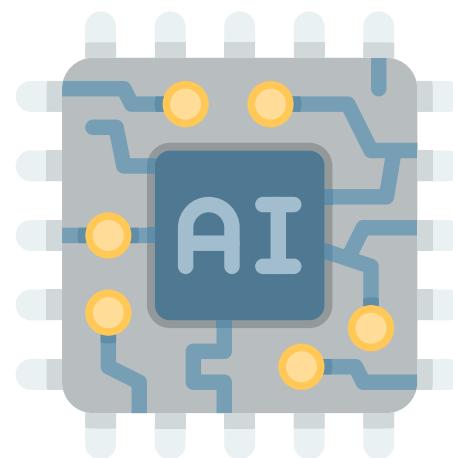


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Artificial Intelligence

Unit 1



Topics to be covered...

Definition of AI

Branches of AI

Role of Machine Intelligence

Types of Artificial Intelligence

Future of Artificial Intelligence

Evolution of AI

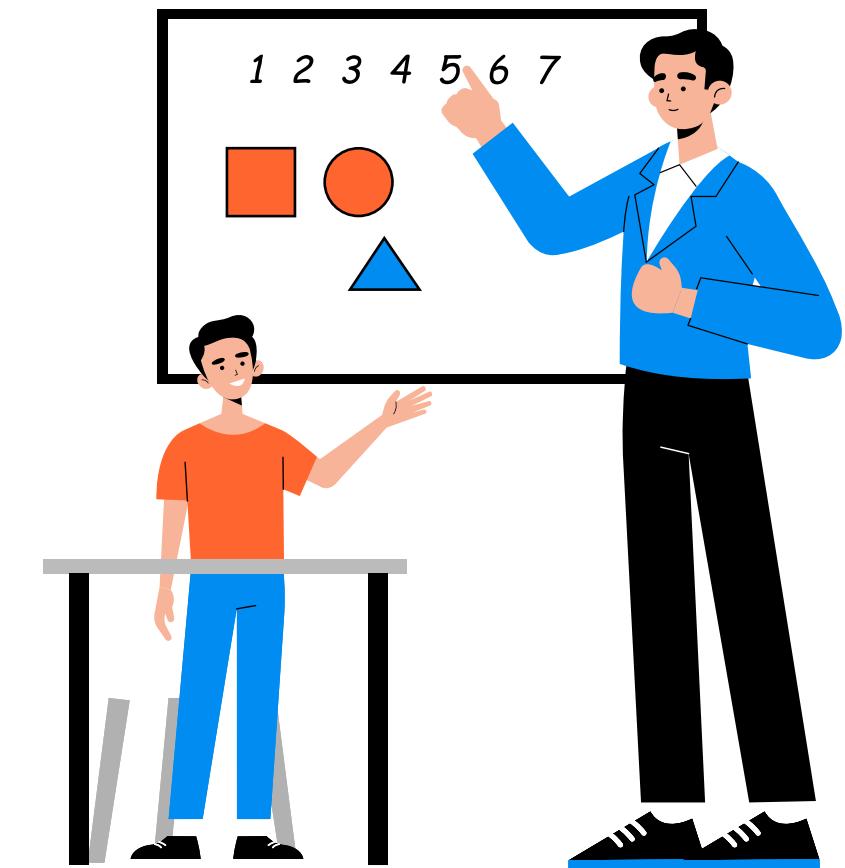
Intelligent Agents & It's Types

Agent Environment in AI

Characteristics and application of Learning Agents

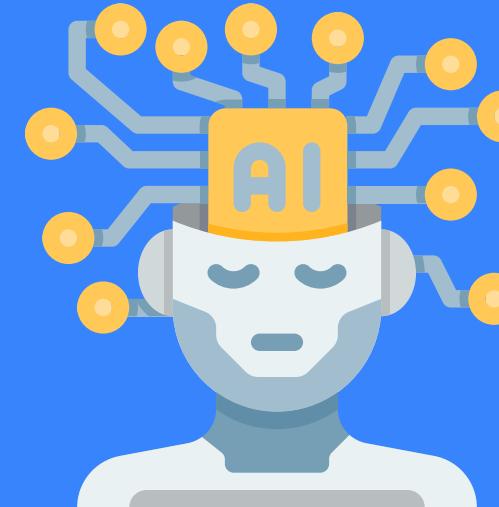
Problem Solving Approach to Typical AI problems

Happy Ending!



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Definition of AI

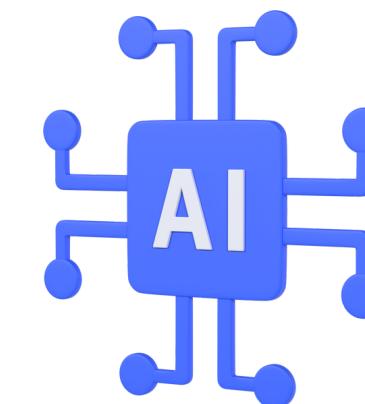
Definition of AI

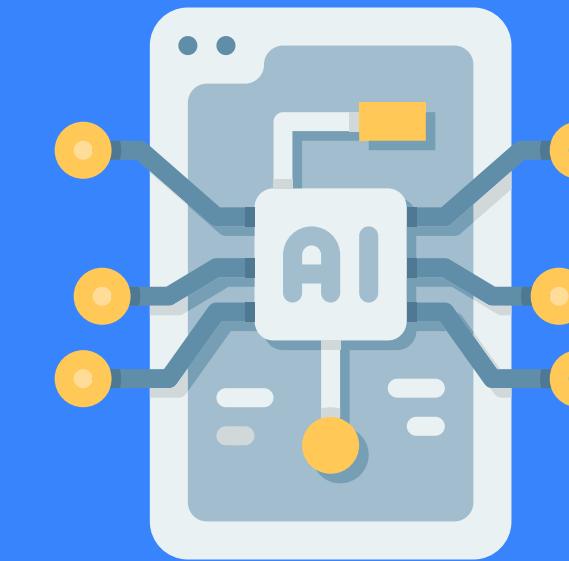
- Artificial intelligence (AI) is the ability of a computer to do tasks that are usually done by humans because they require human intelligence.
- The capacity given by humans to machine to memorize and learn from experience, to think and create, to speak, to judge and make decisions.



