Integrated MCA
Semester-V
1601602 ARTIFICIAL INTELLIGENCE

Unit 1

What is AI?

Some definitions that have been proposed:

- Systems that think like humans
- Systems that act like humans
- Systems that think rationally (intelligently/logically)
- Systems that act rationally

Intelligence

"Intelligence is a property/ability attributed to people, such as to know, think, to talk , to learn".

- Intelligence = knowledge + ability to perceive, feel, comprehend, process, communicate, judge, learn.

- Artificial : what is not real or natural.

- We may term intelligence possessed by human beings as real intelligence because human beings develop this intelligence on their own. Hence artificial intelligence is the intelligence which is created by human beings by applying various scientific and engineering techniques.

AI Definitions

Different researchers have defined the term based on their own research and understanding of the subject.

- According to the father of Artificial Intelligence, **John McCarthy**, it is “The **science and engineering of making intelligent** machines, especially intelligent computer programs”.

- “The art of creating machines that perform functions that require intelligence when performed by people.” (**Kurzweil**)

- “AI is the **automation of activities** that we associate with human thinking, activities such as decision making, problem solving, and learning”. (**Bellman 1978**)

- “AI is concerned with designing intelligent computer systems which exhibit the characteristics we associate with intelligence in human behaviour” (**Barr and Feignenbaum 1981**)

- “AI is the study of how to make computers do things at which, at the moment, people are better”. (Rich and Knight 1991)
- “The **branch of computer science** that is concerned with the automation of intelligent behaviour”. (Luger and Stubblefield 1993)
- “AI is the part of computer science concerned with **designing intelligent computer systems** i.e. systems that exhibit characteristics that we associate with intelligence in human behaviour”. (Advert)

Goals of AI

- To make computers more useful by letting them take over dangerous or tedious tasks from human
- Understand principles of human intelligence

Applications of Artificial Intelligence

Game Playing

- Complex games like checkers, chess, bridge etc. are difficult enough that it takes years for gifted adults to master them.
- All games require seeing patterns, making plans, searching combinations, judging alternative moves, and learning from experience, all being skills which are involved in many daily tasks.
- So game playing has become one of the research areas of artificial intelligence.

Applications of Artificial Intelligence

- There are machines that can play master level chess. There is AI in them, but they play well against people mainly through ***brute force computation***-looking at hundreds of thousands of positions.

Speech Recognition

- Speech recognition is the ***ability of a computer system to respond accurately to verbal commands.***
- The user communicates with the application through the appropriate input device i.e. a microphone.
- The Recognizer converts the analog signal into digital signal for the speech processing. A stream of text is generated after the processing.
- This source-language text becomes input to the ***Translation Engine***, which converts it to the target language text.

Expert System

- They are ***knowledge intensive programs*** that solve problems in a domain that needs a good technical expertise.
- These knowledge based applications of artificial intelligence have enhanced productivity in business, science, engineering, and military.
- Expert systems are concerned with the ***automation of tasks*** like medical diagnosis, equipment repair, financial planning and computer configuration.

Robotics

- A robot is a ***mechanical or virtual artificial agent***, usually an electromechanical machine that is guided by a computer program or electronic circuitry, and thus a type of an Embedded system.
- A human can make decision and perform the action but technology is developing so that it can be done by machines.

E- Commerce

- Ecommerce is a very broad and multi-disciplinary field of study and research as it involves Computer Science, Engineering, law, Business and Management, etc.
- In computer Science, there is a new field of research on the use of artificial intelligence(AI) techniques in E- Commerce. Some applications related to E- commerce could be e-broker and automatic negotiation.

Natural Language Processing

- It is a field of AI which deals with the methods of **communicating with a computer in one's own natural language.**
- This will fill the gap between the humans and the machines. So now one need not be computer literate to communicate with it.

