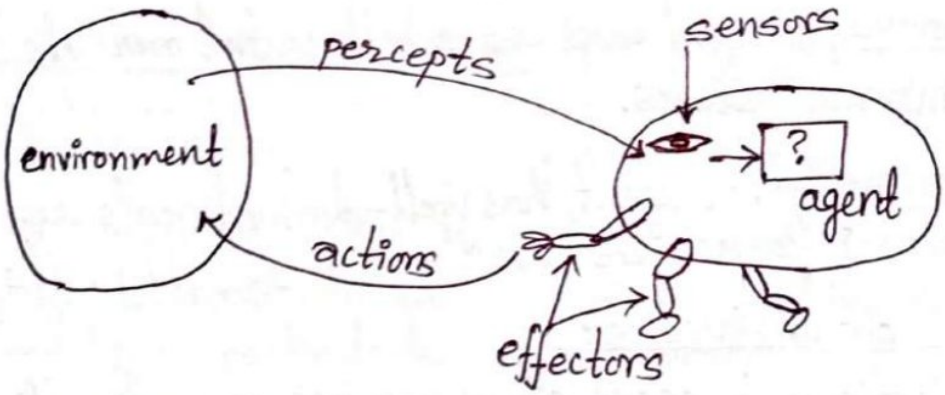
Unit-2
Intelligent Agents

⊛ Introduction:

An agent is anything that can be aware of its environment through sensors and acting upon that environment through actuators. Actuator is a device that causes machine or other devices to operate. An gent gets percepts one at a time and maps this percept sequence to actions.

Percepts → Percepts are the electrical signals from sensors after processing objects in visual field. (like location, colors, loudness, direction etc.)

Structure of intelligent agent:



Agent = Architecture + Program

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

Examples of agent:

i) A software agent → It has keystrokes, file contents, network packages which act as sensors and displays on the screen. Files, sent network packets acting as actuators.

ii) A Human agent → It has eyes, ears, and other organs which act as sensors and hand, legs, mouth etc acting as actuators.

iii) A Robotic agent → It has cameras and infrared range finders which act as sensors and various motors acting as actuators.

⑧ Properties of Intelligent Agents:

ⓐ Internal characteristics:

i) Learning → An agent has ability to learn from previous experience and to successively adapt its own behaviour to the environment.

ii) Reactivity → An agent must be capable of reacting appropriately to information from its environment.

iii) Autonomy → An agent must have both control over its actions and internal states.

iv) Goal-oriented → An agent has well-defined goals and gradually influence its environment to achieve its goals.

ⓑ External characteristics:

i) Communication → An agent often requires an interaction with its environment to fulfill its tasks, such as human and other agents.

ii) Cooperation → Cooperation of several agents provides better and faster solutions for complex tasks.

iii) Mobility → An agent may navigate with electronic communication networks.

iv) Character → Like human, an agent may demonstrate an external behaviour with many human characters as possible.

⑧ Rational Agent:

For each possible percept sequence, a rational agent is that which is expected to maximize its performance measure, given the evidence provided by the precept sequence and whatever built-in knowledge the agent has.

In short a rational agent is one that does right thing. Right thing or action is the one that will cause the agent to be most successful. At any given time rational agent depends on following four things:

i) The performance measure that defines the criteria of sucess.
ii) The agent's prior knowledge of the environment.
iii) The actions that the agent can perform.
iv) The agent's percept sequence to date.

⑨ Differences between AI and Omniscience:

AI	Omniscience
i) AI is simulation of human intelligence demonstrated by machines, particularly computer systems.	i) Omniscience refers to the capacity of knowing unlimited knowledge of all things that can be known.
ii) The idea is to get the machines to think for themselves and make decisions based on data being fed.	ii) Omniscience is the state of possessing unlimited or complete knowledge about all things possible.
iii) AI is based on algorithms created by humans to help the machines think and learn.	iii) It is an attribute given to the god alone because in reality, omniscience is impossible.

⊛. Configuration of Agent:

To design a rational agent we must specify its task environment. Task environment means: PEAS description of the environment.

P → Performance
E → Environment
A → Actuators
S → Sensors.

⊛. PEAS description of Agents:-

For PEAS description of agents let's take an example of fully automated taxi. Now, the agent type becomes taxi driver and PEAS description of task environment for an automated taxi is as follows:-

Performance → Safe, fast, legal, comfortable, maximize profits.

Environment → Roads, traffic signals, weather.

Actuators → Steering, accelerator, brakes, horn.

