Artificial Intelligence

MODULE -1

Introduction: AI Problems, Foundations of AI and History of AI Intelligent Agents: Agents and Environments, the Concept of Rationality, the Nature of Environments, Structure of Agents. Problem-Solving Agents, Problem formulation.

INTRODUCTION

What is Artificial Intelligence?

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

According to the father of Artificial Intelligence, John McCarthy, it is "The science and engineering of making intelligent machines, especially intelligent computer programs".

Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.

AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

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

What is Intelligent?

(1) The ability to learn or understand or to deal with new or trying situations

(2) The ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria

Note: 1. AI : Human intelligence can be implemented in machines [computers]

Since the invention of computers or machines, their capability to perform various tasks went on growing exponentially. Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time.

A branch of Computer Science named Artificial Intelligence pursues creating thecomputers or machines as intelligent as human beings.

Why Artificial Intelligence ?

Following are Some main Reasons To learn about

- with the help of AI You can create Software or devices which can 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 works in an environment where Survival of humans can be at risk.

Philosophy of AI:

While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, “Can a machine think and behave like humans do?”

Thus, the development of AI started with the intention of creating similar intelligencein machines that we find and regard high in humans.

Goals of AI: Following are the main Goals of Artificial Intelligence

- 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 Theorem
    - Playing chess
    - Plan Some Surgical operation
    - Driving Car in traffic.

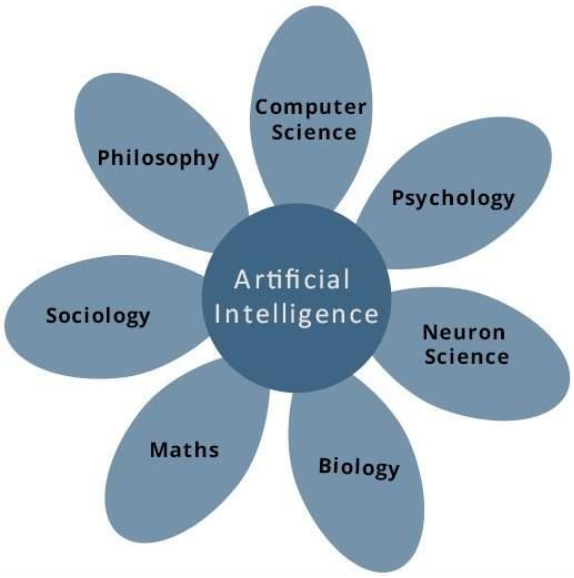
Creating some system which can exhibit intelligence behaviour , learn new things by itself, demonstrate , explain and can advise to its user.

What Contributes to AI: Artificial Intelligence is a Science and Technology based on disciplines such as

- Computer Science
- Biology
- Psychology
- Mathematics
- Socialogy
- Philosophy

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

Out of the following areas, one or multiple areas can contribute to build an Intelligent System.



What is AI Technique?

In the real world, the knowledge has some unwelcomed properties −

- Its volume is huge, next to unimaginable.
- It is not well-organized or well-formatted.
- It keeps changing constantly.

AI Technique is a manner to organize and use the knowledge efficiently in such a way that −

- It should be perceivable by the people who provide it.

- It should be easily modifiable to correct errors.
- It should be useful in many situations though it is incomplete or inaccurate.

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 watter 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. Mathematical theorems and find new and more elegant proofs for some Theorems.

Year 1956 : The word "Artificial Intelligence" first adapted 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 Intelligence humanoid Robot was built in Japan which was name “WABOT-1”.

The First AI Winter: In this period, an Intrest of Publicity on AI was decreased.

A boom of AI- (1980-87):

Year 1980: After AI Winter Duration , AI came back with ”Expert System”. 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 Vacuum cleaner”.
Year 2006: AI came in the business world till the Year 2006 Companies like Face book, Twitter and Netflix also Started Using AI.

Deep Learning Big Data and Artificial General Intelligence (2011- Present):

Year 2011: IBM's Watson Won Jeo Pardy, 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, Face book, IBM and Amazon are working with AI and Creating amazing Devices The future of AI is inspiring and will come with high Intelligence.

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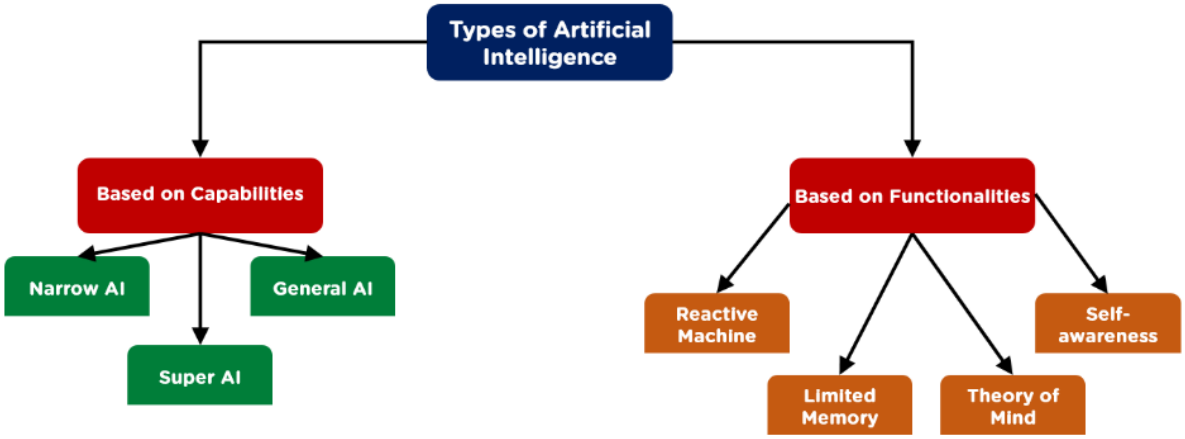
Types of AI:

There are two categories of Artificial Intelligence based on capabilities and functionality of Artificial Intelligence.



Based on Capability AI can be categorized into three types,

1. **Narrow AI:** This 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.

