UNIT-1

INTRODUCTION

* What is Aritificial Intelligence :-

* AI is a branch of Computer Science that creates the Computers or machines as intelligent as human beings.

* According to the father of AI, John McCarthy, it is "The Science and engineering of making Intelligent machines, especially Intelligent Computer Programs.

* Artificial Intelligence is composed of two words Aritificial and Intelligence, where Artificial Defines "Man-Made" and Intelligence defines "Thinking Power" Hence AI Means "a Man-Made Thinking Power"

* Why Artificial Intelligence ?

→ Following are Some main Reasons To learn about AI

* with the help of AI - you can create Software or devices which an solve real-world problems Very easily.

* with the help of AI, you can create your Personal Virtual Assistant such as Google Assistant, Siri, etc.

* with the help of AI, you can build such robots which can work in an environment where survival of humans can be at risk.

* GOALS OF AI:-

* Following Are the main Goals of AI

→ Replicate Human Intelligence

→ Solve Knowledge - Intensive Tasks

→ An Intelligent Connection of Perception and Action.

→ Building a Machine which can perform tasks that requires Human Intelligence Such as:

* Proving a Theorm
* playing chess
* plan Some Surgical operation
* Driving a Car in traffic.

→ Creating Some System which can exhibit Intelligent behavior, learn new things by itself, demonstrate, explain and can advise to its User.

* what Contributes To AI?

* AI is a Science and Technology based on disciplines such as

→ Computer Science

→ Biology

→ psychology

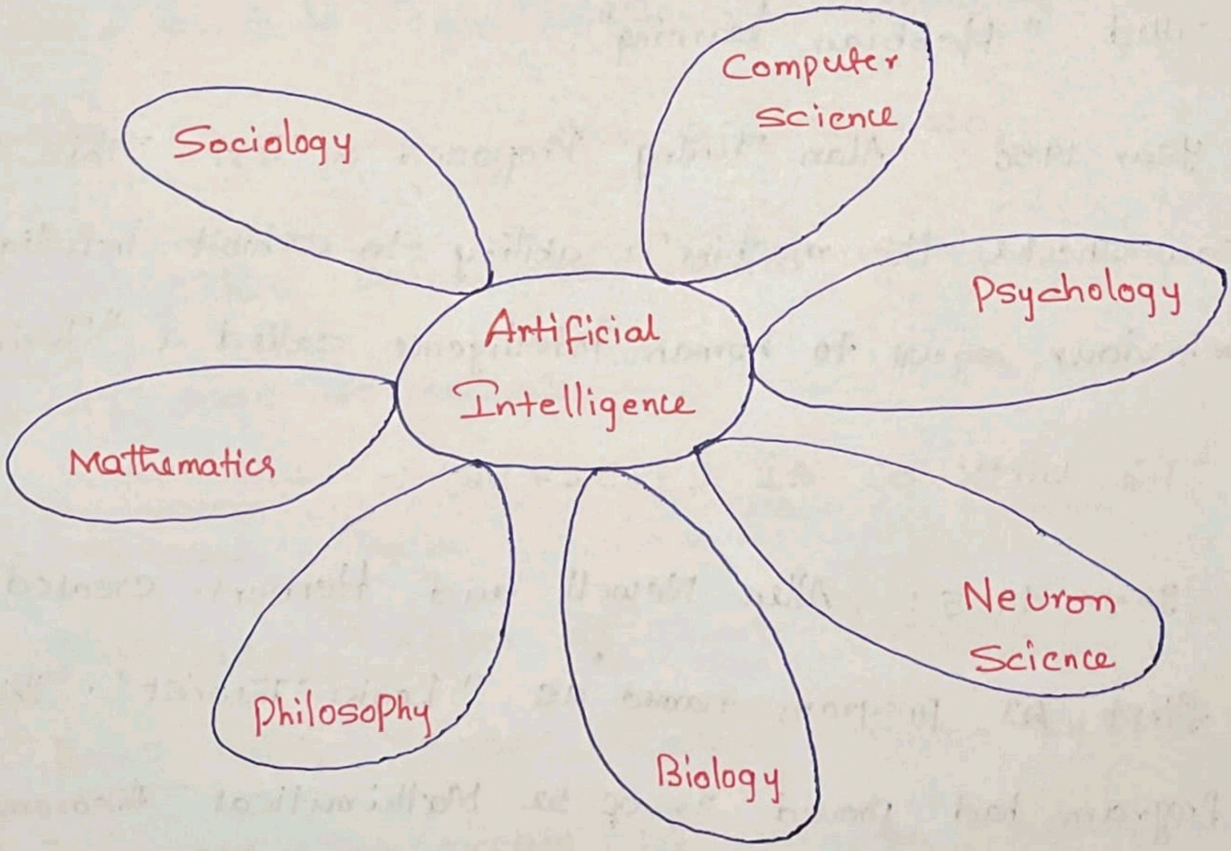
→ Mathematics

→ Sociology

→ Philosophy

* A major trust of AI is in the development of Computer functions associated with human Intelligence such as Reasoning, learning and Problem Solving.

* out of the following areas, one or multiple areas can Contribute to build an Intelligent System.



* History of AI :- * AI is not a new word and Not a New Technology. Following are some milestones in the History of AI which defines the Journey from the AI Generation to till date Development.

→ Maturation of AI (1943-52) :-

* year 1943 : The first AI work was recognized done by Warren and walter pits. They Proposed a model of "Artificial Neurons".

* year 1949 : Donald Hebb updating the rule for Connection Strength between "Neurons". His rule is now called "Hebbian learning".

* year 1950 : Alan Turing Proposed a Test. This Test can checks the machine's ability to exhibit intelligent behaviour equal to human intelligence called a "Turing Test".

→ The birth of AI (1952-56) :-

* year 1955 : Allen Newell and Herbert created the first AI program named as "Logic Theorist". This Program had proved 38 of 52 Mathimatical Theorems and find new and more elegent proofs for Some Theorems.

* Year 1956 : The word "Artificial Intelligence" first adopted by American Computer Scientist "John McCarthy" at the "Dartmouth Conference".

* At that time high level languages such as FORTRAN, LISP and COBOL were invented. And the enthusiasm for AI was very high at that time.

* → The Golden years of AI :- (1956 - 74)

* year 1966 : Joseph Weizenbaum created the first chatbot named as "ELIZA".

* year 1972 : The first Intelligent humanoid Robot was built in Japan which was named as "WABOT-1"

→ The first AI winter :- (1974 - 80)

* In this period, an Interst of publicity on AI was decreased.

→ A boom of AI :- (1980 - 87)

* year 1980 : After AI winter Duration, AI came back with "Expert Systems". These Systems were Programmed that emulate the decision - making ability of a human expert.

