

ARTIFICIAL INTELLIGENCE

UNIT-1 - INTRODUCTION

1

Definition: AI definitions vary along two main categories:-

- ① Thought processes & reasoning
- ② Behavior

(1)

In terms of processes & reasoning

- AI is the exciting new effort to make computers think, machines with minds in full and literal sense [Haugeland , 1985]
- "The study of the computations that make it possible to reason, perceive and act." [Winston , 1992]

(2)

In terms of behavior

- "The study of how to make computers do things at which, at the moment, people do better" [Rich and Knight , 1991]
- AI is concerned with intelligent behavior in artifacts" [Nilson , 1998]

* Approaches followed in AI:

①

Thinking Humanly (eg: psychological experiments)

- ② Acting Humanly (eg: Turing Test)
- ③ Thinking rationally (eg: logics)
- ④ Acting rationally (eg: Rational agent)

2 The foundation of AI

1. Philosophy -
 - provides base to AI
 - provides theories of relations between physical brain & mental mind, rules for drawing valid conclusions
2. Mathematics -
 - provides strong base to AI
 - develop concrete and formal rules for drawing conclusions
 - methods for data compilation
 - techniques to deal uncertain info
3. Economics -
 - support AI to make decision
 - maximize the payoff and make decisions under uncertain circumstances.
4. Neuroscience -
 - gives information that is associated with brain processing.
 - Also, helps to develop data processing techniques

5. Psychology:
- provides strong concepts of thinking.
 - develops process of thinking and actions.

#3

History of AI

1) Gestation of Artificial Intelligence (1943-1955)

- Turing Test was given by Alan Turing in 1950 who was the first who articulated the idea of complete vision of AI.

2) Birth of Artificial Intelligence (1956)

- McCarthy came up with the name "Artificial Intelligence"
- Justification regarding why AI wasn't a branch of mathematics or decision theory and control theory?

→ Reasons → (i) It is duplication of creativity, self-improvement & language use.

Methodology

3.) Early enthusiasm, great expectations
(1952 - 1969)

Newell and Simon's presented GPS (General Problem Solver). GPS was first program "having thinking human approach."

Herbert A. Gelernter constructed Geometry Theorem Prover (1959) capable of solving proving quite tricky mathematics theories.

HLL LISP - dominant AI programming language given by J. McCarthy in 1958.

DENDRAL program was developed by Bushnan in 1969

4.) AI becomes industry (1980 - present)

In 1981, 5th generation project was announced which was a 10 yr plan to build intelligent computers running PROLOG.

US also formed the Micro electronics and Computer Technology Corporation (MCTC) for research in AI.

5)

AI becomes a science (1980 - present)

Hidden Markov Models came to dominate AI field. This model is based on two aspects:-

- ① Rigorous mathematical model theory
- ② Generation by a process of training on a large corpus real speech data

6)

Emergence of intelligent agents (1995 - present)

Since sensory systems cannot deliver perfectly reliable systems information, therefore reasoning & planning systems must be able to handle uncertainty.

#4.

Applications of AI

1.

Autonomous planning and scheduling

Ex: NASA's Remote Agent program - first on-board autonomous planning program to control the scheduling of operations for a spacecraft.

2.

Game Playing

Ex: IBM's Deep Blue

first computer program to defeat world champion in a chess match.

3. Autonomous Control

Ex: ALVINN computer vision system trained to steer a car to keep moving in a lane.

4. Diagnosis

Medical diagnosis programs based on probabilistic analysis have been able to perform at an expert physician level.

5. Logistics Planning

Ex:- Dynamic ^{Analyses} and Replanning Tool (DART) deployed by U.S. forces during Persian Gulf crisis in 1991 to do automated logistics planning & scheduling for transportation.

6. Robotics

Ex: HipNav is a system that uses computer vision techniques to create a 3D model of a patient's internal anatomy.

7. Language understanding and problem

solving

PROVERB is a computer program that solves crossword puzzles better than most humans.

5

Comparison between Humans & Machines.

Humans

Machines

- Brains are analogue
 - Brains are massively parallel machine
 - Processing speed is not fixed in brain
 - Synapses are more subtle complex in nature
 - Processing and memory management is performed by same components
- Machines are digital
 - Machines are serial and modular
 - Machine has fixed speed specification.
 - Electric logic gates are less complex.
 - Processing and memory management is performed by different components.

#6

AI Terms

→ Agents and AI terminology

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.

- For example: Agent : Human

Sensors : Eyes, ears, other organs

Actuators : Hands, legs, mouth

- Agent : Robot

Sensors : Cameras, infrared rangefinder

Actuators : Motors

- Agent : Internet shopping agent

Sensors : HTML, DHTML, pages

Actuators : Forms, display to user, follow

- Percept: Agent's perceptual inputs at any given instant.

