Department of Computer Engineering

T.E. (Computer Sem VI) Assignment -1 Artificial Intelligence (CSC604)

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CO Addressed:–CSC604.1 -To conceptualize the basic ideas and techniques underlying the design of intelligent systems.

Assignment 1:

1. Explain the concept of rationality in the context of intelligent agents. How does rationality relate to the behavior of agents in their environments? Provide examples to illustrate your explanation.
2. Discuss the nature of environments in which intelligent agents operate. What are the key characteristics that define an environment, and how do they influence the design and behavior of agents? Provide examples of different types of environments and the challenges they present to agents.
3. Describe the structure of intelligent agents and the types of agents commonly used in artificial intelligence. What are the components of an agent, and how do they interact to achieve intelligent behavior? Provide examples of different types of agents and their applications in real-world scenarios.
4. Outline the process of problem-solving by searching, including the role of problem-solving agents and the formulation of problems. How do problem-solving agents analyze and approach problems, and what methods do they use to search for solutions? Illustrate your explanation with examples of problem-solving tasks and the strategies employed by agents to solve them.

Rubrics for the First Assignments:

Indicator	Average	Good	Excellent	Marks
Organization (2)	Readable with some missing points and structured (1)	Readable with improved points coverage and structured (1)	Very well written and fully structured	
Level of content(4)	All major topics are covered, the information is accurate (2)	Most major and some minor criteria are included. Information is accurate (3)	All major and minor criteria are covered and are accurate (4)	
Depth and breadth of discussion and representation(4)	Minor points/information maybe missing and representation isminimal (1)	Discussion focused on some points and covers themadequately (2)	Information is presented indepth and is accurate (4)	
Total				

Signature of the Teacher

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Assignment - 1

Q1] Explain the concept of rationality in the context of intelligent agents. How does rationality relate to the behaviour of agents in their environment? Provide example to illustrate your explanation.

—> Rationality: The state of being reasonable, sensible and having a sound sense of judgement is known as rationality. Rationality is concerned with the predicted behaviours and outcomes based on the agents perceptions. An essential aspect of rationality is taking activities intending to collect valuable knowledge.

Rationality at any given time depends on four things

- The performance measure that defines the criterion of sucess
- The agent's prior knowledge of the environment
- The actions that the agent can perform
- The agent's percept sequence to date.

Rational Agent: For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

- The behaviour of rational agents is guided by the principle of achieving the best outcome or maximizing expected utility. It involves making decisions based on reasoning, logical inference, and learning from experience.
- Key components and the relationships between rationality and the behaviour of agents in their environments.

→ Goals and objectives
→ Information and Perception
→ Decision-Making
→ Adaptation and Learning
→ Consistency and Coherence
→ Expected utility
→ Trade-offs and constraints.

Eg. Simple vaccuum-cleaner agent that cleans a square if it is dirty and moved to the other square if not, But here we need to say ~~that~~ what the performance measure is, what is known about the environment, and what sensors and actuators the agent has.

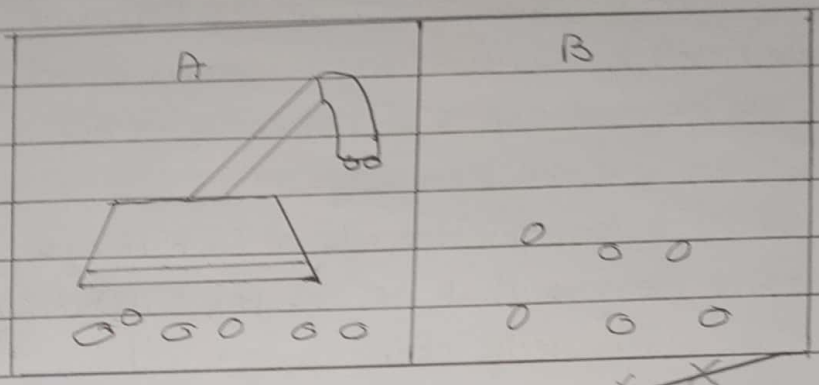


Fig: A vaccum - cleaner with just two locations

Percept Sequence	Action
[A, Clean]	Right
[A, Dirty]	Suck
[B, Clean]	Left
[B, Dirty]	Suck
[A, Clean], [A, clean]	Right
[A, Clean], [A, Dirty]	Suck
⋮	⋮
[A, clean], [A, clean], [A, clean]	Right
[A, clean], [A, clean], [A, Dirty]	Suck.