Definition of AI

- AI programming focuses on three cognitive skills:
 - **Learning:** Focuses on acquiring data and creating rules(algorithm) for how to turn the data into actionable information.
 - **Reasoning:** Focuses on choosing the right algorithm to reach a desired outcome.
 - **Self-correction:** Designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.
- Goal of AI:
 - To create expert systems
 - To implement human intelligence in machines

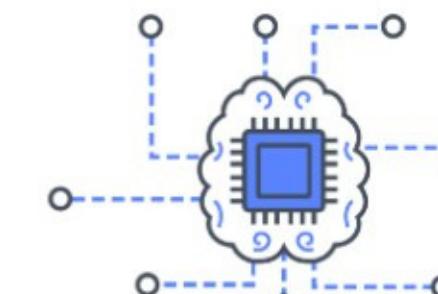




Branches of AI

Branches of AI

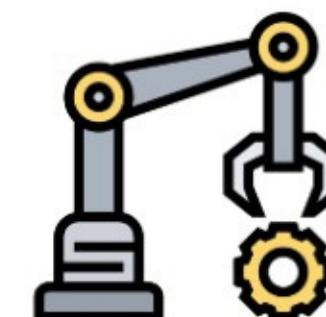
- Machine Learning
- Deep Learning
- Natural Language Processing
- Robotics
- Expert Systems
- Fuzzy Logic



Machine Learning



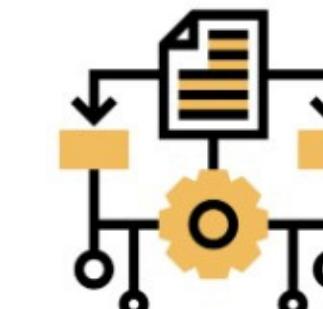
Neural Networks



Robotics



Expert Systems



Fuzzy Logic

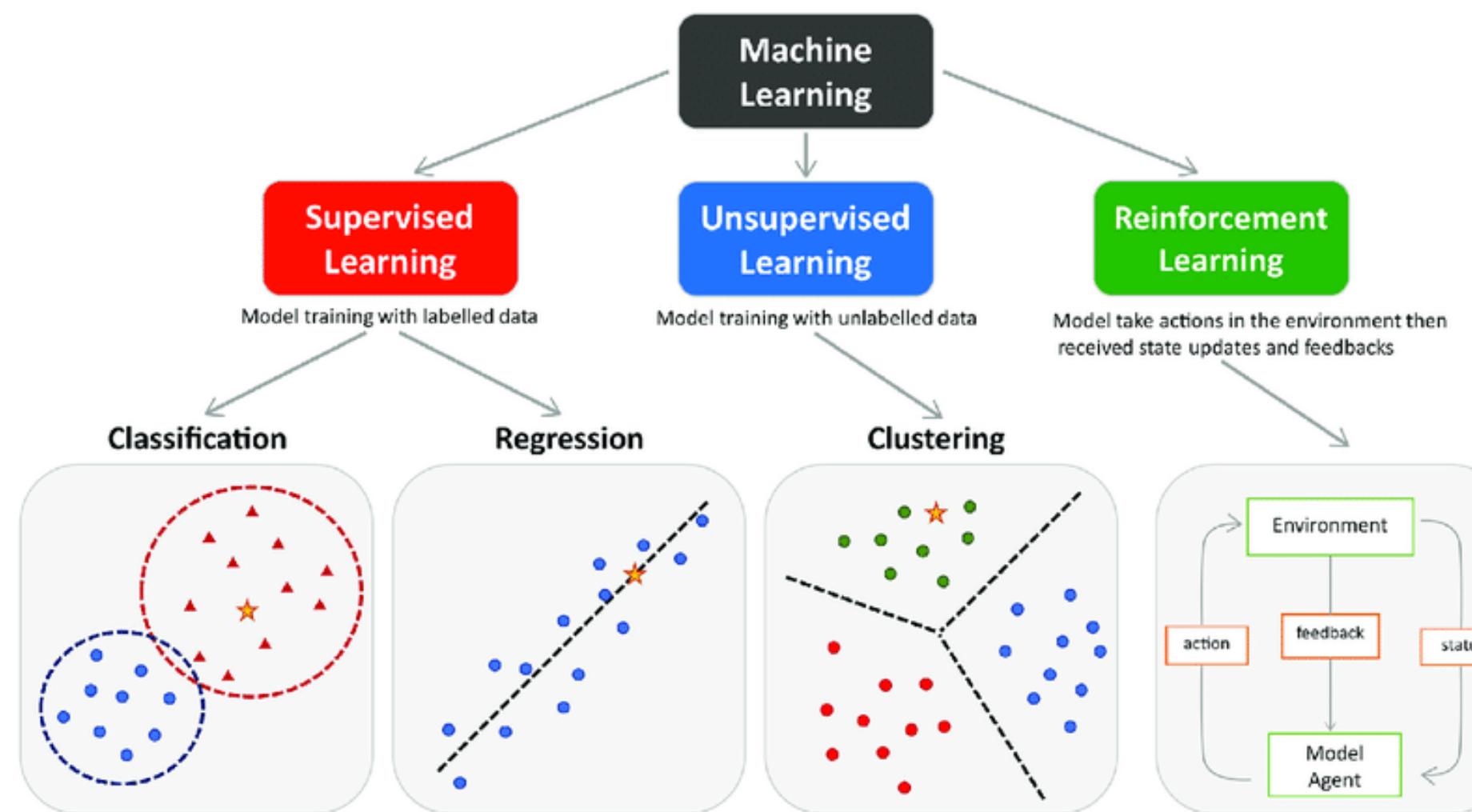


Natural Language Processing

Branches of AI

Machine Learning:

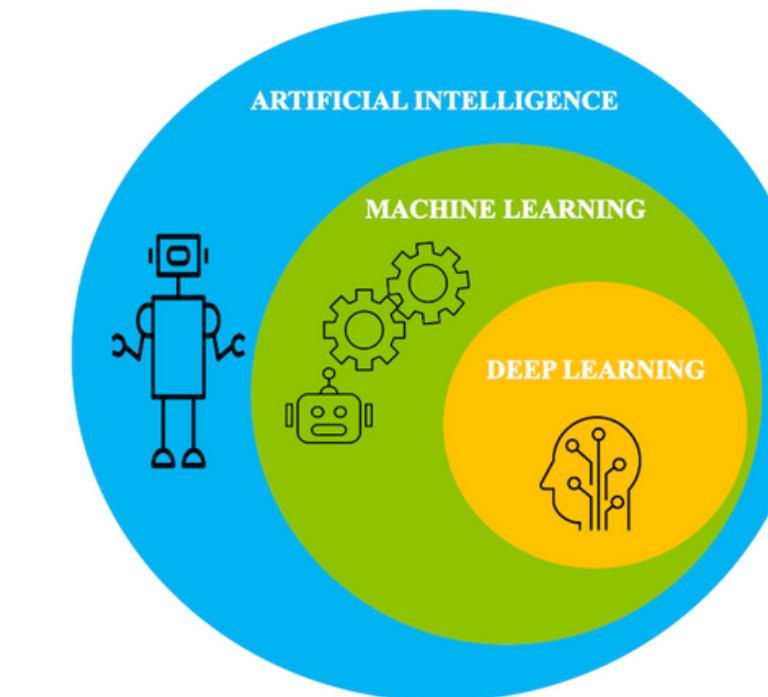
- Machine Learning is the science of getting machines to interpret, process and analyze data in order to solve real-world problems.



Branches of AI

Deep Learning:

- Process of implementing Neural Networks on high dimensional data to gain insights and form solutions.
- Deep Learning is the logic behind the face verification algorithm on Facebook, self-driving cars, virtual assistants like Siri, Alexa and so on.



