Unit-1: AI

What is AI?

1. Artificial intelligence (AI) is the capability of a computer to imitate intelligent human behavior. Through AI, machines can analyze images, comprehend speech, interact in natural ways, and make predictions using data.
2. Any technique that enables computers to mimics human intelligence. It includes machine learnings.
3. It has the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.
4. The earliest substantial work in the field of artificial intelligence was done in the mid-20th century by the British logician and computer pioneer **Alan Mathison Turing**. In 1935 Turing described an abstract computing machine consisting of a limitless memory and a scanner that moves back and forth through the memory, symbol by symbol, reading what it finds and writing further symbols.

What is intelligence?

All but the simplest human behaviour is ascribed to intelligence, while even the most complicated insect behaviour is never taken as an indication of intelligence. What is the difference? Consider the behaviour of the digger wasp, Sphex ichneumoneus. When the female wasp returns to her burrow with food, she first deposits it on the threshold, checks for intruders inside her burrow, and only then, if the coast is clear, carries her food inside. The real nature of the wasp's instinctual behaviour is revealed if the food is moved a few inches away from the entrance to her burrow while she is inside: on emerging, she will repeat the whole procedure as often as the food is displaced. Intelligence—conspicuously absent in the case of Sphex—must include the ability to adapt to new circumstances.

What is Learning?

There are a few different forms of learning as applied to artificial intelligence. The simplest is learning by trial and error. For example, a simple computer program for solving mate-in-one chess problems might try moves at random until mate is found. The program might then store the solution with the position so that the next time the computer encountered the same position it would recall the solution. This simple memorizing of individual items and procedures—known as rote learning—is relatively easy to implement on a computer. More challenging is the problem of implementing what is called generalization. Generalization involves applying experience to analogous new situations. For example, a program that learns the past tense of regular English verbs by rote will not be able to produce the past tense of a word such as jump unless it previously had been presented with jumped, whereas a program that is able to generalize can learn the "add ed" rule and so form the past tense of jump based on experience with similar verbs.

Reasoning

To reason is to draw inferences appropriate to the situation. Inferences are classified as either deductive or inductive. An example of the former is, "Fred must be in either the museum or the café. He is not in the café; therefore, he is in the museum," and of the latter, "Previous accidents of this sort were caused by instrument failure; therefore this accident was caused by instrument failure." The most significant difference between these forms of reasoning is that in the deductive case the truth of the premises guarantees the truth of the conclusion, whereas in the inductive case the truth of the premise lends support to the conclusion without giving absolute assurance. Inductive reasoning is common in science, where data are collected and tentative models are developed to describe and predict future behaviour—until the appearance of anomalous data forces the model to be revised. Deductive reasoning is common in mathematics and logic, where elaborate structures of irrefutable theorems are built up from a small set of basic axioms and rules.

There has been considerable success in programming computers to draw inferences, especially deductive inferences. However, true reasoning involves more than just drawing inferences; it involves drawing inferences relevant to the solution of the particular task or situation. This is one of the hardest problems confronting AI.

Problem solving

Problem solving, particularly in artificial intelligence, may be characterized as a systematic search through a range of possible actions in order to reach some predefined goal or solution. Problem-solving methods divide into special purpose and general purpose. A special-purpose method is tailor-made for a particular problem and often exploits very specific features of the situation in which the problem is embedded. In contrast, a general-purpose method is applicable to a wide variety of problems. One general-purpose technique used in AI is means-end analysis—a step-by-step, or incremental, reduction of the difference between the current state and the final goal. The program selects actions from a list of means—in the case of a simple robot this might consist of PICKUP, PUTDOWN, MOVEFORWARD, MOVEBACK, MOVELEFT, and MOVERIGHT—until the goal is reached.

Many diverse problems have been solved by artificial intelligence programs. Some examples are finding the winning move (or sequence of moves) in a board game, devising mathematical proofs, and manipulating "virtual objects" in a computer-generated world.

Perception

In perception the environment is scanned by means of various sensory organs, real or artificial, and the scene is decomposed into separate objects in various spatial relationships. Analysis is complicated by the fact that an object may appear different depending on the angle from which it is viewed, the direction and intensity of illumination in the scene, and how much the object contrasts with the surrounding field.

