

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 intelligence (AI) system is composed of an agent & its environment. The agent act in their environment. An 'agent' is anything that can perceive its environment through sensors & acts upon that environment through effectors.

An agent in particular can be:

Human Agent : has sensory organs like eyes, ears & other organs like hands, legs for effectors.

Robotic Agent : replaces cameras & infrared range finders for the sensors & various motor & actuators for effectors.

Software Agent : has encoded bit strings as its programs & actions.

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

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 use a model of the world to choose their actions. They maintain an

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Interval state as a persistent information state, the model means knowledge about how things happen in the world that is representation of unobserved aspects of current state depending on percept history.

Goal based agents choose their actions in order to achieve goals. Goal based approach is more flexible than the reflex agent since the knowledge supporting a decision is explicitly modelled, therefore allowing for modification.

Utility based Agents choose action 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 & you need to weigh likelihood of success against the importance of a goal.

An AI is referred to as Rational Agent. A rational agent performs right action that always, where the right action means the action that cause the agent to be most successful in the given percept sequence.

The problem that agent solves is characterised by performance measure, environment, Actuators & Sensors (PEAS). While analysing 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 environment, the environment 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; otherwise it is partially 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 & 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 consists of the agent perceiving & the acting. The quality of its action depends on the episode itself. Subsequent episodes do not depend on actions in the previous episodes. Sequential environment is where current action dictates the future actions.

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

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 the agent.

* WORKING: Search Internet for AI based application in following scenarios & identify who is agent for that application. Further list out PEAS description for the agent environment in each of case. Finally try to classify task environment properties.

like list of attributes from above list of task environment properties.

① Deep Blue chess playing computer game -

- Performance Measure: Win/Lose/Draw, safety of chess pieces, safety of king piece, no. of moves, time for each move.

Environment: Chess board, chess pieces.

Actuators: Desktop screen, CPU.

Sensors: Chess board.

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

② ELIZA, the MLP 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 inputs, ELIZA texts, output window.

Actuators: Text

Sensors: User text input.

Task environment properties: Continuous, fully observable, ~~static~~ ^{dynamic}, deterministic, sequential, single agent, accessible, static.

③ Apple's virtual assistant Siri

- Performance Measure - Understanding user text & speech, producing best result, summoning, response speed

Environment: User, speech, text

Actuators: Mobile screen, speaker

Sensors: Mobile screen, speaker

Task Environment properties: Continuous, fully observable, static, deterministic, episode, single agent, accessible

④ Sophia is a social humanoid robot developed by Hong Kong based company Hanson Robotics.

- Performance Measure: Understanding user, maintaining conversation, facial expressions, response time

Environment: Humans, objects, ...

Actuators: Arms, ~~object~~ mouth, legs, speaker

Sensors: Eyes (cameras), ears, mic, audio sensor

Task environment properties: Continuous, fully observable, dynamic, deterministic, sequential, single agent, accessible.

⑤ Automated crossword solver

- Performance Measure: Understanding hints, analyzing hidden & 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.

* Agent Architecture types *

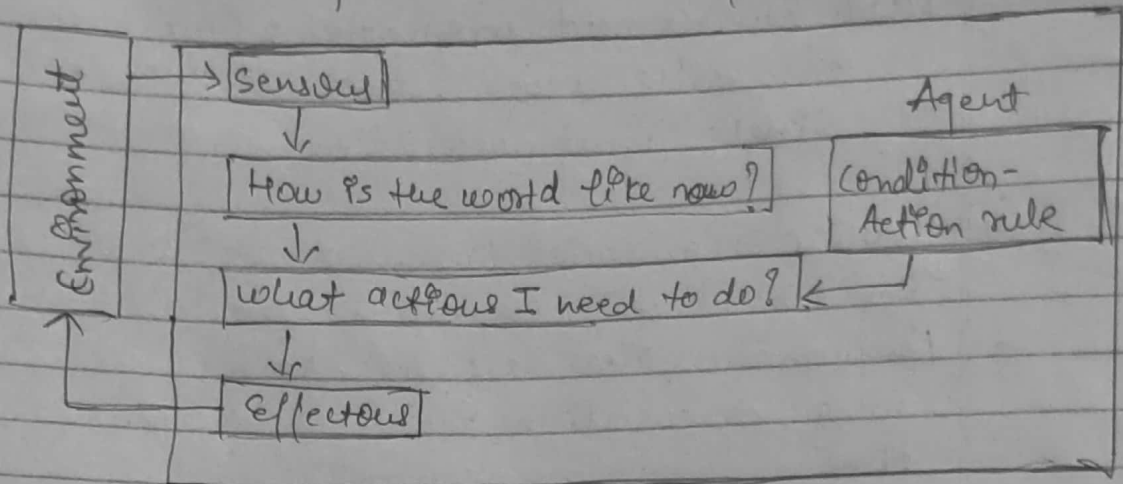


Fig. Simple Reflex Agent.