Branches of AI

Natural Language Processing:

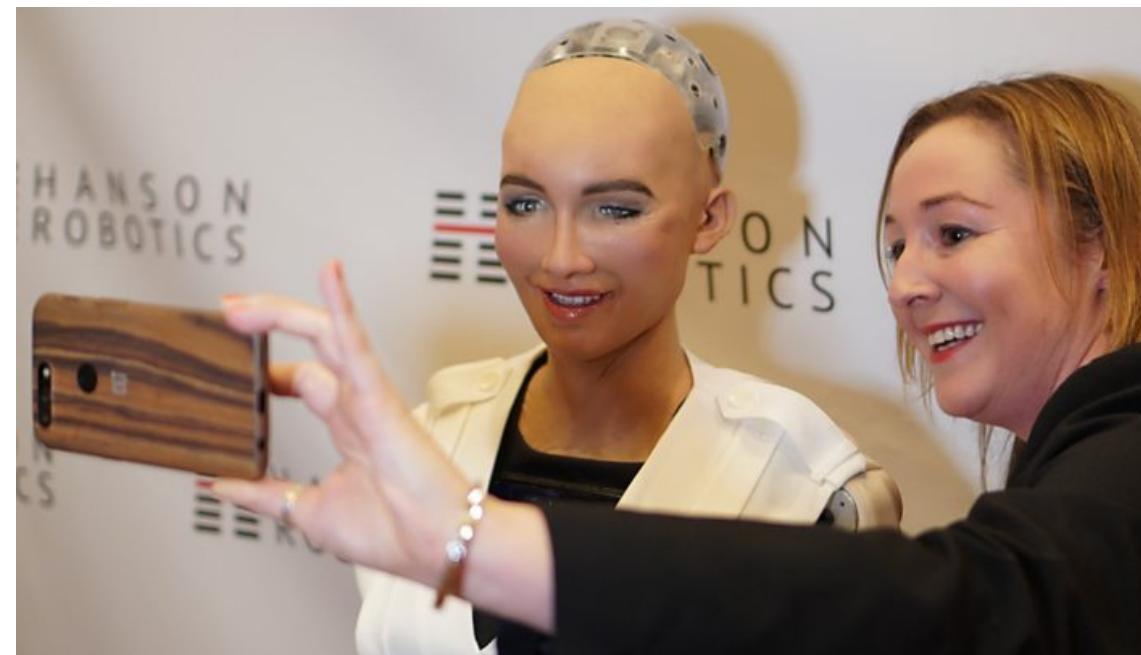
- Natural Language Processing (NLP) refers to the science of drawing insights from natural human language in order to communicate with machines and grow businesses.
- Twitter uses NLP to filter out terroristic language in their tweets, Amazon uses NLP to understand customer reviews and improve user experience.



Branches of AI

Robotics:

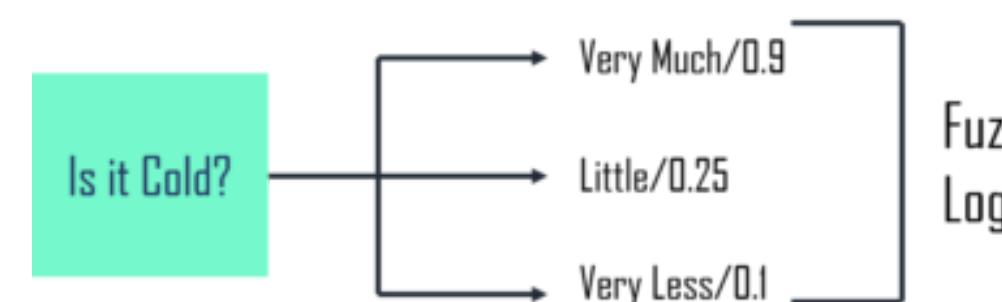
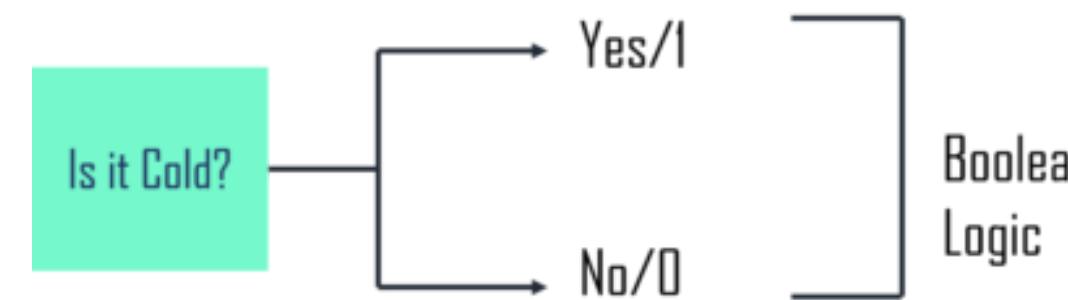
- Robotics is a branch of Artificial Intelligence which focuses on different branches and application of robots. AI Robots are artificial agents acting in a real-world environment to produce results by taking accountable actions.



Branches of AI

Fuzzy Logic:

- Fuzzy logic is a computing approach based on the principles of “degrees of truth” instead of the usual modern computer logic i.e. boolean in nature.
- Fuzzy logic is used in the medical fields to solve complex problems that involve decision making. They are also used in automatic gearboxes, vehicle environment control and so on.



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Role of Machine Intelligence in Human life

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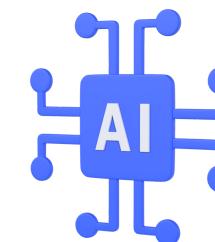
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Role of Machine Intelligence in human life

Two Categories for AI Usage

- i) **Software/Methodology:**
 - Prominent examples of AI software used in everyday life include voice assistants, image recognition for face unlock in mobile phones, and ML-based financial fraud detection. AI software usually involves just downloading software with AI capabilities from an online store and requires no peripheral devices.
- ii) **Embodied:**
 - The hardware side of AI includes its utilization in drones, self-driven vehicles, assembly-line robots, and the Internet of Things (IoT). This involves the design of specific devices that are based on AI capabilities.



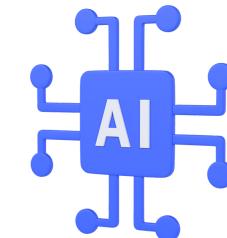
Role of Machine Intelligence in human life

Navigation and Travel

- The work of AI programmers behind navigation apps like Google Maps and Waze never ends.
- Yottabytes of geographical data which is updated every second can only be effectively cross-checked by ML algorithms unleashed on satellite images.

Smart Input Keyboards:

- The latest versions of mobile keyboard apps combine the provisions of autocorrection and language detection to provide a user-friendly experience.



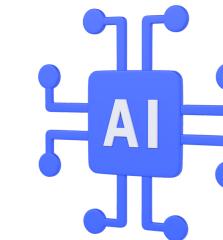
Role of Machine Intelligence in human life

Internet of Things:

- IoT deals with devices interacting with the internet, the AI part helps these devices to learn from data.
- The five broad steps involved in IoT-enabling are - create, communicate, aggregate, analyze and act.

