

## Assignment 1

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

Ans] 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 criteria of success -

→ The agent's prior knowledge of the environment

→ The actions that the agent can perform.

→ The agent's percept sequence to date

• 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 & objectives

→ Information and perception

→ Decision making

→ Adaptation learning.

→ Consistency and coherence

→ Expected utility.

→ Trade offs and constraints

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 and actuators the agent has.

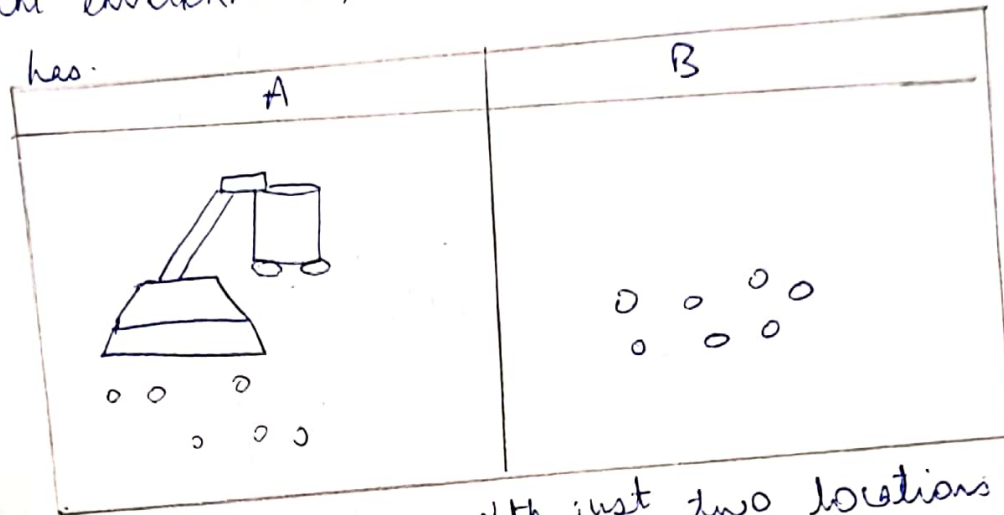


Fig: A vacuum cleaners with just two locations

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 behaviour of agents?

Provide examples of different types of environment and challenges for agent  
 Ans] 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) Fully 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's 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.

Example : 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 stage 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."

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

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

### Q3 (iii) 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

### (iv) Single Agent vs. Multi Agent

Q4 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

### v) 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 it is set in motion and the environment keeps changing every instant.

### vi) Discrete vs. Continuous

If an environment consists of a finite no. 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 actions are performed cannot be numbered i.e. it is not discrete, it is said to be continuous

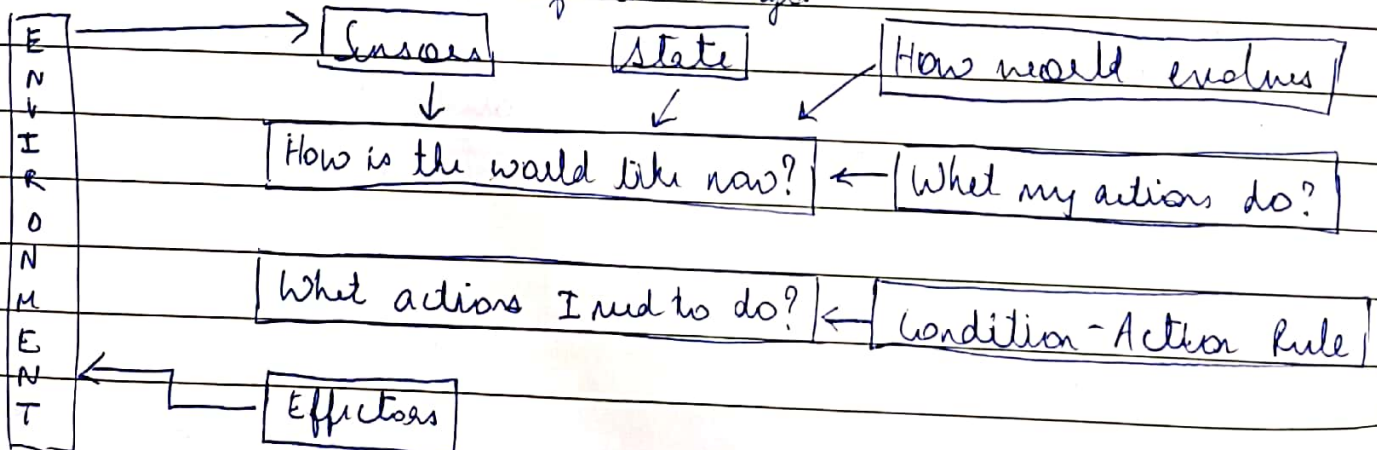
Eg: Discrete grids worlds in robotics or board games like chess.

