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Sem : 4th

Module - 1

1] What is AI?

→ AI is one of the newest fields in science & Engineering.

→ The name was coined in 1956

Some definitions of AI, organized into 4 categorie

Thinking Humanly	Thinking Rationally
The exciting new effort to make computers think ... machines with minds in the full & literal sense (Haugeland 1985)	The study of mental faculti-ies through the use of Computational Models
The automation of activities that we associate with human thinking, activities such as decision-making, problem solving Learning	The study of ~~mental~~ the computations that make it possible to perceive, reason & act.

Acting Humanly	Acting Rationally
The art of creating machines that perform functions that require intelligence when performed by people	Computational Intelli... in the study of the desig... of intelligent agents
The study of how to make Computers do things at which at the moment, people are better.	AI is concerned with intelligent behaviour in artifacts.

(I) Acting Humanly: The Turing Test App...

→ Turning Test proposed by Alan Turning (1950)

→ Why it was designed?

To provide a satisfactory operational definition of intelligence.

The Computer would need to possess/process the following capabilities.

→ Natural Language processing: to enable it to Communicate succesfully in English

- Knowledge representation : to store what it knows or hears
- Automated reasoning : to use the stored info to answer questions & to draw new conclusions
- Machine Learning to adapt to new circumstances & to detect & extrapolate patterns.

In Simple terms

The Turing Test is about testing if a computer can think like a human, without needing to look or act like one.

The test only focuses on how well the computer can talk or write, not on its physical appearance or movement.

The total Turing Test includes a video signal so To pass the total turning test, the computer need

- computer vision to perceive objects
- robotics to manipulate objects & move ab

[perceive → understanding Something through your sens

These six disciplines composes most of AI &

Thinking humanly: The Cognitive Modelling appr

If we say the program thinks like a huma we must have some way of determining how humans think.

There are 3 ways to do this

1) Through Introspection:
2) Through psychological experiments
3) Through brain imaging

(1) Introspection → try to catch our own throughts as they go by

(2) Psychological → observing a person in act

(3) Brain imaging → observing the brain in action.

Once we have sufficient theory of mind it possible to express the theory as a Computy program.

If pgrm program I/P - O/P Behaviour ← match → Human Behaviour

that is the evidence

Program mechanisms could ← match → Human.
operate on

Cognitive science brings together computer models from AI & experimental techniques from psychology to construct precise & testable theories of the human mind.

Thinking Rationally: The "laws of thought" approch

→ An approach to AI & machine learning that is based on the principles of formal logic & reasoning

→ The laws of throught approch aims to develop AI systems that can reason logically & make decisions based on a set of predefined rules

Acting Rationally: The rational agent approch

Agent is just something that acts

A rational agent is one that acts so as to achieve the best outcome

The rational - agent approch has 2 advantages oves othus approches

(I) It is more general than the 'laws of thought'

(II) It is easies to study scientifically than approches based on human behaviour or thought.

2. The Foundations of AI

(1) Philosophy

philosophical views on the mind's & Reasoning

The mind operates through logical rules & reasoning is seen as a process that can be mechanized

By combining both philosophical theories of decision-making which helps how AI system can make choices for giving ~~a do~~ complex decisions.

(2) Mathematics

The mathematical foundations of AI focusing on logic computations, & probability

The huge problems, where the time taken/needed to solve problems grows rapidly

→ Some problems are so complex that they are difficult to solve efficiently

→ NP - complete are hard to solve

(3) Economics

Economics helps make decisions to maximize benefits & get best outcomes

They used utility ← for decision making

game theory ← show how one person's actions can impact others.

→ Covers methods for making decisions with long-te effects [Markov decision process]

(4) Neuroscience & Cognitive Science

Neuroscience: provides the structure & fu? of brain, it inspires the development of artificial neural networks, & deep learning

Understanding how biological neurons words that helps us in mimic neural proc for tasks like pattern recognitions & decision-making.