→ The Second AI winter :- (1987-93)

* In this Period, Investors and government stopped in funding for AI research as due to high cost but not efficient result.

→ The emergence of Intelligent Agents :- (1993-2011)

* Year 1997: IBM Deep Blue beats worlds chess champion. and become the first computer to beat a worlds chess champion.

* Year 2002: for the first time, AI entered the home in the form of "Roomba", "a Vaccum cleaner".

* year 2006: AI came in the business world till the year 2006. Companies like Facebook, Twitter and Netflix also started Using AI.

→ Deep learning, Big Data and Artificial General Intelligence:- (2011 - Present)

* year 2011: IBM's watson won Jeopardy, a quiz show, where it had to solve the complex Questions. watson Proved that it could Understand Natural language

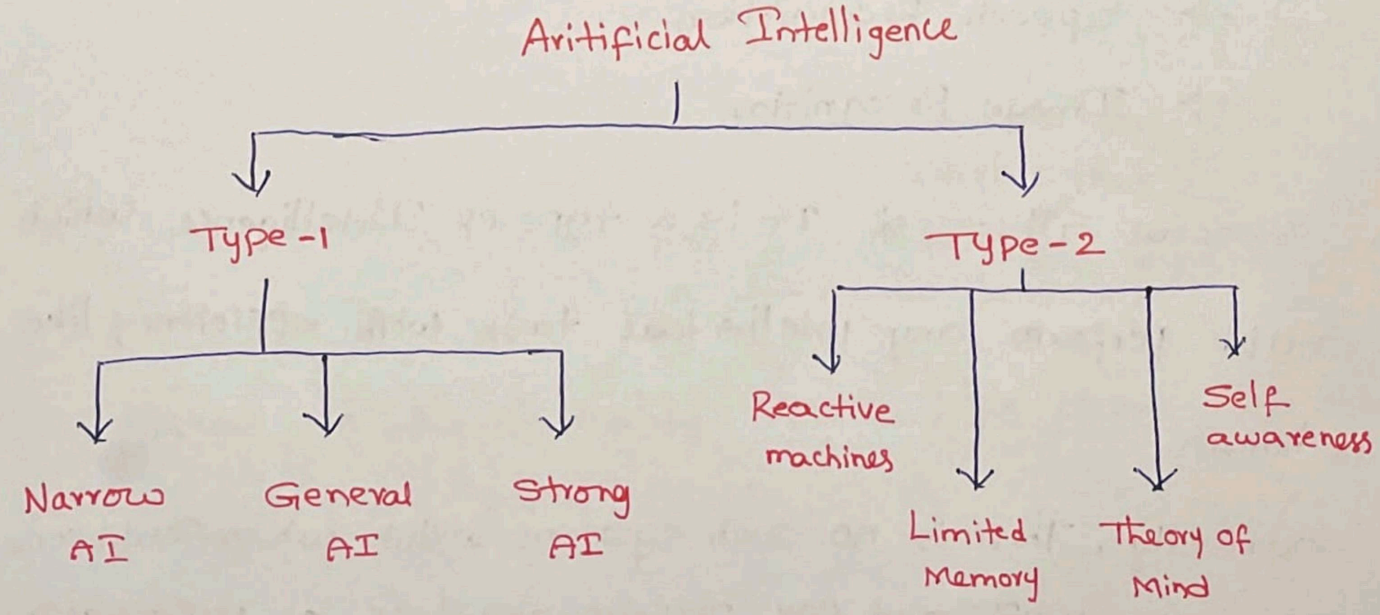
and can solve tricky Questions Quickly.

* Year 2012: Google has launched an Android App feature "Google now", which was able to provide information to the users as a prediction.

* Now AI has developed to a remarkable level. The concept of Deep learning, big data and data Science are now trending.

* Now a days Companies like Google, Facebook, IBM and Amazon are working with AI and Creating amazing Devices. The future of AI is inspiring and will come with high intelligence.

* Types of AI :- * There are two categories of AI based on capabilities and functionality of AI.



* Based on capability AI can be catogorized into three types.

1) Narrow AI :- * which is also called Weak AI which is able to perform a dedicated task with Intelligence

* The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.

* Narrow AI cannot perform beyond its field or limitations as it is only trained for one specific task.

* Apple Siri is a good Example of Narrow AI, but it operates with a limited predefined range of functions.

* Some Examples of Narrow AI are

  → playing chess
  → Purchasing Suggestions on E-comerce Site
  → self driving cars
  → speech Recognition.
  → Image Recognition.

2) General AI :- * It is a type of Intelligence which could perform any intellectual task with efficiency like a human.

* currently, there is no such system exist which could come under general AI and can perform any task as perfectas a human.

3) Super AI :- * It is a level of Intelligence of Systems at which machines could surpass human Intelligence and can perform any task better than human.

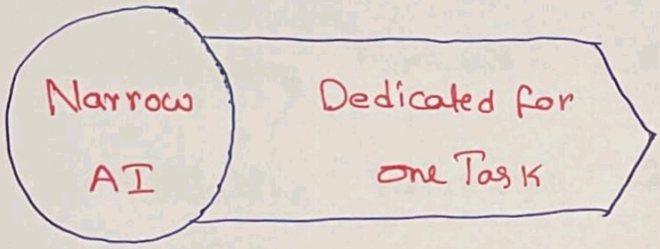
* Some key Characteristics of Strong AI is

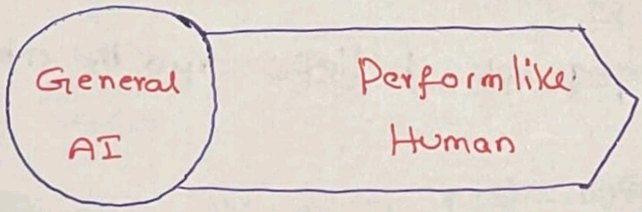
→ The ability to think

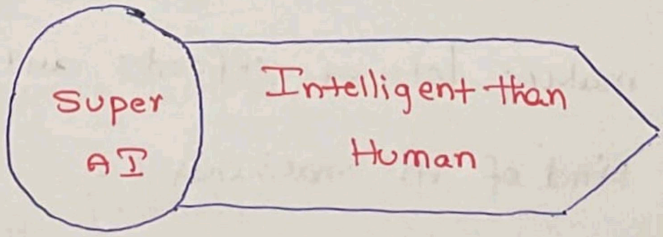
→ solve the puzzle

→ make Judgements

→ plan, learn and Communicate by its own







* Based on functionality AI can be categorized into 4 Types.

1) Reactive Machines :- * These are the most basic types of AI and these machines are not store memories or past Experiences for future actions.

