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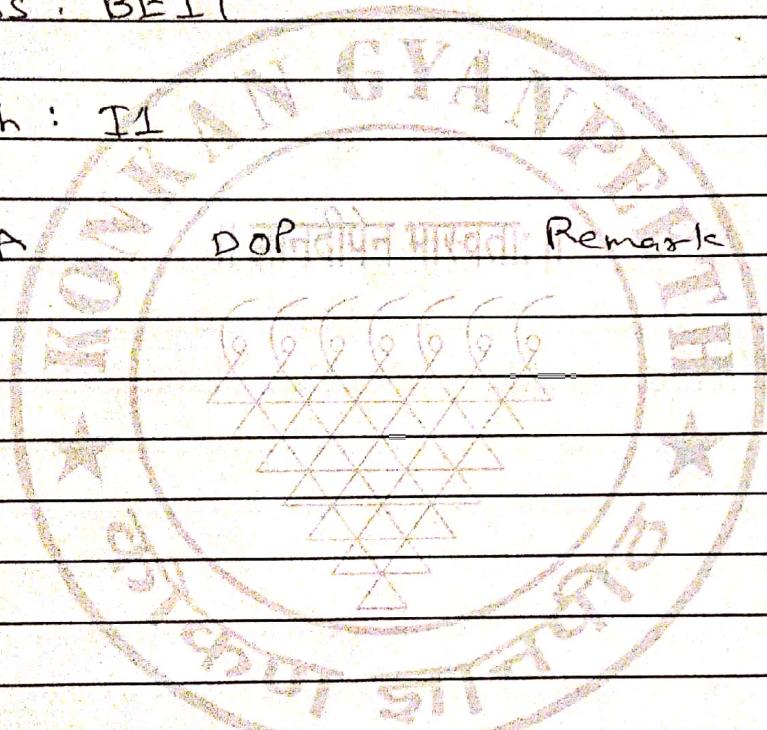
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Tutorial 1: Design of Intelligent Agent

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 system is composed of an agent and its environment. The agents act in their environment.

An agent is anything that can perceive its environment through sensors and acts upon that environment through effectors.

This can be clearly seen in the figure below-

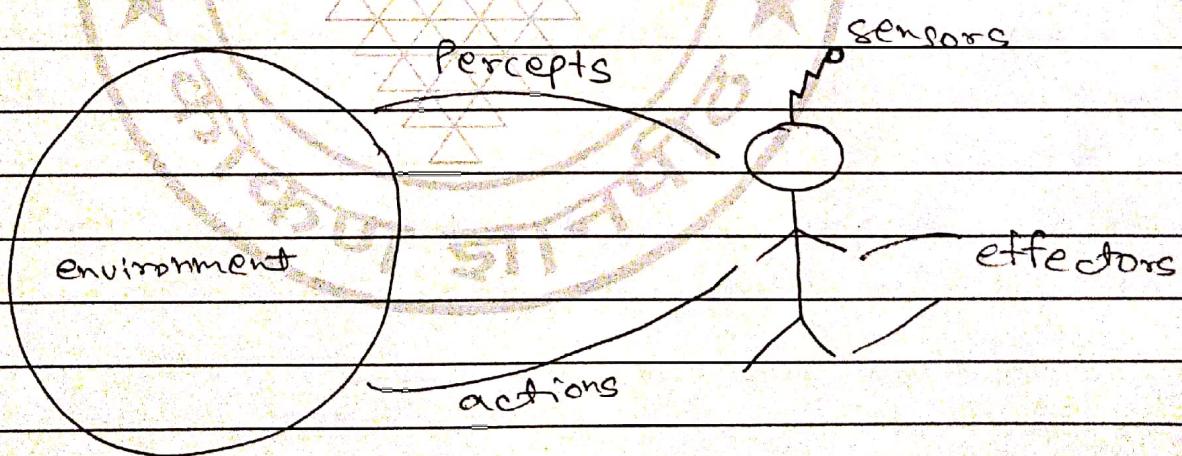


fig. AI agent with environment

Agent in particular can be:

Human agent - Has sensory organs such as eyes, ears, nose, tongue & skin parallel to the sensors, and other organs such as hands, legs, mouth, for effectors.

Robotic agent - Replaces cameras and infrared range finders for the sensors, and various motors and actuators 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 executes on whereas Agent Program is an implementation of an agent function. Below figure will show four important types of agent architectures.