Q2] Discuss the nature of environments in which intelligent agents operate. What are the key characteristics that define an environment, and how do they influence the design and behavior of agents? Provide examples of different types of environments and the challenges they present to agents?

→ An environment in AI is the surrounding of the agent. The agent takes input from the environment through sensors and delivers the output to the environment through actuators. There are several types of environment.

1] Full observable vs Partially observable.

→ When an agent is capable to sense or access the complete state of an agent at each point in time, it is said to be a fully observable environment

→ When the agent has limited or incomplete information about the current state.

Example: Chess - The board is fully observable, and so are the opponent's moves

Driving - The environment is partially observable because what's around the corner is not known.

2] Deterministic vs Stochastic

→ When a uniqueness in the agent's current state completely determines the next state of the agent, the environment is said to be "deterministic"

→ The "stochastic environment" is random in nature which is not unique and cannot be completely determined by the agent.

Example:- Chess - There would be only a few possible moves for a coin at the current state and these moves can be determined.

Self-Driving Cars - The actions of a self-driving car are not unique, it varies time to time.

3] Competitive VS Collaborative

→ An agent is said to be in a "competitive environment" when it competes against another agent to optimize the output.

→ An agent is said to be in a "collaborative environment" when multiple agents cooperate to produce the desired output.

Example: Financial markets, where traders compete to maximize profits, potentially at the expense of others.

Example: Team-based projects in business, where members collaborate to achieve project objectives.

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 the "single-agent" system.

Example: The game of football is multi-agent as it involves 11 players in each team.

5] Static VS Dynamic

→ An idle environment with no change in its state is called a static environment.

→ An environment that keeps constantly changing itself when the agent is up with some action is said to be dynamic.

Example: An empty house is static as there's no change in the surrounding when an agent enters

Example: A roller coaster ride is dynamic as it is set in motion and the environment keeps changing every instant.

6] Discrete vs Continous.

-> If an environment consists of a finite number of actions that can be deliberated in the environment to obtain the output, it is said to be a discrete environment.

-> The environment in which the actions are performed cannot be numbered i.e is not discrete, is said to be continous.

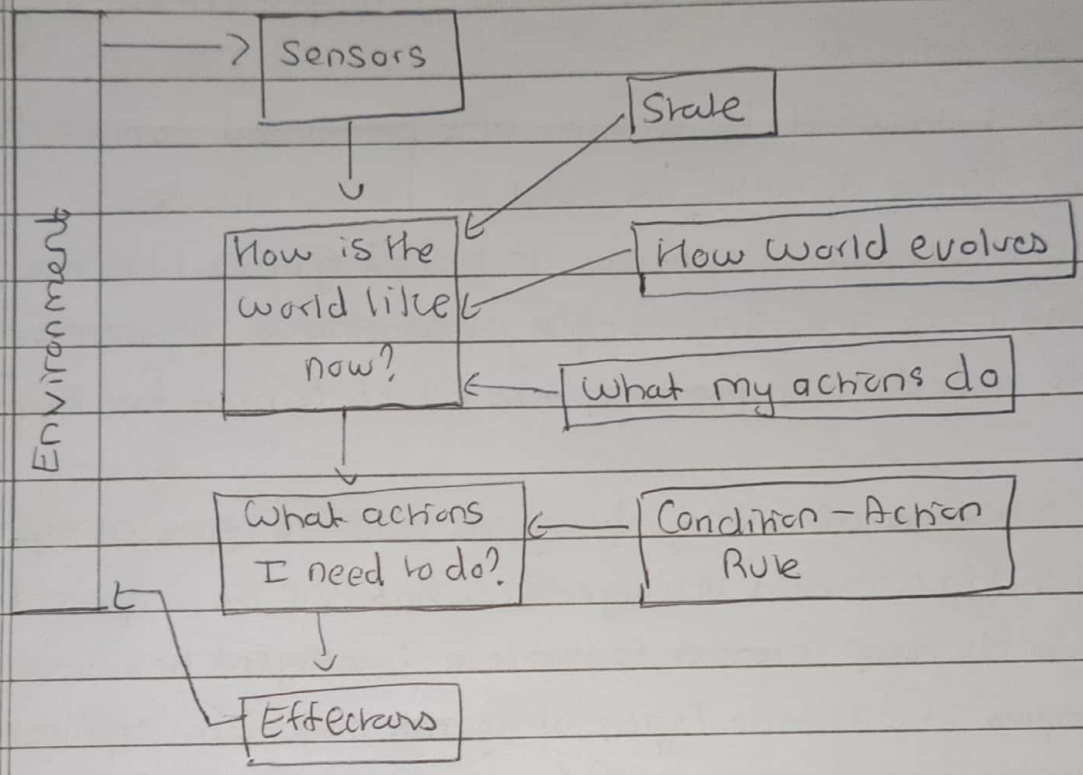
Example: Discrete grid worlds in robotics or board games like chess

Example: Self-driving cars are an example of continous environment as their actions are driving, parking, etc which cannot be numbered.

