

Figure 1. AI Agent with Environment

## Tutorial 1:- Design of Intelligent Agent

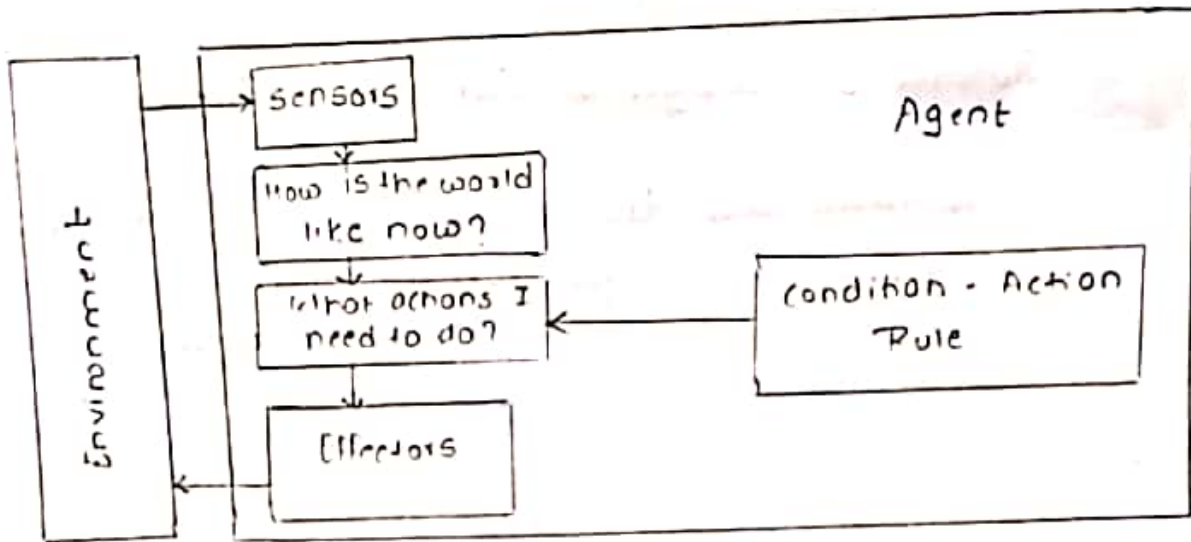
Aim:- To understand the concept of Agent Abstraction by studying definition of Rational Agent, Agent environment, Task Environment Descriptors, environment types.

### Theory:-

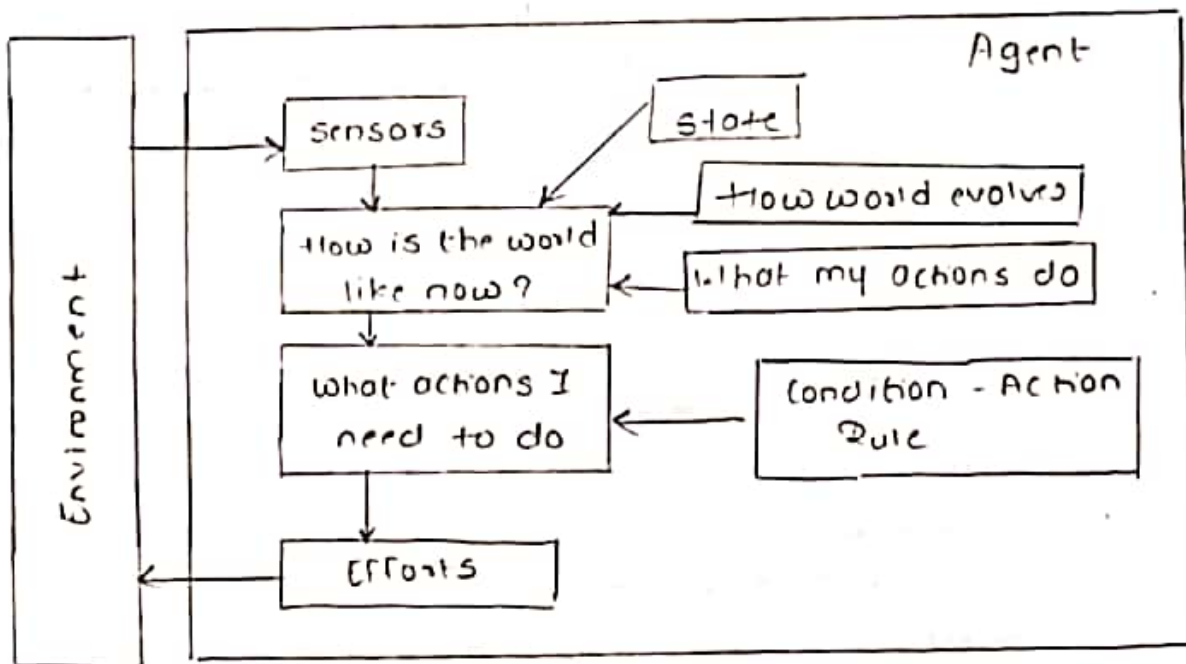
An Artificial Intelligent (AI) system is composed of an agent and its environment. The agent act in their environment. An agent is anything that can perceive its environment through sensors and act upon that environment through effectors. This can be clearly seen in fig 1. An agent in particular can be:-