* These machines only focus on current scenarios.

* Ex :- IBM Deep Blue System

Google's Alpha Go.

2) Limited Memory :- * These machines can store the past experiences or some data for a short period of time.

* Ex :- Self driving Cars

3) Theory of Mind :- * These machines understand the human emotions, people, beliefs and be able to interact socially like Humans.

* These machines are still not developed, but researchers are making lots of efforts and improvement for developing such kind of AI machines.

4) Self - Awareness :- * These machines are the future of AI and these machines will be super intelligent, smatiter than human mind.

* These machines does not exist in reality still and it is a hypothetical Concept.

* **Approaches of AI :-** * With AI we can create intelligent machines which can behave like a Human, think like humans and able to make decisions.

* There are 4 different Approaches of AI

1) Acting Humanly : The Turing Test Approach
2) Thinking Humanly : The Congnitive Modeling Approach
3) Thinking Rationally : the "laws of thoughts" Approach
4) Acting Rationally : The Rational Agent Approach.

1) **Acting Humanly :-** * This approach was designed by Alan Turing. The idea behind this approach is that to checks the machine's ability to exhibit intelligent behaviour equal to human Intelligence.

* Qualities of Acting Humanly

→ Natural Language Processing - to enable it to Communicate successfully in English.

→ Knowledge Representation: To store what it knows or hears.

→ Automated Reasoning - To used the stored information to answer Questions and To draw new conclusions.

→ Machine Learning - To adapt to new circumstances and to detect and extrapolate patterns.

* To pass the Complete Turing Test, The computer will need

→ Computer Vision - To identify the objects represented in digitized images provided by cameras, thus enabling Computers to "see".

→ Robotics - To manipulate objects and move about.

2) Thinking Humanly :- * The idea behind this approach is to determine whether the computer thinks like a Human.

* There are two ways to Understand How human mind works

→ Introspection - Examination or observation of mental and emotional process

→ Psychological Experiment - A scientific procedure Undertaken to make a discovery of fact.

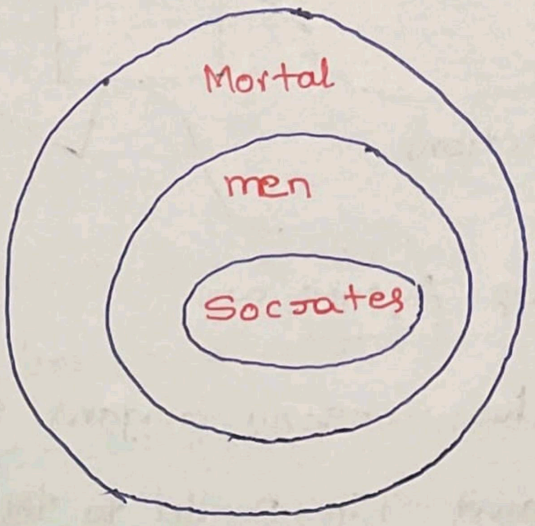
3) Thinking Rationally - * The idea behind this approach is to determine whether the computer thinks Rationally i.e with logical Reasoning.

* In AI, thinking Rationally means thinking Rightly for example if something is True that should True or that must be true or it can't be false.

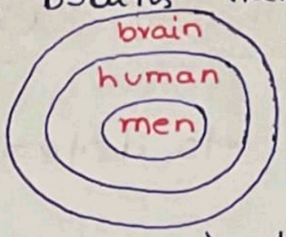
* The greek philosopher Aristotle was one of the first to attempt to codify "Right thinking" for Structured Argument.

* For Example

"Socrates is a men, all men are mortal, therefore Therefore Socrates is mortal"



" All men have brains, All humans have brains therefore all humans are men"

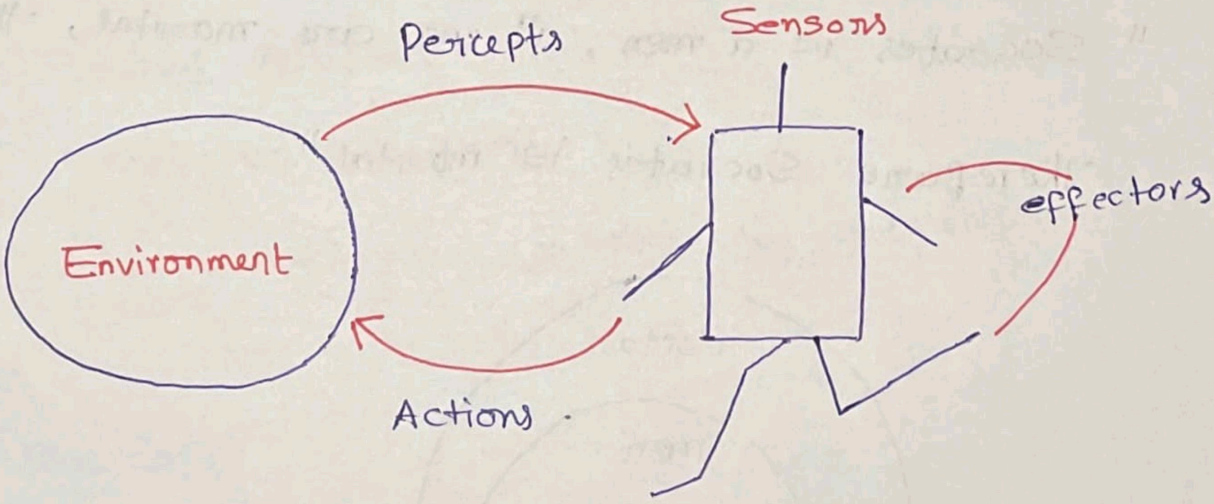


* There are two main drawbacks exist to implement this Approach.

→ This Approach need 100% Knowledge

→ To many Computation Required.

4) Acting Rationally :- * In terms of Artificial Intelligence agent is anything that perceives its environment through Sensor and acts upon that environment through effectors



* Different types of Agents are

1) A Human Agent has Sensory organs such as eyes, ears, nose, tongue and skin parllel to the Sensors and other organs such as hands legs mouth for effectors.

2) A Robotic Agent replaces cameras and infrared range finders for the sensors and various motors and actuartors for effectors.

3) A Software Agent has key Stroke, file content, recieved Network packages which acts as sensors and display on the screen, files, sent network Packates acts as actuators.

* Advantages of AI:- * Following are some main Advantages of AI.

→ High accuracy with less Errors
→ High Speed
→ High Reliability
→ Useful for Risky Areas
→ Digital Assistant
→ Useful as public Utility

* Dis Advantages of AI:- * Following are drawbacks of AI.