Security and Surveillance:

- It is nearly impossible for a human being to keep a constant eye on too many monitors of a CCTV network at the same time. So, naturally, we have felt the need to automate such surveillance tasks and further enhance them by leveraging machine learning methodologies.

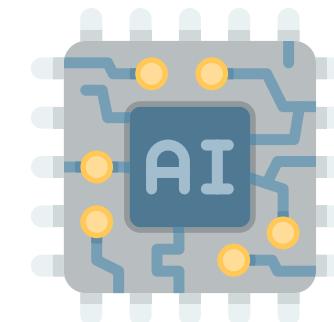
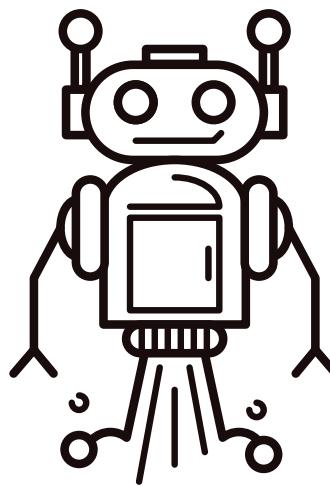




Types of Artificial Intelligence

Types of Artificial Intelligence

1. Purely Reactive
2. Limited Memory
3. Theory of Mind
4. Self-Aware



Types of Artificial Intelligence

1. Purely Reactive

- These machines do not have any memory or data to work with, specializing in just one field of work.
- For example, in a chess game, the machine observes the moves and makes the best possible decision to win.

2. Limited Memory

- These machines collect previous data and continue adding it to their memory. They have enough memory or experience to make proper decisions, but memory is minimal.
- For example, this machine can suggest a restaurant based on the location data that has been gathered.

Types of Artificial Intelligence

3. Theory of Mind

- This kind of AI can understand thoughts and emotions, as well as interact socially.
- However, a machine based on this type is yet to be built.
- A "theory of mind" machine can think emotionally and can respond with emotions.
- For example: Ai like Sofia.

4. Self-Aware

- Self-aware machines are the future generation of these new technologies.
- They will be intelligent, sentient, and conscious.
- These These types of machines can be called human equivalents.
- For example: A robot 'arm' made by a group from Columbia University.

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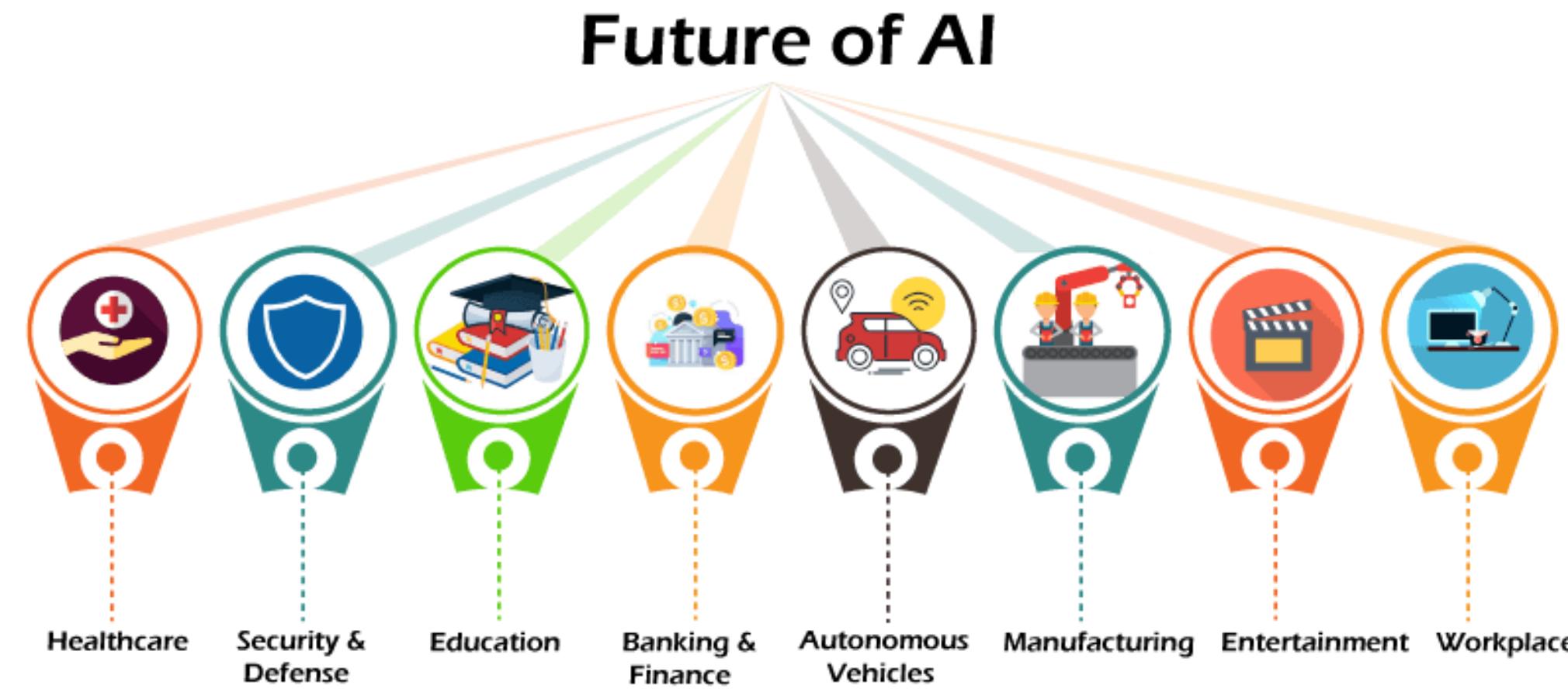


Future of Artificial Intelligence

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Future of Artificial Intelligence



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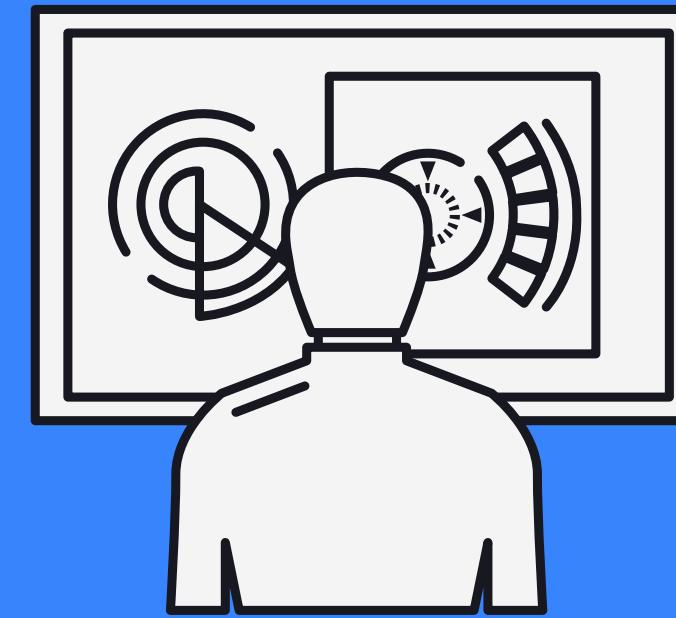