Cognitive Science: Cognitive architecture & models of human reasoning have been integrated into AI to enhance its ability to think like a human process

(5) Psychology

Evolution of psychology theories & behaviours to develop lead to development of Cognitive psychology & Cognitive science, The models helps to understand human behaviour & mental process

(6) Computer Engineering

Development of Computer & AI highlight key inventions, evolution of hardware & software that laid the foundation for modern AI.

(7) Linguistics

Natural language processing focus on enabling AI to understand, interpret & genesate human language.

The development led to the grow of algorithm for language modeling.

Module - I | Chapter - 2

Intelligent Agents

Agents & Environments

Agent → An agent in AI is an entity that perceives [to become aware of, recognize] its environment through sensors & acts upon that environment using actuators to achieve a goal.

Actuators in AI

Refers to a mechanism that allows an AI agent or system to take actions in the real world based on the decisions it makes.

Example

1. Robotics : Motors, wheels

A robotic vacuum cleaner moves & adjusts its direction using motorized wheels

perception (Sensors

General Information.

Agent

→ An agent is something that senses its environment & takes actions based on what it perceives.

→ Percept Sequence → refers to everything the agent has sensed / observed so far

→ The agent makes decisions only based on what it has perceived, not on anything it hasn't

Agent function

→ An agent function is a mathematical way of describing how an agent behaves

→ It takes in a percept sequence & maps it to action

→ If we observe an agent & record its actions for different percept, we can construct this table

Agent programs

Agent program is the actual code / Implementation that carries out the agent function in a real System

Vacuum Cleaner : Example

Agent : The vaccum cleaner robot

Percepts : Current spot is dirty or clean

Agent fu⁇ : Based on percepts sequence, the agent fu⁇ might decide to clean spot if it detects dirt

Agent pgm : The code running on the vaccum cleaner robot that makes it move & clean based on its sensor input

— Refer the Vacuum - Cleaner figure.

Concept of Rationality

→ A rational agent is one that does the right thing

→ It makes decisions based on its percept sequence & uses built-in knowledge

Performance Measure : The notion of the desirability is captured by a performance measure that evaluates any given sequence of environment states.

Rationality

The rationality of an agent depends on the performance measure, knowledge, available actions & percept sequence.

Case 1: Basic Vacuum Cleaner

→ Performance Measure : One point per clean square at each time step

→ Knowledge : The environment (two boxes) is known, but the dirt distribution & initial agent location are unknown.

→ Actions : Left, Right, Suck

→ Percepts : The agent knows its location & whether there is dirt.

The Nature of Environment

Task environments which are essentially the "problems" to which rational agents are the solution

PEAS — Sensors
Actuators
↳ Performance
↳ Environment

PEAS [Taxi]

Agent Type	performance Measure	Environment	Actuators	Sensors
Taxi drives	Safe, fast legal, trip Maximize profits	Roads, traffic customers	Steering accelerator brake horn	camera GPS Engine Sensors

(2) Autonomous Cas

Agent Type	performance Measure	Environment	Actuators	Sensors
Autonomous Cas	Safely transpa traffic laws Avoid, accider	Roads, intersections traffic maps	Steering Horn Doors for passengs Entry	Camera GPS Speedo -meter

(3) Amazon Alexa (Voice Assistant)

Agent Type	Performance Measures	Environment	Actuators	Sensors
Virtual assistant	Accurate respond Control of Smart home	User's home office Internet connection	Speakers Microphone Smart home device	Microphone Cloud-based AI Location Sensor

Customer Service Chatbot (e.g., on a website)

Agent Type	Performance Measure	Environment	Actuata	Sensors
Virtual Chatbox	Respond to customes Query Resolve custo Helpful reply	website / Mobileappl? Customes profile	Text respons Helpful link Contact opt?	NLP Uses input (typing /vo Command

Smart Traffic Lights

Agent Type	Performance Measure	Environment	Actuator	Sensors
Smart Traffic	optimize traffic flow Minimize Waiting times	Urban Streets road condt?	Traffic lights Times for Signal changes	Camera