→ High Cost
→ Can't think out of the box
→ No feelings and emotions
→ Increase dependency on machines
→ No original creativity.

* **Applications of AI:-** * AI has been dominant in various fields such as

1) **Gaming:-** AI plays crucial role in strategic Games such as → chess
→ poker
→ Tic-Tac-Toe etc.,
where the machine can think of number of possible positions based on heuristic knowledge.

2) **Natural Language Processing:-** It is possible to interact with the computer that understands the Natural language spoken by Humans.

3) **Expert Systems:-** * They provide Explanation and advice to the users.

4) **Astronomy:-** * AI can be very useful to solve complex Universe problems. for suppose to analyze the climatic conditions on different planets and calculate the distance between planets, find the Astroids in Universe.

5) **Health care:-** * Health care Industries are applying AI to make a better and faster diagnosis than humans.

6) Finance :- * AI and Finance industries are the best matches for each other. The finance industry implementing

→ Automation

→ chat bot

→ Adaptive intelligence

→ Algorithm Trading.

7) Data Security :- * AI can be used to make your data more Safe and Secure. Some examples such as AEG bot, AI2 platform are used to determine slw bug and cyber attacks in a better way.

8) Social Media :- * Social Media Sites Suchas Face book, Twitter and Snap chat Contains billions of the user profiles which need to be stored and managed in a very efficient way. AI Can organize and manage massive amounts of data.

* AI can analyze lots of data to identify the latest trends, hash tag and requirement of different users.

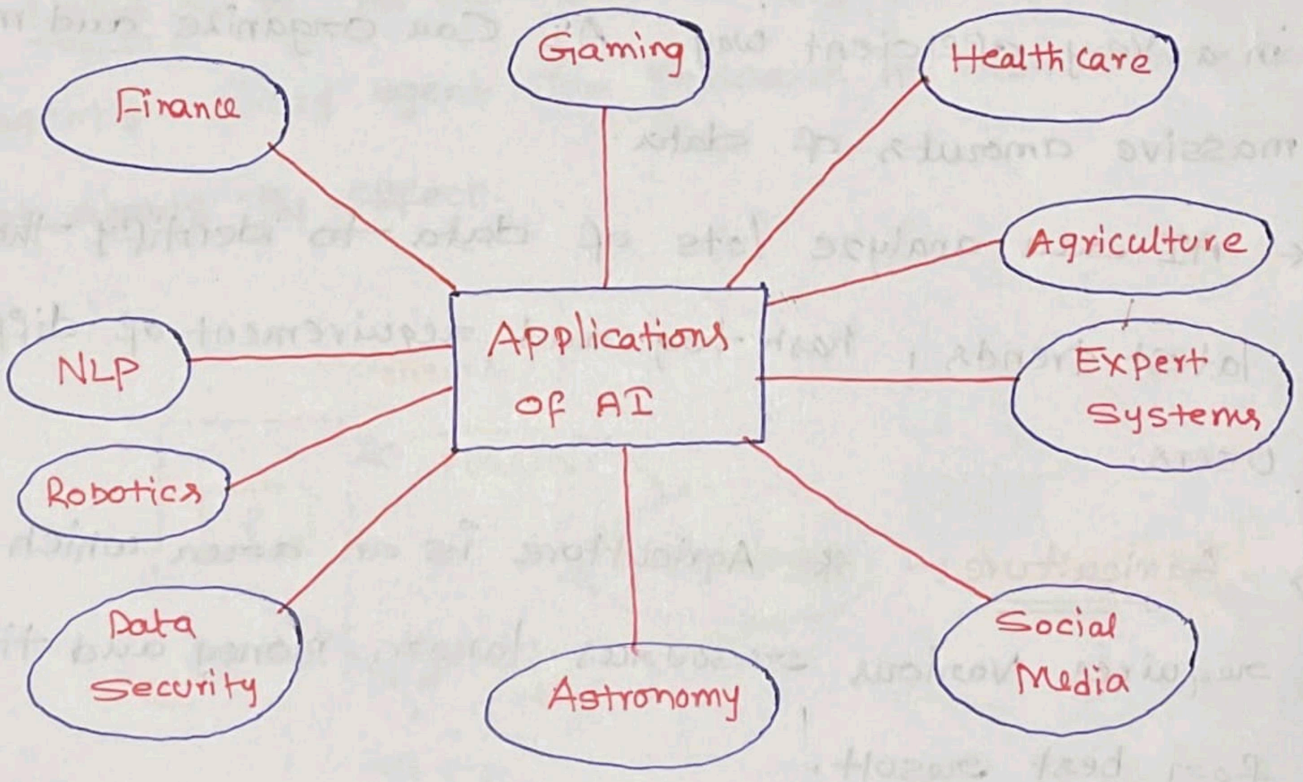
9) Agriculture :- * Agriculture is an area which requires various resources labor, money and time for best result.

* Now a days Agriculture is becoming digital and AI is emerging in this field.

* Agriculture Robotics are used to predict climatic condition, soil and crop monitoring.

10) Robotics :- * AI has a remarkable role in Robotics Usually, General Robots are perform some repititive task but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences with out pre-programmed.

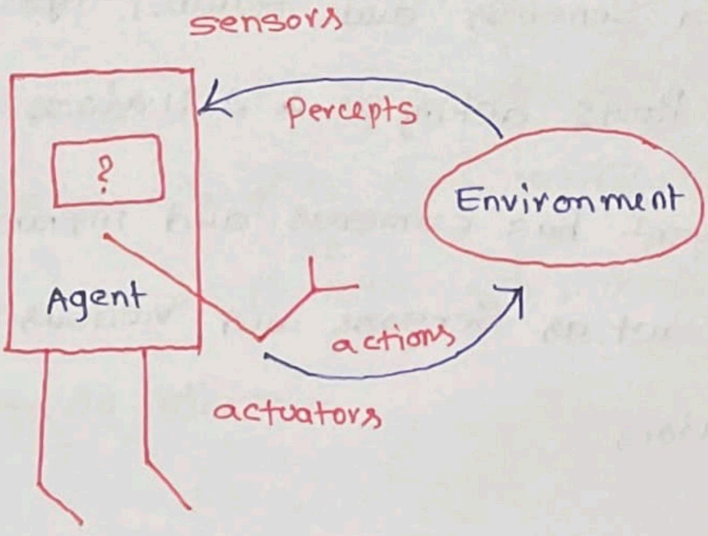
* Humanoid Robots are best examples for AI in Robotics, Recently the intelligent Humanoid Robot named as Erica and sophia has been developed which can talk and behave like humans.



