Unit-2: Intelligence Agents

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Introduction: (Agent / Intelligent agent)

→ 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

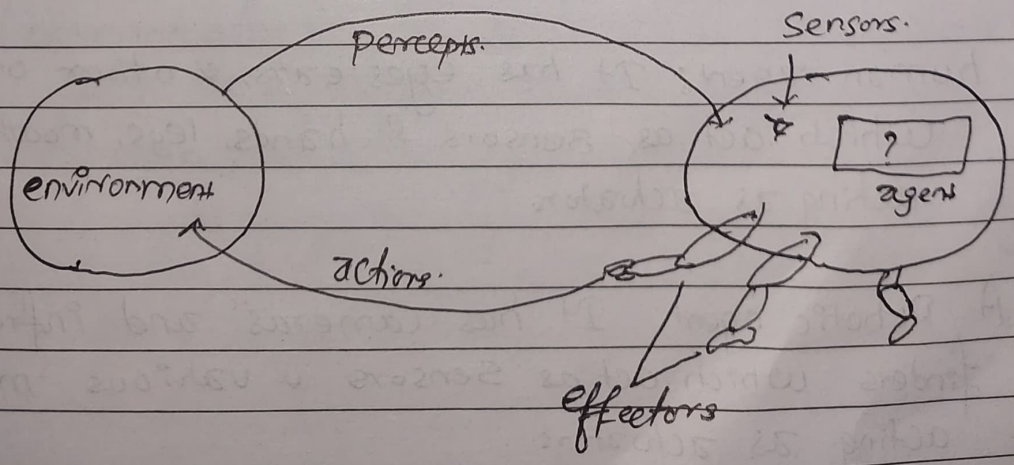
→ An agent gets percepts one at a time and maps this percept sequence to actions

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

Structure of intelligent agent:

→ An intelligent agent is anything which perceives its environment, takes actions autonomously in order to achieve goals, & may improve its performance with learning or may use knowledge.

→ It interacts with surroundings via:- perception through sensors & actions through effectors or actuator.



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Agent = Architecture + function + program.

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The Intelligence Agent consists of three main part: architecture, agent function & agent program

1. Architecture: This refers to machinery or devices that consists of actuators & sensors. The intelligent agent executes on this machinery. Ex: personal computer, a car, or a camera.

2. Agent function: This is a function in which actions are mapped from a certain percept sequence. Percept sequence refers to the history of what the intelligent agent has perceived.

3. Agent Program: It is the implementation or execution of the agent function. The agent function is produced through the agent program's execution on the physical architecture.

* example 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, & other organs which act as sensors & hands, legs, mouth etc acting as actuators.

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

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* Properties of Intelligent Agents:

(a) Internal Characteristics:

* learning → An agent has the ability to learn from previous experience & to successively adopt its own behaviour to the environment

* Reactivity → An agent must be capable of reacting appropriately to information from its environment

* Autonomy → An agent must have control over its action and internal states.

* Goal-Oriented → An agent has well-defined goals and gradually influence its environment to achieve its goals

(b) External Characteristics:

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

* Cooperation → Cooperation of several agents provides better & faster solutions for complex problems.

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* Mobility : An agent may navigate with electronic communication networks.

* Character : Like human, an agent may demonstrate an external behaviour with many human characters as possible.

Rational agent

→ A rational agent is one that does right thing. Right thing or action is the one cause the agent to be most successful.

→ A rational agent could be anything that makes decisions, as a person, firm, machine, or software. It carries out an action with the best outcome after considering past and current percepts.

At any given time rational agent depends on following four things:

i) The performance measure that defines the criteria of success
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.

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* 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:-

→ The PEAS description of Agent Human :

- Sensors : Eyes (vision), ears (hearing), skin (touch), tongue (gestation), nose (olfaction).
- Percepts :
  - ⇒ At the lowest level - electrical signals from these sensors.
  - ⇒ After preprocessing - objects in the visual field. (location, textures, colors ---), auditory streams (pitch, loudness, direction, ----)
- Effectors : limbs, eyes, tongue ----
- Actions : lift a finger, turn left, walk, run, carry an object.