At present, artificial perception is sufficiently well advanced to enable optical sensors to identify individuals, autonomous vehicles to drive at moderate speeds on the open road, and robots to roam through buildings collecting empty soda cans. One of the earliest systems to integrate perception and action was FREDDY, a stationary robot with a moving television eye and a pincer hand, constructed at the University of Edinburgh, Scotland, during the period 1966–73 under the direction of Donald Michie. FREDDY was able to recognize a variety of objects and could be instructed to assemble simple artifacts, such as a toy car, from a random heap of components.

Language

A language is a system of signs having meaning by convention. In this sense, language need not be confined to the spoken word. Traffic signs, for example, form a minilanguage, it being a matter of convention that ⚠ means “hazard ahead” in some countries. It is distinctive of languages that linguistic units possess meaning by convention, and linguistic meaning is very different from what is called natural meaning, exemplified in statements such as “Those clouds mean rain” and “The fall in pressure means the valve is malfunctioning.”

An important characteristic of full-fledged human languages—in contrast to birdcalls and traffic signs—is their productivity. A productive language can formulate an unlimited variety of sentences.

It is relatively easy to write computer programs that seem able, in severely restricted contexts, to respond fluently in a human language to questions and statements. Although none of these programs actually understands language, they may, in principle, reach the point where their command of a language is indistinguishable from that of a normal human. What, then, is involved in genuine understanding, if even a computer that uses language like a native human speaker is not acknowledged to understand? There is no universally agreed upon answer to this difficult question. According to one theory, whether or not one understands depends not only on one’s behaviour but also on one’s history: in order to be said to understand, one must have learned the language and have been trained to take one’s place in the linguistic community by means of interaction with other language users.

AI concepts

Algorithm

An *algorithm* is a sequence of calculations and rules used to solve a problem or analyze a set of data. It is like a flow chart, with step-by-step instructions for questions to ask, but written in math and programming code. An algorithm may describe how to determine whether a pet is a cat, dog, fish, bird, or lizard. Another far more complicated algorithm may describe how to identify a written or spoken language, analyze its words, translate them into a different language, and then check the translation for accuracy.

Machine learning

Machine learning (ML) is an AI technique that uses mathematical algorithms to create predictive models. An algorithm is used to parse data fields and to "learn" from that data by using patterns found within it to generate models. Those models are then used to make informed predictions or decisions about new data.

The predictive models are validated against known data, measured by performance metrics selected for specific business scenarios, and then adjusted as needed. This process of learning and validation is called *training*. Through periodic retraining, ML models are improved over time.

Deep learning

Deep learning is a type of ML that can determine for itself whether its predictions are accurate. It also uses algorithms to analyze data, but it does so on a larger scale than ML.

Deep learning uses artificial neural networks, which consist of multiple layers of algorithms. Each layer looks at the incoming data, performs its own specialized analysis, and produces an output that other layers can understand. This output is then passed to the next layer, where a different algorithm does its own analysis, and so on.

Bots

A *bot* is an automated software program designed to perform a particular task. Think of it as a robot without a body. Early bots were comparatively simple, handling repetitive and voluminous tasks with relatively straightforward algorithmic logic. An example would be web crawlers used by search engines to automatically explore and catalog web content.

Bots have become much more sophisticated, using AI and other technologies to mimic human activity and decision-making, often while interacting directly with humans through text or even speech. Examples include bots that can take a dinner reservation, chatbots (or conversational AI) that help with customer service interactions, and social bots that post breaking news or scientific data to social media sites.

With many layers in each neural network-and sometimes using multiple neural networks-a machine can learn through its own data processing. This requires much more data and much more computing power than ML.

Autonomous systems

Autonomous systems are part of an evolving new class that goes beyond basic automation. Instead of performing a specific task repeatedly with little or no variation (like bots do), autonomous systems bring intelligence to machines so they can adapt to changing environments to accomplish a desired goal.

Smart buildings use autonomous systems to automatically control operations like lighting, ventilation, air conditioning, and security. A more sophisticated example would be a self-directed robot exploring a collapsed mine shaft to thoroughly map its interior, determine which portions are structurally sound, analyze the air for breathability, and detect signs of trapped miners in need of rescue-all without a human monitoring in real time on the remote end.

What are agents in ai?

In artificial intelligence, an agent is a computer program or system that is designed to perceive its environment, make decisions and take actions to achieve a specific goal or set of goals.