Q3 Describe the structure of intelligent agents and the types of agents commonly used in artificial intelligence. What are the components of an agent, and how do they interact to achieve intelligent behaviour? Provide examples of different types of agents and their applications in real-world scenarios.

-> The Intelligent Agent (IA) structure consists of three main parts: Architecture, Agent function and Agent programme.

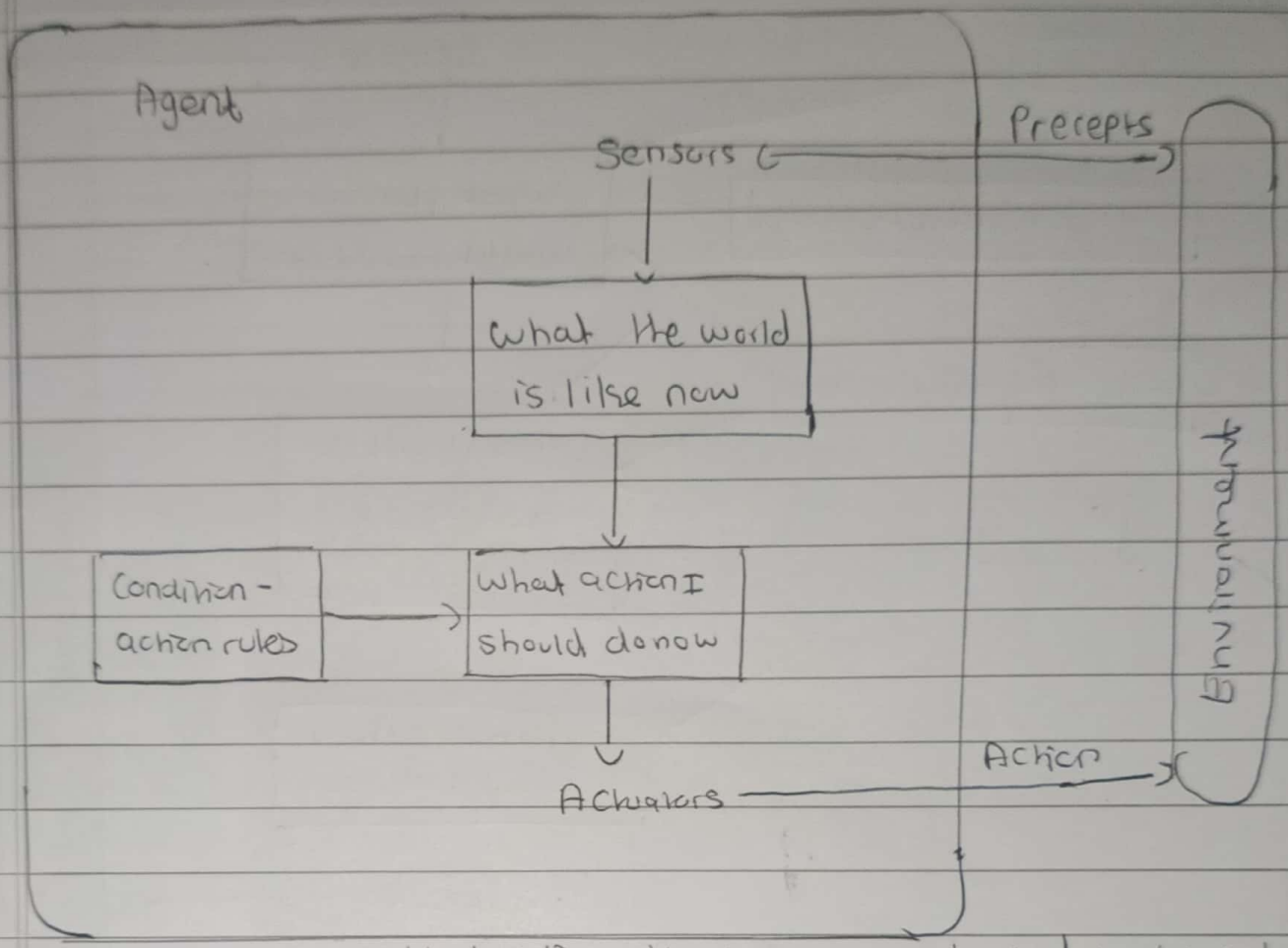
-> Architecture refers to machinery or devices that consist of actuators and sensors. The IA executes on this machinery. The tool allows the adjusting of image details and clarities. Using this tool we can obtain great detail or get a smoother picture with less detail. This is the main tool to increase the ~~co~~contrast of the image and visualize more details of the image.



