

## 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:**

<b>Indicator</b>	<b>Average</b>	<b>Good</b>	<b>Excellent</b>	<b>Marks</b>
<b>Organization (2)</b>	Readable with some missing points and structured (1)	Readable with improved points coverage and structured (1)	Very well written and fully structured	
<b>Level of content(4)</b>	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)	
<b>Depth and breadth of discussion and representation(4)</b>	Minor points/information maybe missing and representation is minimal (1)	Discussion focused on some points and covers them adequately (2)	Information is presented indepth and is accurate (4)	
<b>Total</b>				

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**Signature of the Teacher**

## 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 examples to illustrate your explanation.
- Rationality: The state of being reasonable, sensible and having a sound sense of judgement. It 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 interior of success
    - The agent's prior knowledge of the environment
    - The actions that the agent can perform
    - The agent's percept sequence to data
  - The behaviour of rational agents is guided by the principle of achieving the best outcome for 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

e.g. simple vacuum-cleaner agent that cleans a square if it is dirty and moves

to the other square if not. But here we need to say what the performance

measure is, what is known about the environment, and what sensors hard

on it to it. the agent has

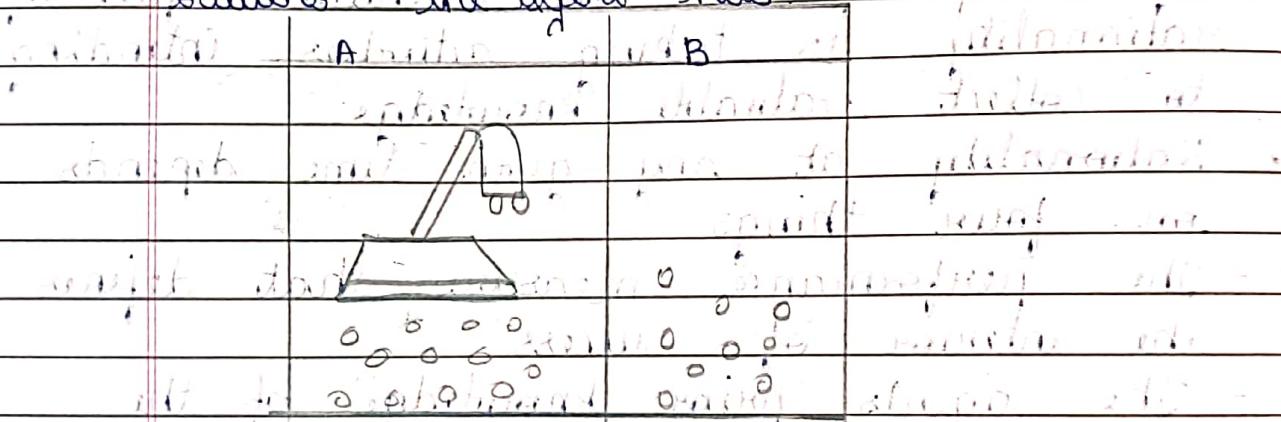


Fig: A vacuum-cleaner with just two locations

and a simple percept sequence starting with

Percent sequence starting with Action

[A, clean] Right

[A, dirty] Suck

[B, clean] Left

[B, dirty] Suck

[A, clean], [A, clean] Right

[A, clean], [A, dirty] Suck

[A, dirty], [B, clean] Right

[B, clean], [B, dirty] Suck

[A, clean], [A, clean], [A, clean] Right

[A, clean], [A, clean], [A, dirty] Suck

repeating from scratch

## Environment

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 behaviour of agents?

Provide examples of different type 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.

i) 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.

eg chess - The board is fully observable, and so are the opponent's moves.

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

ii) 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.

"deterministic"

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

Eg: chess - there would be only a few possible moves for a win at the current state, and these moves can be determined

Eg: self-driving cars - the actions of a self-driving car are not unique, it varies from 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.

Eg: financial markets, where traders compete to maximize profits, potentially at the expense of others

Eg: 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.

Eg: A person left alone in a maze is an example of the "single-agent" system.

Eg: 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.

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

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

### 6) Discrete vs Continuous

- 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 continuous.