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Agent = taxi driver

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→ Lets take an example of fully automated taxi. Now, the agent type becomes taxi driver & 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, speedometer, GPS, odometer, sonar engine sensors.

→ Agent = Medical diagnosis system

Performance: Healthy patient, minimize costs, lawsuit

Environment: Patient, hospital, staff

Actuators: Screen display (questions, tests, diagnoses, treatments, referrals)

Sensors: Keyboard (entry of symptoms, findings, patients, answers)

Types of Agents:
- Simple reflexive agent
- Model based agents
- Goal Based agents
- Utility Based agents

Simple reflexive agents

→ They are the most simple agents.
→ They take decisions on the basis of the current percepts & ignore rest of the percept history.
Note: Percept history is the history of all that an agent has received till date.
→ The agent function is based on the condition-action rule. A condition action rule is a rule that maps a state. ie. condition to an action. If the condition is true, then the action is taken, else not.

Problems:
- Very limited intelligence
- No knowledge of non-perceptual parts of state.
- Usually too big to generate & store.
- If there occurs any change in the environment, then the collection of rules need to be updated.

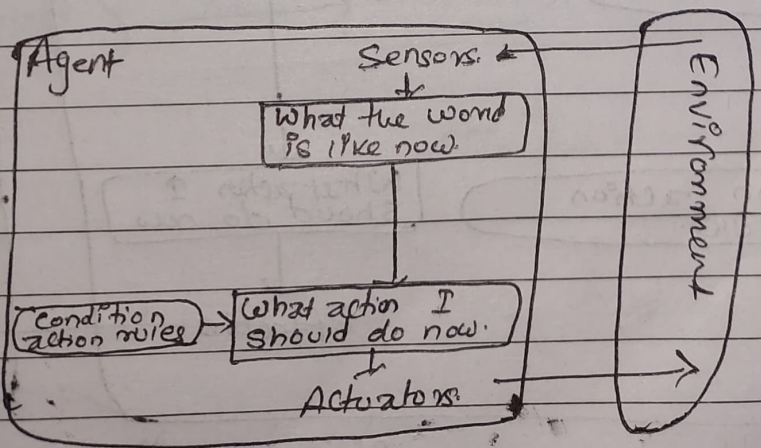

Fig: Ex. of simple reflexive agent

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Model-Based Agents

→ It works by finding a rule whose condition matches the current situation

→ A model-based agent can handle partially observable environments by use of model about the world

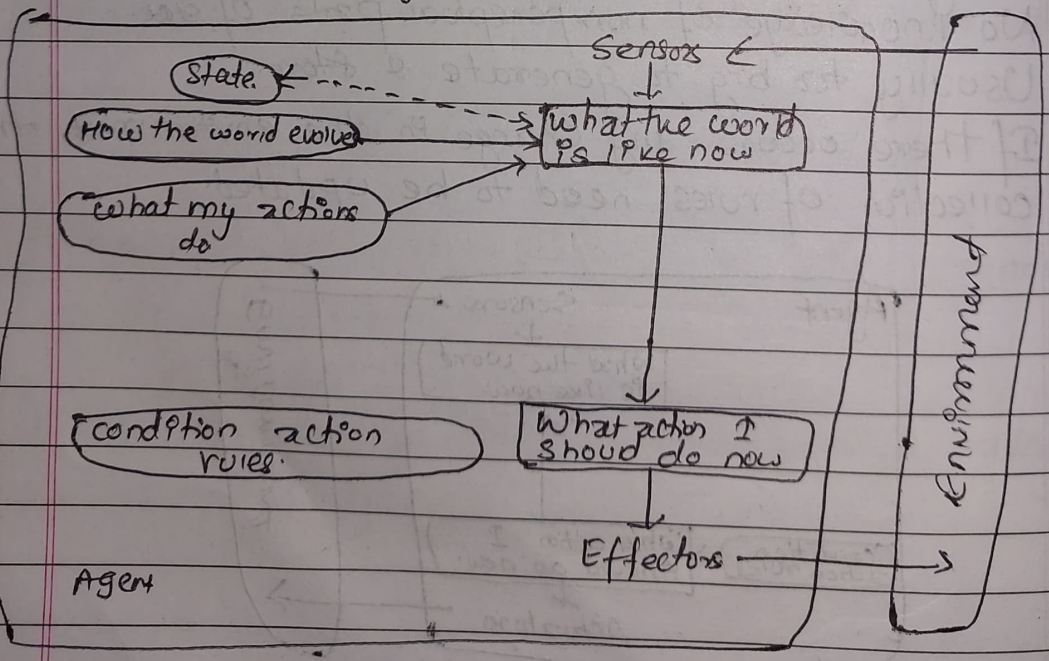
A model-based agent has two important factor.