Eg: Self driving cars are an example of continuous environments as their actions are driving, parking, etc. which can 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 behavior? Provide examples of different types of agents and their applications in real world scenarios.

Ans] The intelligent Agent (IA) structure consists of three main parts Architecture, Agent function, Agent programme.

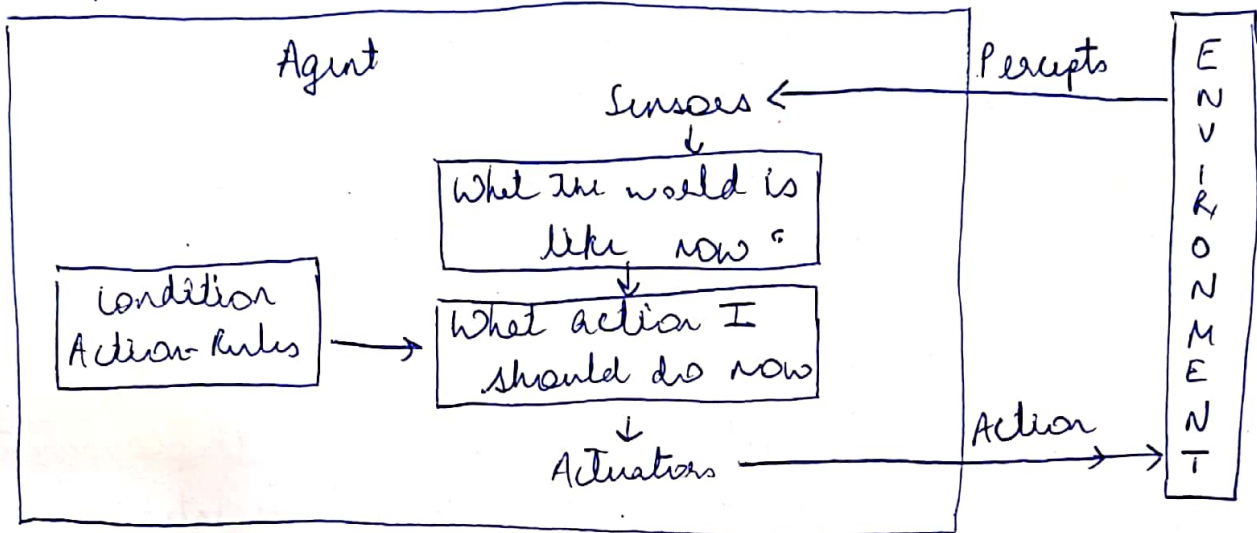
→ Architecture refers to machinery or devices that consists of actuators and sensors. The IA executes on this machinery. The tool allows the adjusting of image details and clarifies. Using this tool we can obtain great detail or get a smoother picture with less detail. This is the main tool to increase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