ATM

Agent Type	Performance measure	Environment	Actuator	Sensor
ATM Machine	Procen transac -tions (withdrawals deposits, bala) Timely respons to user input	public places (bank branches Shopping malls) users financial Institutions	Cash disp -enser Deposit slot Keyboard Touchscre	Card rea Camera paper ja touch Scree

8A Biometric Authentication System

Agent Type	Performance Measure	Environment	Actuators	Sensors
Biometric Authentic - ation system	Accuracy: Speed Security Reliability Uses Convenience	User Biometric data Authentication device Backend system	Authentication response Display Alarm / Notification	Fingerprint Sensors Camera Infrared Sensor pressure / Toouch Sensa

Properties of Task Environments

(1) Fully Observable Vs Partially Observable

If an agent's sensors give it access to the complete state of the environment at each point in time, then we say that the task environment is fully observable.

(2) Partially observable: An environment might be partially observable bcoz of noisy & inaccurate sensors / missing from the sensor data

Single - Agent

↳ one agent interacts with the environ -ment

Multiagent : Multiple agents interact with each other & the environment

Agent may be Competitive / co-operative

Deterministic vs Stochastic

- Deterministic → what happens next is totally predicable. If you know the current situation & your action [Ex: Chess]

- Stochastic → what happens next is uncertain bcoz random events can change thing. Even if you know your current situation & action, the outcome can vary

Ex: In taxi driving, you can't predict exactly, how traffic is

unexpected will happen like flat tire

Episodic vs Sequential

Episodic → The agent's decisions in each episode are independent, & future actions do not depend on previous ones

Sequential → The agent's current action can influence future actions & decisions.

Static vs Dynamic

↳ The environment does not change while the agent is making decisions.

Dynamic → The environment changes while the agent is deciding on actions

Discrete vs Continuous

↳ The environment, actions & time are distinct & finite

Continuous → The environment, actions & time are continuous & can vary smoothly

Known vs Unknown

↳ The agent has complete knowledge of the environment's laws & outcomes of actions

Unknown : The agent has incomplete or no knowledge of the environment & must learn.

The Structure of Agents

Agent = Architecture + program

Agent programs

Many agent programs have the same skeleton : they take the current percept as input from the sensors & return the action to the actuators.

Four Basic kinds of agent programs that embody the principles

- ✓ Simple reflex agents
- ✓ Model - based reflex agents
- ✓ Goal - based agents &
- ✓ Utility - based agents
- ✓ Learning Agent