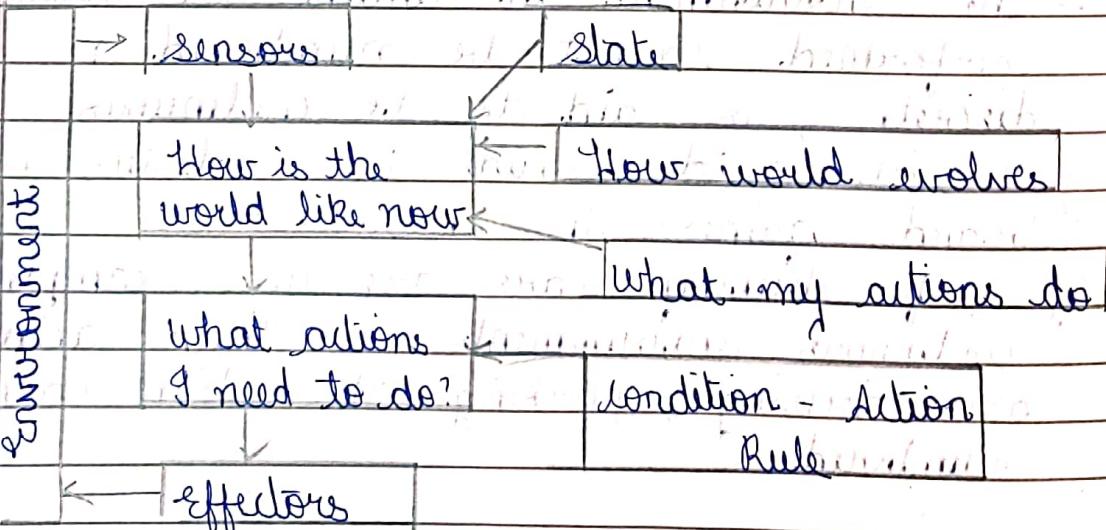
Eg: Discrete grid worlds in robotics or board games like chess.

Eg: self-driving cars are an example of continuous environments 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

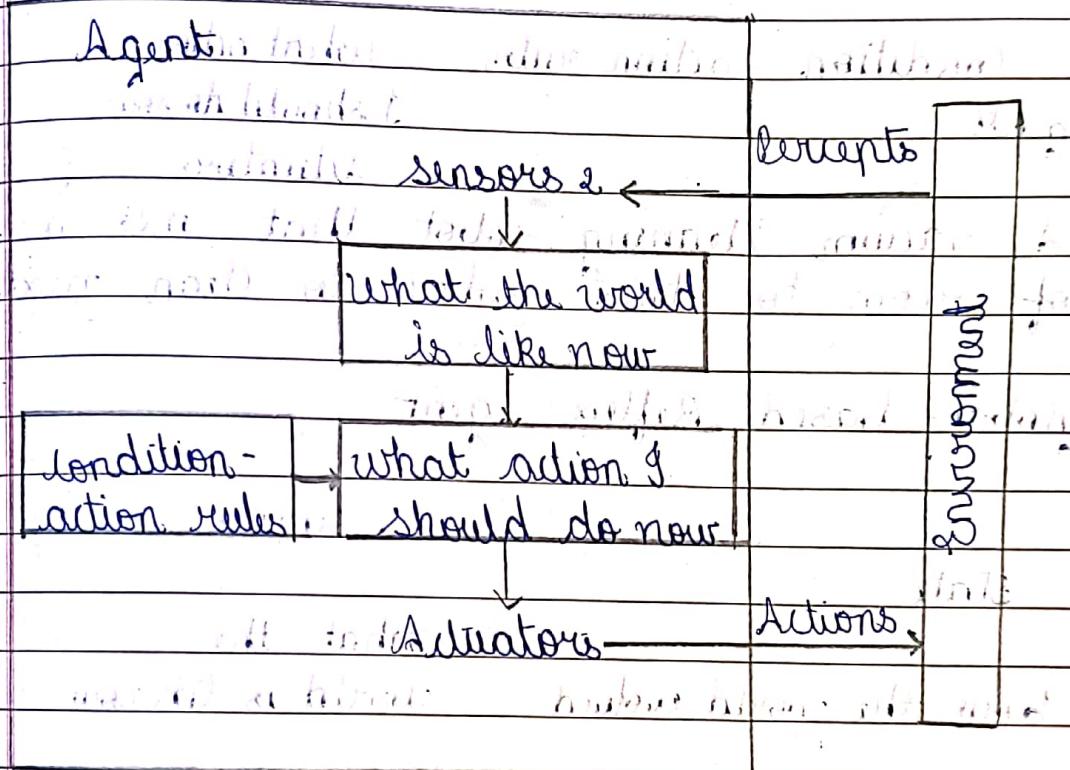
Architecture refers to machinery or devices that consists of actuators and sensors. The IA executes on this machinery. The tool allows the adjusting of image details and clarifies. Using this tool, we can obtain great detail or get a smoother picture with less detail. This is the main tool to increase the contrast of the image and visualize more details of the image to fit the environment with its surroundings. It also helps in getting more information about the world with the help of sensors.