* Structure of Intelligent Agents :-

Intelligente is defined as the study of Rational Agents

* A Rational Agent could be anything that makes decisions, as person, firm, machine or a Software
* It carries out actions with best outcome after Considering Past and current percepts.
* An AI System is composed of an agent and its environment. The agents act in their environment
* An Agent is anything that can be viewed as
  - → Perceiving its environment through Sensors
  - → acting upon that environment through actuators.
* NOTE :- * The environment may contain other agents. Every agent can perceive its own actions but not always the effect.



* To Understand the Structure of Intelligent Agents, we should be familiar with Arichitecture and Agent Programs.

→ Architecture is the machinery that the agent executes on. it is a device with Sensors and actuators for Example

→ a Robotic Car
→ a Camera
→ a pc.

→ Agent Program is an implementation of an agent function. An Agent function is a map from the percept sequence to an action (abstract mathematical Description)

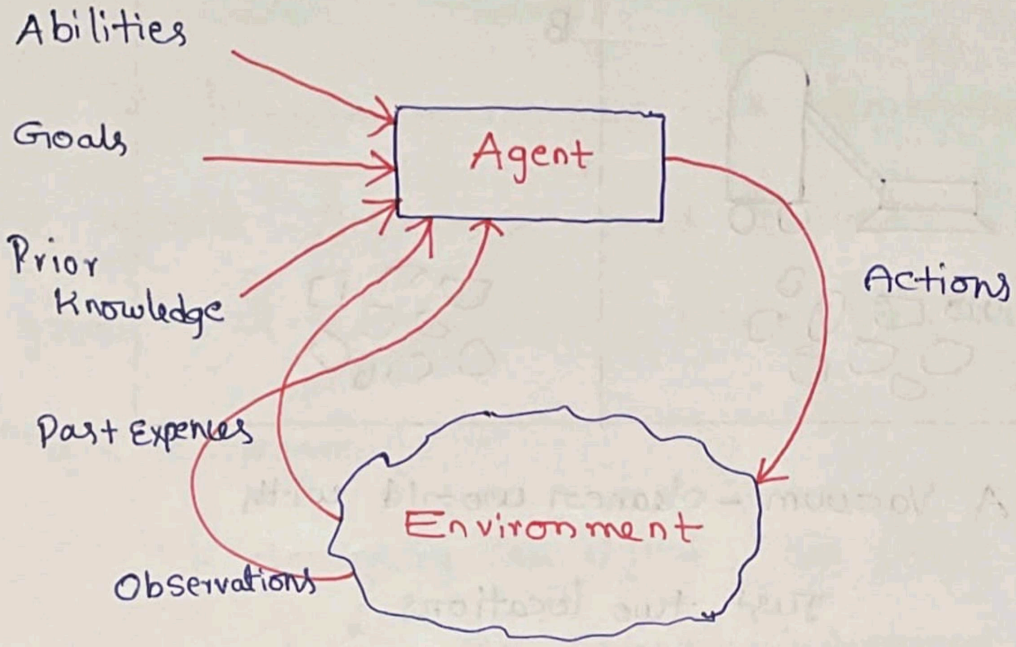
Agent = Architecture + Agent Program

* Examples of Agent :-

1) A Human Agent has eyes, ears and other organs which act as a Sensors and Hands, legs, mouth and other body Parts acting as actuators.

2) A Robotic Agent has cameras and infrared range finders which act as Sensors and Various motors acting as actuators.

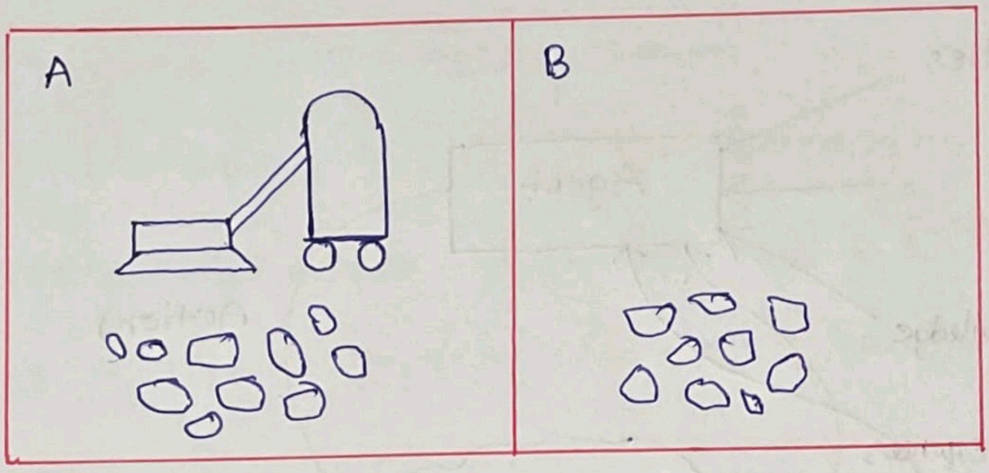
3) A Software Agent has key strokes, file contents, recieved Network packages which act as sensors and displays on the screen, files, sent Network packets acting as actuators.



* To illustrate these ideas, we will use very simple Example - The Vacuum-cleaner world shown in the below figure.
* This particular world has just two locations:
  Squares A and B.
* The vacuum agen perceives which square it is in and whether there is dirt in the square.
* It can choose to move left, move right, suck up the dirt, or do nothing

* one very simple Agent function is the following

→ If the current square is dirty then suck otherwise move to the other square



A Vacuum-cleaner world with just two locations

Percept Sequence	Action
[A, clean]	right
[A, Dirty]	suck
[B, clean]	Left
[A, clean], [A, clean]	Right
[A, clean], [A, Dirty]	suck
[A, clean], [A, clean], [A, clean]	Right
[A, clean], [A, clean], [A, Dirty]	Suck

Partial Tabulation of Simple Agent function for the Vacuum-cleaner world.

* The Nature of Environments :-

* Task environments, which are essentially the "problems" To which the Rational Agents are "solutions"

* Specifying the Task Environment :-

The Performence measure, the Environment, and the agent's Actuators and Sensors (PEAS), groups all these together Under the heading of Task Environment.

In designing an agent, the first step must be always to specify Task Environment as fully as Possible.

* the below Table Shows the Examples of Agents Type and their PEAS descriptions.

Agent Type	Performence Measure	Environment	Actuators	Sensors
Taxi driver	Safe, Fast legal, Profits Comfortable Trips	Roads customers Traffic	Steering Accelerator brake Signal Horn	Cameras Speedometer GPS engine Sensor
Medical Diagnosis System	Healthy Patient minimize costs	Patient Hospital staff	Treatements Tests	Key board Entry of Symptoms Cameras

Interactive English Tutor	Maximize Student Score on The Test	set of Students	Display Excersise Corrections	Key board Entry

* Properties of Task Environments:- * An Environment is Everything in the world which surrounds the Agent But it is not a part of an agent itself.