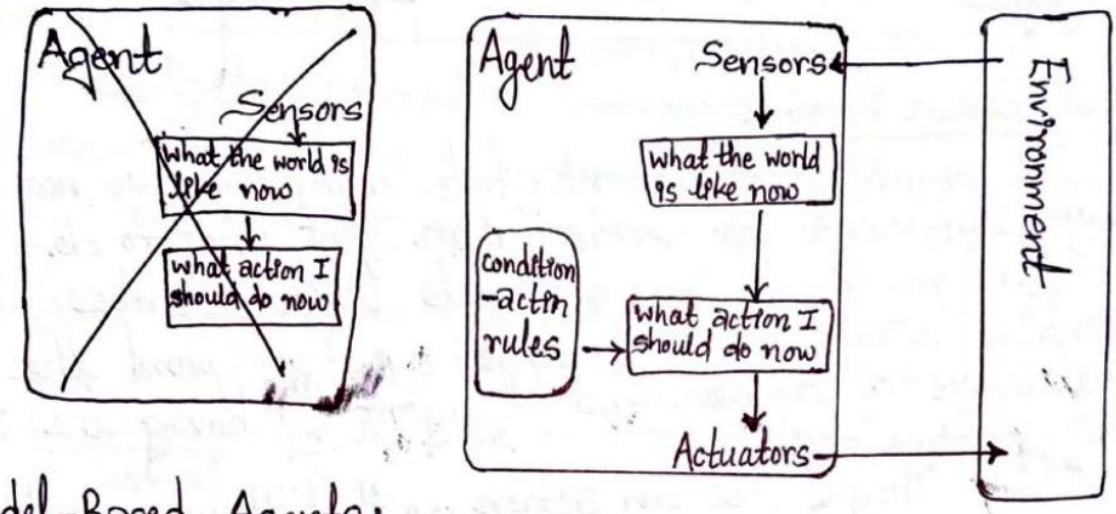
Sensors → Cameras, sonar, speedometer, GPS, odometer, engine sensors.

⊛. Types of 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. These agents only succeed in the fully observable environment.

The simple reflex agent works on condition-action rule, which means it maps the current state to action. ~~Such as~~ i.e, if the condition is true, then the action is taken, else not. Such as a Room Cleaner agent, it works only if there is dirt in the room.

The problem with simple reflex agent is that they have very limited intelligence and they are not adaptive to changes in the environment.



2. Model-Based Agents:-

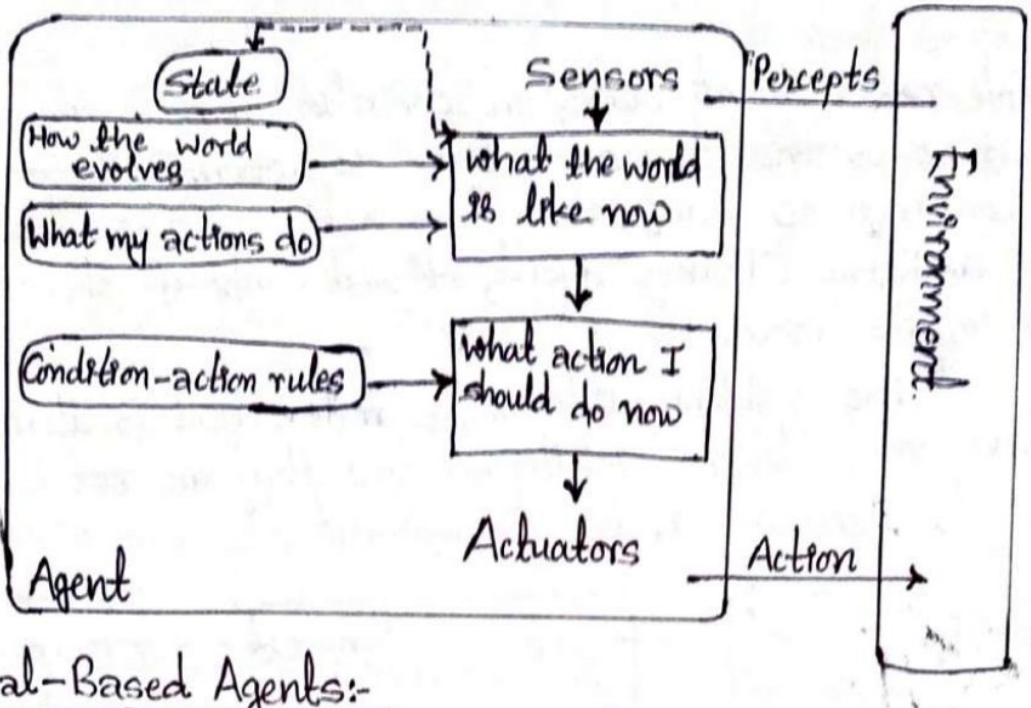
The model-based agent can work in a partially observable environment, and track the situation. A model-based agent has two important factors:

1. **Model:** It is knowledge about "how things happen in the world," so it is called a Model-based agent.
2. **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. Updating the agent state requires information about:

→ How the world evolves.

→ How the agent's action affects the world.



3. Goal-Based Agents:-

The knowledge of current state environment is not always sufficient to decide for an agent what to do. The agent needs to know its goals 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.

> Note: Figure is same as above figure just replace condition-action rules by Goals and some small changes only have a look once.

4. Utility-based agents:

These agents are similar to the goal based agent but provide an extra component of utility measurement which makes them different by providing a measure of success at a given state. Utility-based agent act based not only goals also the best way to achieve 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.

Note:- Figure is similar but small certain chages so look once.