Evolution of AI

Evolution of AI

- Beginning of AI (1993)
- AI knowledge-based expert system (1970)
- Machine learning (1998)
 - Formal
 - Informal
- Supervised learning (2004)
 - Spam filters
 - Facial recognition
- Unsupervised learning
 - Clustering algorithm
 - Market segmentation
- Genetic programming
- Future of AI





Intelligent Agents & It's Types

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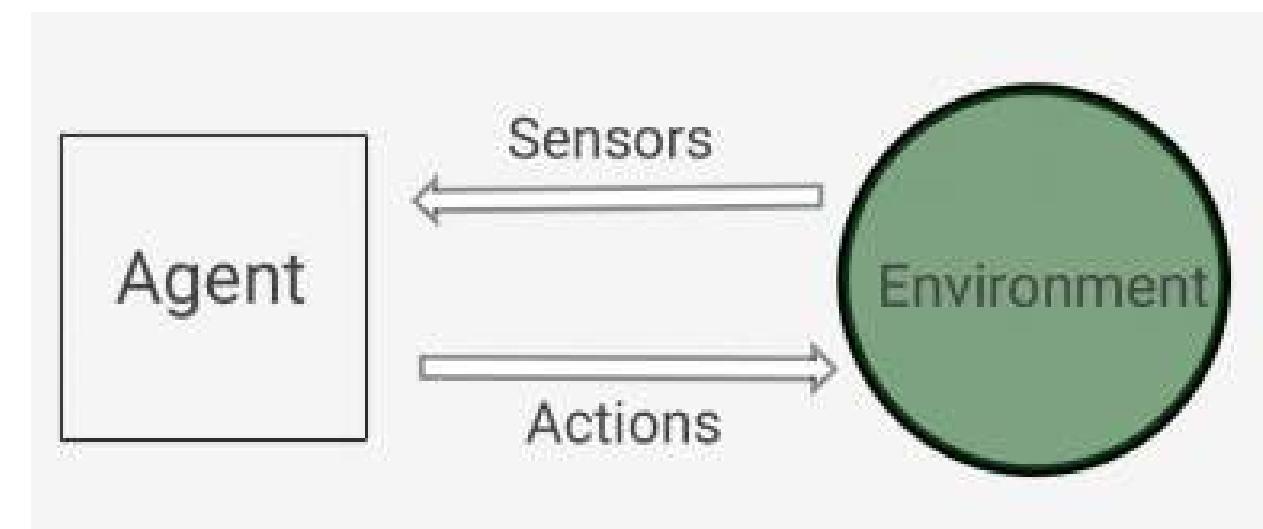


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Intelligent Agents

- An intelligent agent is an autonomous entity which acts upon an environment using sensors and actuators for achieving goals.
- An intelligent agent may learn from the environment to achieve their goals
- **Following are the main four rules for an AI agent:**
 - Rule 1: An AI agent must have the ability to perceive the environment.
 - Rule 2: The observation must be used to make decisions.
 - Rule 3: Decision should result in an action.
 - Rule 4: The action taken by an AI agent must be a rational action.



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Intelligent Agents Types

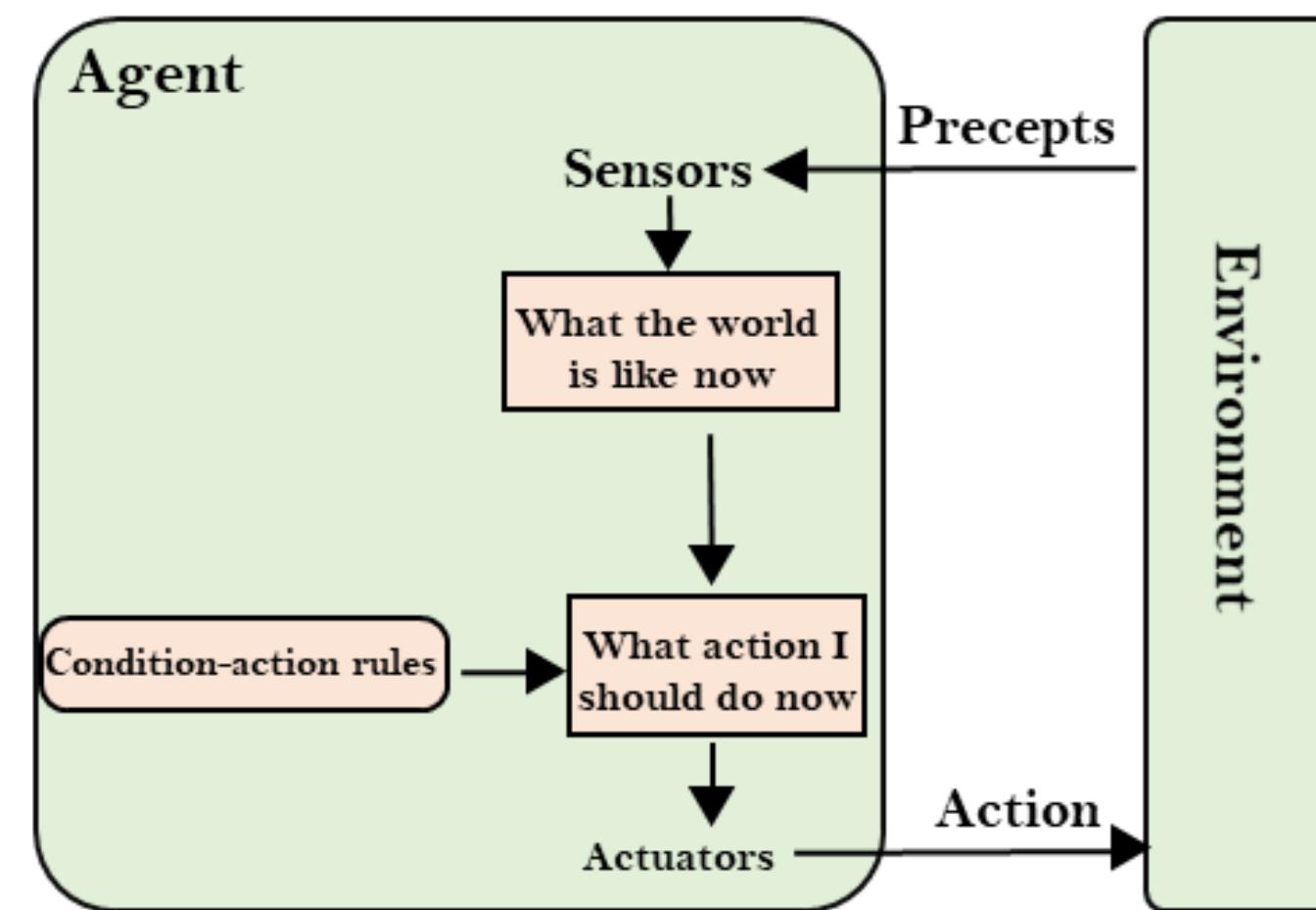
- Simple reflex agent
- Model-based reflex agent
- Goal-based agents
- Utility-based agents



