

## Tutorial 1: Design of Intelligent Agent

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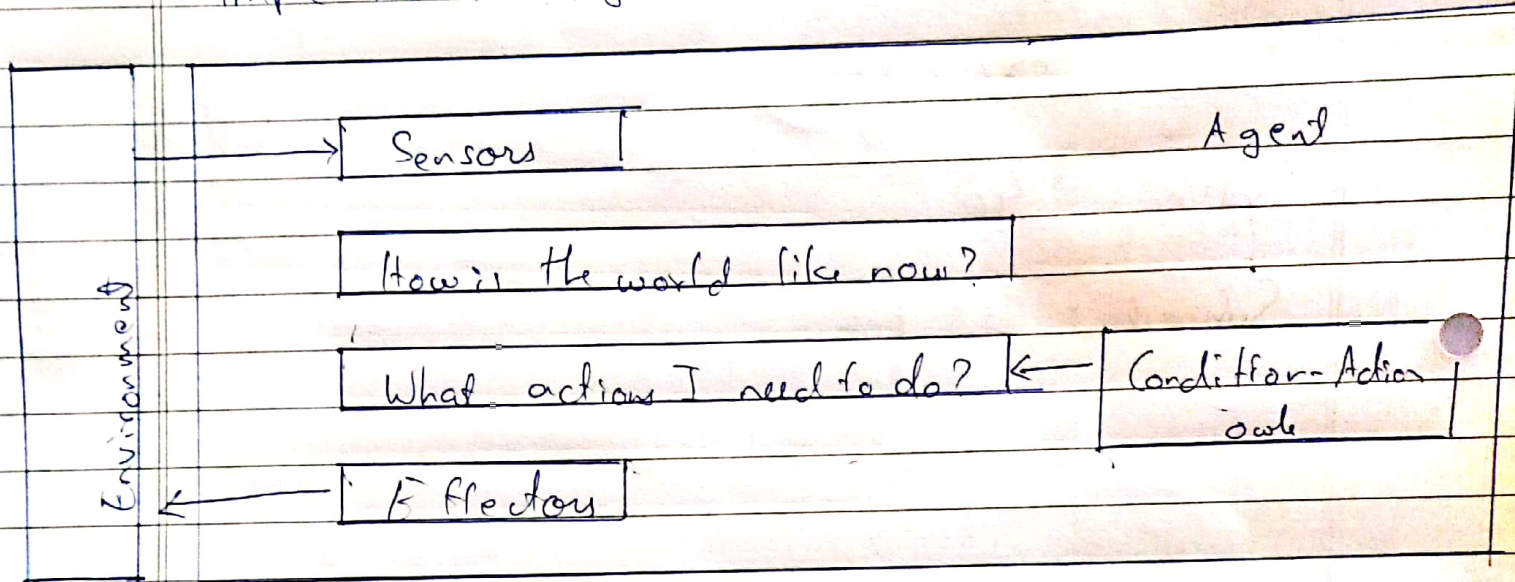
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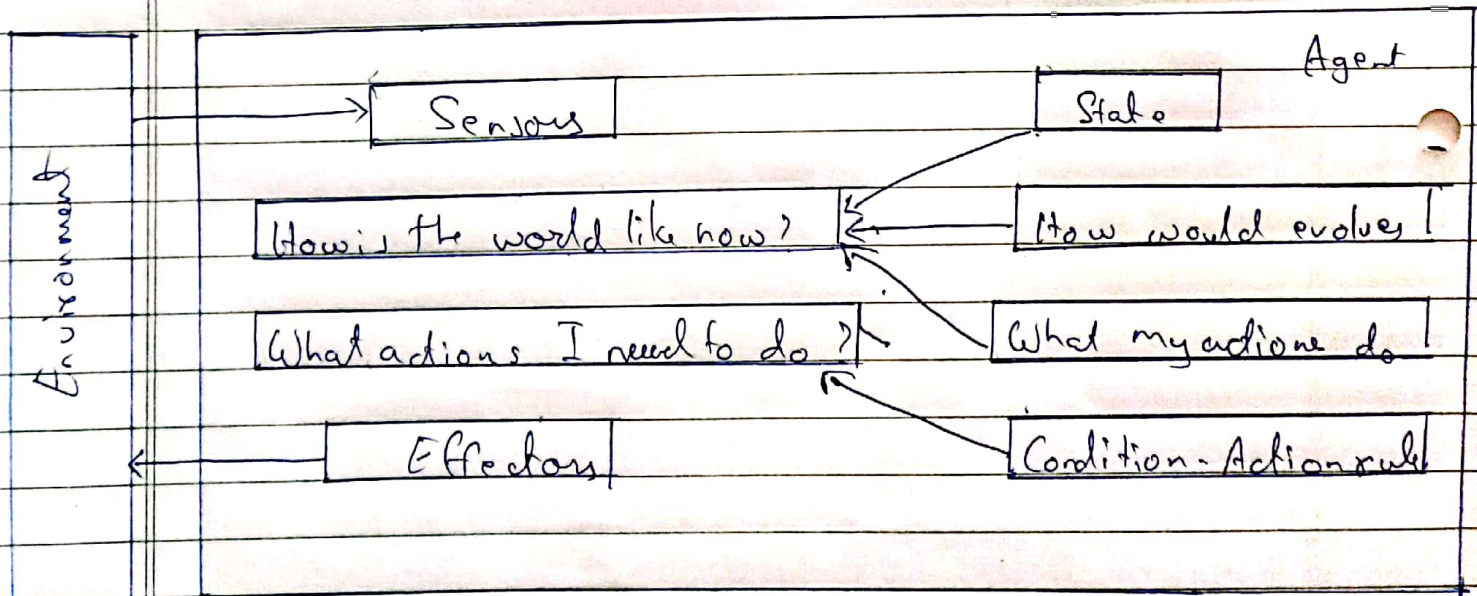
Subject :- IS Lab