- Human Agent:- has sensory organs such as eyes, ears, nose, tongue and skin parallel to the sensors, and other organs such as hands, legs, mouth for effectors.
- Robotic Agent replace camera and infrared range finders for sensors, and various motors and actuator for effectors.
- Software agent has encoded bit strings as its programs and actions.

Agent structure can be viewed as a combination of Agent architecture and Agent Program. Agent Architecture refers to the machinery that an agent executed on whereas Agent Program is an implementation of an agent function. Fig 2 shows four important types



(a) Simple Reflex Agent



(b) Model Based Reflex Agent



of agent architecture.

As seen in Fig 2a, Simple Reflex agents choose actions only based on the current percept only.

They are rational only if a correct decision is made only on the basis of current percept.

Agent environment for such agents is fully observable.

Model based Reflex Agents as shown in Fig

2b use a model of the world to choose their

actions. They maintain an internal state as a persistent information file. The model means knowledge

about how the things happen in the world that is representation of unobserved aspects of current state

depending on percept history. Agent take into account

how its actions in order to achieve goals. Goal-based

approach is more flexible than reflex agent since

the knowledge supporting a decision is explicitly modeled

thereby allowing for modifications. Goal is a description

of desirable ~~me~~ situations. Finally, the Utility

Based Agents shown in Fig 2d choose actions

based on a preference for each state. Goals are

inadequate when there are conflicting goals, out of which only few can be achieved, goals have some

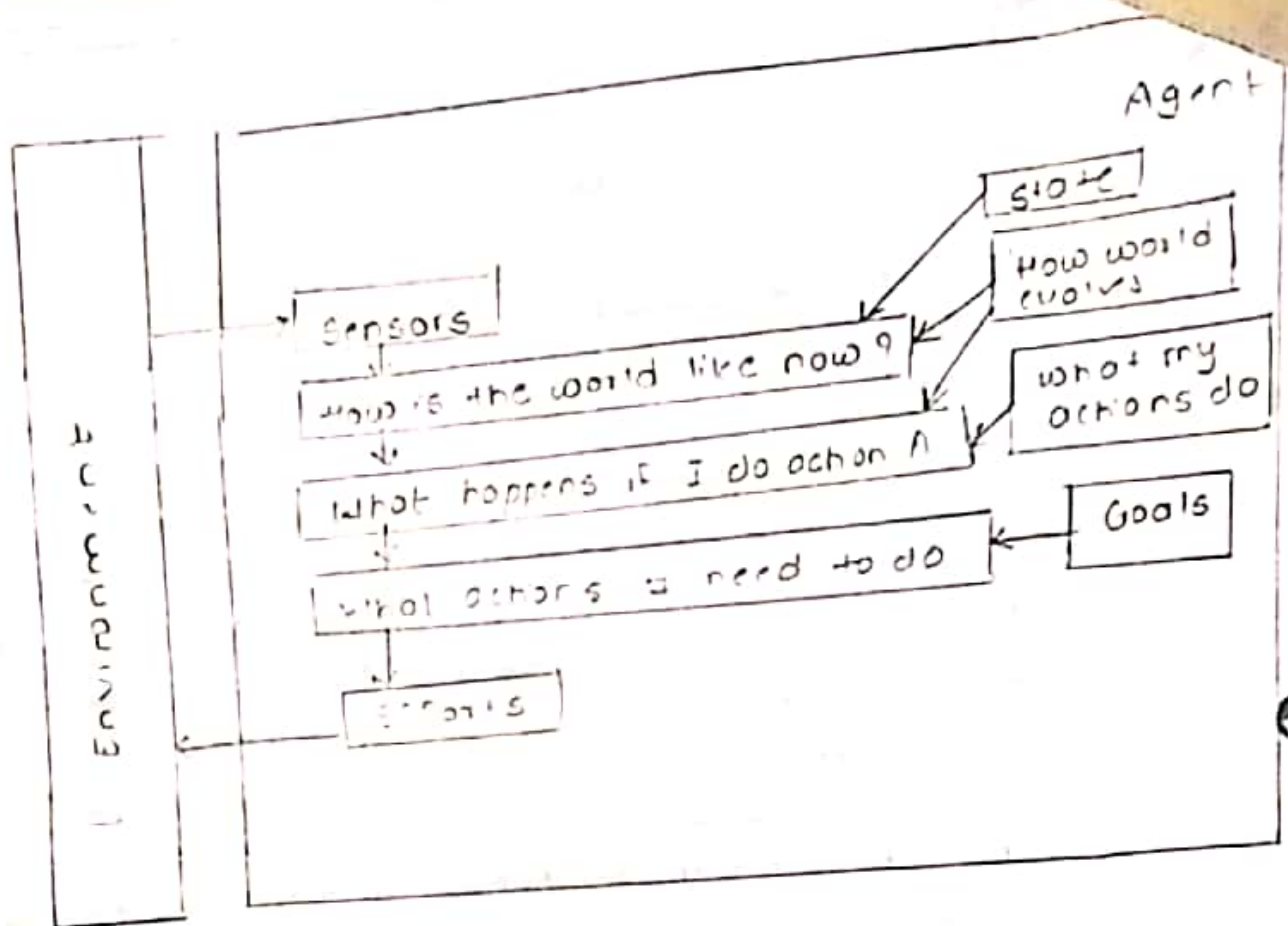
uncertainty of being achieved and you need to