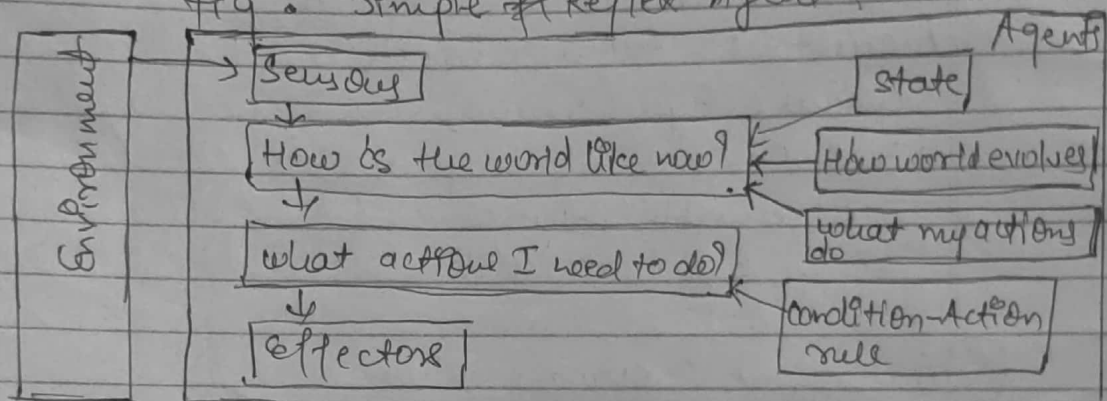


Fig. Goal Model Reflex Agent.

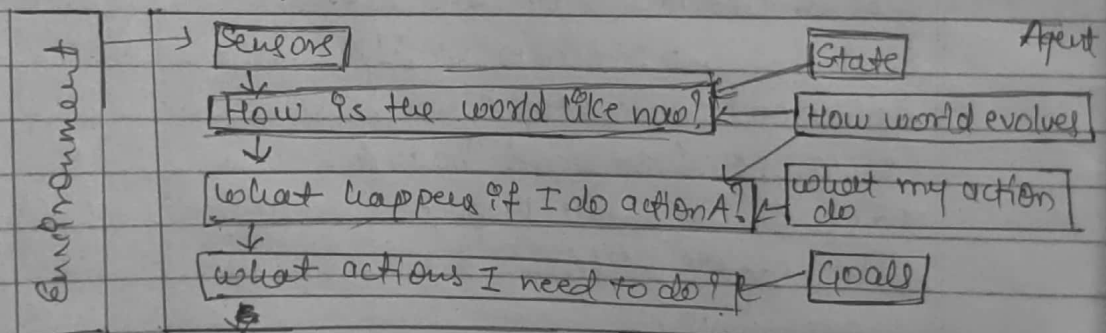


Fig. Goal based Agent.

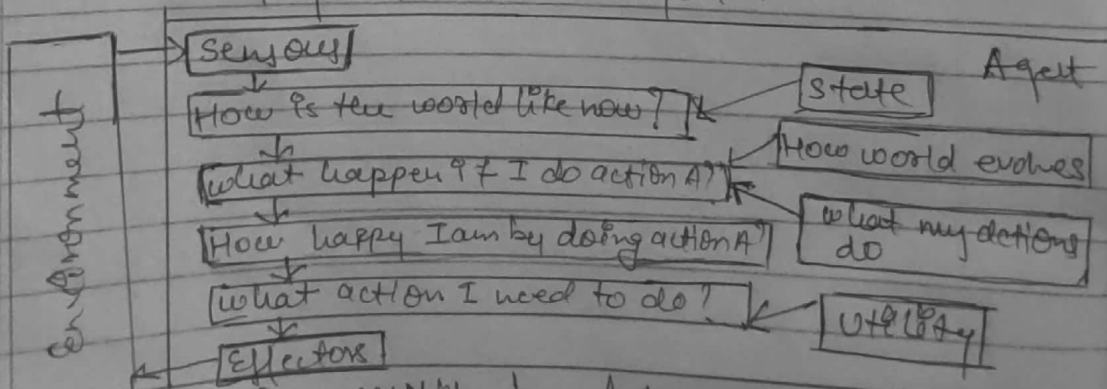


Fig. Utility based Agent.