## Agent Architecture types

### Simple Reflex Agent



### Model based Reflex Agent





## Tutorial: Design of Intelligent Agent

\* Aim: To understand the concept of Agent Abstraction by studying definition of Rational Agent, Agent environment, Task Environment Descriptive environment types

\* Theory:

An Artificial Intelligence (AI) system is composed of an agent and its environment. The agent acts in their environment. An agent is anything that can perceive its environment through sensors and acts upon that environment through effectors. An agent in particular can be

Human agent: has sensory organs like eyes, ears and other organs like hands, legs for effectors

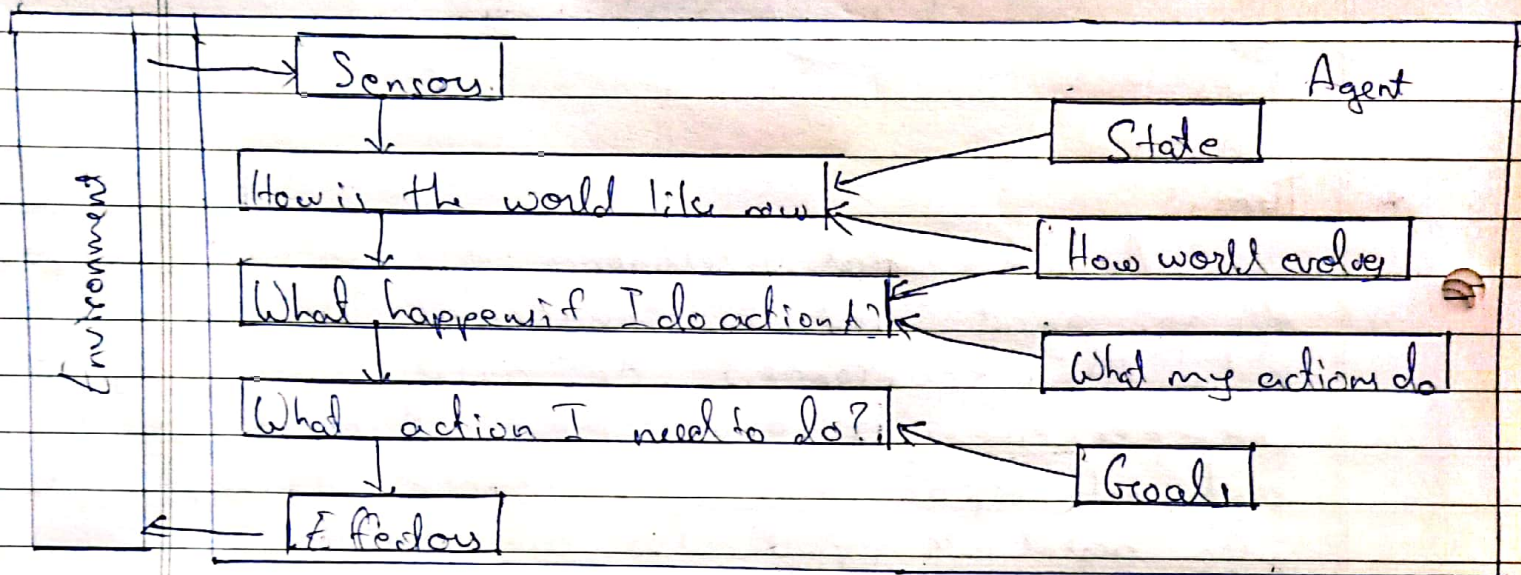
Robotic agent:- Replaces camera & improved range finder for the sensor and various motors & actuators for effectors