Example: Human agent perceives "Bird flying in the sky through eyes and takes the snap."

- Robotic agent perceives "Temperature of"

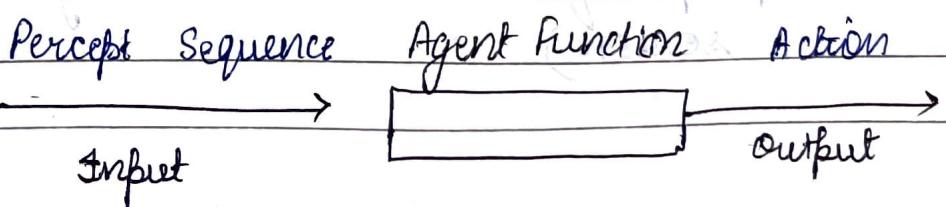
"boiler" through cameras and takes the control action.

→ Percept Sequence

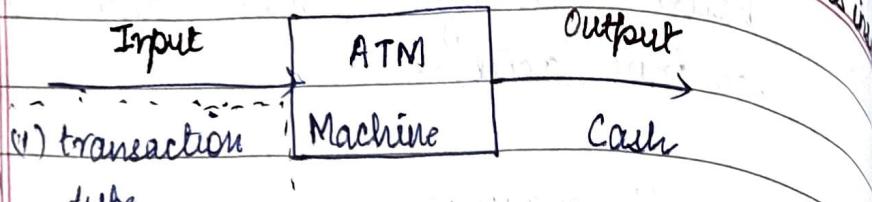
- Agent's percept sequence is the complete history of everything that agent has ever perceived.
- Example: A robotic agent monitoring temperature of a boiler will be sensing it continuously and keep on maintaining the percept sequence.
- The percept sequence helps robot agent to know:
 - temperature fluctuation and action will be taken on the percept sequence for controlling temperature.

→ Agent Function

- Mathematical function
- Maps each and every possible percept seq. to a possible action.



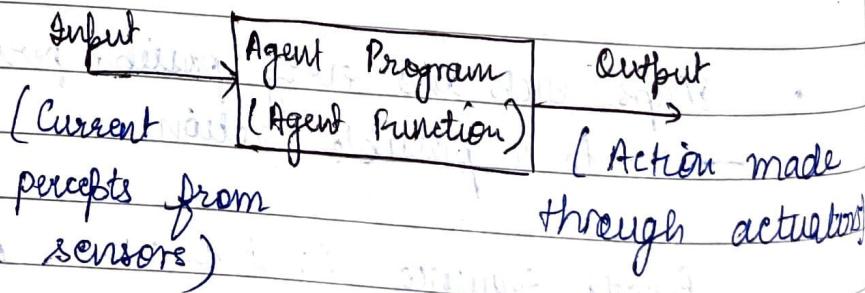
for withdrawing money when ATM card is in



(2) PIN Number → percept sequence

→ Agent Program

- An agent program is responsible to implement agent function for an intelligent agent. It tabulates all agent functions that describe any given agent.
- In order to implement agent functions the percept sequences and action will be external characteristics of the agent.
- Agent program → concrete implementation running on the agent architecture.
- Agent function → abstract mathematical description.



→ Example for Tabulation of a Agent

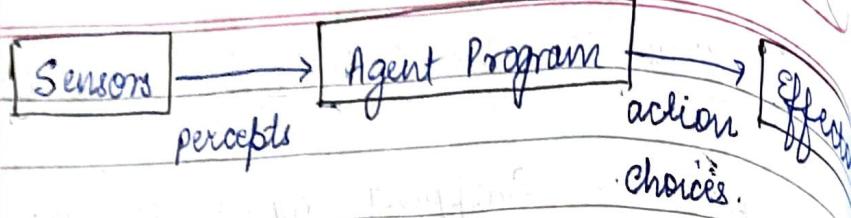
Agent :- Shopping agent on internet called as bot

S.No.	<u>Seq. of percepts</u>	<u>Action</u>
1.	[Type URL of greeting site mygreeting.com]	Display website
2.	[Navigation and observation of greetings to be purchased]	clicks on the link
3.	[To get details of greeting in terms of a form] purchased	Form filling
4.	[To perceive completion of a process]	Receiving receipt or bill.