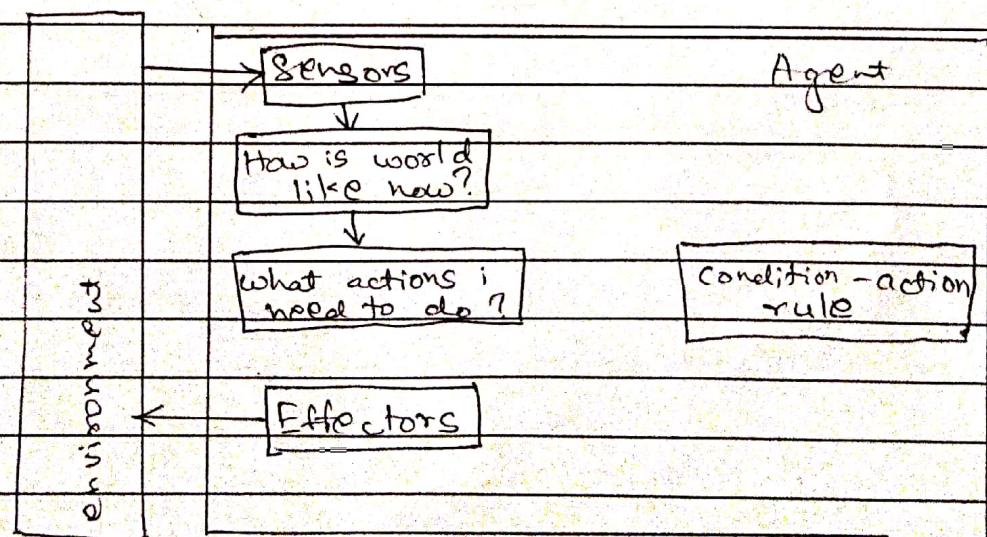


fig A. Simple Reflex agent

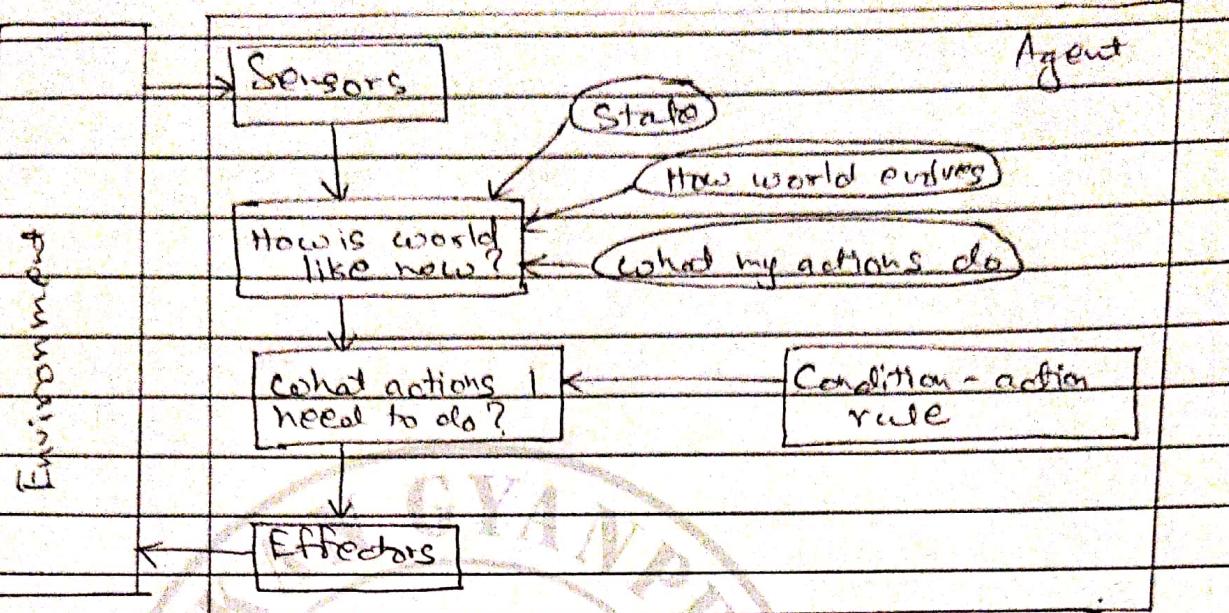


fig. B Model Based Reflex agent

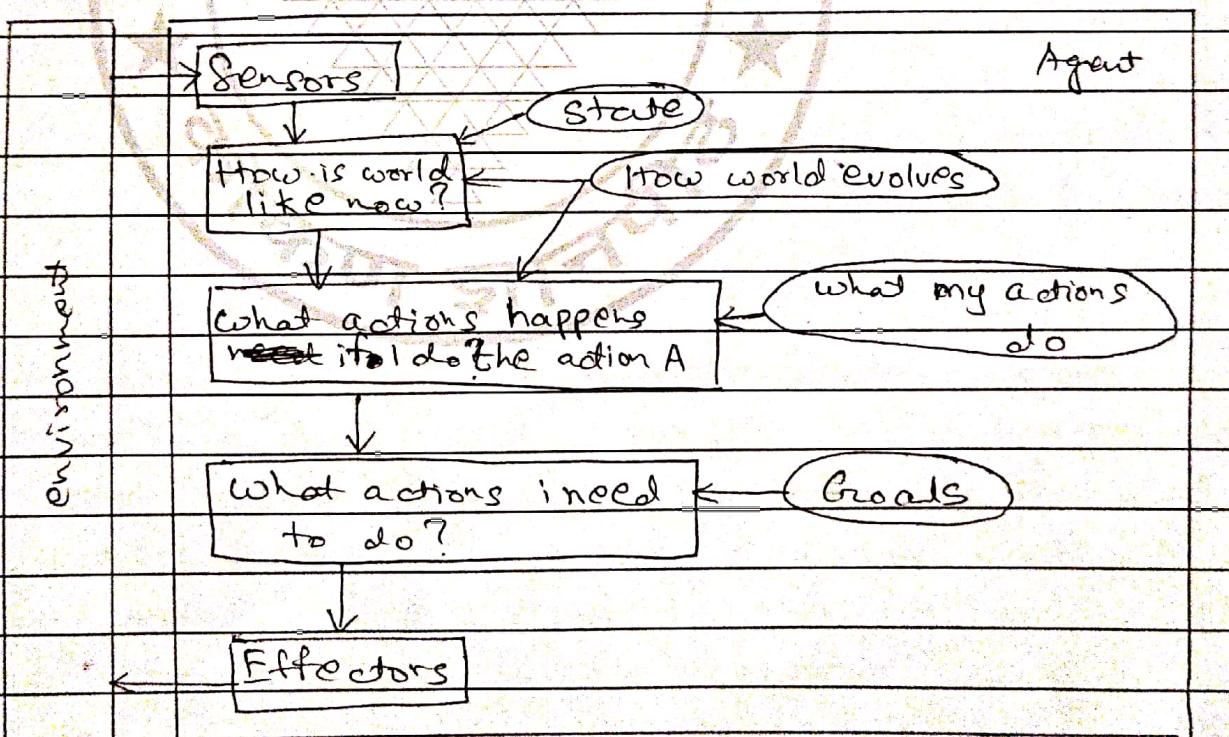


fig C. Goal Based agent

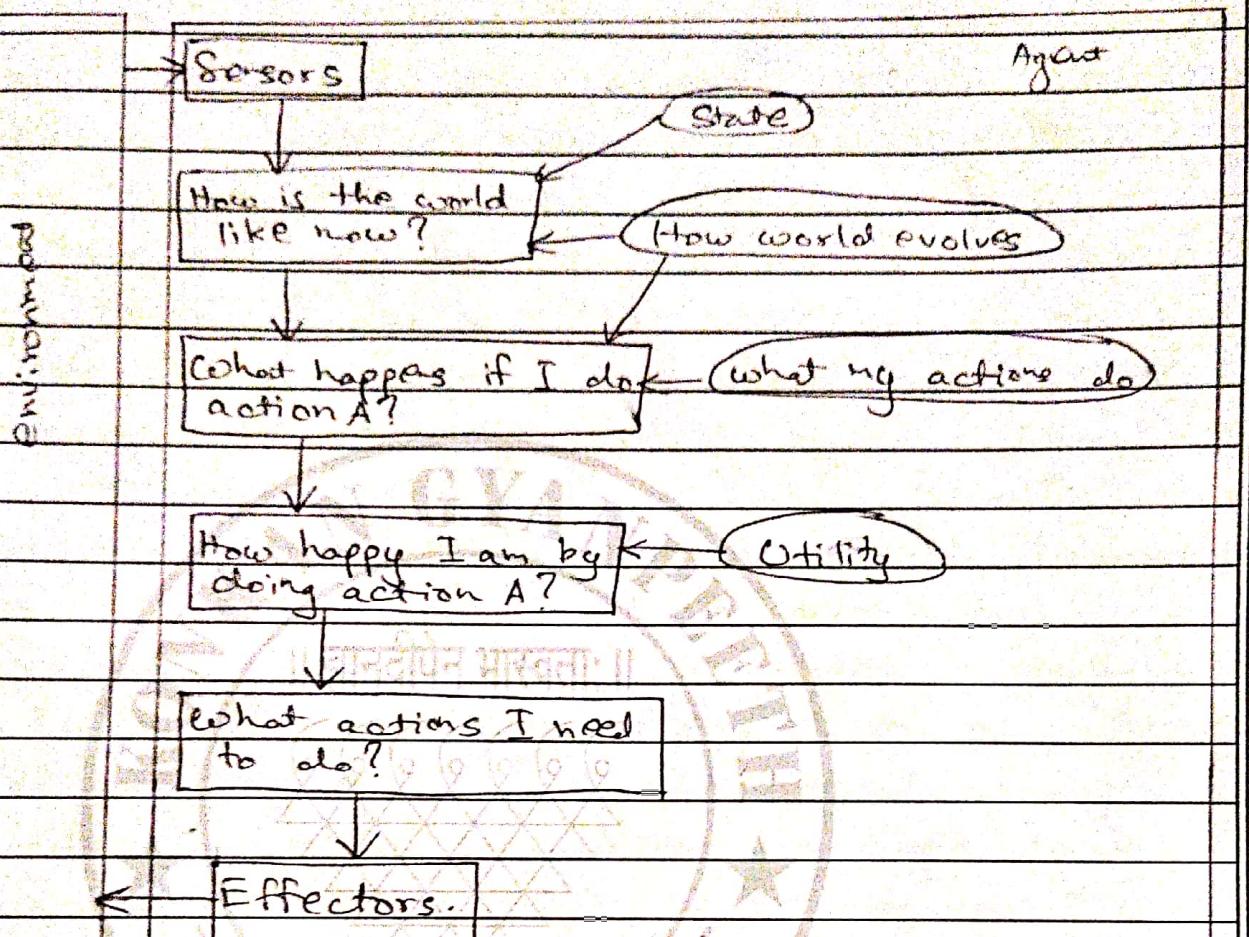


fig D. Utility Based Agent

As seen in figure A, Simple Reflex agents choose actions only based on the current percept only. They are rational only if a correct decision is made only on basis of current percept. Agent environment for such agents is fully observable. Model Based Reflex agents as shown in figure B 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 things happen in world that is representation of observed aspects of current state depending on percept history. Agent take into account how its actions affect the world. Goal based agents in figure C, choose their actions in order to achieve goals. Goal based approach is more flexible than reflex agent. Goal is the description of desirable situations.

Finally, the Utility Based agents shown in figure D choose actions based on preference (utility) for each state.

An AI agent is referred to as Rational agent. A rational agent always performs right action, 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 characterized by Performance Measure, Environment, Actuators and Sensors (PEAS).

These are collectively referred to as PEAS descriptors for the agent task environment.