Software agent:- has encoded bit strings as its programs and actions

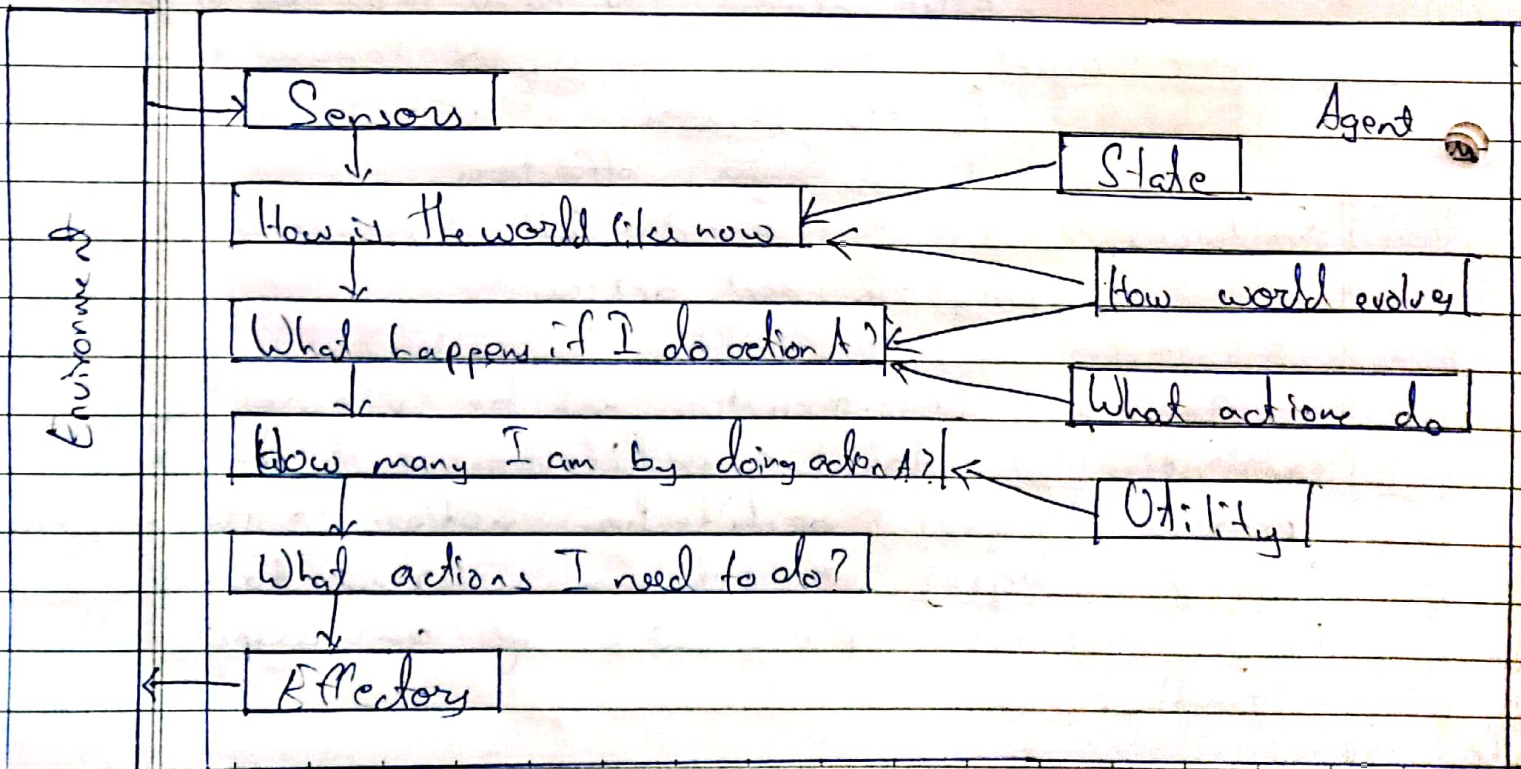
An agent structure can be viewed as a combination of Agent architecture and Agent program. Agent architecture refers to the machinery that an agent executes on, whereas Agent Program is an implementation of an agent function.