weigh likelihood of success against the importance

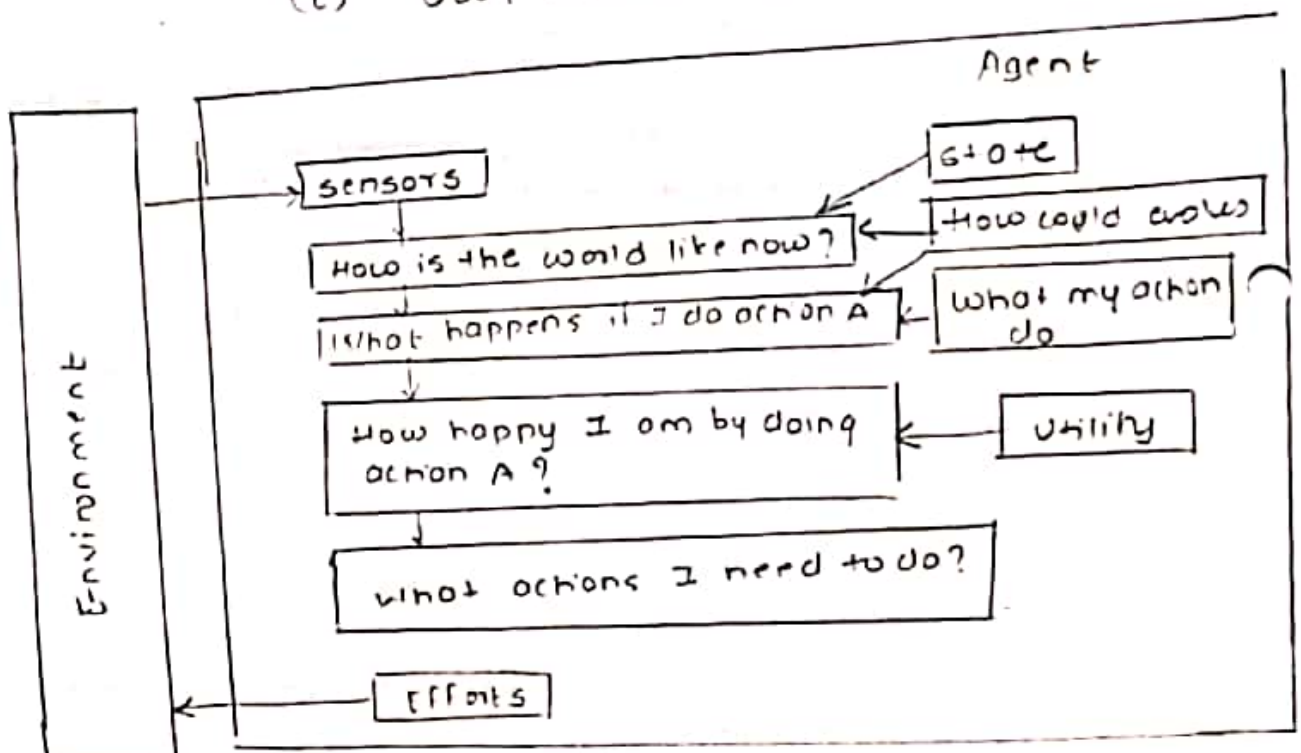
of a goal. On the other hand utility function