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



e.g: Thermostat that adjusts the temperature based on current readings.

sensor inputs

current readings

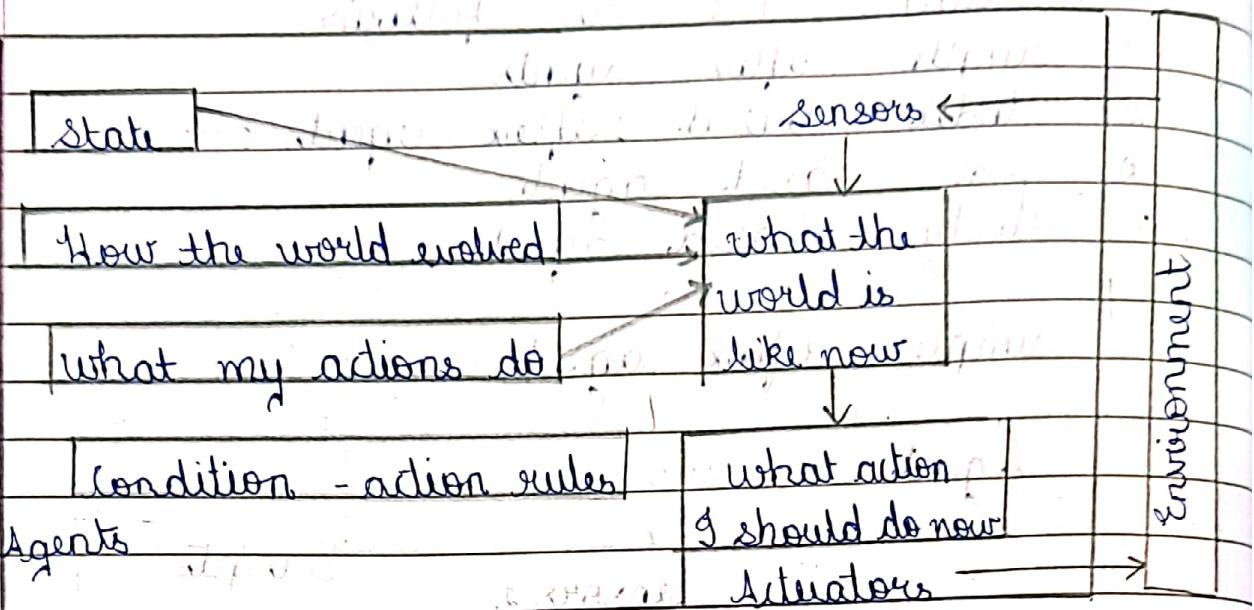
Actions

adjust temperature

turn on air conditioner

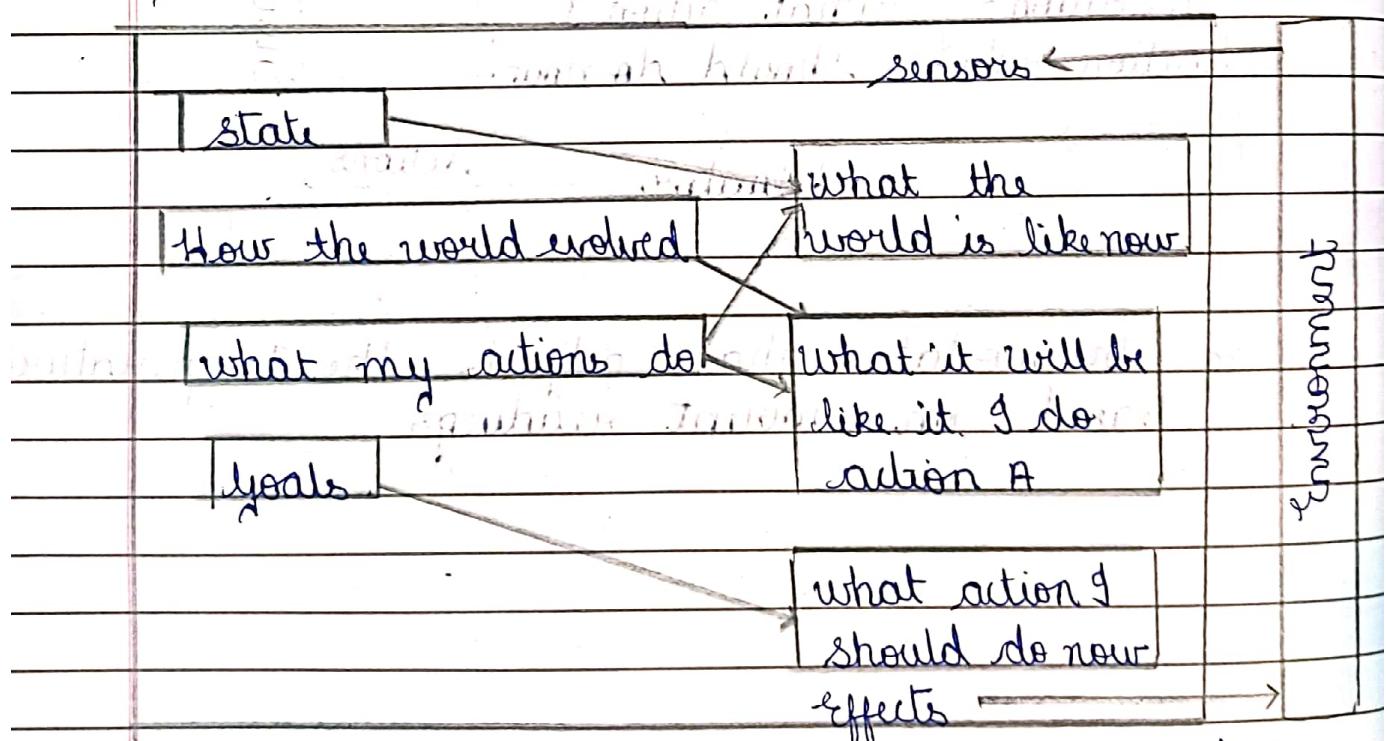
turn off air conditioner

## Model-based reflex agent



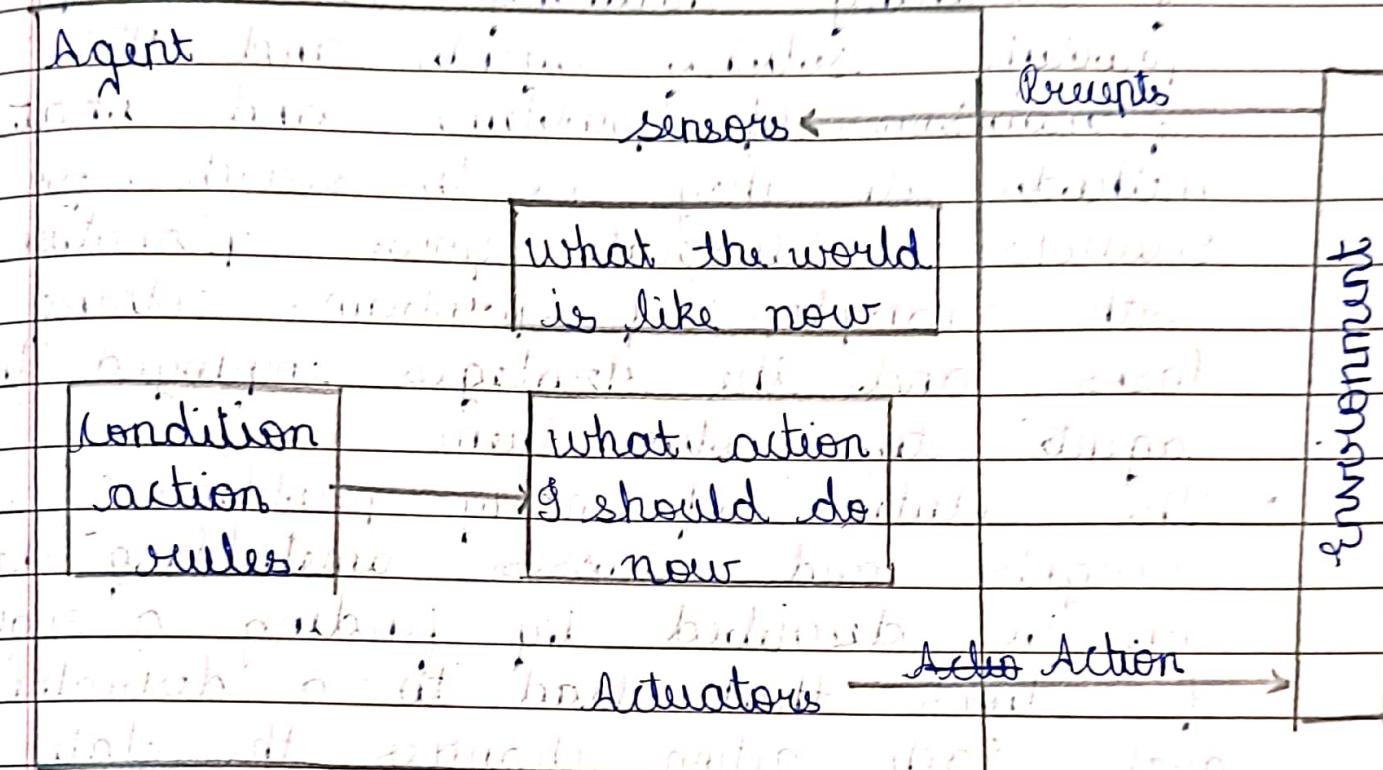
e.g.: A vacuum cleaning robot that uses a map of room to decide where to clean next.

## Goal-based Reflex Agent



e.g.: Delivery Drone that navigates to deliver packages to specific locations.

## Utility Based Reflex Agent



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

already provides a solution for this. A task prioritization algorithm prioritizes tasks based on user-defined priorities and constraints such as time, location, and urgency. This allows users to set up recurring tasks and receive notifications or reminders at the right time and place.

(Q4) Outline the process of problem-solving by searching, including the role of problem-solving agents and the formulation of 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.

