Tutorial 01

NAME : Aditi .R. Mandavkar

ROLL NO. : 34

CLASS : BE-IT

SUB : IS LAB

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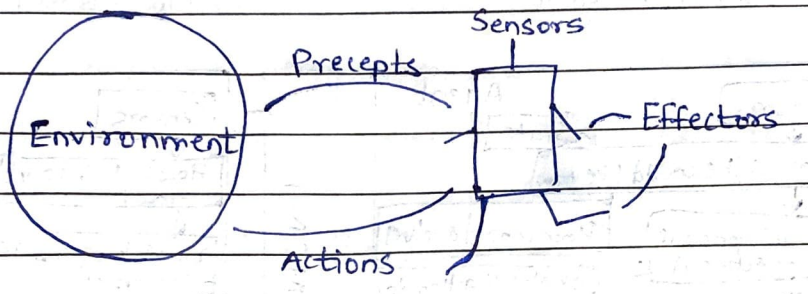
1.1 Tutorial 1 : Design of Intelligent Agent

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

Theory :

An Artificial Intelligent (AI) system is composed of an agent and it's environment. The agent act in their environment. An agent is anything that can perceive it's environment through sensors and acts upon that environment through effectors. This can be clearly seen in fig.



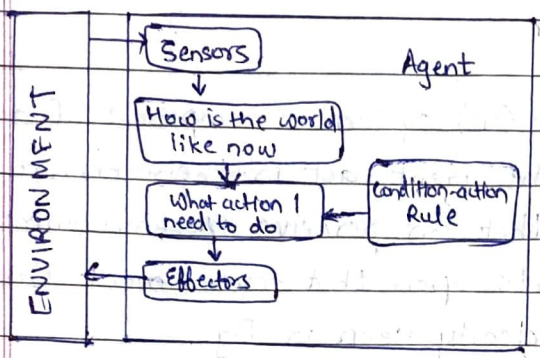
An agent in particular can be :

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.

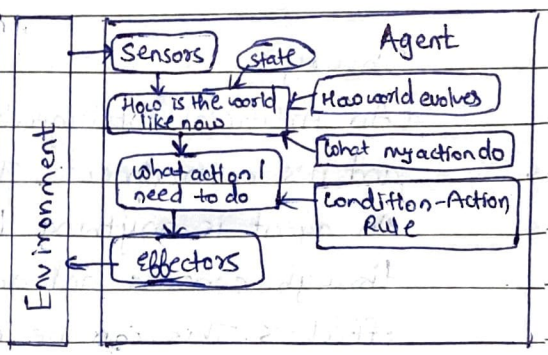
Robotic agent replaces cameras and infrared range finders for the sensors and various motors and actuators for effectors.

Software agent has encoded bit strings as it's programs and actions.

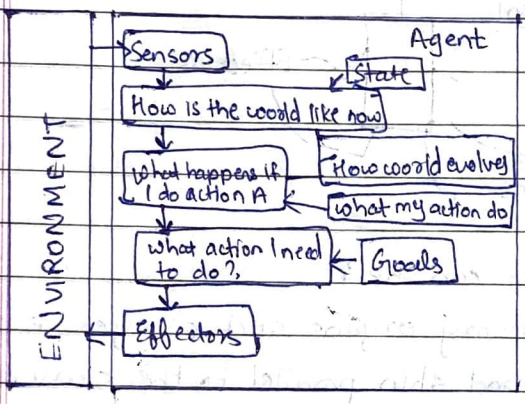
Agent structure can be viewed as a combination of Agent architecture and Agent Program. Agent Architecture refers to the machinery that an agent executes on whereas Agent Program is an implementation of an agent function.

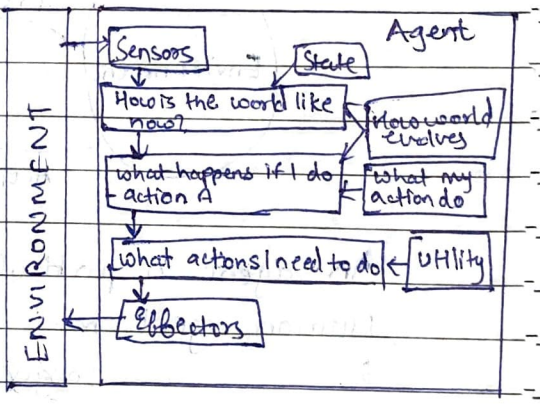


(a) Simple Reflex Agent.



(b) Model Based Reflex Agent





(c) Goal Based Agent

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. Here the model means knowledge about how the things happend in the world that is representation

of unobserved aspects of current state depending on percept history. Agent take into account how it's actions affect the world. Goal based agents shown in fig. 2c, choose their action 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 the modifications. Goal is the description of desirable situations. Finally, the Utility Based Agents shown in fig 2d, choose actions based on a performance (utility) for each state. Goals are inadequate when there are conflicting goals, out of which only few can be achieved, goals have some uncertainity 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.

An AI agent is referred to as Rational Agent. A rational agent always performs right action, where the right action means the action that causes the agent to be most successful in the given percept sequence. The problem the agent solves is characterized by Performance Measure, Environment, Actuators and sensors (PEAS). These are collectively reffered to as PEAS descriptors for the agent task environment. PEAS descriptor 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 or Continuous : If there are a limited number of distinct, clearly defined, states of the environment, the environment is discrete (for eg., chess); otherwise it is continuous (for e.g. 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 percept it is observable, otherwise it is only partially observable.

3. Static or Dynamic : If the environment does not change while as 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 action 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 and then acting. The quality of it's action depends just on the episode itself. Subsequent episodes do not depend on the actions in the previous episodes. Episodic environments are much simpler because the agent does not need to think ahead, e.g. Part Picking robots. Complementary to this is sequential environment where current action dictates the future action.

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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.

7. Accessible or Inaccessible : If the agent's sensory apparatus can be 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 PEAS descriptors for agent environment in each of the case. Finally try to classify task environment Properties like a list of attibutes from above list.

1. Deep Blue chess playing computer program.
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 NLP computer program created from 1964 to 1966 at the MIT Artificial Intelligence Laboratory by Joseph Weizebaum

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Performance Measure : Understanding user maintaining conversatio
environment : User, program, keyboard, user text Input,
Eliza texts, output window.
Actuators : Texts
Sensors : User texts inputs
Task environment properties : Continuous, fully observable,
static, Deterministic, Sequential, single agent, Accesible.

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, ...
Actuator : Arms, Mouth, legs, speaker
Sensors : Eyes (cameras), ears, mic, audio sensors
Task environment properties = Continuous, fully observable, dynamic,
Deterministic, sequential, single agent Accessible.

4. Apple's virtual assistant Siri
Performance Measure : Understanding user text and speech, providing 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
Sensors = Crossword board.
Task Environment properties : Discrete, fully observable, static,
Deterministic, Episodic, single agent, Accessible.