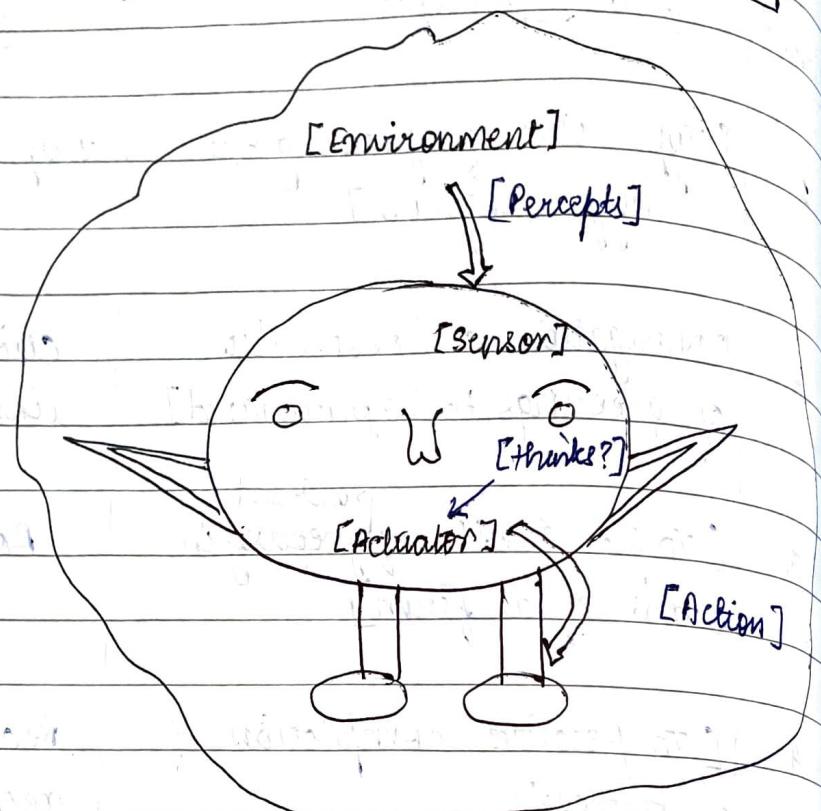
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Architecture of Agent

- Agent runs on some sort of computing device called as architecture.
- Program chosen should be one which is accepted and run on the architecture.



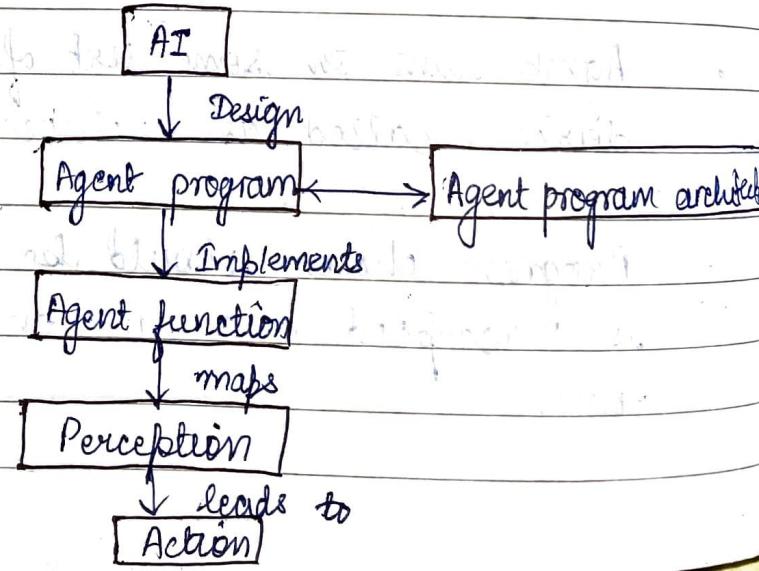
Agent = Architecture + Program.



Agent and its Environment

#8

AI Agent performing action



#9

Concept of Rational Agent

If every entry in the agent function is filled correctly then the agent will always do the right thing.

Such agent is called as rational agent.

To design performance measure for identifying the success of rational agent following 4 things are considered.

- 1) Performance measure that defines criterion of success.
- 2) Agent's prior knowledge about environment.
- 3) Actions that agent can perform.
- 4) Agent's percept sequence till date.

Thereby a rational agent can be defined as:-

Agent should select an option that is expected to maximize the performance measure on the basis of percept sequence and built in knowledge of agent

(1)

Optimal behavior

(2)

Result into desired seq. of states

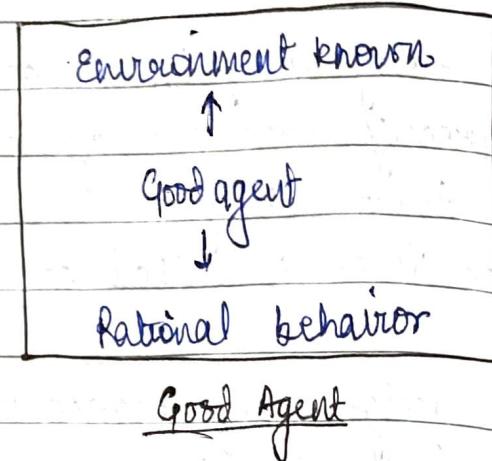
(3)

Perceive sequence

(4)

Agent coupled with complex env.