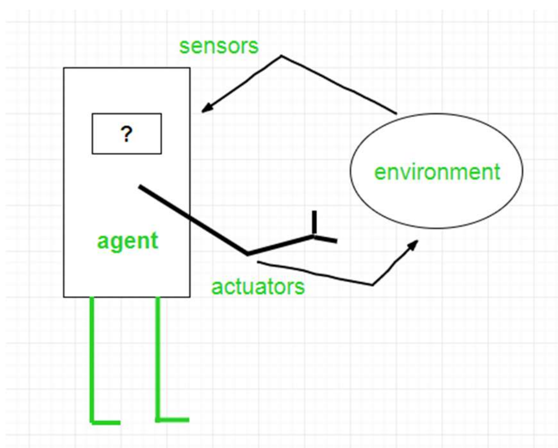
The agent operates autonomously, meaning it is not directly controlled by a human operator.

Agents can be classified into different types based on their characteristics, such as whether they are reactive or proactive, whether they have a fixed or dynamic environment, and whether they are single or multi-agent systems.

Reactive agents are those that respond to immediate stimuli from their environment and take actions based on those stimuli. proactive agents, on the other hand, take initiative and plan ahead to achieve their goals.

The environment in which an agent operates can also be fixed or dynamic. fixed environments have a static set of rules that do not change, while dynamic environments are constantly changing and require agents to adapt to new situations.

Agents are used in a variety of applications, including robotics, gaming, and intelligent systems. they can be implemented using different programming languages and techniques, including machine learning and natural language processing.



An agent is anything that can be viewed as :

- perceiving its environment through **sensors** and
- acting upon that environment through **actuators**

To understand the structure of Intelligent Agents, we should be familiar with *Architecture* and *Agent* programs.

Architecture is the machinery that the agent executes on. It is a device with sensors and actuators, for example, a robotic car, a camera, and a PC. **Agent program** is an implementation of an agent function. An **agent function** is a map from the percept sequence (history of all that an agent has perceived to date) to an action.

Examples of Agent:

There are many examples of agents in artificial intelligence. Here are a few:

- **Intelligent personal assistants:** These are agents that are designed to help users with various tasks, such as scheduling appointments, sending messages, and setting reminders. Examples of intelligent personal assistants include Siri, Alexa, and Google Assistant.

- **Autonomous robots:** These are agents that are designed to operate autonomously in the physical world. They can perform tasks such as cleaning, sorting, and delivering goods. Examples of autonomous robots include the Roomba vacuum cleaner and the Amazon delivery robot.

- **Gaming agents:** These are agents that are designed to play games, either against human opponents or other agents. Examples of gaming agents include chess-playing agents and poker-playing agents.

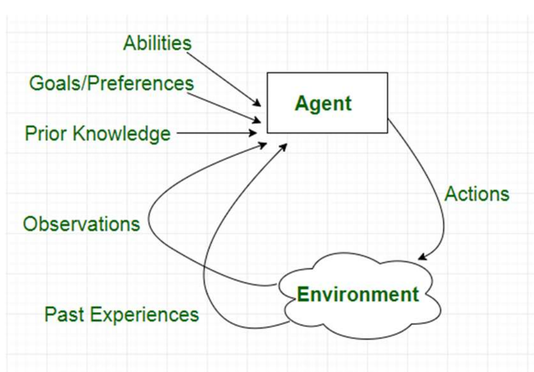
- **Fraud detection agents:** These are agents that are designed to detect fraudulent behavior in financial transactions. They can analyze patterns of behavior to identify suspicious activity and alert authorities. Examples of fraud detection agents include those used by banks and credit card companies.

- **Traffic management agents:** These are agents that are designed to manage traffic flow in cities. They can monitor traffic patterns, adjust traffic lights, and reroute vehicles to minimize congestion. Examples of traffic management agents include those used in smart cities around the world.

- A **software agent** has Keystrokes, file contents, received network packages which act as sensors and displays on the screen, files, sent network packets acting as actuators.

- A Human-agent has eyes, ears, and other organs which act as sensors, and hands, legs, mouth, and other body parts acting as actuators.

- A **Robotic agent** has Cameras and infrared range finders which act as sensors and various motors acting as actuators.



Types of Agents

Agents can be grouped into five classes based on their degree of perceived intelligence and capability:

- Simple Reflex Agents
- Model-Based Reflex Agents
- Goal-Based Agents
- Utility-Based Agents
- Learning Agent
- Multi-agent systems
- Hierarchical agents