1. Simple reflex agent

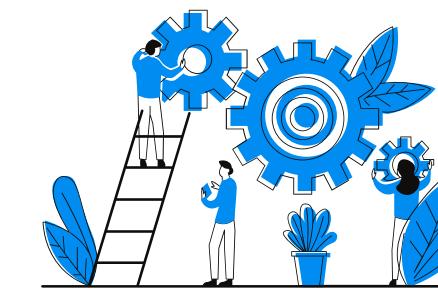
- The Simple reflex agents are the simplest agents. These agents take decisions on the basis of the current percepts and ignore the rest of the percept history.
- The Simple reflex agent works on Condition-action rule, which means it maps the current state to action. Such as a Room Cleaner agent, it works only if there is dirt in the room.
- **Problems for the simple reflex agent design approach:**
 - They have very limited intelligence
 - They do not have knowledge of non-perceptual parts of the current state
 - Mostly too big to generate and to store.
 - Not adaptive to changes in the environment.

1. Simple reflex agent

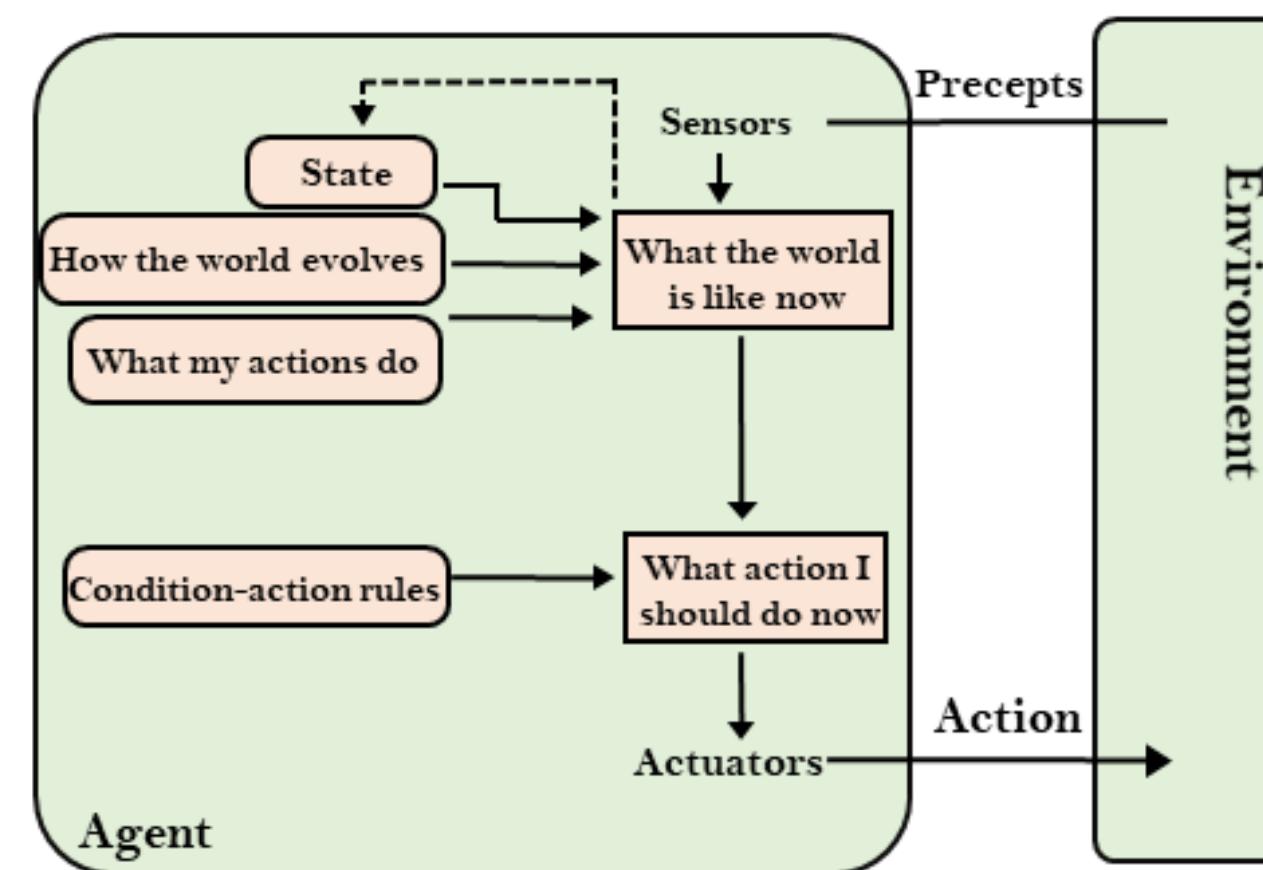


2. Model-based reflex agent

- The Model-based agent can work in a partially observable environment, and track the situation.
- A model-based agent has two important factors:
 - **Model:** It is knowledge about "how things happen in the world," so it is called a Model-based agent.
 - **Internal State:** It is a representation of the current state based on percept history.
- These agents have the model, "which is knowledge of the world" and based on the model they perform actions.