* The Good and Bad Agent



* The Weak and Strong Agent

Weak idea of agent is a hardware or software based computer system having following properties

- Autonomy - (freedom to act- independently)
- Social ability -
- Reactivity -
- Pro- activeness -

Strong idea of an agent says it has mental properties : intention, belief, obligation, knowledge.

It has certain properties such as :-

- Mobility (capacity of movement/ changeability)
- Veracity (quality of stating / speaking Truth)
- Rationality (logical behavior)
- Sentience (possession of awareness sensory)
- Consciousness
- Sapience (possess wisdom)

#10

The Agent & its Environment : Example

BLACK BALL PICKER

(1)

Environment : Picker World

Has. 2 buckets at 2 locations L1 & L2 (square area location) full of BLACK & WHITE colour balls.

(2)

Perceptions

Picker perceives at which location is there a BLACK BALL

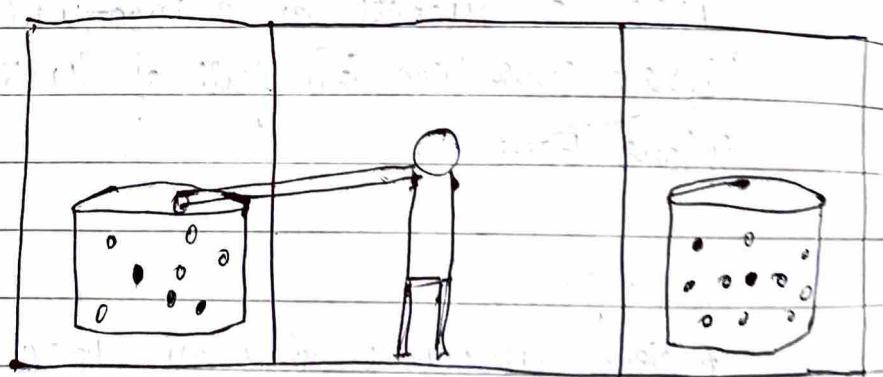
(3)

Actions (Agent)

Picker can choose - MOVE LEFT, MOVE RIGHT, PICK UP BLACK BALL or be idle

Agent function - If current location has more black balls then PICK, otherwise move to next square

<u>Percept Sequence</u>	<u>Action</u>
[L1] NO Black Ball]	Right
[L1, More Black Balls]	Pick
[L2, NO Black Ball]	Right
[L2, More Black Balls]	Pick
:	
:	
[L1, NO Black Ball], [L1, NO Black Ball]	Right
[L1, NO Black Ball], [L1, More Black Balls]	Pick
:	
:	



Black Ball Picker with two buckets

agents working together to take & act. The environment can be cooperative and competitive as well. This is called as multi-agent environment. ^{of independent}

example:- Maze game
Fantasy Football [cooperative]
Trading agents [competitive]

#12

Intelligent Agent

- Intelligent Agent is one who observes and act upon an environments.
- Example: A human agent, A robotic agent

★

Characteristics

- Learn large amount of data
- Learn and improve through interaction with environment.
- Must have good storage and retrieval capacity.
- Adapt online as well as in real time situation.
- Accommodate new problem solving rules.