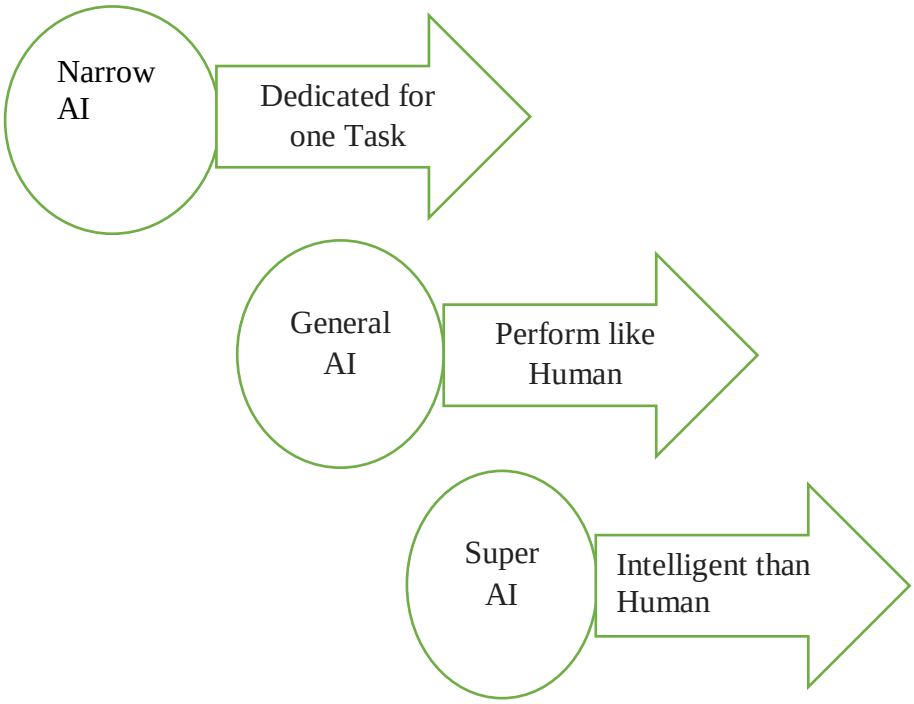
Some Examples of Narrow AI are:

- Playing chess.
- Purchasing Suggestions on E-commerce 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 perfect as 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:** There 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.

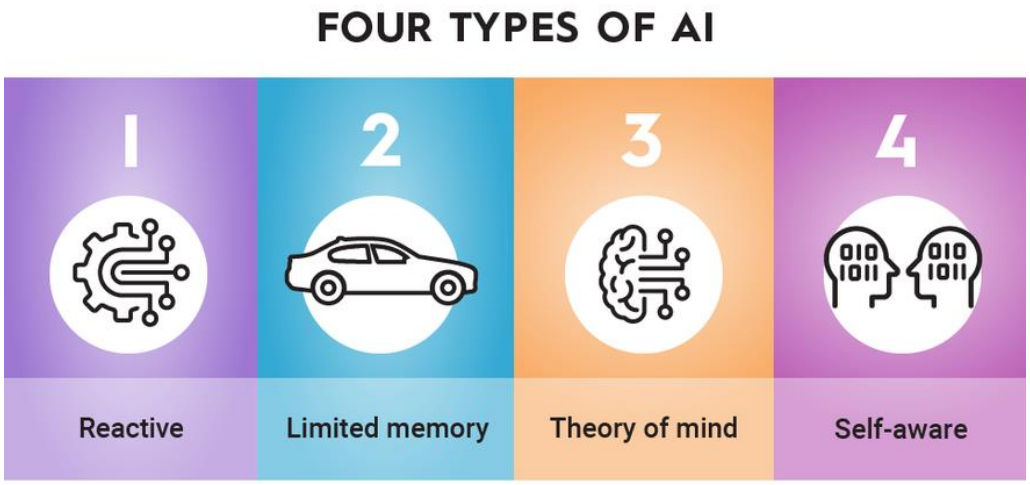
EX: IBM Deep Blue System, Google's Alpha Go.

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

Ex: Self driving cars.

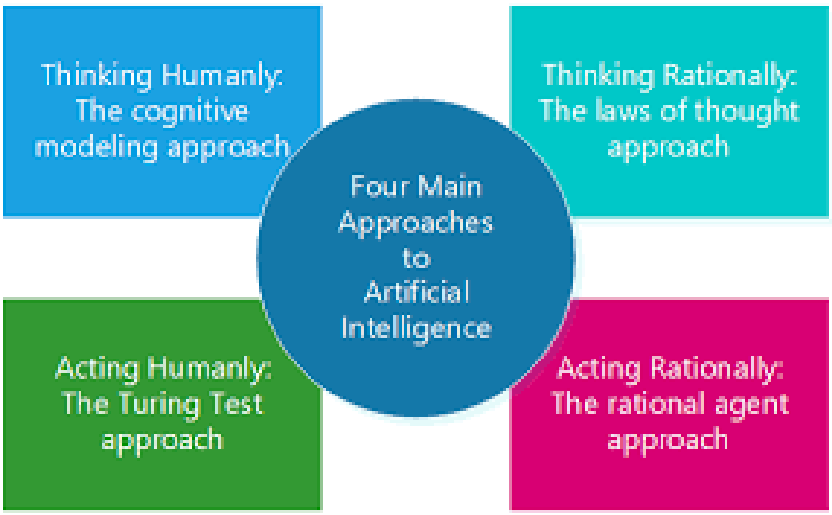
3. **Theory of Mind:** These machines understand the human emotions, people, beliefs and be able to interact socially like Humans. These machines are still not developed, but researchers. are making lots of efforts and improvement for developing Such kind of AI machines.