## Global based Agent



## Utility Based Agent.





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 agent is fully observable.

Model based Reflex agent use a model of the world to choose their actions. They maintain an internal state as a persistent information. Here, 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 takes into account how its actions affect the world.

Utility based Agents choose actions based on a utility 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.

An AI agent is referred to as Rational Agent. A rational agent performs right action always, where the right actions mean the action that causes the agent to be the most successful in the system in the given percept sequence. The problem that agent solves is characterized by Performances Measures, Environment, Actuators and Sensors (PEAS).



While analyzing task environment the agent architect needs to consider following properties:

1. Discrete or Continuous: if there are a limited number of distinct, clearly defined states of the environment it is discrete (like chess); otherwise it is continuous (like automated driving).
2. Observable or Partially Observable: If it is possible to determine the complete state of the environment at each time point from the percepts it is observable.
3. Static or Dynamic: If the environment doesn't 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 the current state and the actions of the agent, then the environment is deterministic, otherwise it is non-deterministic.
5. Episodic or Sequential: In an episodic environment each episode of events consist of the agent perceiving & then acting. The quality of its actions depends on just on the episode itself. Subsequent episodes do not depend on the actions in the previous episodes. Episodic environment are much simpler because the agent does not need to think ahead. Sequential environment is where current action decides the future actions.



6. Single agent or multiple agent: The environment may contain single agent or other agents which may be of the same or different kind as that of the agent. These agents may be co-operating or competing with each other.
7. Accessible or Inaccessible: If the agent's sensory apparatus can have access to the complete status of the environment then the environment is accessible to that agent.

\* Working:

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

1. Deep Blue chess playing computer program.

Performance Measure: Win/Lose/Draw, Safety of a chess piece, Safety of King piece, no. of moves, time for each move.

Sensor: Chess board

Environment: Chess board, chess pieces

Actuators: Desktop Screen, CPU

Task environment properties: Discrete, Fully observable, static, Deterministic, Sequential, Accessible.



2. ELIZA, the NLP computer program created from 1964 to 1966 at the MIT Artificial Intelligence Laboratory by Joseph Weizenbaum.

Performance Measure: Understanding user, maintaining conversation  
Environment: User, Program keyboard, user text input, Eliza, text, output window.

Actuators: Text.

Sensors: User text inputs.

Task environment properties: Continuous, Fully observable, static, Deterministic, sequential, Single agent, Accessible.

3. Sophia is a social humanoid robot developed by Hong Kong based company Hanson Robotics.

Performance Measure: Understanding user, maintaining conversation, facial expression, response time.

Environment: Humans, objects.

Actuators: Arms, mouth, legs, speaker.

Sensor: Eyes (cameras), ears, mic, audio sensor.

Task environment properties: Continuous, fully observable, Dynamic, Deterministic, Sequential, Single Agent, Accessible.



#### 4. Apple's virtual assistant Siri

Performance Measure: Understanding user intent & speech producing best results, summoning (trigger), response speed

Environment: User, speech, text

Actuators: Mobile screen, speaker

Sensor: Mobile screen, mic, button

Task environment properties:

Continuous, Fully observable, static, Deterministic,  
Episodic, Single agent, Accessible

#### 5. Automated Crossword Solver

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

Environment: Hints, visible letters, crossword board

Actuators: Desktop screen, program

Sensor: Crossword board

Task Environment ~~board~~ Properties:

Discrete, Fully observable, static, Deterministic,  
Episodic, Single agent, Accessible