- Model: It is the knowledge about "how things happen in the world" so, it is called model-based agent

- Internal state: It is a representation of the current state based on percept history.

→ These agents have a model & 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



model based agent: simple reflex agent + model

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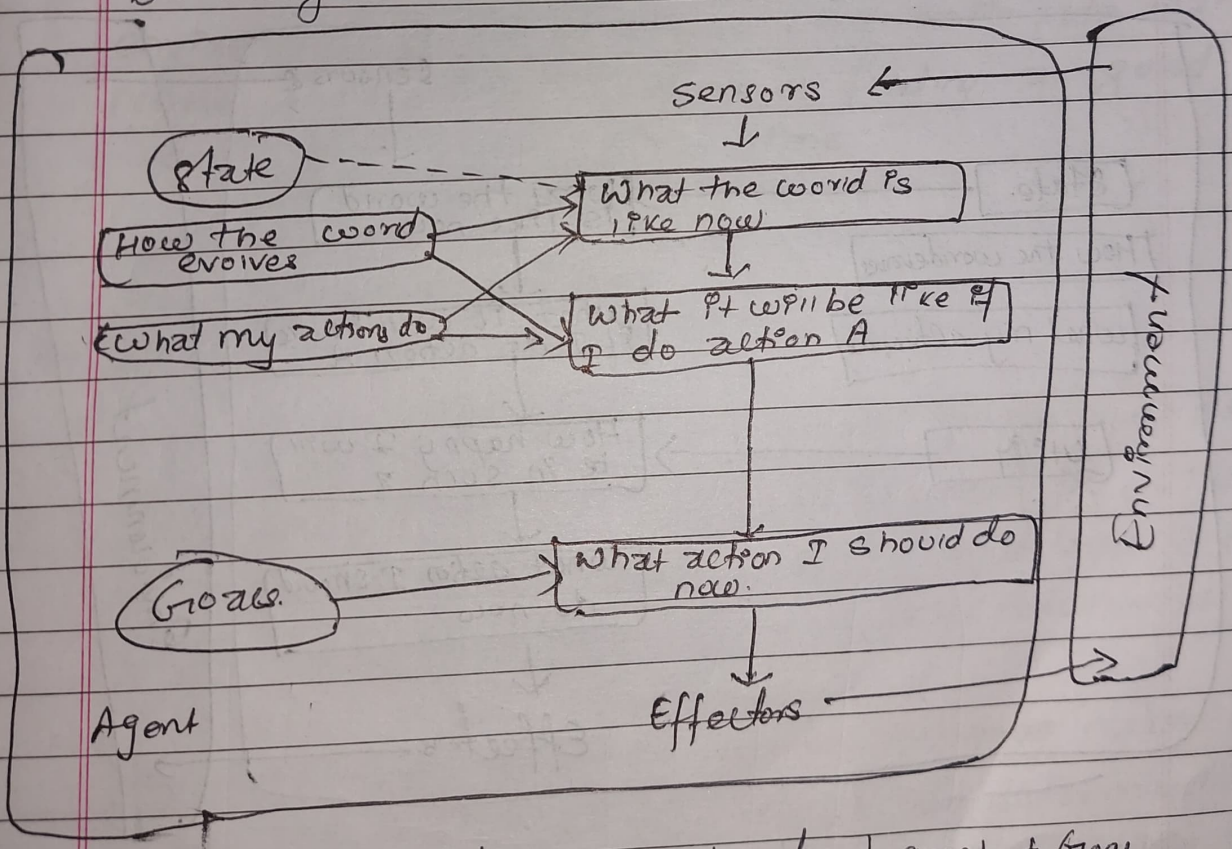
Goal based Agents.