4. **Self- Awareness:** These machines are the future of AI and these machines will be super intelligent, Smatter 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,



- Acting Humanly : The Turing Test Approach
- Thinking Humanly : The Cognitive Modelling Approach
- Thinking Rationally : The "laws of Thoughts' Approach
- 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 Pattern. To pass the Complete Tusing 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

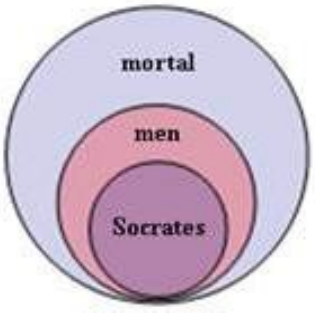
* Introspection: examination or observation of emotional Process.
* Psychological Experiment: A scientific Procedure Undertaken to make a discovery of fact..

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 on that must be true as 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 Socrates is mortal "



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- There are two main draw back exist to implement
    - This Approach need 100%. Knowledge
    - Too many Computation Required.

4. Acting Rationally: An agent can be anything that perceive its environment through sensors and act upon that environment through actuators. An Agent runs in the cycle of **perceiving**, **thinking**, and **acting**. Different types of Agents are:

1)**A Human Agent** has sensory organs such as eyes, ear, nose, tongue and Skin parallel to the sensors and other organs such as hands legs mouth for effector.

2)**A Robotic Agent** replaces cameras and infrared range finders for the sensor and Various motors and actuators 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 Packages acts a actuators.

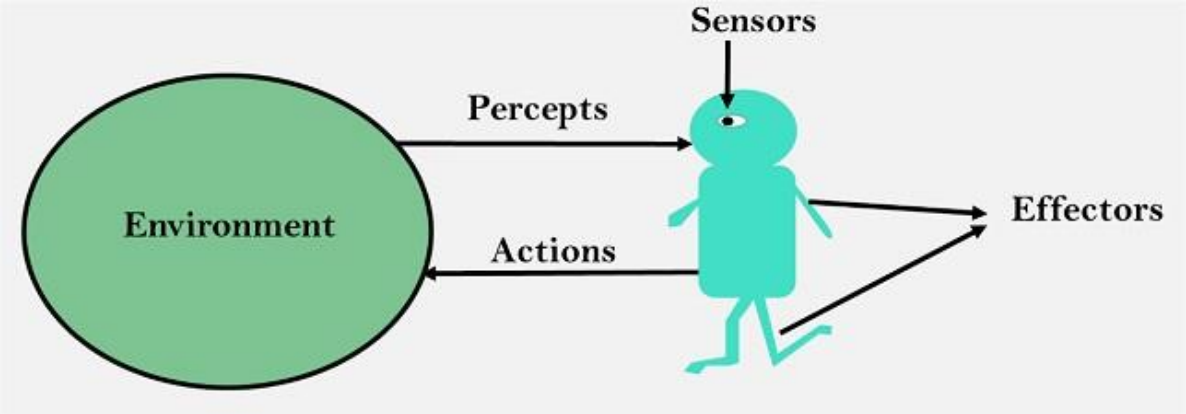
Hence the world around us is full of agents such as thermostat, cellphone, camera, and even we are also agents.

Before moving forward, we should first know about sensors, effectors, and actuators.

Sensor: Sensor is a device which detects the change in the environment and sends the information to other electronic devices. An agent observes its environment through sensors.

Actuators: Actuators are the component of machines that converts energy into motion. The actuators are only responsible for moving and controlling a system. An actuator can be an electric motor, gears, rails, etc.

Effectors: Effectors are the devices which affect the environment. Effectors can be legs, wheels, arms, fingers, wings, fins, and display screen.



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 algorithms have attracted close attention of researchers and have also been applied successfully to solve problems in engineering. Nevertheless, for large and complex problems,AI algorithms consume considerable computation time due to stochastic feature of the search approaches : Business; financial strategies, Engineering: check design, offer suggestions to create new product, expertsystems for all engineering problems, Manufacturing: assembly, inspection and

maintenance, Medicine: monitoring, diagnosing, Education: in teaching, Fraud detection, Object identification, Information retrieval, Space shuttle scheduling.

Gaming : AI plays crucial role in strategic games such as chess, Poker, Tic-Tac-Toe etc. where the machine can thinks of number of possible Position based on heuristic knowledge.

Natural Language Processing: It is possible to interact with the computer that understands the Natural language Spoken by Humans.

Expert System : They provide Explanation and advice to the User.

Astronomy: AI can be very useful to solve Complex universe problems. for suppose to analyze the Climatic condition on different planets and calculate the distance between Planets, find the Astronaut's in Universe.