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Types of Intelligent Agents

1. Simple reflex agents.
2. Model based reflex agents.
3. Utility based agents.
4. Goal based agents.

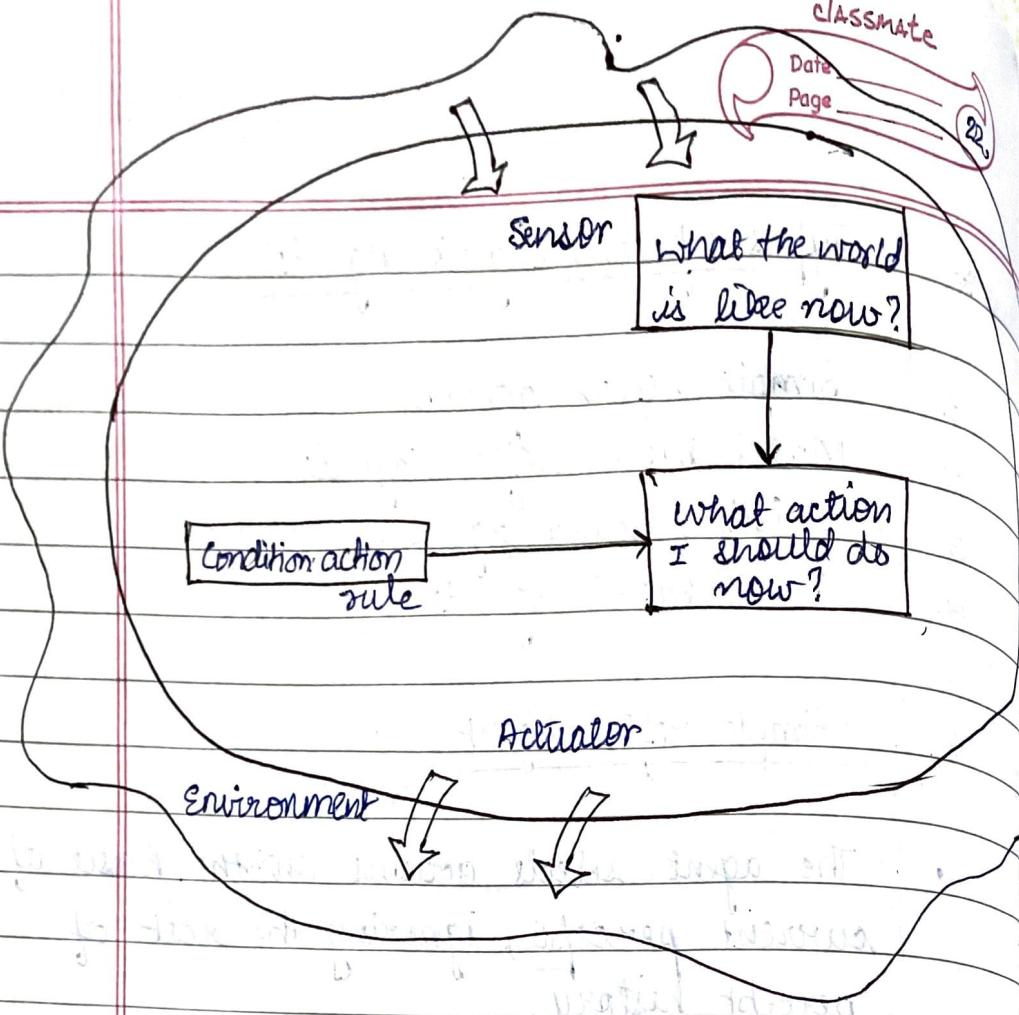
1. Simple reflex agent

- The agent selects actions on the basis of current percept, ignoring the rest of percept history.
- Example:- ATM agent system ; while PIN matches with given account no. then customer gets money.

★

Properties :

1. Simple but intelligence is limited.
2. Work only if environment is fully observable environment.
3. In case of partially observable environment it leads to infinite loops.
4. Randomizing the actions can avoid the infinite loop.
5. Randomized simple reflex agent thereby performs better than deterministic reflex agent.



Simple reflex agent

2. Model Based reflex agent

- This agent stores model of possibilities of its actions.
- Internal state of agent stores current state of environment which describe part of unseen world.

Example:- Car driving agent (maintains internal state and act according to environment)

* Properties:

- Ability to handle partially observable

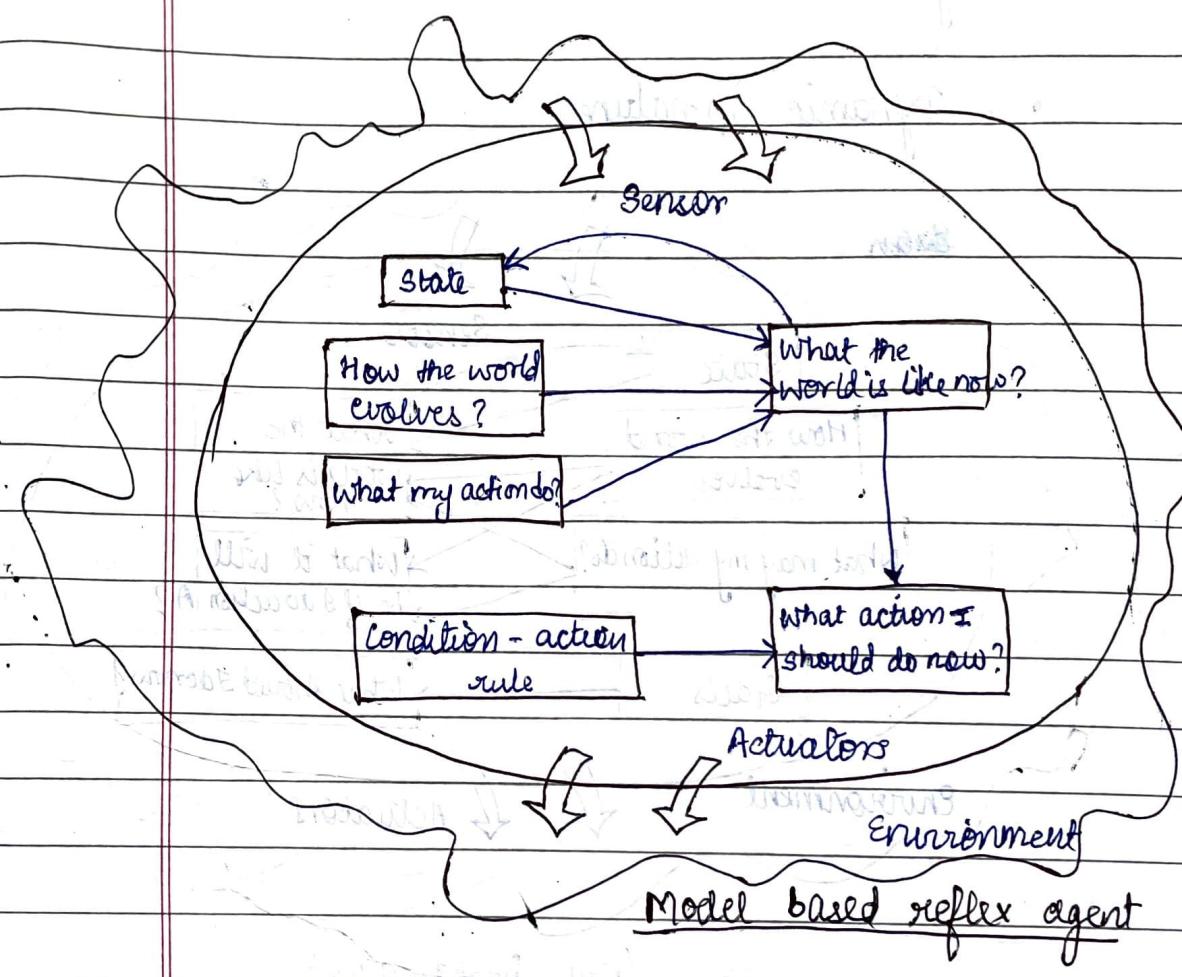
environment.

2.

Old - internal state + current percept

RL

update state



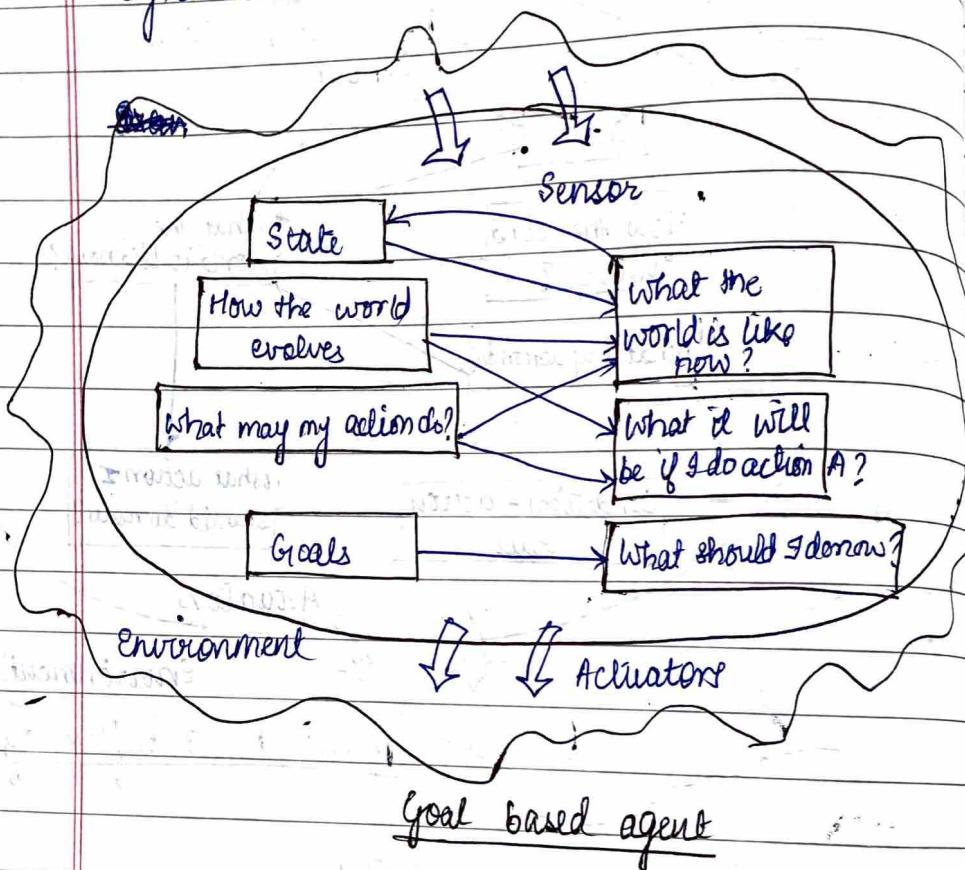
3.