Areas of Artificial Intelligence

- Perception
- Machine vision
- Speech understanding
- Robotics
- Expert Systems
- Machine Learning
- Theorem Proving
- Symbolic Mathematics , Game Playing , Touch (tactile or haptic) sensation
- Natural Language Processing
- Natural Language Understanding
- Speech Understanding
- Language Generation
- Machine Translation
- Planning

The AI and Consciousness

- “Artificial Consciousness” – i.e. **the ability for a machine (created by humans) to be self-aware**, have **independent** original **thoughts and feelings, interact with the physical world**.
- Efforts have been made to develop a relationship between the concepts of Artificial Intelligence and human Consciousness.
- It is analyzed that whether a machine can be developed giving the attention toward a particular problem like a human being.

- Even a machine that passed the Turing Test would not necessary be conscious in its efforts like human being are.
- The supporter of strong AI claim that machine can really develop the human consciousness equal to human being.

Strong AI & Weak AI

Strong AI

- Strong AI claims that computers can be **made to think almost equal to the level of human being** and they can possibly be conscious about themselves.
- Strong AI supposes that it is possible for machines to become self aware, but may or may not exhibit human like thought processes.
- The strong AI was orginally coined by John Searle, who writes

  “according to strong AI, the computer is not merely a tool in the study of the mind; rather, the appropriately programmed computer really is a mind.”

Strong AI

- This categorization of AI able to replace the manual human operative task by a programmed machine. These machines today most popularly available with an intelligent system such as robots, which treated as the same rights as humans.

Strong AI & Weak AI

Weak AI

- Weak AI refers to the use of software to study or accomplish specific problem solving or reasoning tasks **that do not encompass the full range of human cognitive abilities .**

- *Strong AI* : Computer can almost think like human beings
- *Weak AI* : Computers cannot be intelligent like human beings

Turing Test

- A Turing Test is a method of inquiry in artificial intelligence (AI) for **determining whether or not a computer is capable of thinking like a human being.** The test is named after Alan Turing, the founder of the Turing Test.
- Turing proposed that a computer can be said to possess artificial intelligence if it can mimic human responses under specific conditions. The original Turing Test requires three terminals, each of which is physically separated from the other two. **One terminal is operated by a computer, while the other two are operated by humans.**

- During the test, one of the humans functions as the **questioner**, while the **second human and the computer function as respondents.** The questioner interrogates the respondents within a specific subject area, using a specified format and context. After a preset length of time or number of questions, the questioner is then asked to decide which respondent was human and which was a computer.