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

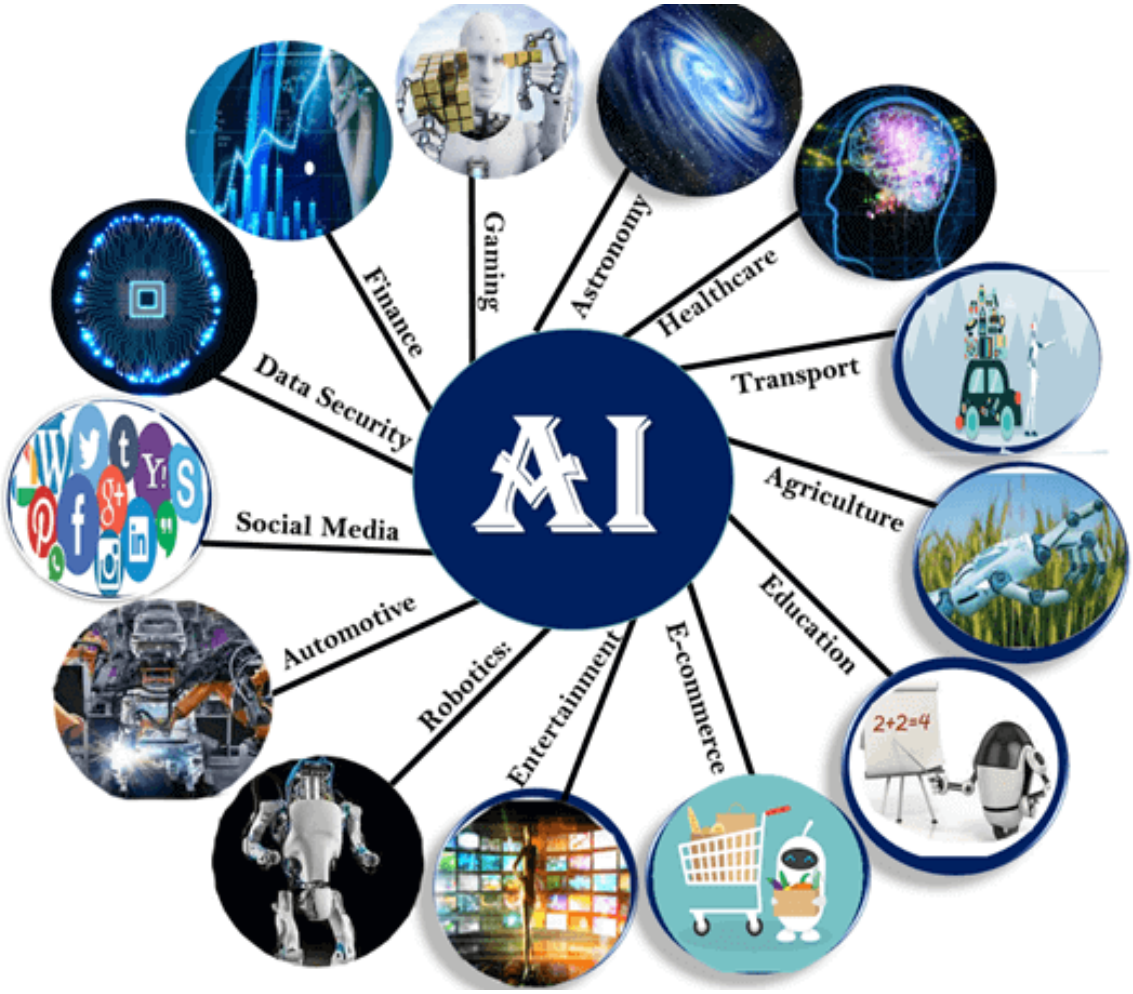
Finance: AI and Finance industries are the best matches for each other. "The Finance industry implementing Automation, chat boat, Adaptive intelligence, Algorithm Trading.

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 Software bug and Cyber-attacks in a better way.

Social Media: Social Media Sites Such as face book, Twitter and Snap chat Contains billions of the user profiles which need to be stored and managed a Very efficient way. AI Can organize and manage in a massive amount of data.AI can analyze lots of data to identify the latest trends, hash tag and requirement of different Users.

Agriculture: Agriculture is an area which requires various resources labour, 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.

Robotics : AI has a remarkable role in Robotics Usually General Robots are perform Some repetitive task but with the help of AI. we can create intelligent robots which can perform tasks with their own experiences without 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 behave like humans.



Intelligent Agents:

An intelligent agent is autonomous entities which act upon an environment using sensors and actuators for achieving goals. An intelligent agent may learn from the environment to achievetheir goals. A thermostat is an example of an intelligent agent.

Following are the main four rules for an AI agent:

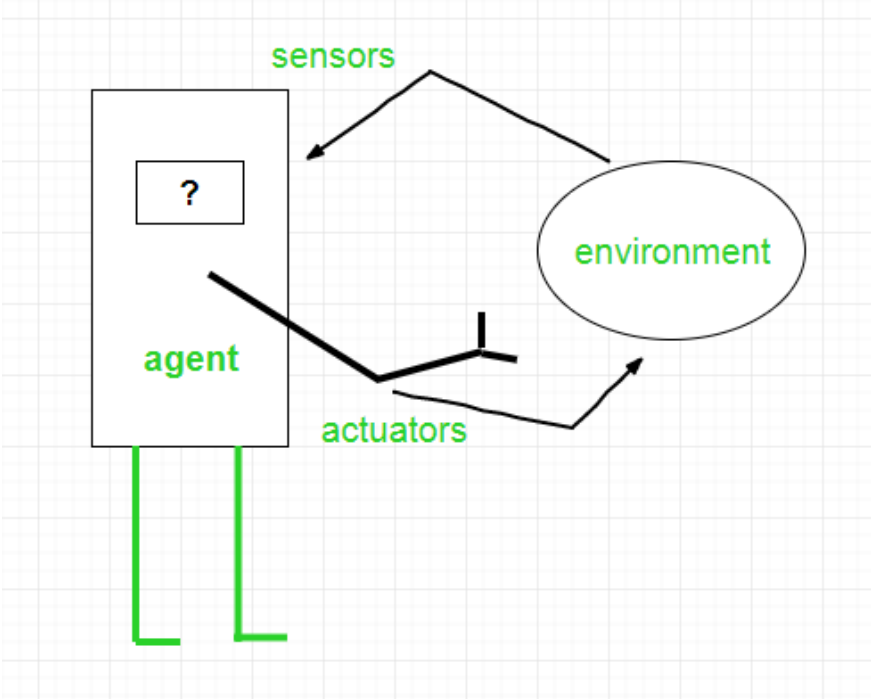
- **Rule 1:** An AI agent must have the ability to perceive the environment.
- **Rule 2:** The observation must be used to make decisions.
- **Rule 3:** Decision should result in an action.
- **Rule 4:** The action taken by an AI agent must be a rational action.

Structure of Intelligent Agents : Artificial Intelligent is defined as the study of Rational Agents. A Rational Agent could be any thing that makes decisions, as person, firm, machine on a Software. It carries out actions with best cannot come 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 familiar with Architecture 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 percent sequence to an action (abstract mathematical Description).

Agent =Architecture + Agent Program

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Agent Program is a function that implements the agent mapping from precepts to actions. There exists a variety of basic agent program designs, reflecting the kind of information made explicit and used in the decision process. The designs vary in efficiency, compactness, and flexibility. The appropriate design of the agent program depends on the nature of the environment.