Types of agents commonly used in artificial intelligence are as follows.

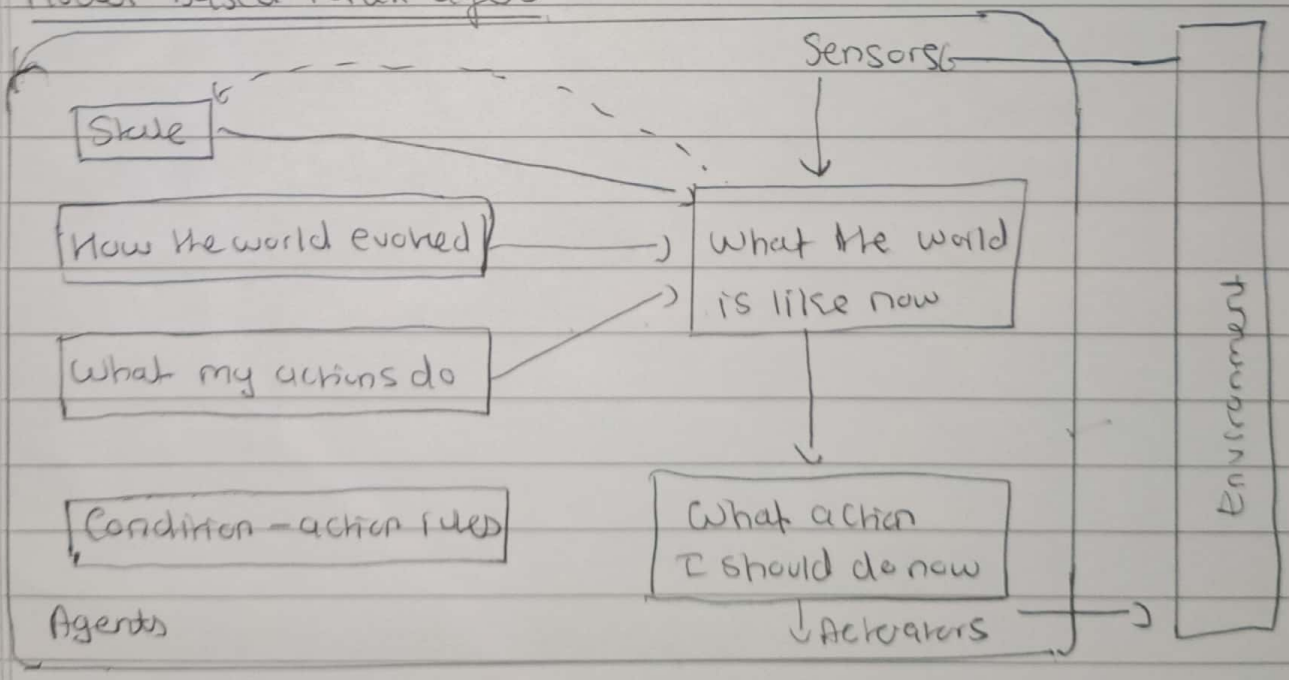
(1) Simple reflex agents
(2) Model - based reflex agents
(3) Goal - based agents
(4) Utility - based agents.

