K.G.C.E.
Karjat - Raigad

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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 & its environment. The agents act in their environment. An agent is anything that can perceive its environment through sensors & acts upon that environment through effectors. This can be clearly seen in following fig.

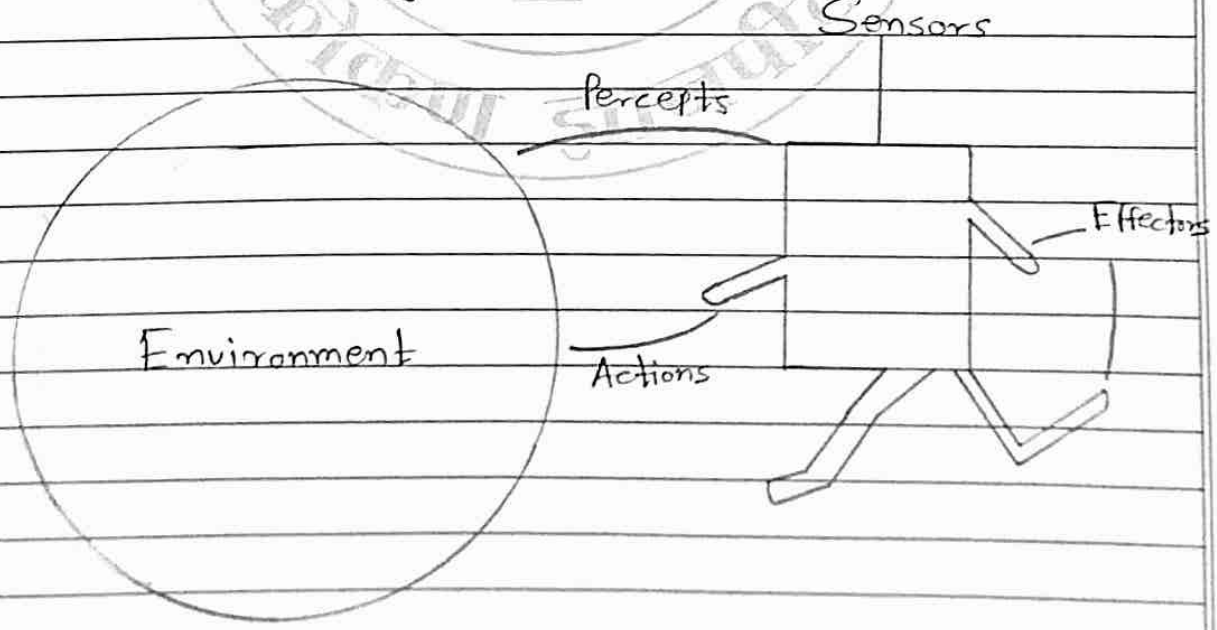


fig.: AI Agent with Environment

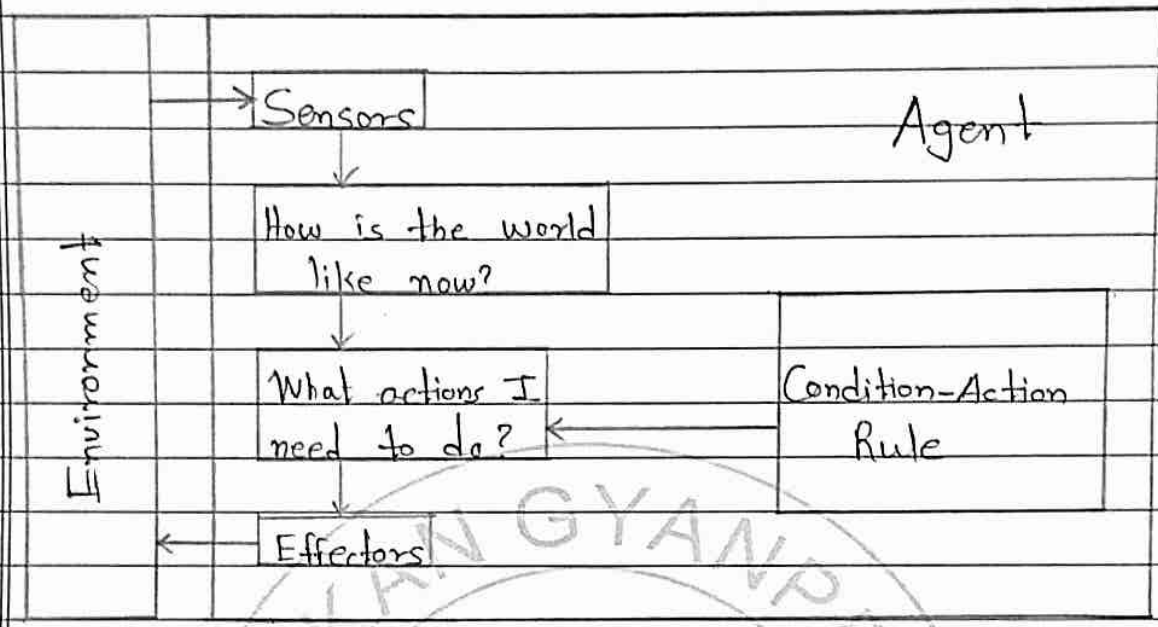
An agent in particular can be:

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

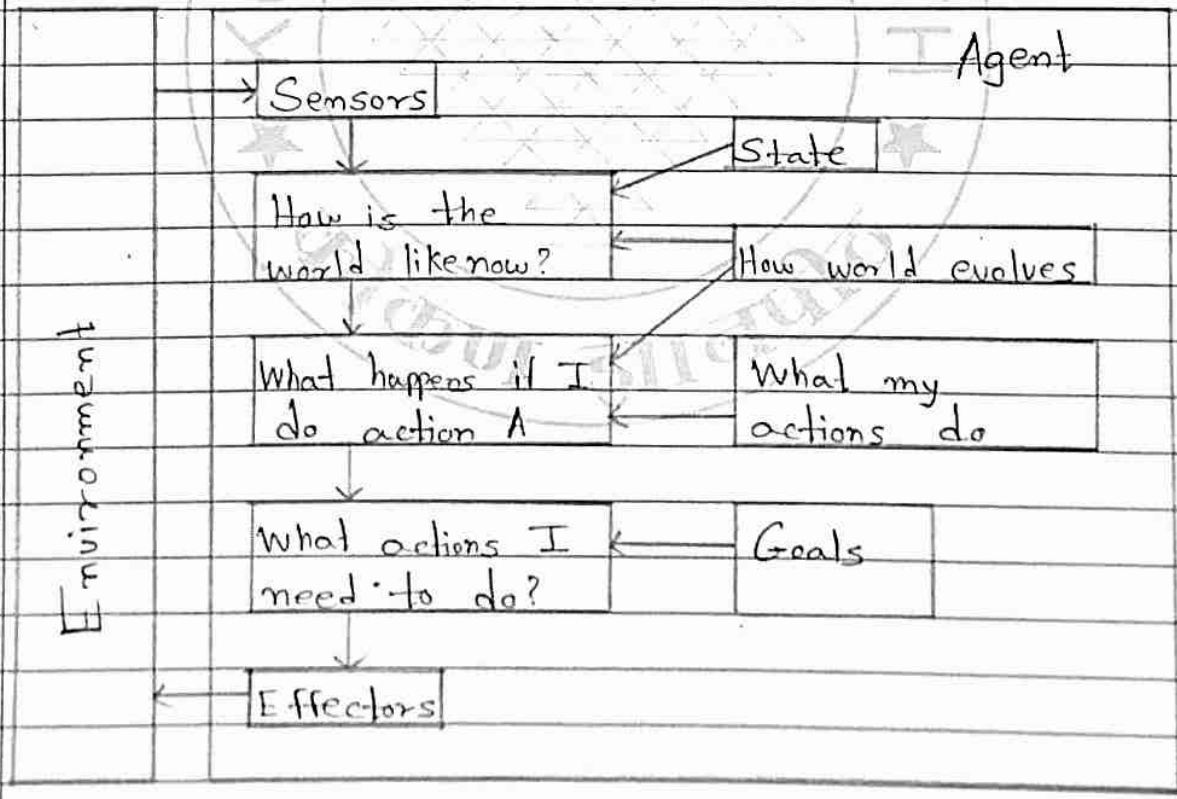
Robotic agent replaces cameras & infrared range finders for the sensors, & various motors & actuators for effectors.