Following are the main three terms involved in the structure of an AI agent:

Architecture: Architecture is machinery that an AI agent executes on.

Agent Function: Agent function is used to map a percept to an action.

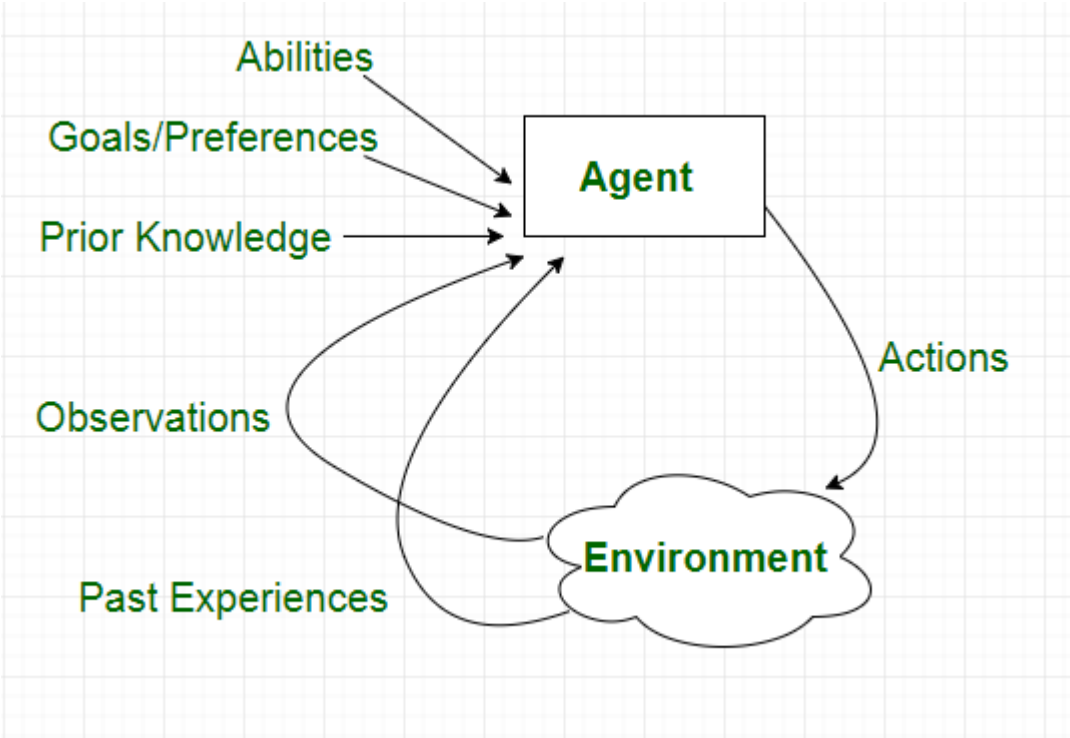
Agent program: Agent program is an implementation of agent function. An agent programexecutes on the physical architecture to produce function f.

Examples of Agent:

1) **A Human Agent** has eyes, ears and other organs which alt as a Sensors and Hands, legs, mouth and other body Parts acting as a 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, received Network Packages which act as Sensory and displays on the screen, files, Sent Network packets acting as actuators.

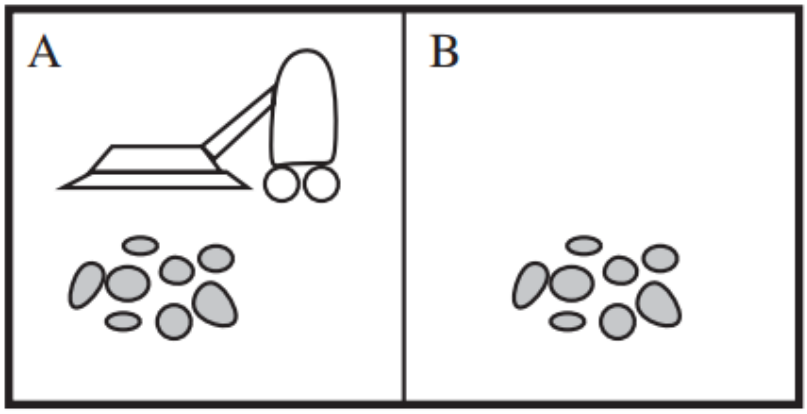


*To illustrate these ideas, we will use Vesty Simple Example - The Vacuum cleaner would shown in the below figure.

*This particular world has Just two locations: Squares A and B.

*The Vacuum agent 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 Other wise 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
[B, Dirty]	Suck
[A, Clean], [A, Clean]	Right
[A, Clean], [A, Dirty]	Suck
⋮	⋮
[A, Clean], [A, Clean], [A, Clean]	Right
[A, Clean], [A, Clean], [A, Dirty]	Suck
⋮	⋮

Figure (B)Partial tabulation of a simple agent function for the vacuum-cleaner world

What is Environment / The Nature of Environments:

The environment is the **Task Environment (problem)** for which the **Rational Agent is the solution.** Any task environment is characterized on the basis of PEAS.

1. **Performance** – What is the performance characteristic which would either make the agent successful or not. For example, clean floor, optimal energy consumption might be performance measures.
2. **Environment** – Physical characteristics and constraints expected. For example, wood floors, furniture in the way etc
3. **Actuators** – The physical or logical constructs which would take action. For example for the vacuum cleaner, these are the suction pumps
4. **Sensors** – Again physical or logical constructs which would sense the environment. From our previous example, these are cameras and dirt sensors.

Specifying the Task Environment:

The Performance 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.

Examples of agent types and their PEAS description

PEAS: Performance Measure, Environment, Actuators, sensors

Agent type	P	E	A	S
Medical Diagnosis System	Healthy patient, minimize costs, lawsuits	Patient, Hospital Staff	Display questions, tests, diagnoses, treatments, referrals	Keyboard entry of symptoms, findings, patient's Answers.
Interactive English Tutor	Maximize student's score on test.	Set of students, testing agency.	Display exercises, suggestions, corrections	Typed words.
Satellite Image Analysis System	Correct categorization	Downlink from orbiting satellite	Display categorization of scene.	Colour pixel arrays.
Refinery Controller	Maximize purity, yield, safety	Refinery, operators	Valves, pumps, heaters, displays	Temperature, pressure, chemical sensors
Taxi Driver	Safe: fast, legal, comfortable trip, maximize profits	Roads, other traffic, pedestrians, customers	Steering, accelerator, brake, signal, horn, display.	Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard.