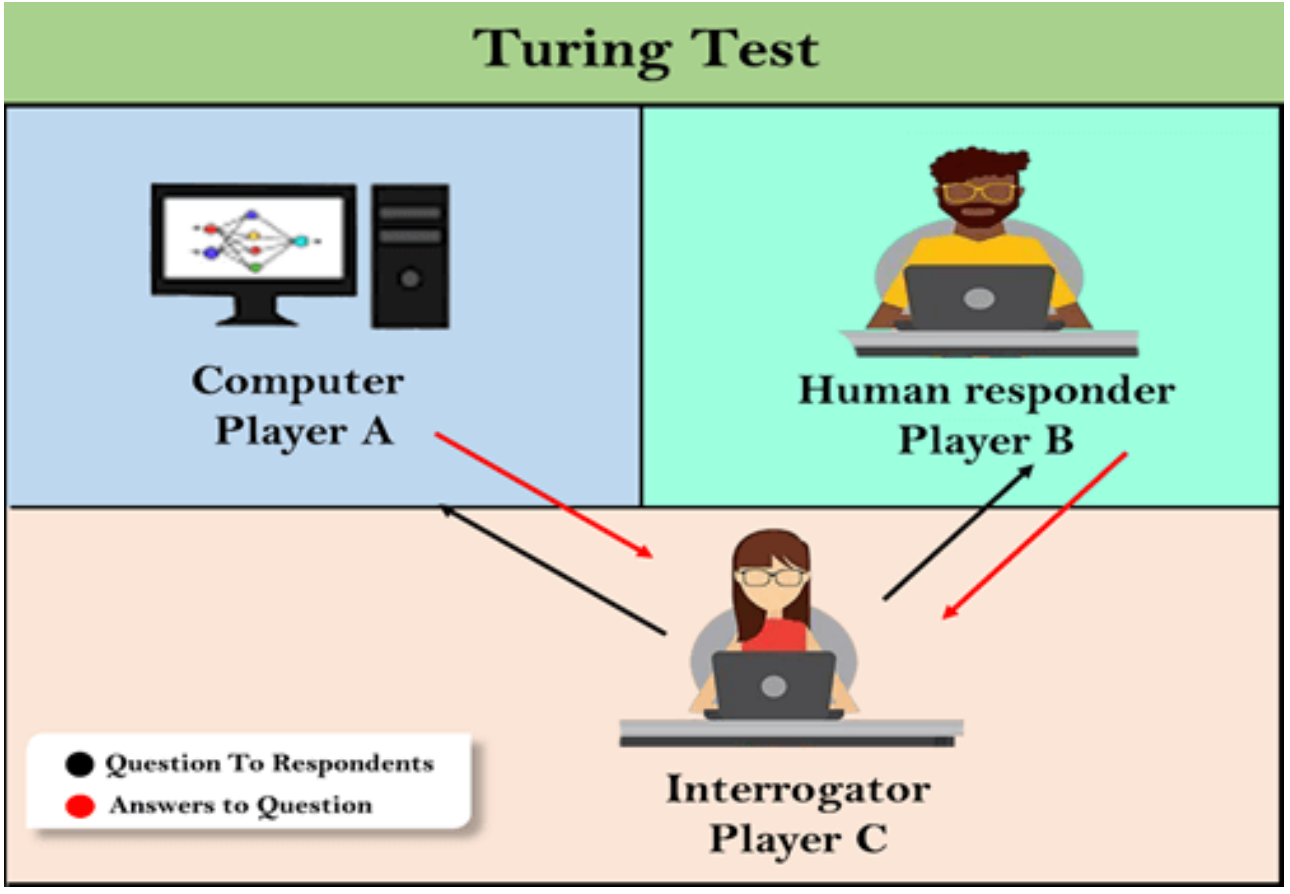
- The test is repeated many times. If the questioner makes the correct determination in half of the test runs or less, the computer is considered to have artificial intelligence because the questioner regards it as "just as human" as the human respondent.

History of Turning Test

- The test is named after Alan Turing, who pioneered machine learning during the **1940s and 1950s.** Turing introduced the test in his 1950 paper called **“Computing Machinery and Intelligence” while at the University of Manchester.**

- In his paper, Turing proposed a twist on what is called **“The Imitation Game.”** The Imitation Game involves no use of AI, but rather three human participants in three separate rooms. Each room is connected via a screen and keyboard, one containing a male, the other a female, and the other containing a **male or female judge**. The female tries to convince the judge that she is the male, and the judge tries to disseminate which is which.

- Turing **changes the concept of this game to include an AI, a human and a human questioner. The questioner’s job is then to decide which is the AI and which is the human.**


Turing Test
Computer
Player A
Human responder
Player B
Question To Respondents
Answers to Question
Interrogator
Player C