5. Learning Agents:

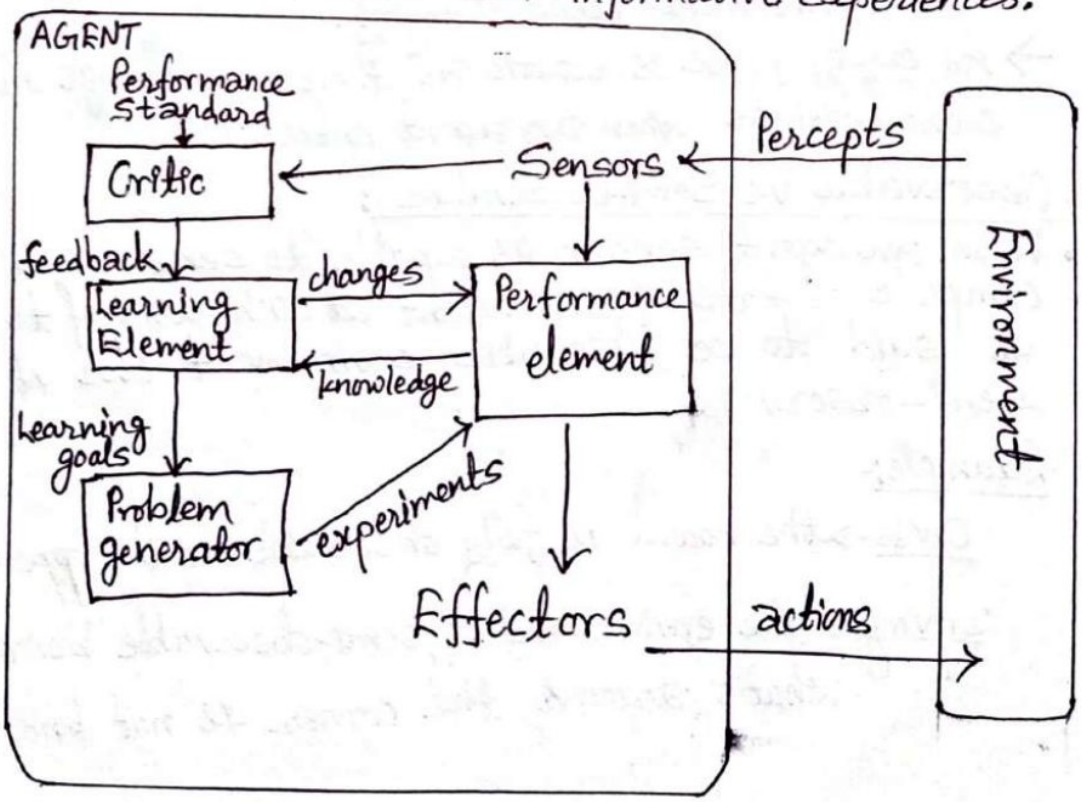
A learning agent in AI is the type of agent which can learn from its past experiences, or it has learning capabilities. It starts to act with basic knowledge and then able to act and adopt automatically through learning. Hence, learning agents are able to learn, analyze performance, and look for new ways to improve the performance. A learning agent has mainly four conceptual components, which are:-

i) Learning element → It is responsible for making improvements by learning from environment.

ii) Critic → It describes how well that agent is doing with respect to a fixed performance standard.

iii) Performance element → It is responsible for selecting external action.

iv) Problem generator → It is responsible for suggesting actions that will lead to new and informative experiences.



⊛. Environment Types:

1. Deterministic vs Stochastic:

- When an uniqueness in the agent's current state completely determines the next state of the agent, the environment is said to be deterministic.
- Stochastic environment is random in nature which is not unique and cannot be completely determined by the agent.

Example:

Chess → there would be only few possible moves for a coin at the current state and these moves can be determined.

Self Driving Cars → the actions are not unique, it varies time to time.

2. Dynamic vs Static:

- An environment that keeps constantly changing itself when the agent is up with some action is said to be dynamic.
- An idle environment with no change in its state is called a static environment.

Example:

→ A roller coaster is dynamic as it is set to motion and the environment keeps changing.

→ An empty house is static as there's no change in the surroundings when an agent enters.

3. Observable vs Semi-Observable:

- When an agent sensor is capable to sense or access the complete state of an agent at each point of time, it is said to be observable environment else it is semi-observable.

Example:-

Chess → the board is fully observable, so the opponent moves.

Driving → the environment is semi-observable because what is around the corner is not known.

4. Single-agent vs Multi-agent:

- An environment consisting of only one agent is said to be a single agent environment.
- An environment involving more than one agent is a multi agent environment.

Example:

→ A person left alone in a maze is an example of single agent system.

→ The game of football is multi agent as it involves 10 players in each team.

5. Discrete vs Continious:

- The environment in which the actions performed ~~cannot~~ can be numbered is said to be discrete environment.
- The environment in which the actions performed cannot be numbered is said to be continious environment.

Example:

→ The game of chess is discrete as it has only finite number of moves. The number of moves might vary with every game, but still, it's finite.

→ Self-driving cars are continious as their actions like driving, parking etc. cannot be numbered.