→ The solution of many problems (e.g. noughts and crosses, timetabling, chess) can be described by finding a sequence of actions that lead to a desirable goal. Each action changes the state and the aim is to find the sequence of actions, and states that lead from the initial (start) state to a final (goal) state.

- A Role of Problem-solving Agents
  - 1) Problem-solving agents operate independently making decisions and taking actions to achieve desired goals ~~are~~ 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 accommodate new information or new constraints
  - 4) They can handle a wide range of problem types and complexities from simple

puzzles to complex real-world scenarios.

- formulation of problems
- i) Problem formulation involves abstracting real-world scenarios into a formal representation that can be understood and processed by problem-solving agents.
- ii) Problems are represented in a way that captures essential elements such as initial states, goal states, actions and constraints.
- iii) Formulating problems provides a structured approach to problem-solving, breaking down complex issues into smaller, more manageable components.
- Methods used for searching solutions
- i) Uniformed search: Agents explore the problem space systematically without consideration of domain specific knowledge  
Eg: Breadth-first search, Depth-first search
- ii) Informed search: Agents use domain specific knowledge, heuristics to guide the search towards promising solutions  
Eg: A\* search, greedy best-first search
- iii) Local search agents - Agents iteratively improve candidate solutions by making small modifications

## examples

- 1) Routing Planning : In navigation systems, problem - solving agents search for the shortest path between two locations and they analyze the road network to consider traffic conditions and employ algorithm like A\* to find optional routes.
- 2) Puzzlesolving : Grid 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 strategy like constant 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, consider constraints and employ planning algorithms like PSL to generate action sequences.