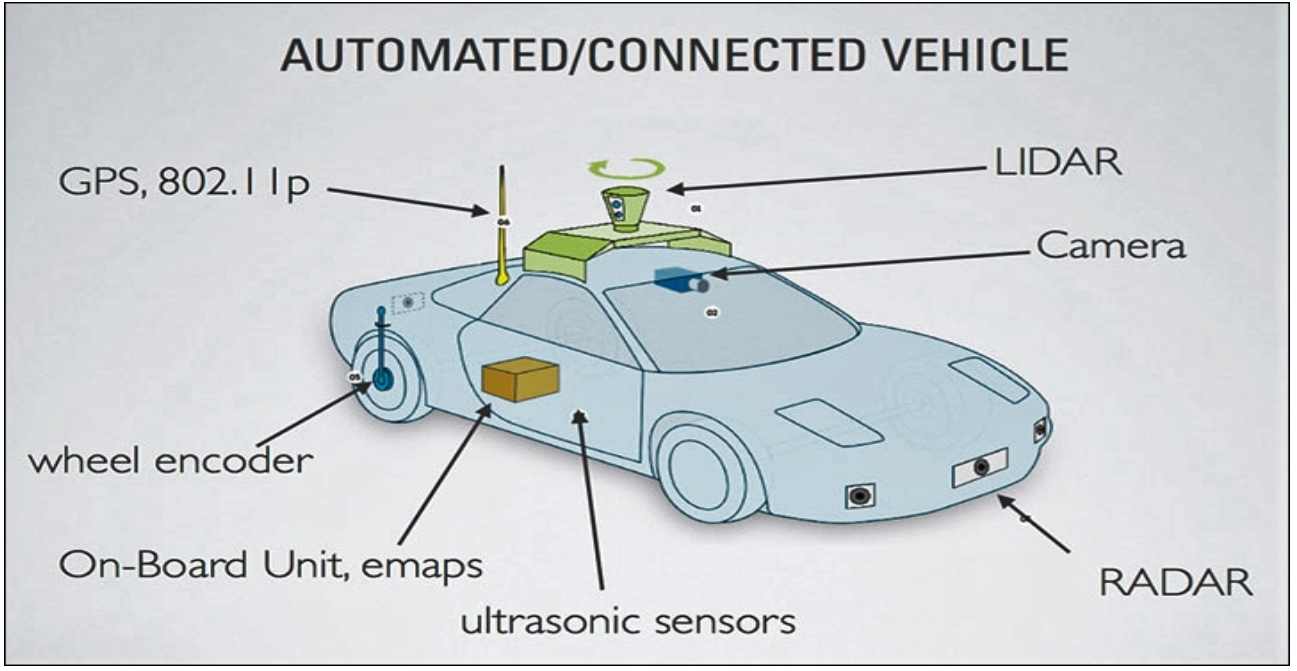
Limitation of Turning Test

- **Befooling somebody is not intelligence**. Rather intelligence should be defined in a positive sense because doing the assigned work properly and more efficiently is intelligence.
- Computer as a **machine possesses more memory** than human being does.
- The speed of solving a task from computer should be **faster than human being.**

Practical system based on AI

Autonomous Vehicles

- The autonomous vehicle segment is the fastest growing segment in the automotive industry. Artificial Intelligence is indeed the most important and sophisticated component of self driving vehicles (Carmody, Thomas, 2019).
- The number of sensors with real time data and the need for intelligent processing of the data can be overwhelming.


AUTOMATED/CONNECTED VEHICLE
GPS, 802.11p
LIDAR
Camera
wheel encoder
On-Board Unit, emaps
ultrasonic sensors
RADAR