Properties of Task Environments / Types of Environment in artificial intelligence:

An environment in artificial intelligence is the surrounding of the agent. The agent takesinput from the environment through sensors and delivers the output to the environment through actuators. There are several types of environments:

- Fully Observable vs Partially Observable
- Deterministic vs Stochastic
- Accessible vs Inaccessible
- Single-agent vs Multi-agent
- Static vs Dynamic
- Discrete vs Continuous
- Episodic vs Sequential
- Known vs Unknown

1. Fully Observable vs Partially Observable

- When an agent sensor is capable to sense or access the complete state of an agent ateach point in time, it is said to be a fully observable environment else it is partially observable.
- Maintaining a fully observable environment is easy as there is no need to keep track ofthe history of the surrounding.
- An environment is called **unobservable** when the agent has no sensors in all environments.
- **Examples:**
    - **Chess –** the board is fully observable, and so are the opponent's moves.
    - **Driving –** the environment is partially observable because what's aroundthe corner is not known.

2. Deterministic vs Stochastic

- When uniqueness in the agent's current state completely determines the next state ofthe agent, the environment is said to be deterministic.
- The stochastic environment is random in nature which is not unique and cannot be completely determined by the agent.
- **Examples:**
    - **Chess –** There would be only a few possible moves for a coin at the currentstate and these moves can be determined.
    - **Self-Driving Cars-** The actions of a self-driving car are not unique, it varies time to time.

3. **Accessible vs In accessible:** If an agent can obtain Complete and accurate Information about the environment thin such an environment is called Accessible environment else it is called Inaccessible Environment.

Example: Task Environment is Taxi Driving- It is a Partially Observable, Stochastic, Sequential dynamic, continuous, multi-Agents Environment.

4. **Single-agent vs Multi-agent**

- An environment consisting of only one agent is said to be a single-agent environment.
- A person left alone in a maze is an example of the single-agent system.
- An environment involving more than one agent is a multi-agent environment.
- The game of football is multi-agent as it involves 11 players in each team.

5. **Dynamic vs Static**

- An environment that keeps constantly changing itself when the agent is up with someaction is said to be dynamic.
- A roller coaster ride is dynamic as it is set in motion and the environment keeps changing every instant.
- An idle environment with no change in its state is called a static environment.
- An empty house is static as there's no change in the surroundings when an agententers.

6. **Discrete vs Continuous**

- If an environment consists of a finite number of actions that can be deliberated in the environment to obtain the output, it is said to be a discrete environment.
- The game of chess is discrete as it has only a finite number of moves. The number ofmoves might vary with every game, but still, it's finite.
- The environment in which the actions are performed cannot be numbered i.e. is not discrete, is said to be continuous.
- Self-driving cars are an example of continuous environments as their actions aredriving, parking, etc. which cannot be numbered.

7. **Episodic vs Sequential**

- In **an Episodic task environment**, each of the agent's actions is divided into atomic incidents or episodes. There is no dependency between current and previous incidents.In each incident, an agent receives input from the environment and then performs the corresponding action.

- **Example:** Consider an example of **Pick and Place robot**, which is used to detect defective parts from the conveyor belts. Here, every time robot(agent) will make the decision on the current part i.e. there is no dependency between current and previousdecisions.
- In a **Sequential environment**, the previous decisions can affect all future decisions. The next action of the agent depends on what action he has taken previously and whataction he is supposed to take in the future.
- **Example:**
    - **Checkers-** Where the previous move can affect all the following moves.

8. Known vs Unknown

- In a known environment, the output for all probable actions is given. Obviously, incase of unknown environment, for an agent to make a decision, it has to gain knowledge about how the environment works.

Good Behavior: The Concept of Rationality

An agent should act as a Rational Agent. A rational agent is one that does the right thing thatis the right actions will cause the agent to be most successful in the environment.

Performance measures

A performance measures embodies the criterion for success of an agent‘s behavior. As a general rule, it is better to design performance measures according to what one actually wantsin the environment, rather than according to how one thinks the agent should behave.

Rationality

What is rational at any given time depends on four things:

The performance measure that defines the criterion of success.The
agent‘s prior knowledge of the environment.
The actions that the agent can perform. The
agent‘s percept sequence to date.

This leads to a **definition of a rational agent** (ideal rational agent)

“For each possible percept sequence, a rational agent should select an action that is expected to

maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has, that is the task of rational agent is to improvethe performance measure depends on percept sequence"

A rational agent should be **autonomous** – it should learn what it can to compensate for partialor incorrect prior knowledge. Concrete implementation, running on the agent architecture.

Types of agents in artificial intelligence:

To perform the mapping task **four types of agent programs** are there. They are:

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

1. Simple reflex agents

The simplest kind of agent is the simple reflex agent. It responds directly to precepts i.e. theseagent select actions on the basis of the current percept, ignoring the rest of the percept history.

These are the Simple agents and these Agents-take decisions on the basis of the current Percepts and ignore the just 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 mean 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.

An agent describes about how the condition action rules allow the agent to make the connection from percept to action.

Condition action rule: if condition then action

Rectangle to denote the current internal state of the agents decision process.

Oval to represent the background information in the process.