PEAS descriptors provide important insight into agent and the task environment it operates in. Another important info. is task environment properties. While analysing task environment the agent architect needs to consider following properties:

(1) Discrete or Continuous - If there are limited no. of distinct, clearly defined, states of 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 environment at each time point from precepts it is ~~as~~ 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 environment is completely determined by current 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 events consists of the agent perceiving and then acting. The quality of its actions depends just on the episode itself. Episodic environments are much simpler because the agent does not need to think ahead eg. Part picking robots. Complementary to this is sequential environment where current actions 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. These agents may be co-operating or competing with each other.

② Accessible or inaccessible - If the agent's sensory apparatus can have access to the complete state of the environment, then the 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 PFAE descriptors for agent for that environment application 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 Autonomous Lunar Rover
- ② Deep Blue Chess playing computer program
- ③ Eliza the natural language processing computer program created from 1964 to 1966 at the MIT Artificial Intelligence laboratory by Joseph Weizenbaum.
- ④ Automatic Portfolio management
- ⑤ Apple's virtual assistance Siri.
- ⑥ Sophia is a social humanoid robot developed by Hong Kong based company.
- ⑦ AlphaGo is a computer program that plays the board game Go.
- ⑧ Endurance: A Companion for Dementia Patients.

- ⑨ Casper: Helping Insomniacs Get Through night.
- ⑩ Marvel: Guarding the Galaxy with Comic-Book crossovers.
- ⑪ Automated Crossword Solver.

Resources - The diagrams are taken from online tutorial available at Tutorials point on topic AI - Agents and Environments.

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 (camera), ears, mic, audio sensor.

2. Deep Blue Chess playing Computer Program.

Performance measure: Win/lose/draw, Safety of chess pieces, safety of king piece, 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, single agent, accessible.

3. Eliza the natural language processing computer program created 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: Users texts inputs.

Task environment properties: Continuous, Fully observable, static, sequential, signalized.

4. Apple's virtual associate Siri:

Performance measure: Understanding user text and speech, producing best results, response speed.

Environment: User, speech, text.

Actuators: Mobile speakers, screen.

Sensors: Mobile screen, mic, button.

Task Environment properties: Continuous, fully observable, static, deterministic, episodic, accessible.

5. Automated Cross word solver.

Performance measure: Understanding hints,
analysing 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, deterministic, accessible.