Computer Chess

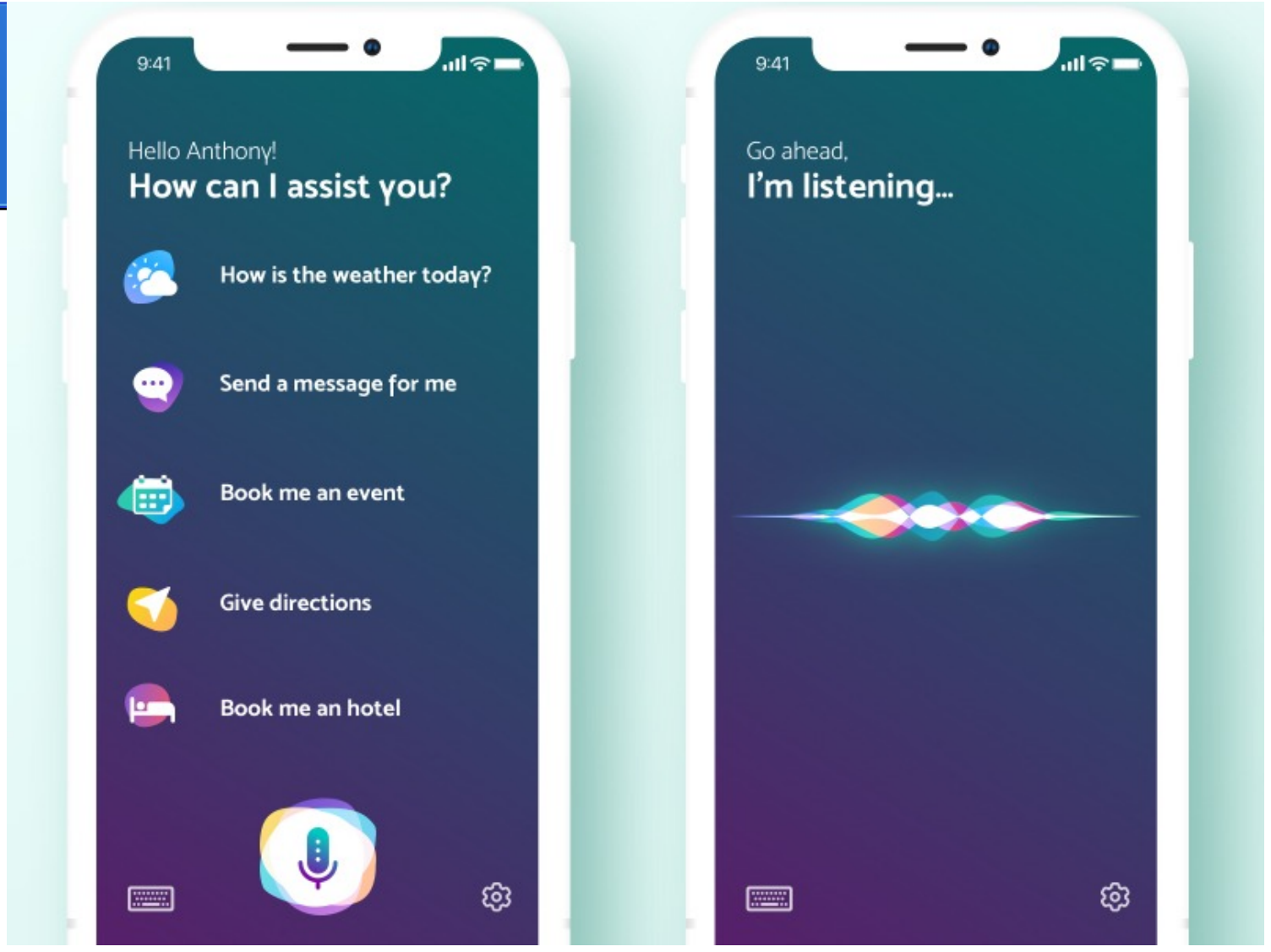
- Computer chess includes both hardware (dedicated computers) and software capable of playing chess. Computer chess provides opportunities for players to practice even in the absence of human opponents, and also provides opportunities for analysis, entertainment and training.
- *Deep Blue*, a chess computer built by IBM researchers, defeated world champion *Gary Kasparov* in a landmark performance.

Mathematical theorem Proving

- proving theorems is considered to require high intelligence
- if knowledge is represented by logic, theorem proving is reasoning
- theorem proving uses AI techniques, such as (heuristic) search

Advanced user interface

- An intelligent user interface (Intelligent UI, IUI, or sometimes Interface Agent) is a user interface (UI) that involves some aspect of artificial intelligence (AI or computational intelligence). There are many modern examples of IUIs, the most famous (or infamous) being the Microsoft Office Assistant.