2. Model-based reflex agent

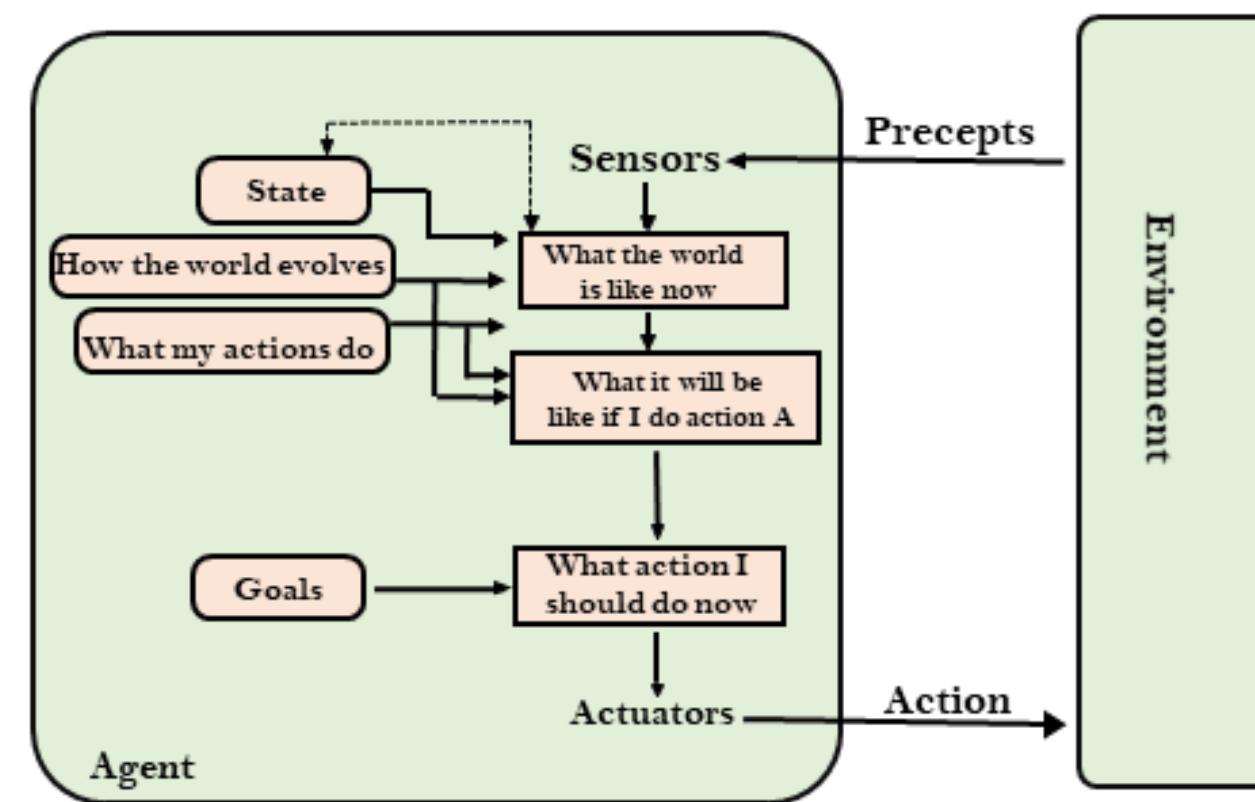


3. Goal-based agents

- The knowledge of the current state environment is not always sufficient to decide for an agent to what to do.
- The agent needs to know its goal which describes desirable situations.
- Goal-based agents expand the capabilities of the model-based agent by having the "goal" information.
- They choose an action, so that they can achieve the goal.
- These agents may have to consider a long sequence of possible actions before deciding whether the goal is achieved or not. Such considerations of different scenario are called searching and planning, which makes an agent proactive.



3. Goal-based agents

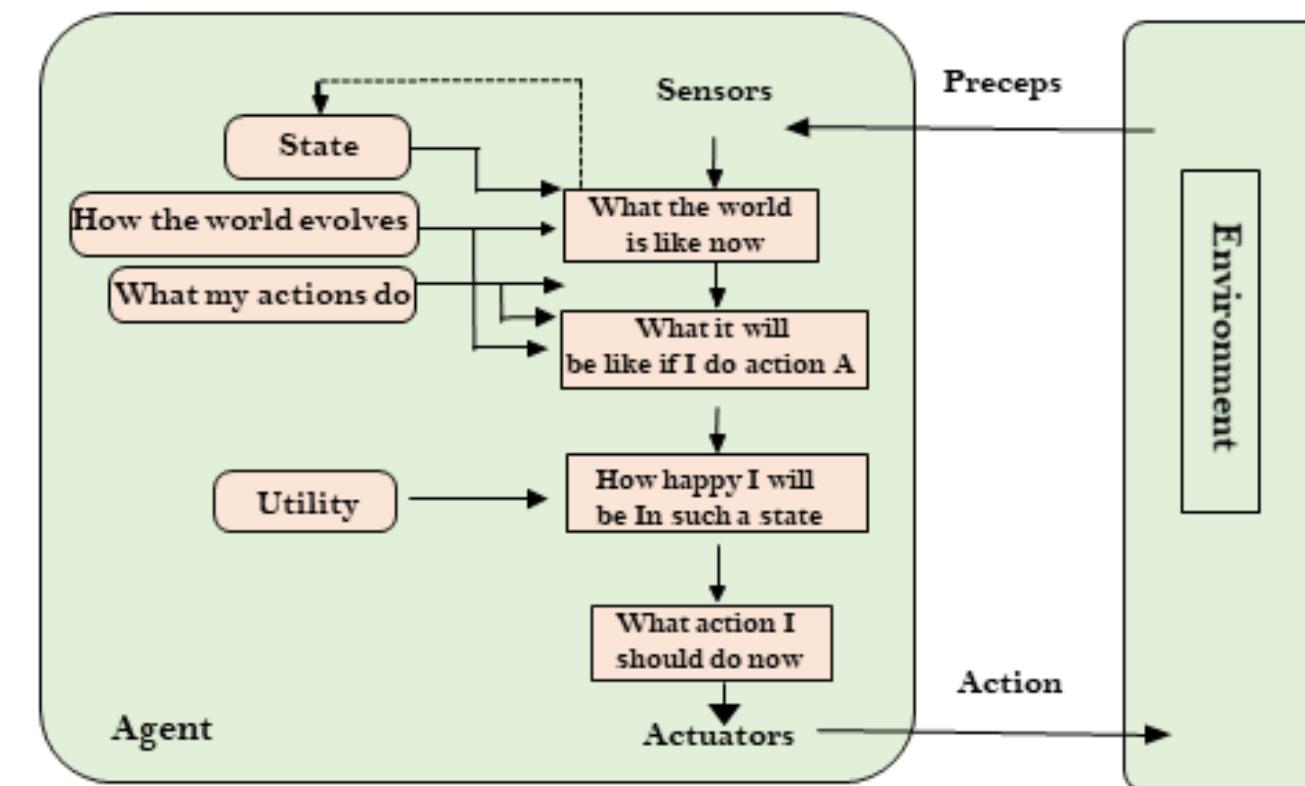


4. Utility-based agents

- These agents are similar to the goal-based agent.
- Utility-based agent act based not only goals but also the best way to achieve the goal.
- The Utility-based agent is useful when there are multiple possible alternatives, and an agent has to choose in order to perform the best action.
- The utility function maps each state to a real number to check how efficiently each action achieves the goals.