* An Environment can be described as a situation in which an agent is present.

* As per Russell and Norvig, an environment can have various features from the point of view of an Agent.

1) Fully observable Vs Partially observable
2) Static Vs Dynamic
3) Discrete Vs Continous
4) Deterministic Vs Stochastic
5) Single - Agent Vs Multi - Agent
6) Episodic Vs Sequential
7) known Vs Unknown
8) Accessible Vs Inaccessible.

1) Fully observable Vs Partially Observable - If an agent Sesor can sense the Complete State of an environment at each point of time then it is a fully

observable environment, else it is partially observable.

* An Agent with no sensors in all environments then such an environment is called as "Unobservable".

2) Deterministic Vs Stochastic :- * If an agents sensor Completly determine the next state of enviroment then such environment is called Deterministic environment else it is Stochastic Environment.

3) Discrete Vs Continous :- * If in an environment there are a finite number of Percepts and actions that can be performed within it, then such an environment is called a discrete environment else it is called Continous Environment.

* A chess game comes Under discrete Environment and A self driving car is an Example of a Continous Environment.

4) Static Vs Dynamic :- * If the environment can change it self while an agent is deliberating then such environment is called a dynamic environment else it is called Static Environment.

* A self driving car is an Example of dynamic Environment. and A chess Game Comes Under Static

5) Single Agent Vs Multi Agent :- * If only one agent is involved in an environment then such an environment is called Single Agent environment else it is called Multi Agent Environment.

6) Episodic Vs Sequential :- * In an episodic environment, there is a series of one-shot actions and only the current percept is required for the action.

* In Sequential Environment, an agent requires memory of past actions to determine the next best actions.

7) Known Vs Unknown :- * If the results of the actions known to the agent then such an environment is called known Environment else it is called Unknown.

8) Accessible Vs In accessible :- * If an agent can obtain Complete and accurate Information about the environment then such an environment is called Accessible environment else it is called In accessible Environment.

* Example :- Task Environment is Taxi Driving

- It is a Partially Observable, Stochastic, Sequential dynamic, continous, multi-Agents Environment.

* Types of AI Agents :- * Agents can be grouped into five classes based on their Intelligence and capability. These are given below.

1) Simple Reflex Agents
2) Model - Based Reflex Agents
3) Goal - Based Agents
4) Utility - Based Agents
5) Learning Agents.

1) Simple Reflex Agents:- * These are the simple agents and these Agents take decisions on the basis of the current percepts and ignore the rest of the percept history.

* These agents only succeed in the fully Observable Environment.
* These agents does not Consider history of the percepts during their decision and action process
* These agent works on Condition - Action Rule, which means it maps the current state to action. Such as a Room cleaner agent, it works only if there is dirt in the room.

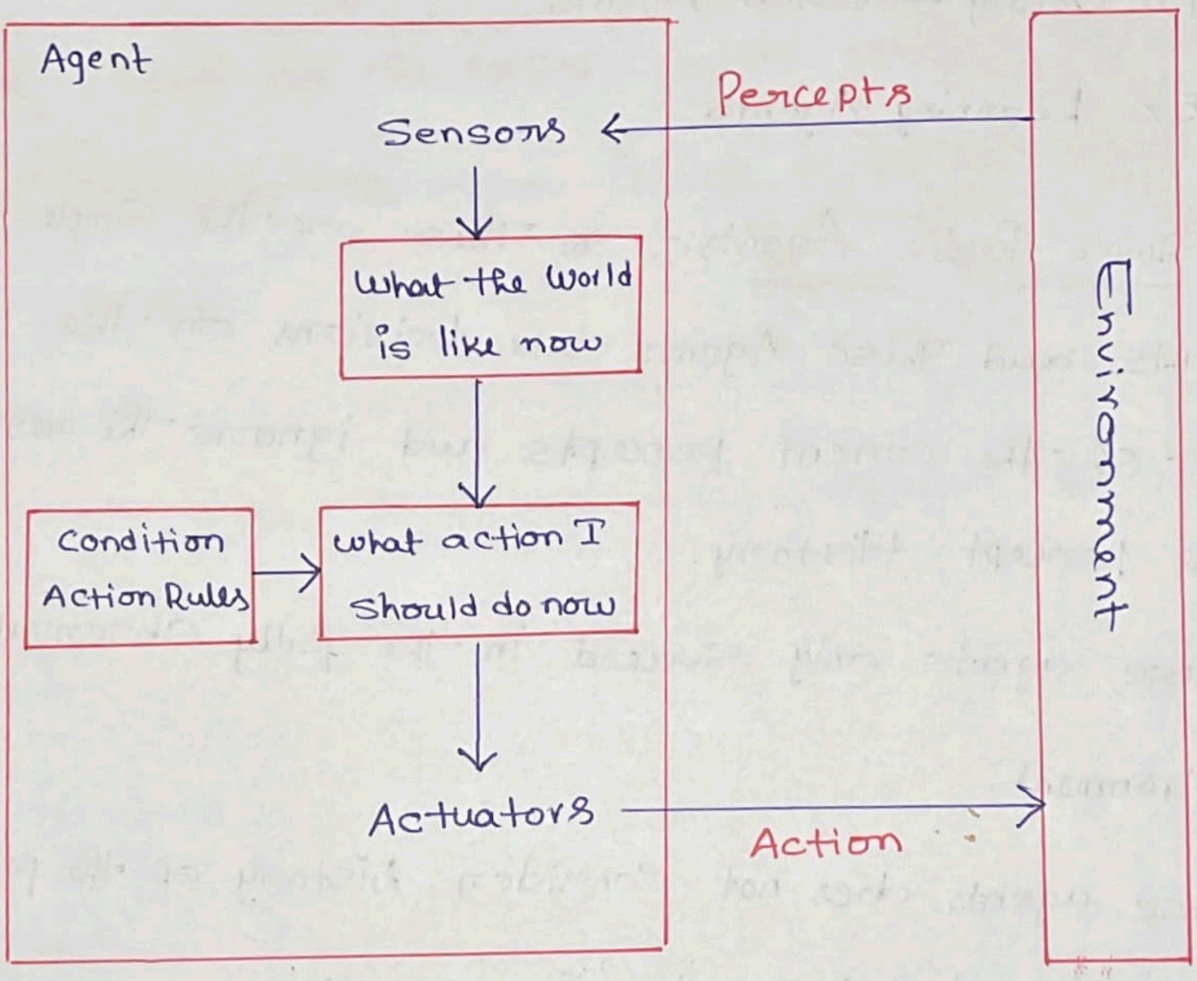
* Problems for the Simple reflex Agent design Approach :

→ They have limited Intelligence

→ Not Adaptive to changes in the environment

→ They do not have knowledge of non-Perceptual parts

→ Mostly too big to generate and to store.