Goal based agent

- This agent stores state description along with the goal state information
- example:- Agent searching a solution for 8-queen puzzle.

* Properties :

- Works to achieve a goal.
- Searching & planning to deal with diverse goals.
- Dynamic in nature.



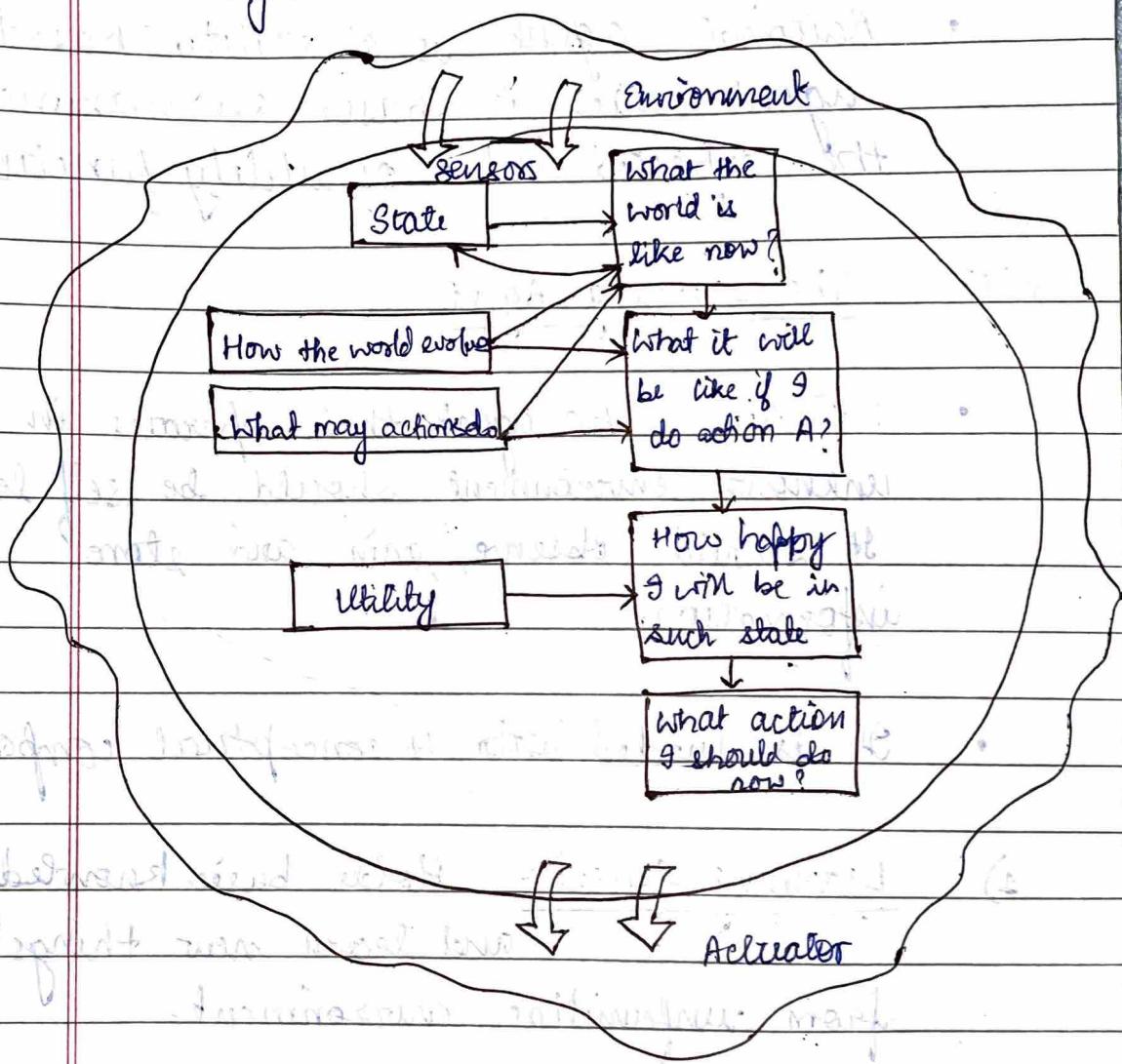
4.

Utility Based Agent

- When the agent has multiple goals, the framework can accommodate different preferences for different goals.
- Such systems have a utility function.

that maps a state or sequence of states to a real valued utility.

- Action by agent maximizes the utility.
- Example:- Military Planning robot that gives a certain plan of action. Its environment is too complex and expected performance is also high.



utility - based agent

* Properties

- utility function maps a state on to a real number.
- utility agent provide a way to measure likelihood of success against importance of goals.
- Rational agent is a utility based agent which is based on maximizing the expected value of utility function.