→ These kinds of agents take decision based on how far they are currently from their goal. Their every action is intended to reduce its distance from goal. This allows the agent a way of choosing among multiple possibilities, selecting the one which reaches a goal state.

→ The knowledge that supports its decisions is represented explicitly and can be modified, which makes these agents more flexible. They usually require searching & planning. The goal based agent's behaviour can easily be changed.



Goal based agent = Model based agent + Goal

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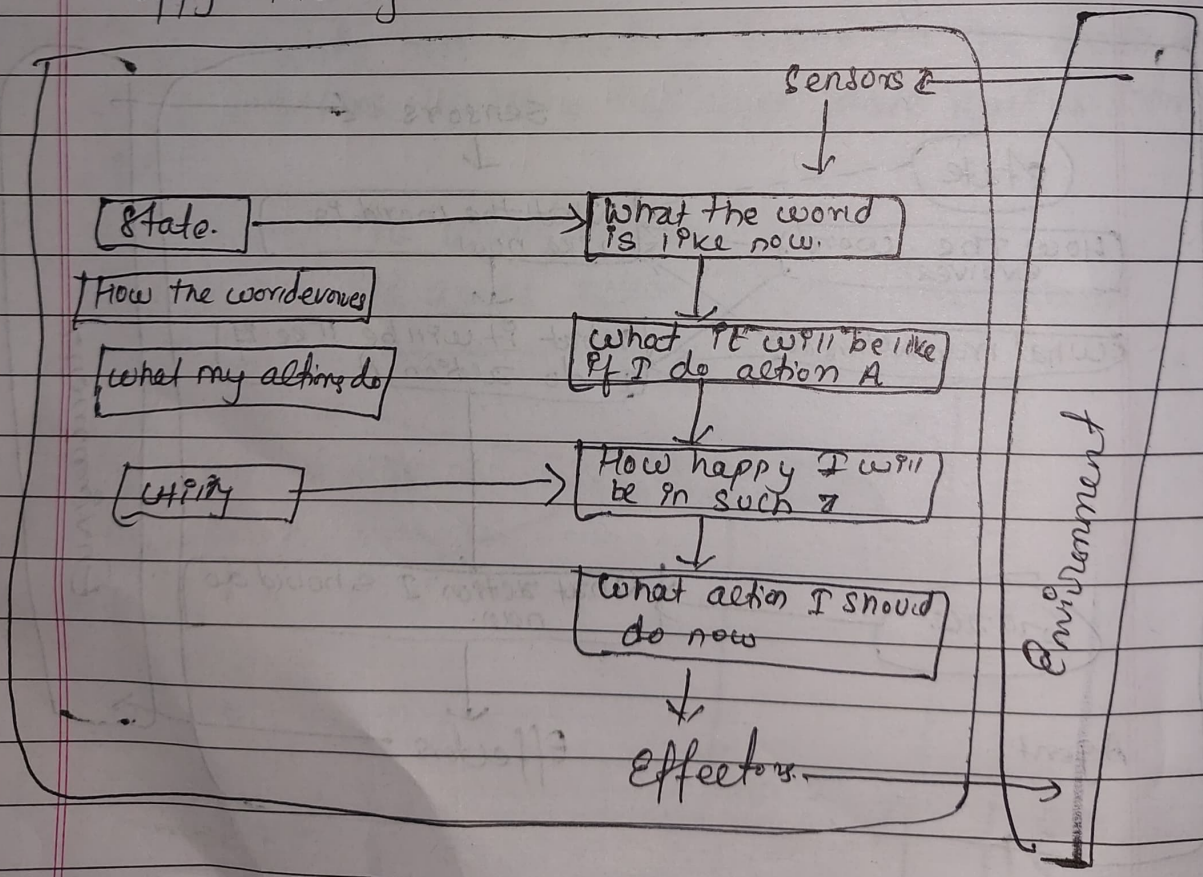
Utility based Agents

→ The agents which are developed having their end uses as building blocks are called utility based agents. When there are multiple possible alternatives, then to decide which one is best, utility based agents are used They choose actions based on the preference. (utility) for each state.