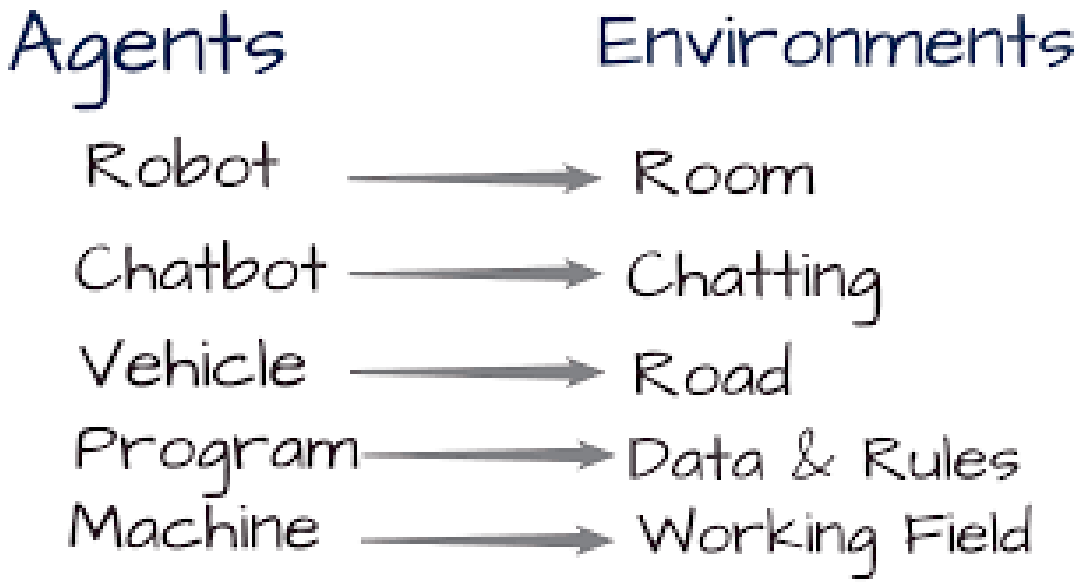

9:41
Hello Anthony!
How can I assist you?
How is the weather today?
Send a message for me
Book me an event
Give directions
Book me an hotel
9:41
Go ahead,
I'm listening...

Agents

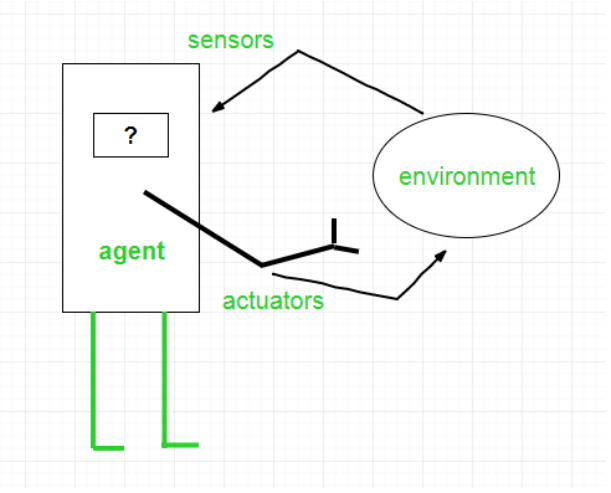
- **An agent is a computer program or system** that is designed to **perceive its environment, make decisions and take actions to achieve a specific goal** or set of goals. The agent operates autonomously, meaning it is **not directly controlled by a human operator.**
- An artificial intelligence (AI) agent is a software program that can **interact with its environment, collect data, and use the data to perform self-determined tasks** to meet predetermined goals.
- An AI agent independently **chooses the best actions** it needs to perform to achieve those goals.