Simple reflex agents



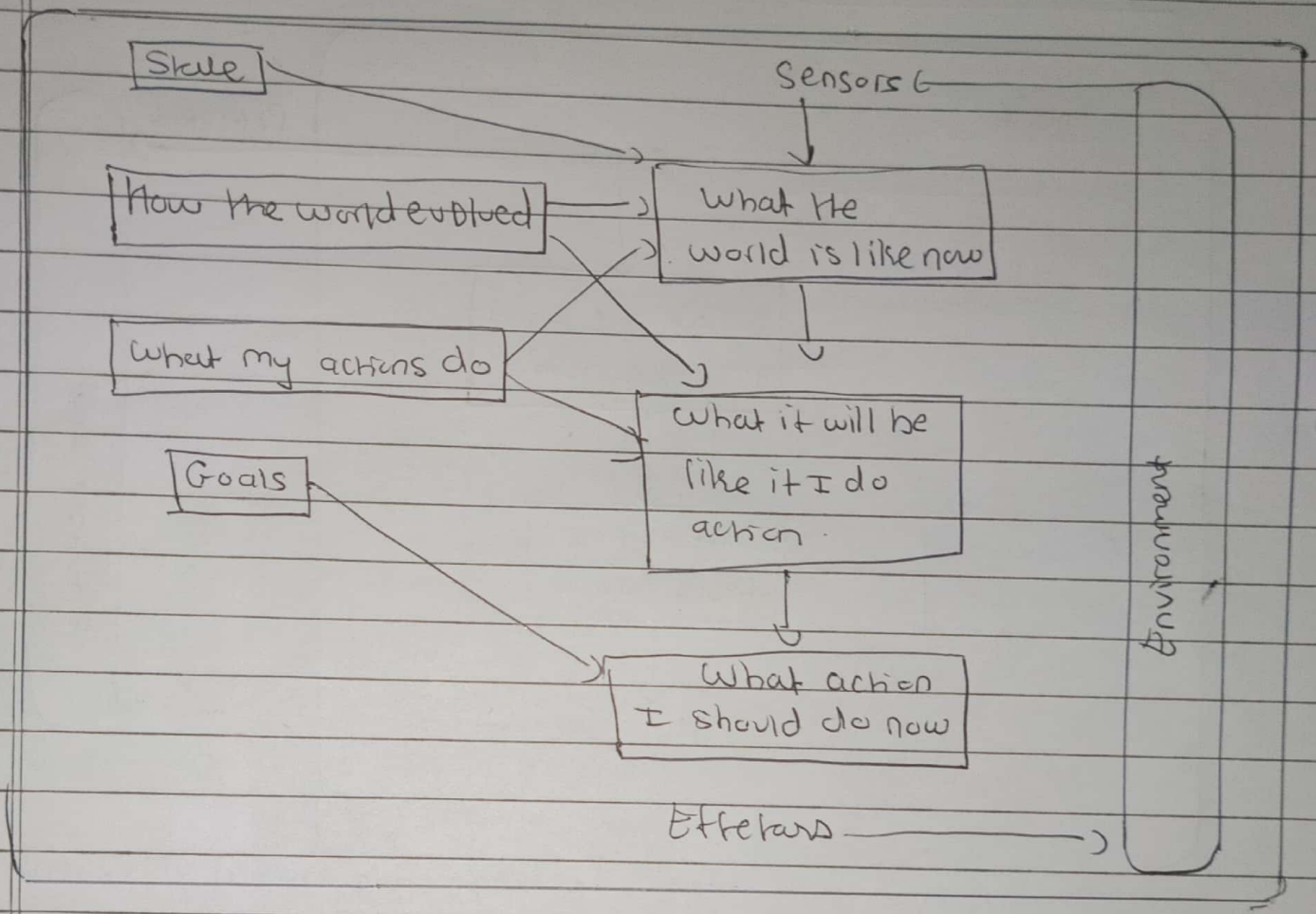
Eg: Thermostat that adjusts the temperature based on current readings