2) Model-Based Reflex Agents :- * These agents can work in a partially observable Environment and track the Situation.

* These agents has two important factors.

→ Model :- It is knowledge about "how things happen in the world" So it is called Model based Agent.

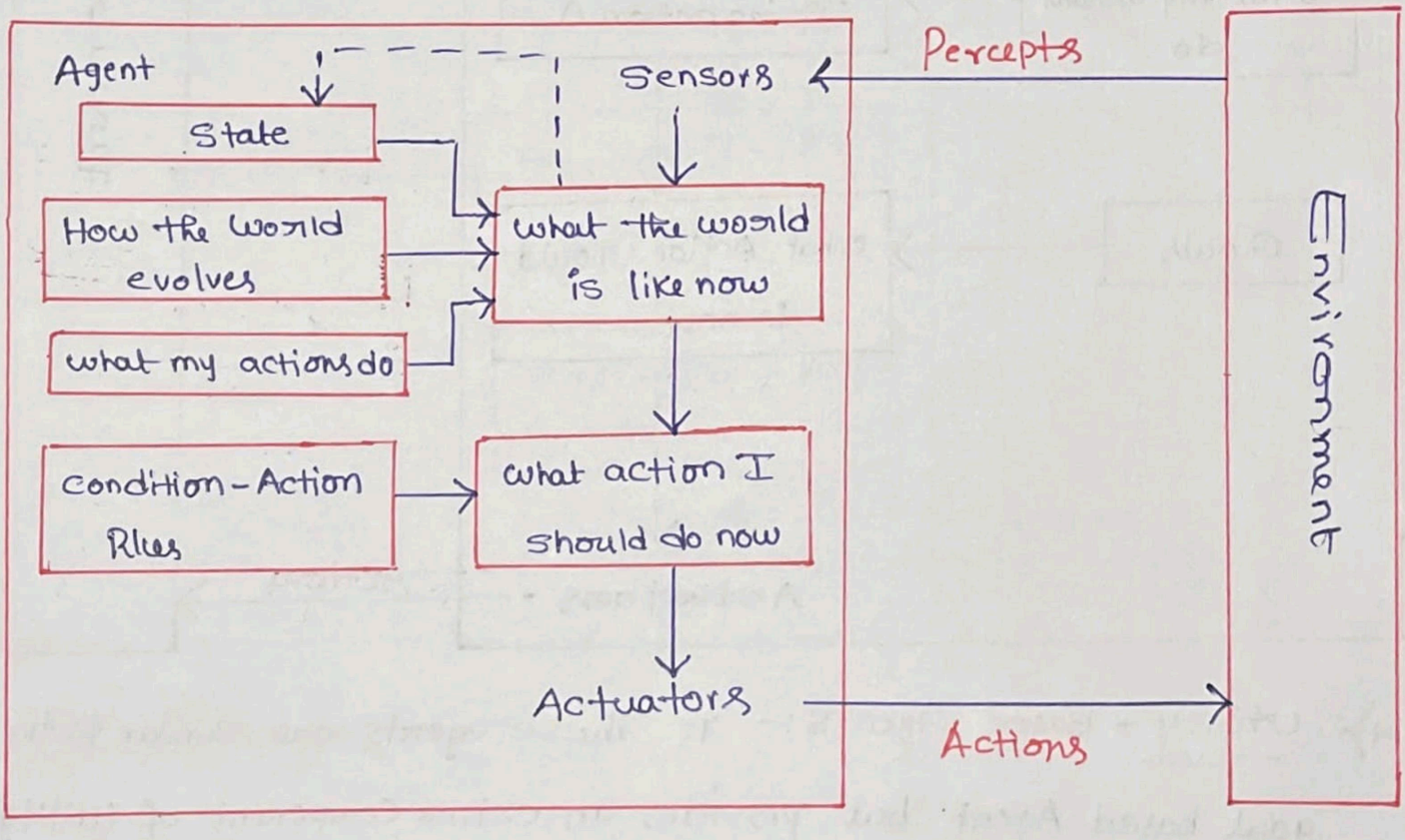
→ Internal State :- It is a representation of current state based on the model percept History

* Based on the model Agents perform the actions.

* updating the agent state requires Information about :

→ How world evolves

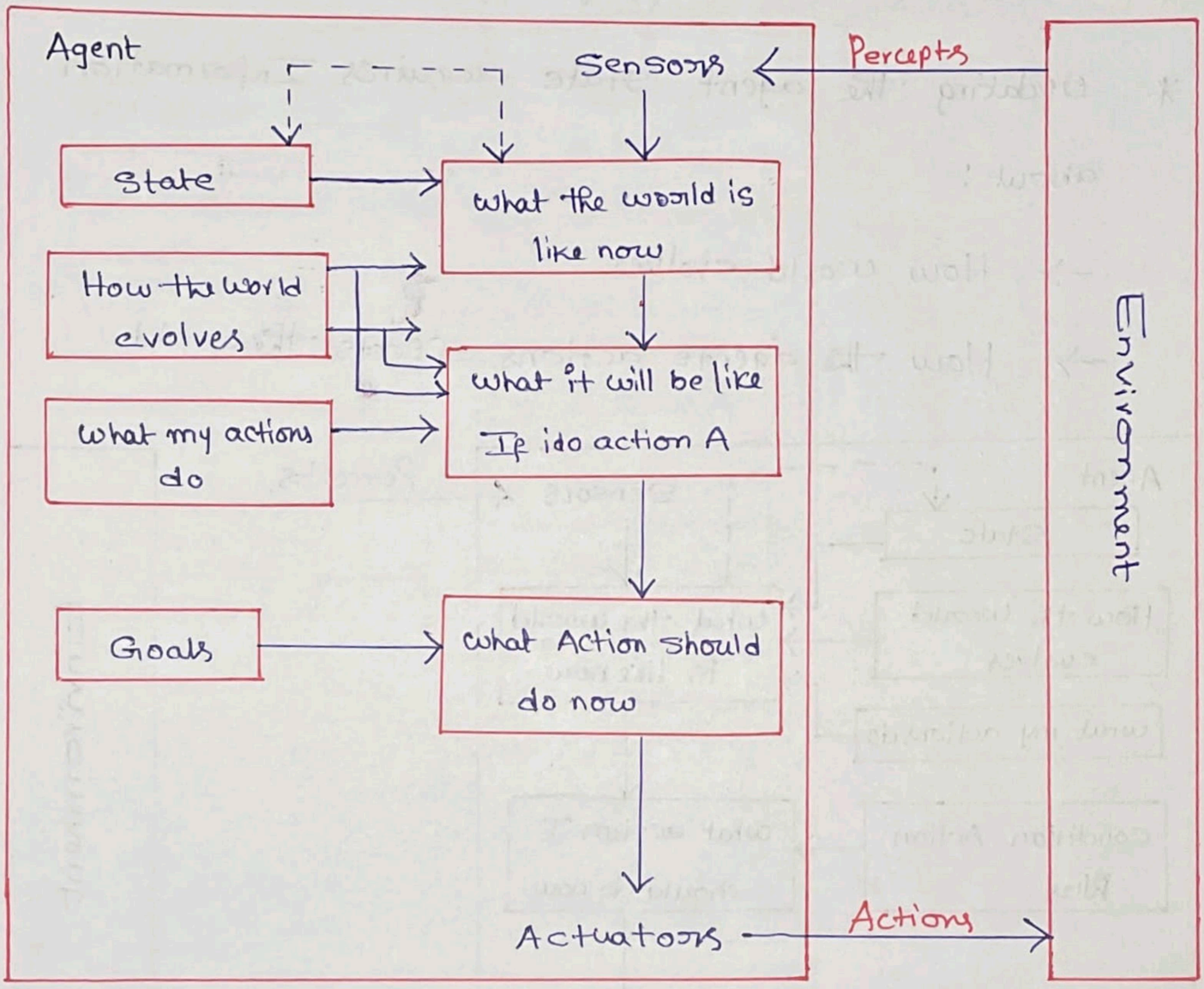
→ How the agents actions effects the world.