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The Learning Agent

- Definition : An agent that operates in unknown environment should be self learning. It should observe, gain and store information.
- It is divided into 4 conceptual components

1) Learning Element: Holds basic knowledge and learn new things from unfamiliar environment.

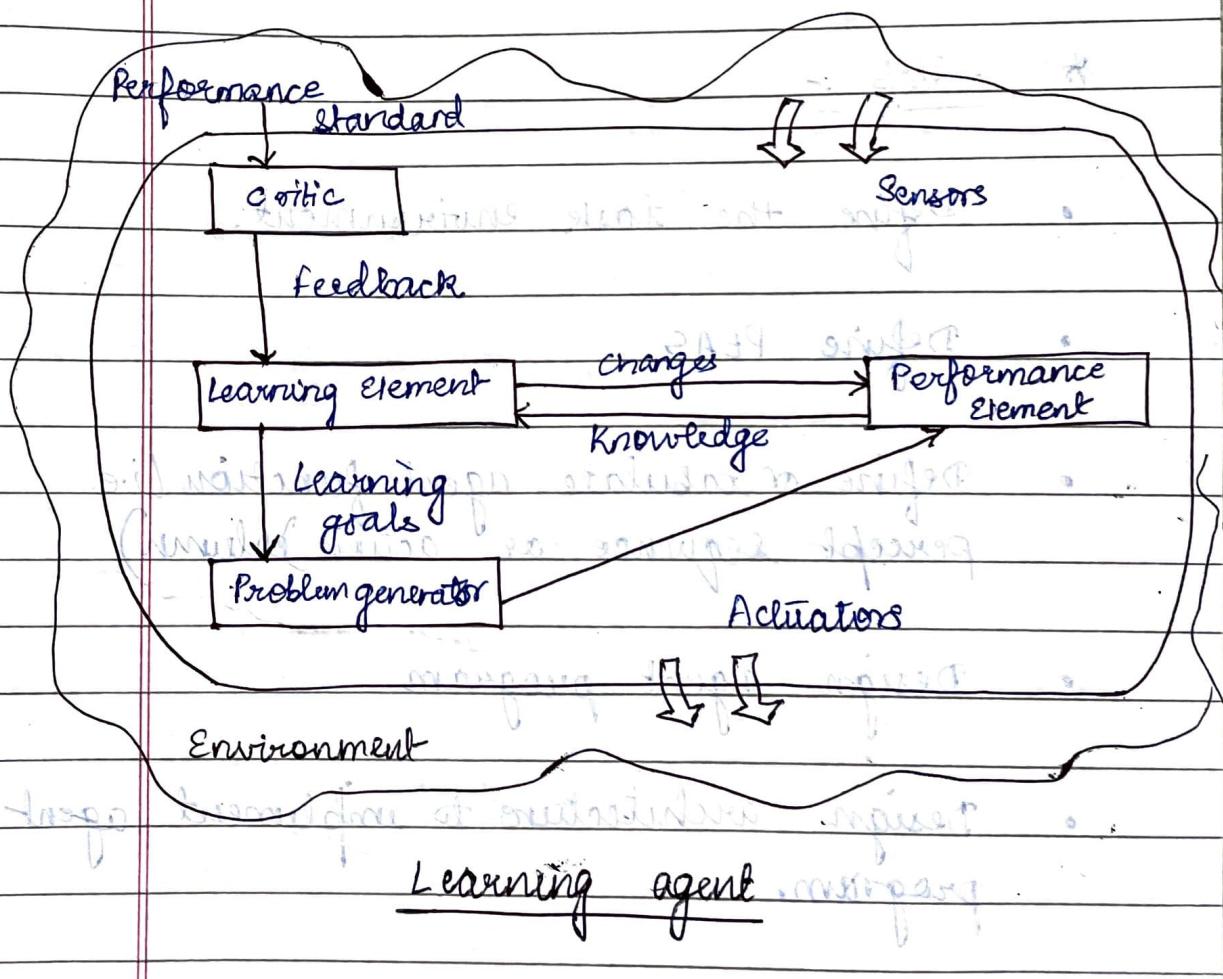
2) Performance Element: The element is responsible for selecting external actions. It perceives and decides actions.

3)

Fault Reflector Element / Critic: It gives feedback and analyzes corrective actions in order to get max. success.

4)

Problem generator Element: This element generates new & informative experience by suggesting new actions to agent.



#14

Designing an Agent System

- In order to design an agent we need to have following:-

- P - Performance
- E - Environment
- A - Actuators
- S - Sensors.



Steps :-

- Define the task environment.
- Define PEAS.
- Define or tabulate agent function (i.e. percept sequence or action column)
- Design agent program
- Design architecture to implement agent program.
- Implement an agent program.