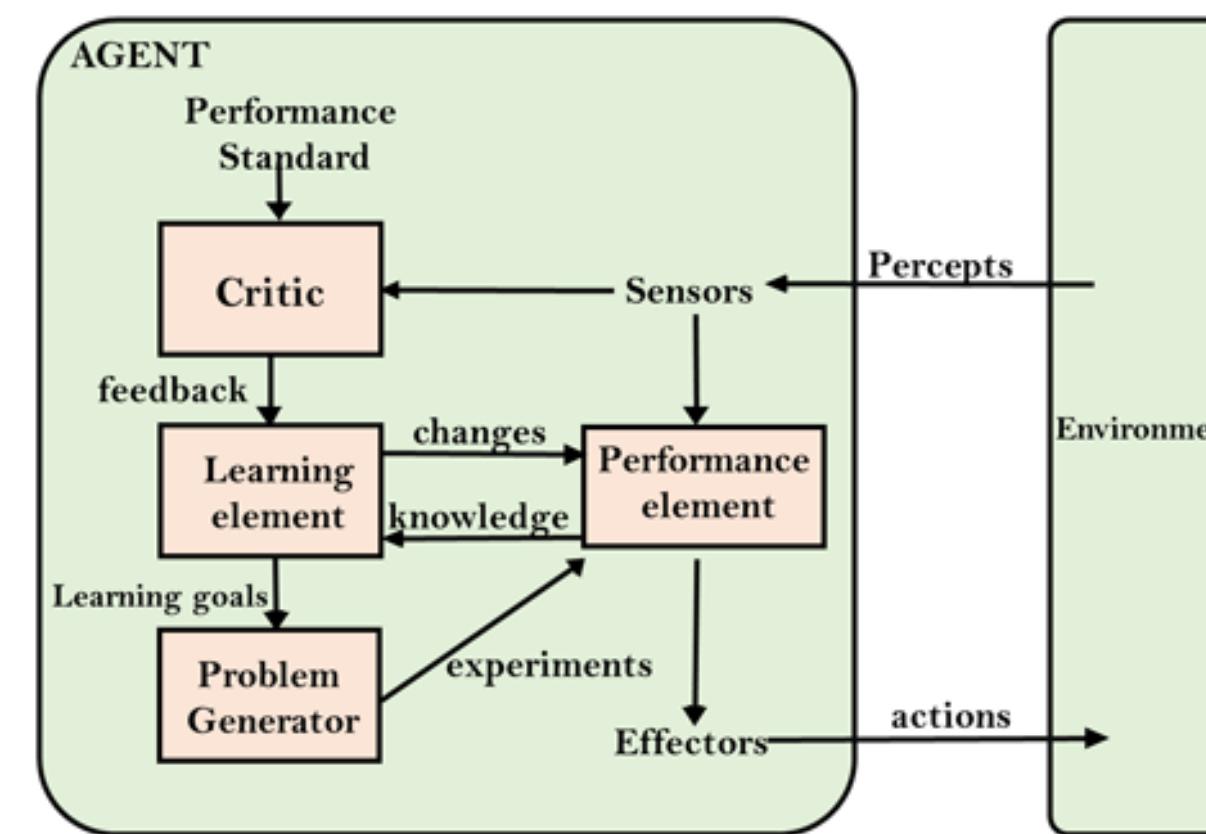
4. Utility-based agents



5. Learning agents

- A learning agent in AI is the type of agent which can learn from its past experiences, or it has learning capabilities.
- It starts to act with basic knowledge and then able to act and adapt automatically through learning.
- **A learning agent has mainly four conceptual components, which are:**
 - **Learning element:** It is responsible for making improvements by learning from environment
 - **Critic:** Learning element takes feedback from critic which describes that how well the agent is doing with respect to a fixed performance standard.
 - **Performance element:** It is responsible for selecting external action
 - **Problem generator:** This component is responsible for suggesting actions that will lead to new and informative experiences.

5. Learning agents



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Agent Environment in AI

Agent Environment in AI

- An environment is everything in the world which surrounds the agent, but it is not a part of an agent itself. An environment can be described as a situation in which an agent is present.
- The environment is where agent lives, operate and provide the agent with something to sense and act upon it. An environment is mostly said to be non-feministic.
- **Features of Environment**
 - Fully observable vs Partially Observable
 - Static vs Dynamic
 - Discrete vs Continuous
 - Deterministic vs Stochastic
 - Single-agent vs Multi-agent
 - Episodic vs sequential
 - Known vs Unknown
 - Accessible vs Inaccessible



1. Fully observable vs Partially Observable

- If an agent sensor can sense or access the complete state of an environment at each point of time then it is a fully observable environment, else it is partially observable.
- An agent with no sensors in all environments then such an environment is called as unobservable.

2. Deterministic vs Stochastic:

- If an agent's current state and selected action can completely determine the next state of the environment, then such environment is called a deterministic environment.
- A stochastic environment is random in nature and cannot be determined completely by an agent.

3. Single-agent vs Multi-agent

- If only one agent is involved in an environment, and operating by itself then such an environment is called single agent environment.
- However, if multiple agents are operating in an environment, then such an environment is called a multi-agent environment.

4. Static vs Dynamic

- If the environment can change itself while an agent is deliberating then such environment is called a dynamic environment else it is called a static environment.
- Static environments are easy to deal because an agent does not need to continue looking at the world while deciding for an action.
- Example: Taxi driving(DE), Crossword puzzles(SE).

5. Accessible vs Inaccessible

- If an agent can obtain complete and accurate information about the state's environment, then such an environment is called an Accessible environment else it is called inaccessible.
- An empty room whose state can be defined by its temperature is an example of an accessible environment.
- Information about an event on earth is an example of Inaccessible environment.





Characteristics and application of Learning Agents

Characteristics

- 1. Situatedness:** When an agent receive some form of sensory input from its environment, it then perform some actions that change its environment in some way.
- 2. Autonomy:** This agent characteristics means that an agent is able to act without direct intervention from humans or other agents this type of agent has almost complete control over its own actions and internal state
- 3. Adaptivity:** This agent characteristics means that it is capable of reacting flexibility to changes within its environment.
- 4. Sociability:** This type of characteristics means that the agent is capable of interacting in a peer to peer manner with other agents or humans.

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Applications

Classification

prediction

Search engines

Computer vision

Self driving car

Recognition of gestures.





Problem Solving Approach to Typical AI problems

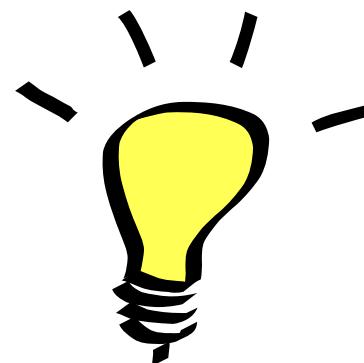
Problem-solving agent steps

According to computer science, a problem-solving is a part of artificial intelligence which encompasses a number of techniques such as algorithms, heuristics to solve a problem.

- **Goal Formulation:** It is the first and simplest step in problem-solving. It organizes the steps/sequence required to formulate one goal out of multiple goals as well as actions to achieve that goal.
- **Problem Formulation:** It is the most important step of problem-solving which decides what actions should be taken to achieve the formulated goal.
 - **Initial State:** It is the starting state or initial step of the agent towards its goal.
 - **Actions:** It is the description of the possible actions available to the agent.
 - **Transition Model:** It describes what each action does.
 - **Goal Test:** It determines if the given state is a goal state.
 - **Path cost:** It assigns a numeric cost to each path that follows the goal. The problem-solving agent selects a cost function, which reflects its performance measure. Remember, an optimal solution has the lowest path cost among all the solutions.

Problem-solving agent steps

- **Search:** It identifies all the best possible sequence of actions to reach the goal state from the current state. It takes a problem as an input and returns solution as its output.
- **Solution:** It finds the best algorithm out of various algorithms, which may be proven as the best optimal solution.
- **Execution:** It executes the best optimal solution from the searching algorithms to reach the goal state from the current state.



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Happy Ending!



Congratulations!