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

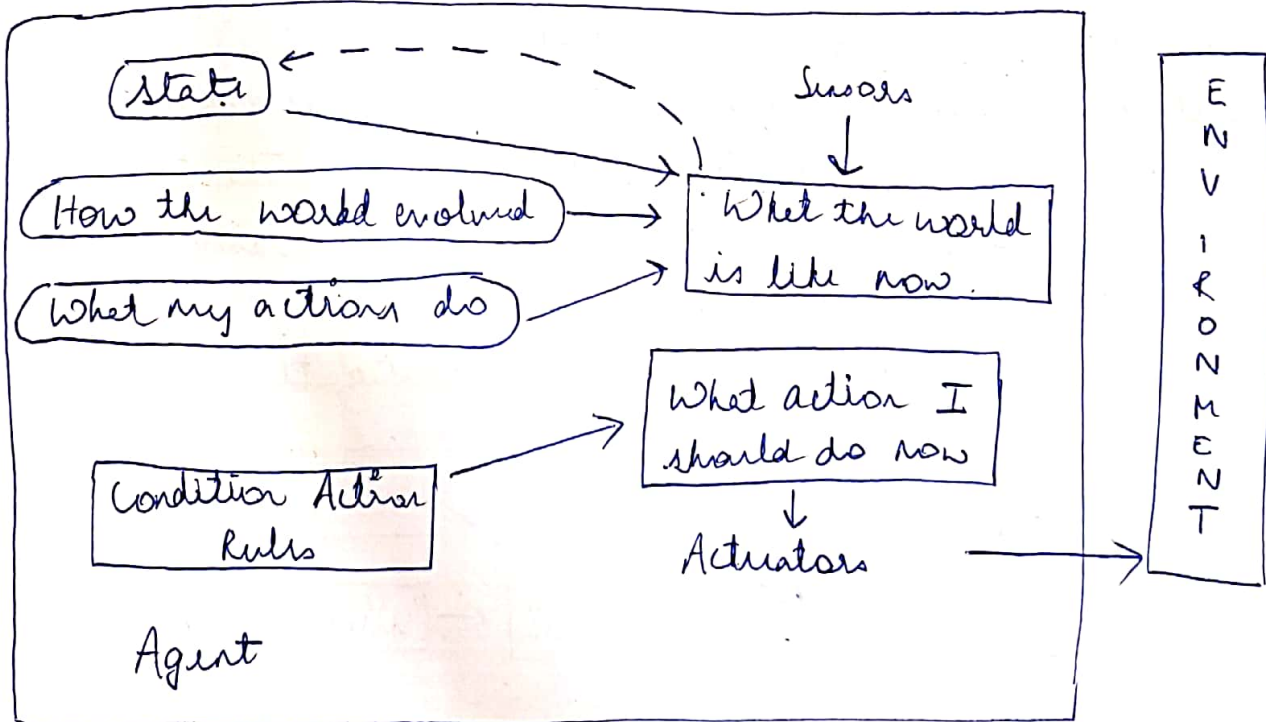
1. Simple reflex agents
2. Model Based reflex agents
3. Goal based agents
4. Utility based agents

### 1. Simple reflex agents



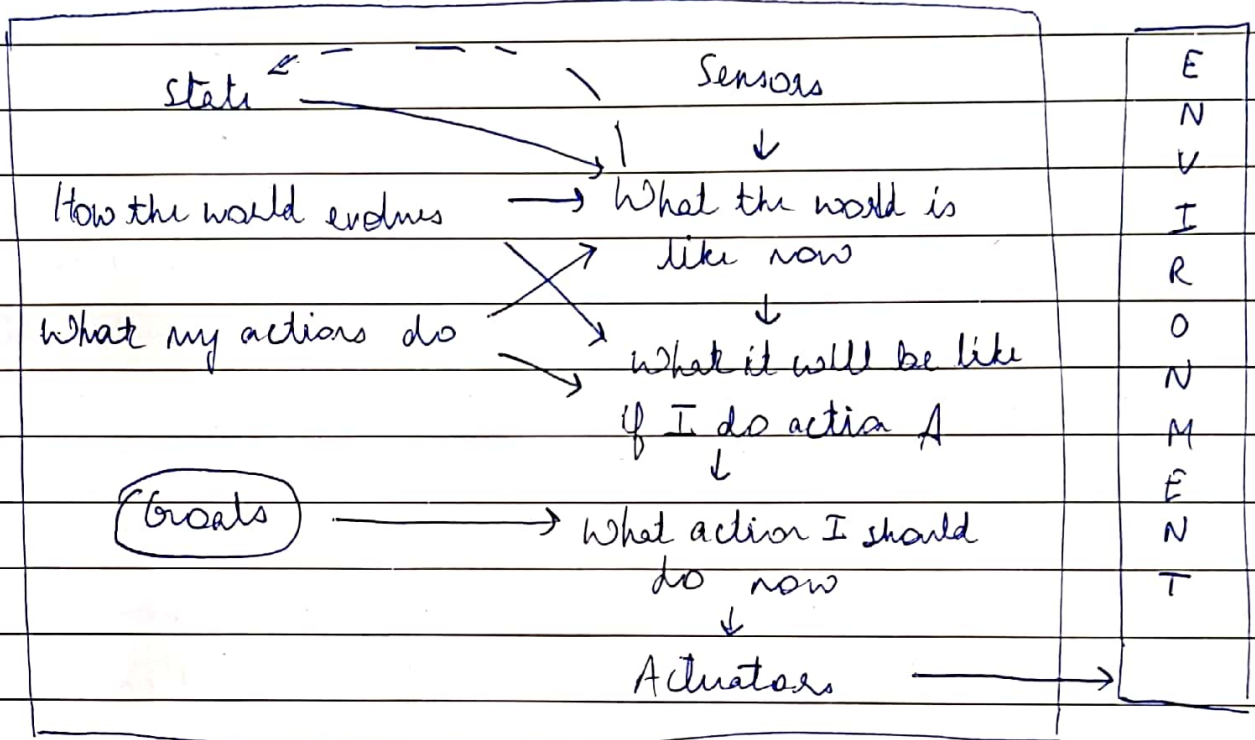
Eg: Thermostat that regulates the temperature based on the current readings.