- For example, consider a **contact center AI agent** that wants to resolves customer queries. The agent will automatically ask the customer different questions, look up information in internal documents, and respond with a solution.
- Based on the customer responses, it determines if it can resolve the query itself or pass it on to a human.

Agents and Environment

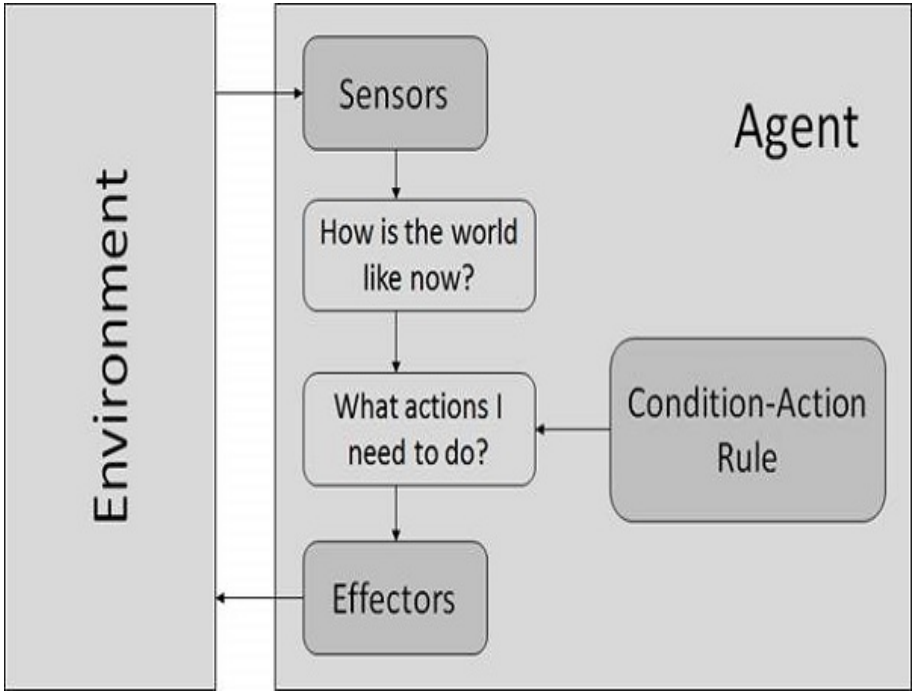


- **Environment**: area around the agent that it interacts with. An environment can be anything like a **physical space, a room or a virtual space** like a game world or the internet.
- **Sensors**: Sensors are tools that AI agent uses to perceive their environment. They can be any physical like **cameras, microphones, temperature sensors or a software sensor** that read data from files.
- **Actuators**: Tools that AI agent uses to interact with their environment through some actions. They can be any physical actuators like **wheels, motors, robotic hands, or computer screens** or they can be software actuators that send messages.
- **Effectors**: Effectors take instructions from decision making mechanism and translates them into actions and these actions are performed through actuators.