3) Goal - Based Agents :- * The knowledge of the current state environment is not always sufficient to decide for an action agent to what to do.

* The agent needs to know its goal which describes the desirable situations.

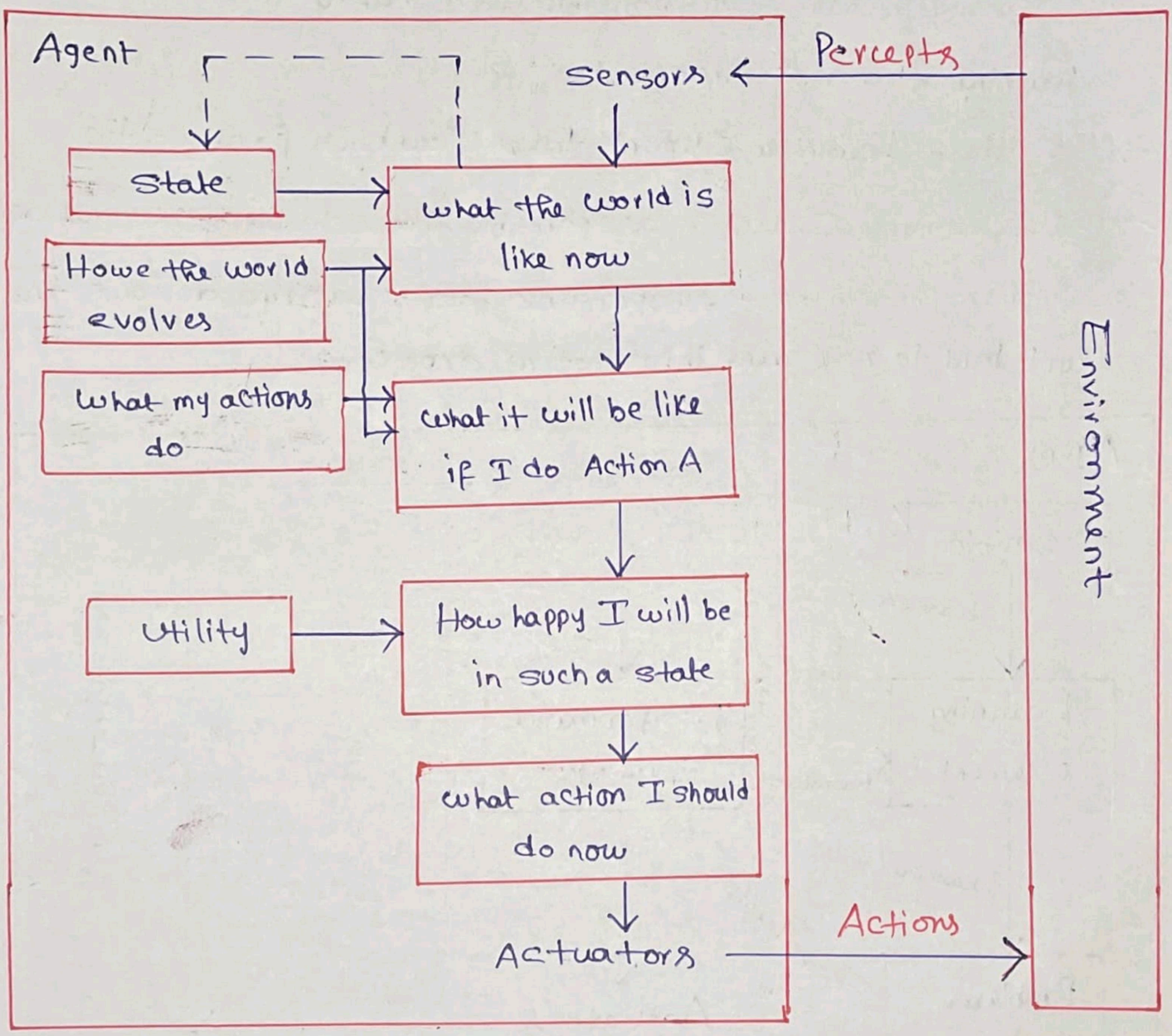
* Goal based agents expand the capabilities of the model - based agent by having the "Goal" Information



4) Utility - Based Agents :- * These agents are similar to the goal based Agent but provides an extra component of utility

measurement which makes them different by Providing a measure of Sucess at a given State.

* These agents act based not only goals but also the best way to achieve the Goals.
* These agents are Useful when there are multiple possible alternatives and an agent has to choose inorder to perform the best action.



5) Learning - Agents :- * A learning agent in AI is the type of agent which can learn from its past experiences or it has learning capabilities.

* It starts to act with basic knowledge and then able to act and adapt automatically through learning.

* A learning agent has mainly four Conceptual Components which are:

→ Learning Element - responsible for making improvements by learning from environment.

→ Critic - Learning Element takes feedback from critic

→ Performance Element - responsible for selecting external action

→ Problem Generator - responsible for suggesting actions that will lead to new and informative experiences.