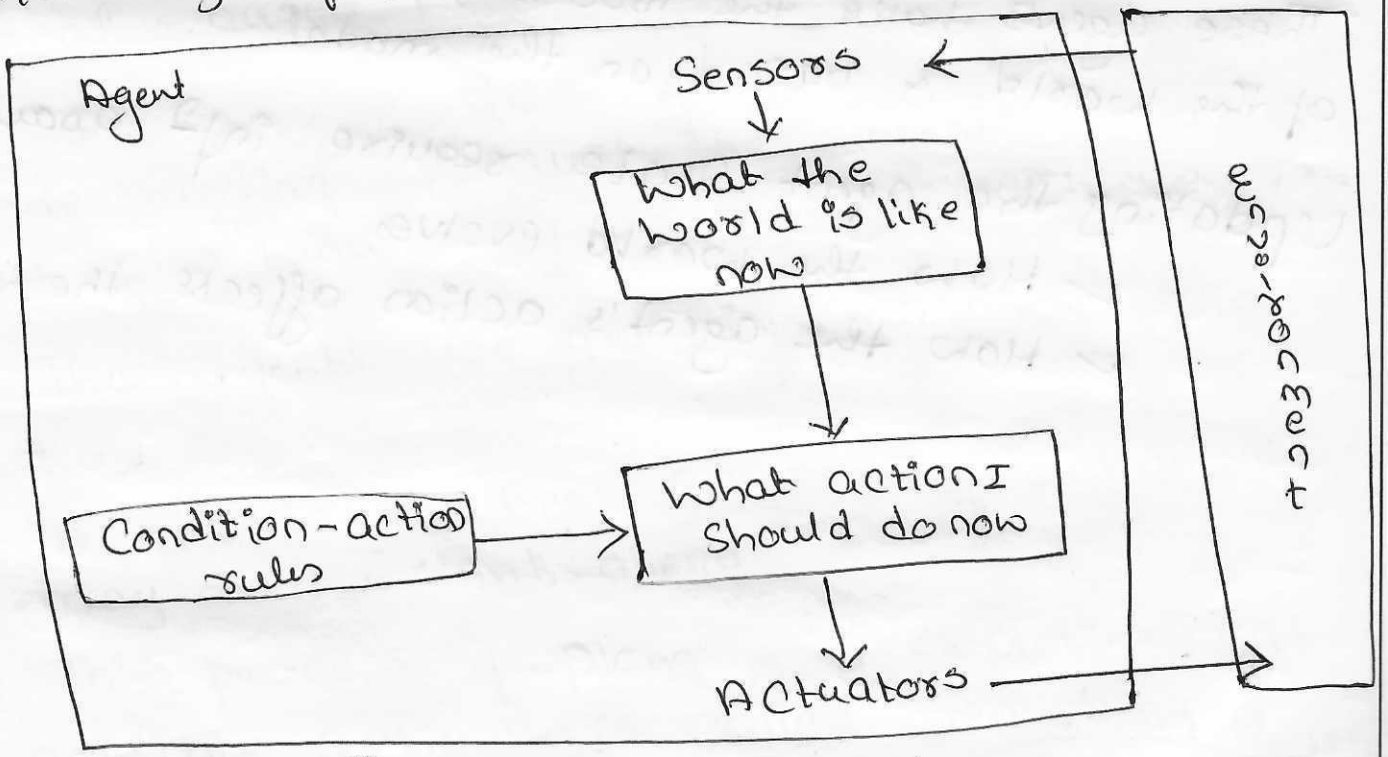
(1) Simple Reflex agents.

A simple reflex agents are the simplest agent These agent take decisions on the basis of the current percepts & ignore the rest (past State)

These agents only succeed in the fully observable environment

The main points

1. Limited decision-making : It makes decision based on current percept without considering past
2. Condition-Action Rules : A agent operates using condition-action rules
3. No Adaptability : Cannot adapt to changes in the environment
4. Low Intelligence : bcoz it react to immediate.
5. Lack of Context Awareness : The agent has no knowledge of past states or future possibilities.



Simple reflex agent

Model Based Reflex Agents

The model-based agent can work in a partially observable environment, & track the situation.