Software agent has encoded bit strings as its programs & actions.

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. Following fig. shows four important types of agent architectures.

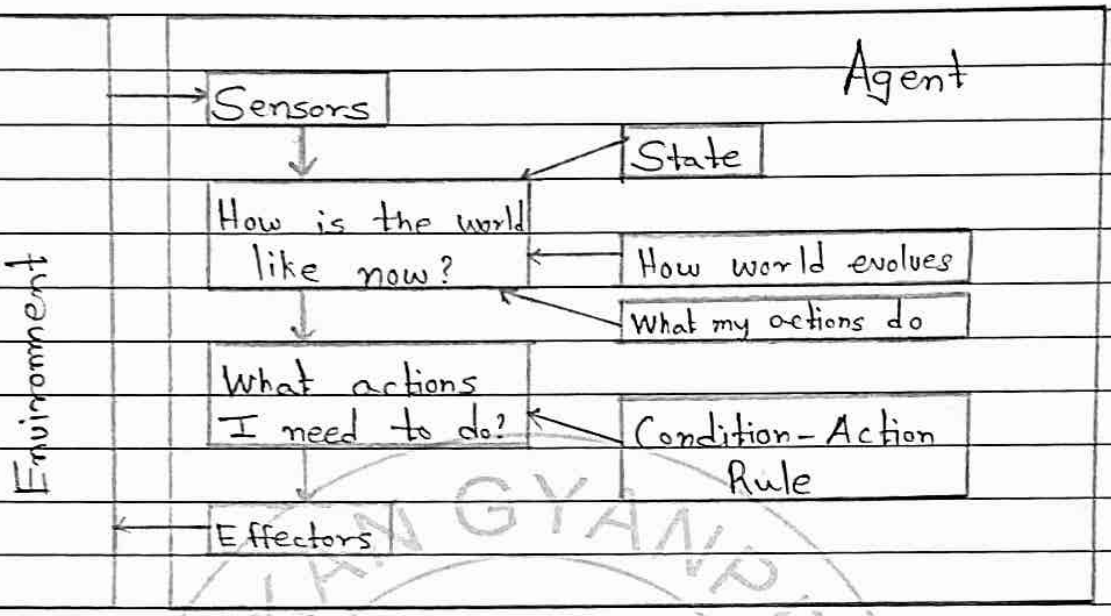


(a) Simple Reflex Agent

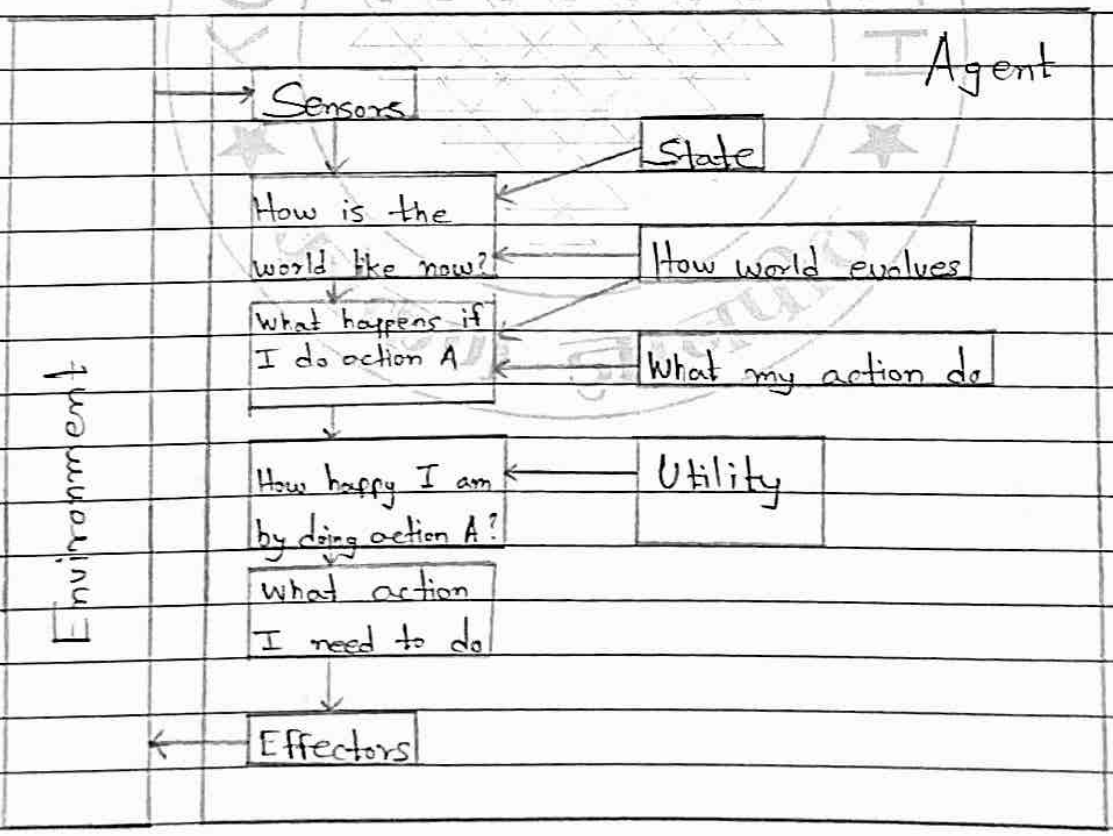


(c) Goal Based Agent

fig.2 : Agent Architecture Types



(b) Model Based Reflex Agent



(d) Utility Based Agent

fig. 2: Agent Architecture Types

As seen in figure 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 precept. Agent environment for such agents is fully observable.

Model based reflex agents as shown in figure 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 happen in the world i.e. representation of unobserved aspects of current state depending on percept history.

Agent take into account how its actions affect the world. Goal based agents shown in figure 2c, choose their 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 the description of desirable situations. Finally the Utility Based Agents shown in figure 2d choose actions based on a

preference (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. 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 agent solves is characterized by Performance Measure, Environment, Actuators, & Sensors (PEAS). These are collectively referred as PEAS descriptors for the agent task environment. PEAS descriptors provide important insight into agent & 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 example, chess); otherwise it is continuous (For example, 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 precepts it is observable; otherwise it is only partially observable.

3. Static or Dynamic:
If the environment ~~at each time point from the~~ P does no 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 & then acting. The quality of its 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 dectates 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.

7. 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 the agent.

* Working:

Search internet for AI based applications 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 chess pieces, safety of king piece, no. of moves, time for each move

Environment: Chess board, Chess pieces

Actuators: Desktop screen, CPU

Sensors: Chess Sound

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 Weizenbaum

Performance Measure: Understanding User, maintaining conversation.
Environment: User, Program, Keyboard, User text inputs, Eliza texts, output window
Actuators: Text
Sensors: User texts inputs
Task environment properties: Containers, 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 expressions, response time.
Environment: Humans, objects, real-world.
Actuators: 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 (Voice):

Performance Measure: Understanding user's text & speech, producing best results, summoning (trigged), response speed
Environment: User, speech, text
Actuators: Mobile screen, speaker
Sensors: Mobile screen, mic, button
Task environment properties: Continuous, fully observable, static, Deterministic, 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.