The agent program, which is also very simple, is shown in the following figure.function SIMPLE-REFLEX-AGENT (percept) returns an action

static: rules, a set of condition-action rules

state ← INTERPRET – INPUT(percept)

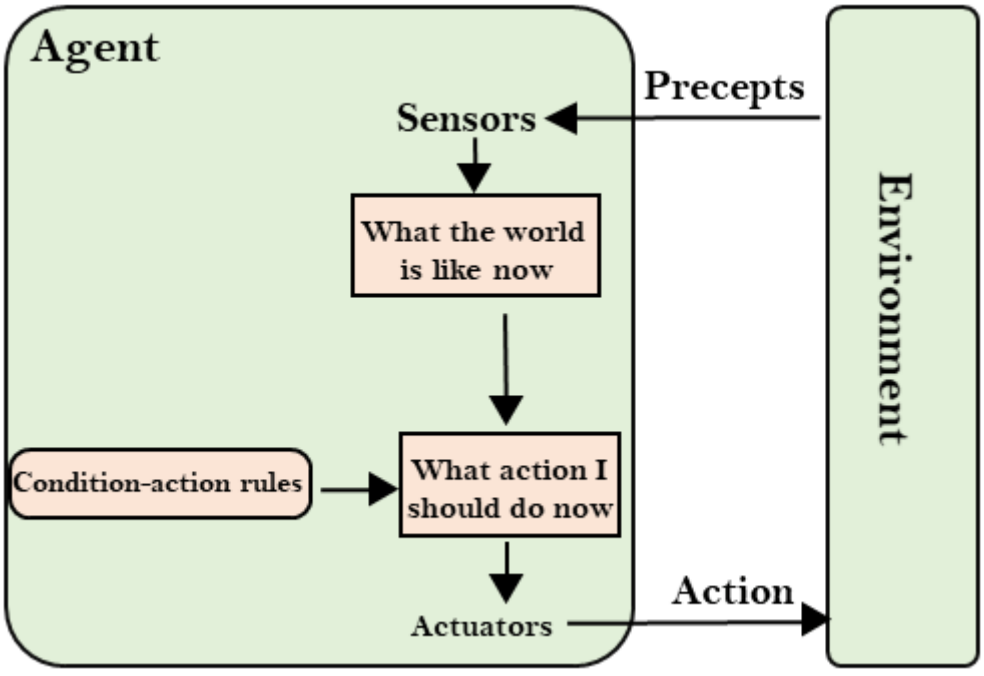
rule ← RULE – MATCH(state, rules)

action ← RULE – ACTION[rule]

return action

Example: Medical diagnosis system

if the patient has reddish brown spots **then** start the treatment for measles.



2.Model-based reflex agents

The agent which combines the current percept with the old internal state to generate updated

description of the current state. The current percept is combined with the old internal state andit derives a new current state is updated in the state description is also.

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 action.
- ✓ Updating the agent state requires Information about: How world evolves, How the agents actions effects the world.

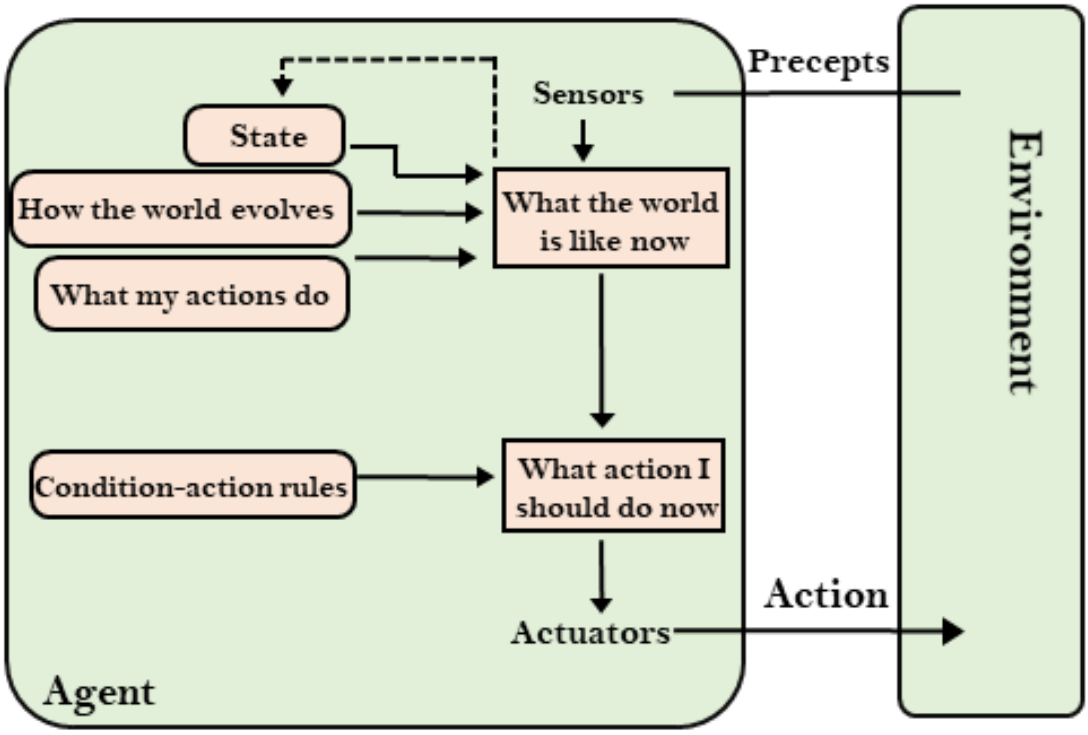
This updating requires two kinds of knowledge in the agent program.

First, we need some information about how the environment evolves independently ofthe agent.