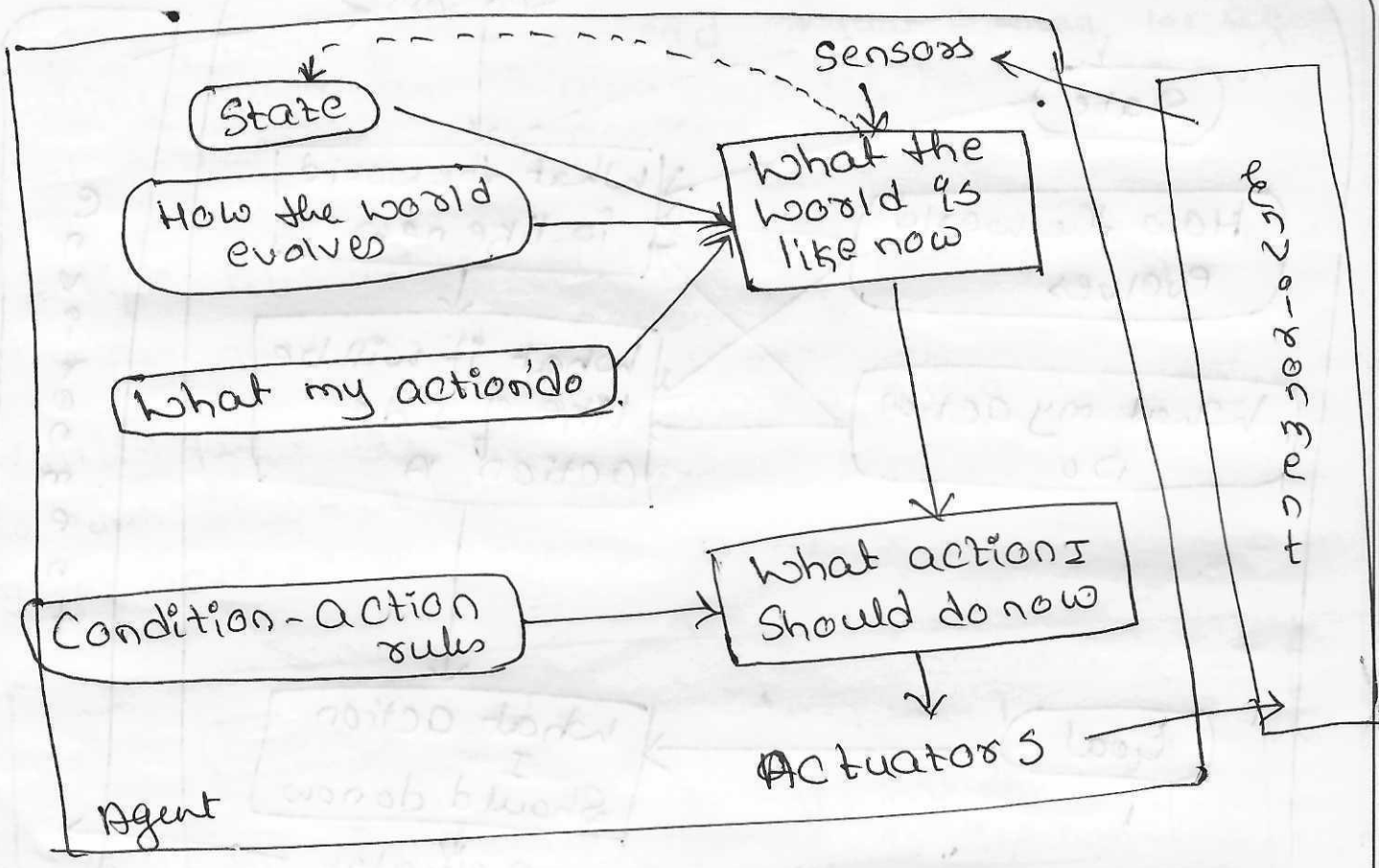
The model-based agent has 2 importa factors

- Model : It is knowledge about "how things happen in the world" so it is called a model-based agent
- Internal State : It is a representatio of the current state based on percept history

These agents have the model, "which is knowl of the world & based on the model.