The Structure of Intelligent Agents

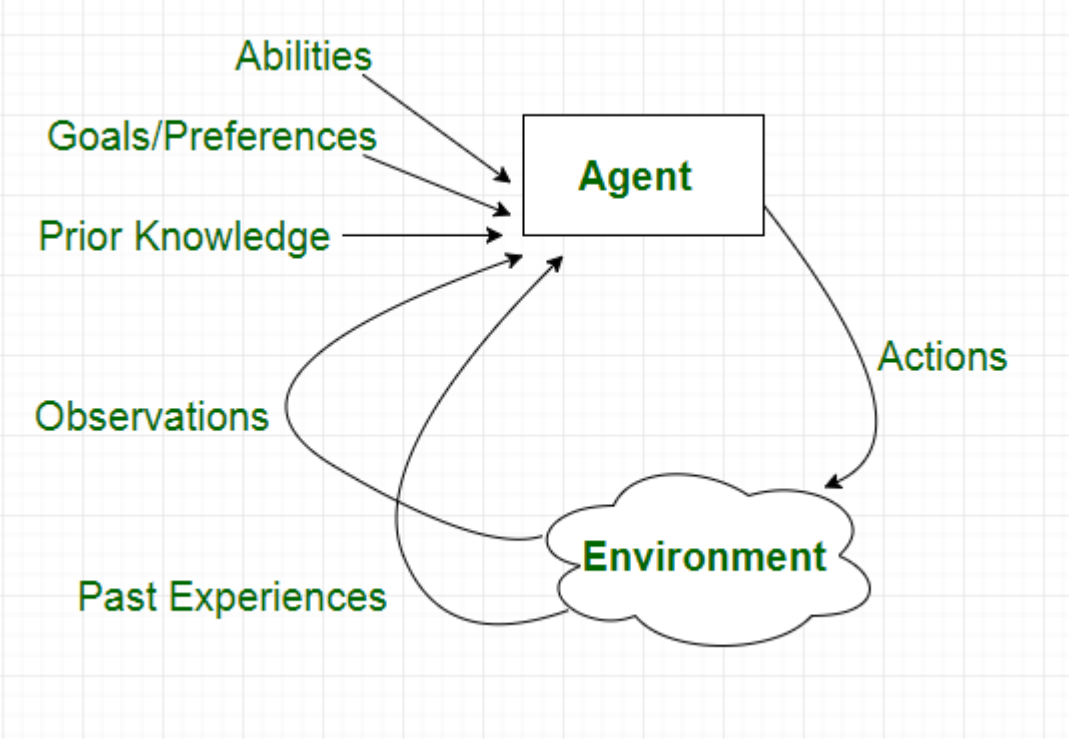
- Agent = Architecture + Agent Program
- Architecture = the machinery that an agent executes on.
- Agent Program = an implementation of an agent function.



Examples of Agents

- **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**: 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 that act as sensors and displays on the screen, files,** and 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** act as actuators.
- A **Robotic agent** has Cameras and infrared range finders which act as sensors and various motors act as actuators.


Abilities
Goals/Preferences
Prior Knowledge
Agent
Actions
Observations
Environment
Past Experiences

Agent Type	Performance Measure	Environment	Actuators	Sensors
Taxi driver	Safe, fast, legal, comfortable trip, maximize profits	Roads, other traffic, pedestrians, customers	Steering, accelerator, brake, signal, horn, display	Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard

Figure 2.4 PEAS description of the task environment for an automated taxi.

Types of Agents

- **Human-Agent**: A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.
- **Robotic Agent:** A robotic agent can have **cameras**, **infrared** range finder, **NLP** for sensors and **various motors** for actuators.
- **Software Agent**: Software agent can have keystrokes, file contents as sensory input and **act on those inputs and display output on the screen.**

Rational Agent

- The rational agent is used in **game theory and decision theory** to help us apply artificial intelligence to various real-world scenarios.
- A rational agent is a **mathematical model** that tries to represent the behavior of an intelligent being, like a person or animal. It uses a set of rules to determine the best course of action for a given situation.
- These agents usually work by **comparing their current state with their previous state and then choosing an action** based on how much better or worse they feel about their position now compared to before.
- The most basic form of this type of agent is called a **reinforcement learning agent**, which gets its name from the fact that it learns from experience as it goes along—it tries things out and then rates them based on how well they worked out in the past.

Examples of Rational Agent

- **Self-driving cars** make decisions based on sensor data and optimize for safety and efficiency.
- **Game-playing** AI, such as **AlphaGo**, makes decisions based on the game's rules and the board's current state to maximize the chances of winning.
- **Virtual personal assistants**, such as Siri or Alexa, understand natural language commands and take appropriate actions based on the user's request.
- **Stock trading algorithms** make buy and sell decisions based on market data and predictions about future performance.
- **Robotics**, such as industrial robots, performs task based on programmed instructions and sensor inputs.