### 2. Model based reflex Agents



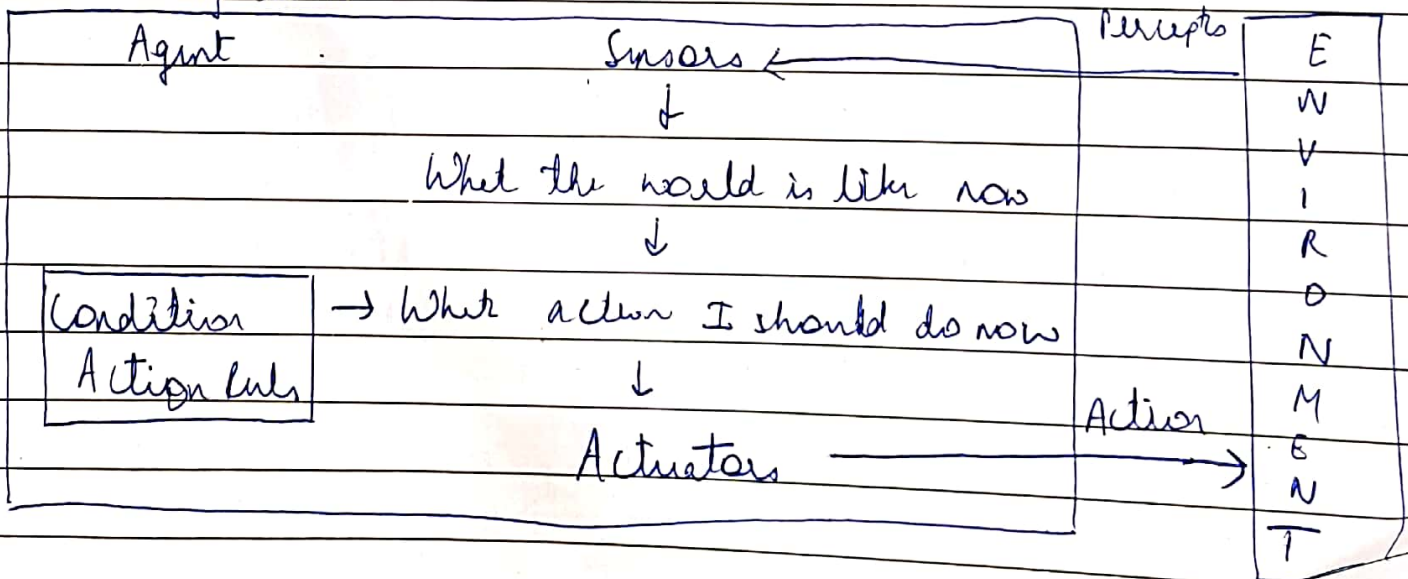
Eg: A vacuum cleaning robot that uses a map of room to decide where to clean next

iii Global based reflex agent



Eg: Delivery drone that navigates to deliver packages to specific locations

iv. Utility based





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

Q4] Outline the process of problem solving by searching, including the role of problem solving agents and the formulation of problem. How do problem solving agents analyze and represent problem, 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

Ans] The solution of many problems (Eg: 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.

→ Role of Problem solving agents

- (i) Problem solving agents operate independently making decisions and taking actions to achieve desired goals without human intervention
- (ii) These agents are designed to efficiently explore and navigate problem spaces to find optimal or satisfactory solutions.
- (iii) Problem solving agents can adapt to changes in their environment or problem domain adjusting their strategies to accommodate new information or new constraints
- (iv) 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 state, goal state, action & constraints.



(ii) Formulating problems provides a structured approach to problem-solving by breaking down complex issues into smaller, more manageable components.  
→ Methods used for searching solutions

(i) Uninformed 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, or 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 then analyze the road network considering 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 the solutions satisfying certain constraints. They analyze the puzzle's initial state, explore possible moves and use strategies like constraint propagation or backtracking to solve the puzzle.
3. Automated planning - in robotics or automated systems problem agents plan sequences of actions to achieve desired outcomes. They analyze the environment, consider constraints and employ planning algorithms like POPL to generate action sequences.