Updating the agent state require info about

- How the world evolves
- How the agent's action affects the w



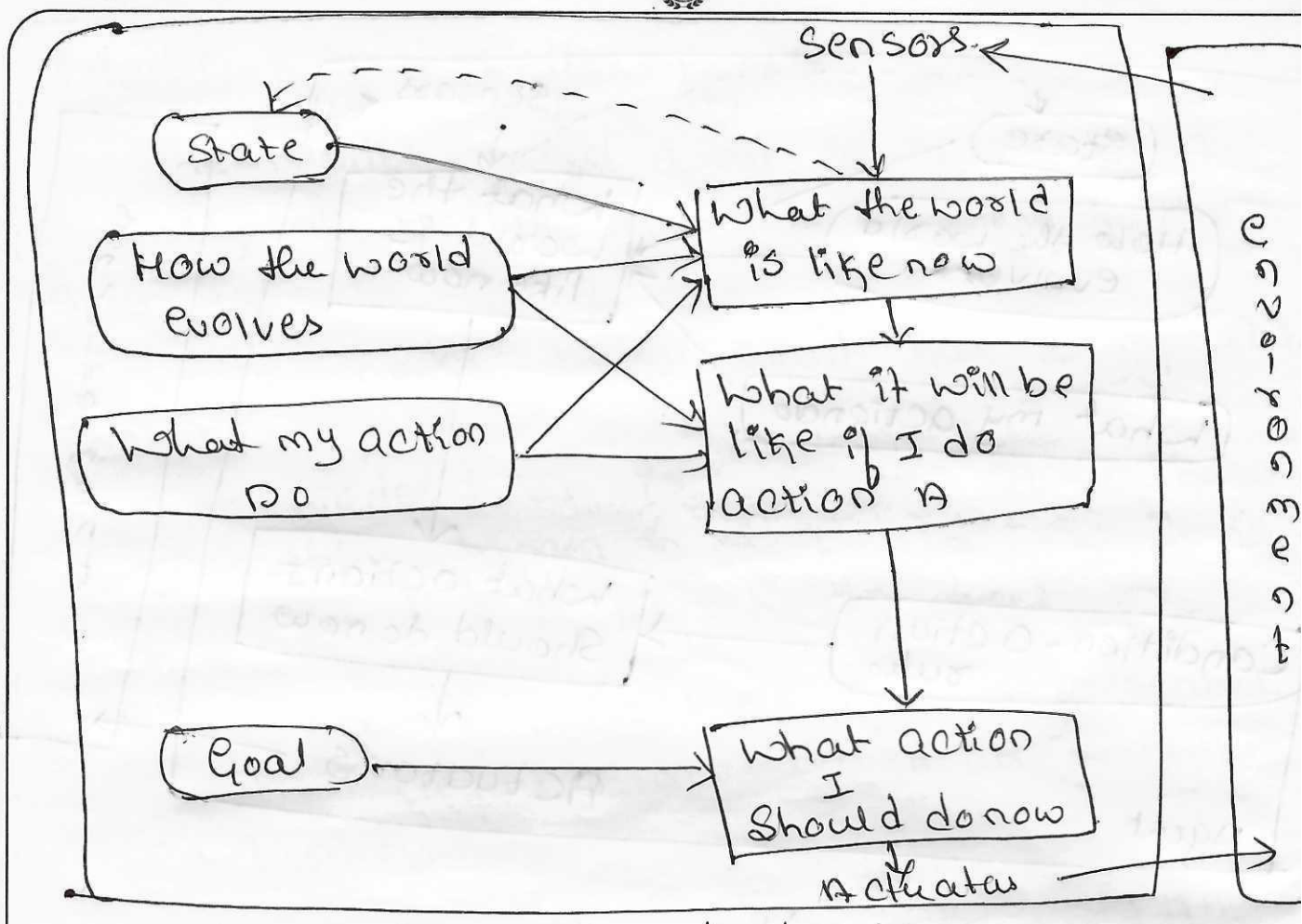
Goal - based Agents

~~The~~ ~~Keeps~~ → GBA go a step further by understanding not just the current situation, but also what they are trying to achieve.

→ The agents use goal information to guide this actions,

→ To decide the best course of action, they may need to think ahead

→ This process of planning & exploring diff possible actions is called Searching & planning