Model-based reflex agent



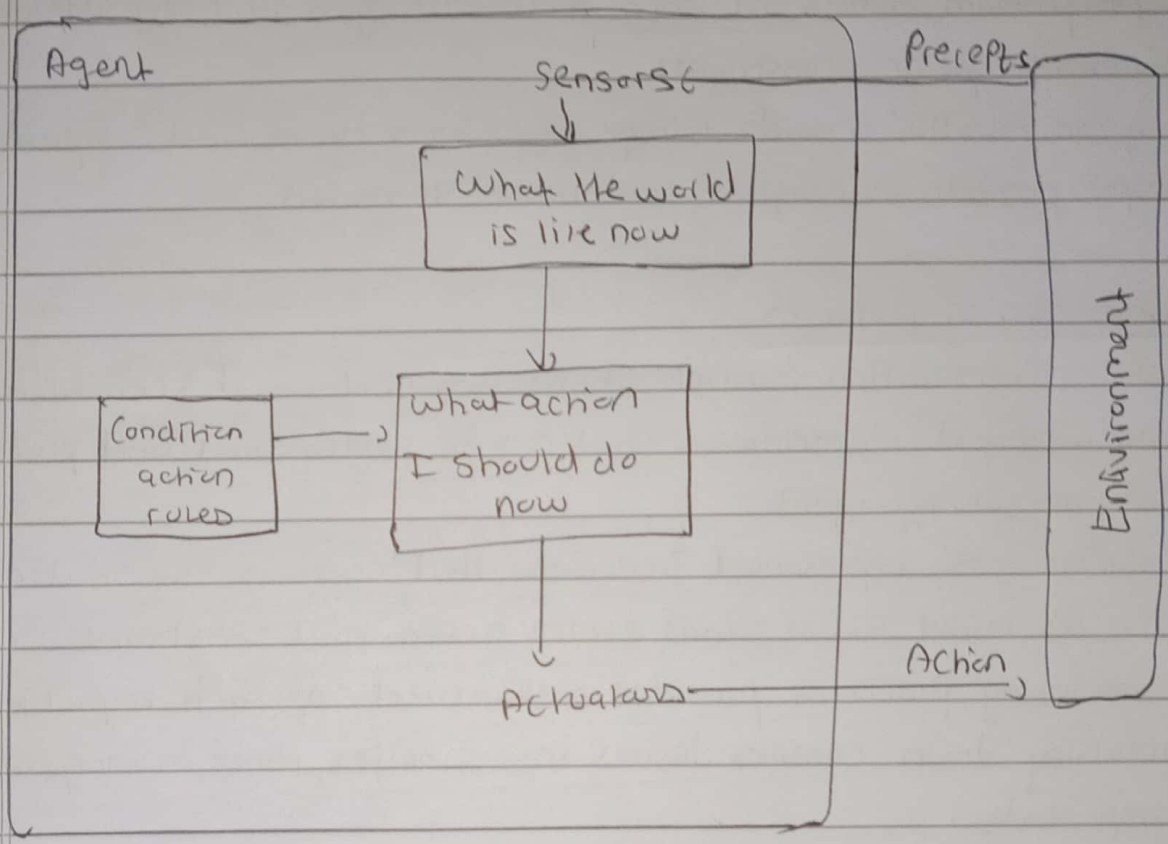
Eg: A vacuum cleaning robot that uses a map of room to decide where to clean next

Global-based Reflex Agent-



Eg: Delivery Drone that navigates to deliver packages to specific location.

Utility-Based Better Agent.



Eg: A personal assistant app that schedules tasks based on user preferences and priorities.

Q4] Outline the process of problem-solving by searching, including the role of problem-solving agents and the formulation of problems. How do problem-solving agents analyze and approach problems, and what methods do they use to search for solutions?
Illustrate your explanation with examples of problem-solving tasks and the strategies employed by agents to solve them.

→ Role of problem-solving agents.

1] Problem-solving agents operate independently making decisions and taking actions to achieve desired goals without human intervention

2] These agents are designed to efficiently explore and navigate problem spaces to find optimal or satisfactory solutions.

3] Problem-solving agents can adapt to changes in their environment or problem domain adjusting their strategies to accomodate new information or new constraints.

4] They can handle a wide range of problem types and complexities from simple puzzels to complex real-world scenarios.

Formulation of problems

1] Problem formulation involves abstracting real-world scenarios into a formal representation that can be understood and processed by problem-solving agents.

2] Problems are represented in a way that captures essential elements such as initial states, goal states action and constraints.

3] Formulating problems provides a structured approach to problem-solving, breaking down complex issues into smaller, more manageable components.

Methods used for searching solutions:

1] Uninformed search: Agents explore the problem space systematically without consideration of domain specific knowledge.
Eg: Breadth first search, depth-first search.

2] Informed search Agents use domain specific knowledge or heuristics to guide the search towards promising solutions Eg: A* search, greedy best-first search

3] Local search agents - Agents iteratively improve candidate solutions by making small modifications.

4] Examples:-

1] Routing Planning:- In navigation systems, problem-solving agents search for the shortest path between two locations and they analyze the road network considers traffic conditions and employ algorithms like A* to find optimal routes.

2] Puzzle Solving:- In games like Sudoku or Rubik's cube agents aim to find solutions satisfying certain constraints. They analyze the puzzle's initial state explore possible moves and ~~use~~ use strategies like constraint propagation or backtracking to solve the puzzle.

3] Automated planning:- In robotics or automated systems problem solving agents plan sequences of actions to achieve desired outcomes. They analyze the environment considers constraints and employ planning algorithms like PDSL to generate action sequences.