objectively map how much being in a particular

state is desirable.



(c) Goal Based Agent



(d) Utility Based Agent



An AI agent is defined as Rational Agent. A rational agent always perform right action, where the right action means the action that causes the agent to be most successful in given percept sequence. The problem the agent solves is characterized by Performance Measure, Environment, Actuators, and Sensors (PEAS). These are collectively referred to as PEAS descriptors for agent task environment.

PEAS descriptors provide important insight into agent and the task environment it operates in. These insights are very useful in agent design.

Another important piece of information is task environment properties. While analyzing task environment the agent architect needs to consider following properties:

1. Discrete and Continuous:- If there are a limited no. of distinct, clearly defined states of the environment, the environment is discrete (for eg. Chess); otherwise it is continuous (for eg. automated driving).
2. Observable or Partially Observable IF it is possible to determine the complete state of the environment at each time point from percepts it is observable otherwise it is only partially observable.
3. Static or Dynamic:- If the environment does not change while an agent is acting, then it is static otherwise it is dynamic.
4. Deterministic or Non-deterministic IF the next state of the environment is completely determined by current state and actions of agent, then

The environment is deterministic, otherwise it is non-deterministic.

5. Episodic or sequential In an episodic environment, each episode of event consists of agent perceiving and then acting. The quality of this action depends just on the episode itself. Episodic environments are much simpler because the agent does not need to think ahead e.g. Post Picking robots.

Complementary to this is sequential environment where current action decides the future action.

6. Single agent or Multiple agents The environment may contain single agent or other agents which may be of the same or different kind as that of the agent.

7. Accessible or Inaccessible If the agent's sensor apparatus can have access to complete state of environment, then environment is accessible to that agent.

Working :-

Search Internet for AI based applications in following scenarios and identify who is agent for that application. Further list out PEPs descriptors for agent environment in each case. Finally try to classify task environment properties like a list of attributes from above list of 7 task environment properties.



1. Sophia is a social humanoid robot developed by Hong Kong based Company Hanson Robotics.

Performance Measure :- Understanding users maintaining conversation, social expressions, response time.

Environment :- Humans, objects, ...

Actuators :- Arms, mouth, leg, speakers.

Sensors :- Eyes/cameras, ears, mic, audio sensor.

2. Deep Blue Chess playing Computer Program.

Performance Measure :- Win/Lose/Draw, safety of chess pieces, safety of king pieces, number of moves, time for each move.

Environment :- Chess board, Chess pieces.

Actuators :- CPU, Desktop Screen

Sensors :- Chess board

Task environment properties :- Discrete, fully observable, static, deterministic, sequential, single agent, accessible.

3. Eliza the natural language processing computer program existed from 1964 to 1966 at the MIT Artificial Intelligence laboratory by Joseph Weizenbaum.

Performance Measure :- Understanding user, monitoring conversation.

Environment :- User, program, keyboard, user text inputs, Eliza texts, output window.

Actuators :- Texts

Sensors :- user-texts inputs

Task environment properties :- Continuous, Fully observable,  
Static, Deterministic, sequential, Single agent, Accessible

4. Apples virtual assistant Siri

Performance Measure :- Understanding user text and speech,  
producing best results, triggering,  
response speed.

Environment :- User, speech, text

Actuators :- mobile speaker, screen.

Sensors :- mobile screen, mic, button.

Task Environment properties :- Continuous, fully observable,  
static, deterministic, episodic, single  
agent, Accessible.

5. Automated cross word solver

Performance Measure :- Understanding hints, analyzing hidden  
and visible letters, time to solve.

Environment :- Hints, visible letters, crossword  
board.

Actuators :- Desktop screen, program

Sensors :- crossword board

Task Environment Properties :- discrete, fully observable,  
static, deterministic, episodic, single  
agent, Accessible.