Goal - Based Agent

Utility Based Agent

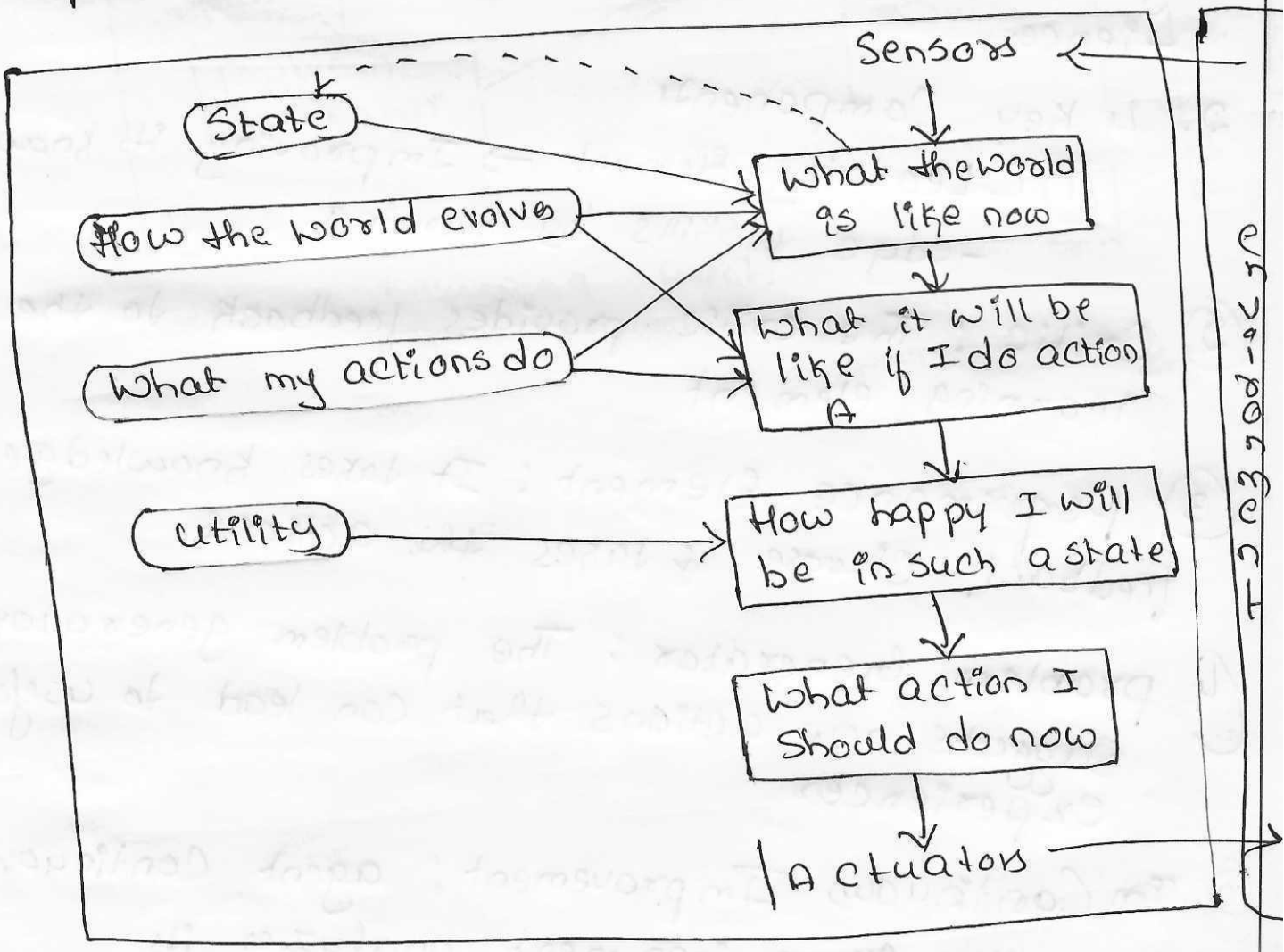
Utility - based agents are similar to goa
-based agents but add an extra component
called utility measurement.

1. Utility Measurement: These agents have a
"level of happines" or utility, which is
way of measuring success in a given stat

Goal & Best path: Instead of just aiming for a goal utility-based agents also consider how to achieve that goal in the best possible way.

Multiple Alternatives: They are especially useful when there are many possible actions to take

Utility fn: The utility function assigns a real numb to each state, which represents how well that stat helps achieve the agent's goals.



Utility-based agent

Learning Agents

A learning agent in AI is agent that has the ability to learn from its past experiences & improve its performance over time.

