.

Turing Test:

The success of an intelligent behaviour of a system can be measured with Turing Test.

Properties / Types of Environment:

(i) Discrete / Continuous:

If there are a limited number of distinct, clearly defined states of the environment is discrete otherwise it is continuous.

Ex: Driving is continuous.
Chess is discrete.

(ii) Observable / Partially Observable:

It is possible to determine the complete state of the environment at each time from the percepts, it is observable. Otherwise, it is partially observable.

(iii) Static / Dynamic:

If the environment does not change while an agent is acting, then it is static, otherwise it is dynamic.

(iv) Single / Multiple Agents:

The environment may contain other agents which may be of the same or different kind as that of the agent.

(v) Accessible / Inaccessible :-

If the agent sensory can have access to the complete state of the environment, then it is accessible, otherwise inaccessible to that agent.

(vi) Deterministic / Non-deterministic :-

If the next state of the environment is completely determined by the current state and the actions of the agent, then it is called deterministic, otherwise it is non-deterministic.

(vii) Episodic / Non-episodic :-

In an episodic environment, each episode consists of the agent perceiving and then acting. Otherwise, it is non-episodic.

Agent :-

Anything that perceiving its environment through sensors and acting on the environment through effectors (actuators).

ex:- Self Driving car:

PEAS { Performance : Safety, time, Legal drive, comfort.
Environment : Roads, Other cars, Road signs.
Actuators : Steering, accelerator, brake, signal, horn.
Sensors : Camera, sonar, GPS, speedometer, odometer, engine sensors, keyboard, accelerometer.

The study of the design of rational agents is really important part of AI.