→ Sometimes achieving the desired goal is not enough. We may look for quicker, safer, cheaper trip to reach a destination. ie. Agent happiness should be taken for consideration. Utility describes how "happy" the agent is



Utility based agent = (Goal based agent + utility

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* Environment Types (on the basis of Properties)

There are several aspects those distinguish AI environments. The shape & frequency of data, the nature of the problem and so on. There are several categories we use to group AI problems based on the nature of the environment.

- Complete vs. Incomplete

complete AI environments are those on which, at any given time, we have enough information to complete a branch of the problem. ex: Chess.

On the other hand, Poker is an example of incomplete environment as AI strategies can't anticipate many moves in advance, they focus on finding a good 'equilibrium' at any given time.

- Deterministic vs. stochastic

An environment is deterministic if the next state of the environment is solely determined by the current state of the environment & the actions selected by the agents. Ex: Chess. (Its moves are determined)

Stochastic environment is random in ~~order~~ nature which is not unique & cannot be completely determined by the agent. Ex: Self driving cars : the actions are not unique, it varies from time to time.

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- Static vs. Dynamic

An idle environment with no change in its state is called a static environment. Ex: an empty house is static, as there's no change in the surroundings when an agent enters.

An environment that keeps constantly changing itself when the agent is up with some action is said to be dynamic. Ex: A roller coaster is dynamic as it is set to motion & the environment keeps changing

- Discrete vs. Continuous

The environment in which the actions performed can be numbered is said to be discrete environment. It means finite set of possibilities can drive the final outcome of the task. Ex: Chess (no. of moves is different in every game but finite)

Continuous AI environments rely on rapidly changing data sources. The actions performed cannot be numbered. Ex: self driving cars are continuous as their actions like driving, parking, etc cannot be numbered

- Competitive vs collaborative.

Competitive AI environments face AI agents against each other in order to obtain the best possible outcome Games like chess is an example of competitive AI environments

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Collaborative AI environments rely on the cooperation between multiple AI agents. Ex: self driving cars are cooperating to avoid collisions or smart home sensors interactions are examples of collaborative AI env.

Football game is an example of both competitive and collaborative environment.

- Fully observable vs. Partially observable

A fully observable AI environment has access to all required information to complete target task. Ex: Chess: the board is fully observable, so the opponent moves

Partially observable AI environment doesn't have full access to all required information to complete target task. Ex: driving: the environment is semi-observable because what's around the corner is not known.

- Single-agent vs Multiple-agent:

An environment consisting of only one agent is said to be a single agent environment. Ex: A person left alone in a maze.

An environment involving of more than one agent is said to be multiple agent environment. Ex: The game of football is multi agent as it involves 10 players in each team.

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Questions asked from this chapter.

Q. How agent can be configured using PEAS framework? Illustrate with example (2078 - 5 marks)

Q. What do you mean by rational agents? Are the rational agents intelligent? Explain (2075 - 5 marks)

Q. What is intelligent agent? Design PEAS framework for,.

① Soccer playing agent

Soln * Performance Measure (P): To play, Make Goal & win the Game.

* Environment (E): Soccer, Team members, opponents, Refree, Audience, & Soccer Field.
* Actuators (A): Navigator, Legs of Robot, Voice Detectors
* Sensors (S): Camera, Touch sensors, etc.

② Internet Shopping Assistant

Soln Performance Measure (P): Price, Quality, efficiency.
Environment (E): WWW sites, Vendors, shippers.
Actuators (A): display to user, follow URL, fill in form
Sensors : HTML pages (text, graphics, scripts).

Q. What are intelligent agents? Differentiate between Model based agents & utility based with examples. (2076 - 5 marks)

Q. Discuss the types of environment where an agent can work on. (2076 - 5 marks)

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