1> Start with Basic knowledge : The learning agent begins with simple knowledge /rules & gradually adapts & improves based on its Ex -iences

2. 4 key Components

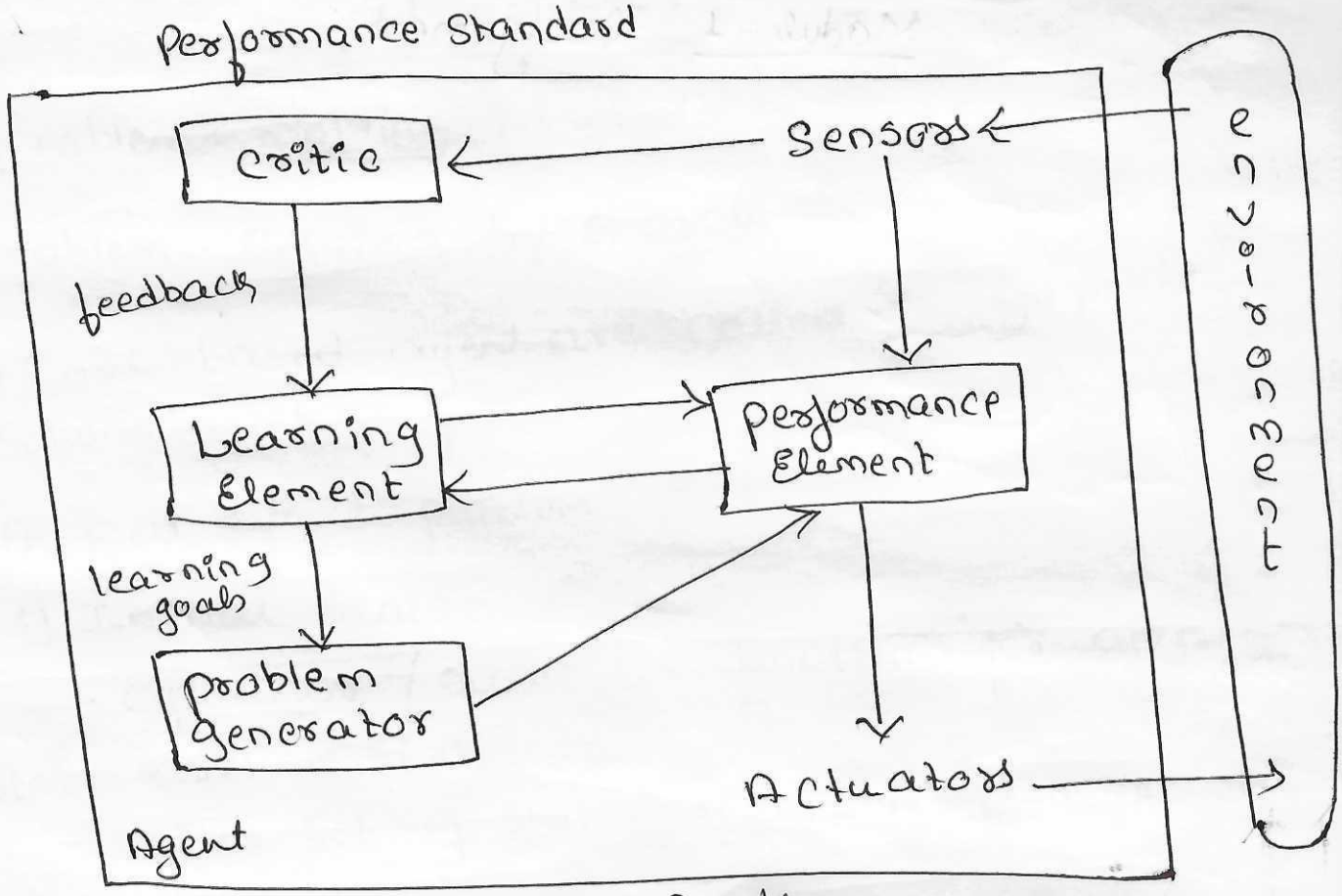
(1) L Learning Element → Improving its knowledge & skills by learning

(2) Critic : The critic provides feedback to the learning element

(3) Performance Element : It takes knowledge feedback Choose & takes the actions

(4) problem Generator : The problem generator suggests new actions that can lead to usefe experiences

(3) Continuous Improvement : agent continuously learns from its environment analyzes its performance & seeks out new ways to improve



Learning Agents