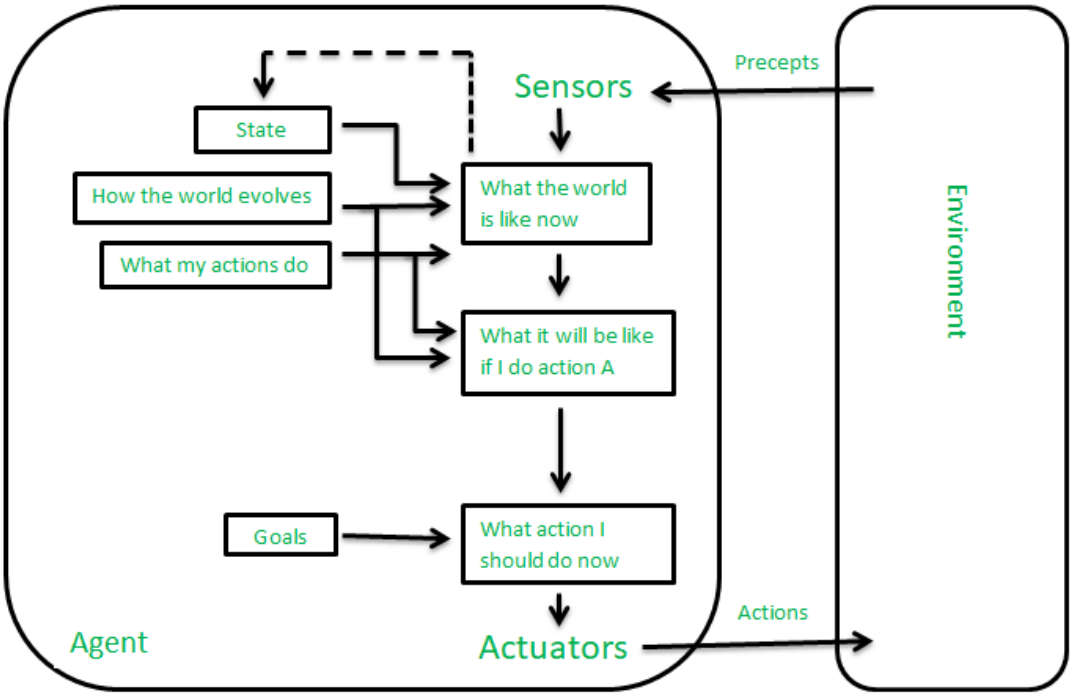
Second, we need some information about how the agents own actions affect the environment..

function REFLEX-AGENT-WITH-STATE (percept) returns an actionstatic:
state, a description of the current world state
rules, a set of condition-action rules
action, the most recent action, initially none
state ← UPDATE-STATE(state, action, percept)

rule ← RULE-MATCH(state, rules)
action ← RULE-ACTION[rule]
return action



3. Goal Based Agents : An agent knows the description of current state and also needs some sort of goal information that describes situations that are desirable. The action matches with the current state is selected depends on the goal state. The goal based agent is more flexible for more than one destination also. After identifying one destination, the new destination is specified, goal based agent is activated to come up with a new behavior. Search and Planning are the subfields of AI devoted to finding action sequences that achieve the agents goals. The goal-based agent appears less efficient, it is more flexible because the knowledge that supports its decisions is represented explicitly and can be modified. The goal-based agent‘s behavior can easily be changed to go to a different location.



4. Utility-based agents (Utility – refers to ―the quality of being useful‖):

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 Success 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 in order to perform the best action.

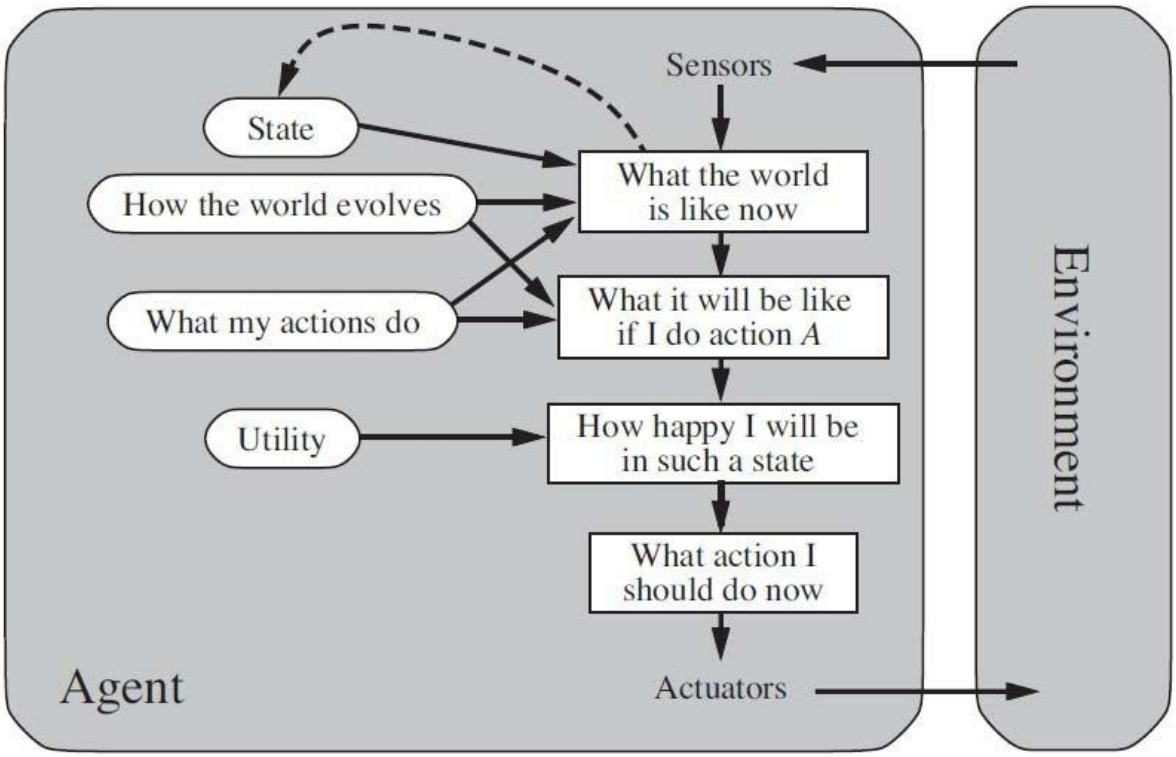
An agent generates a goal state with high – quality behavior (utility) that is, if more than one sequence exists to reach the goal state then the sequence with more reliable, safer, quicker and cheaper than others to be selected.

A utility function maps a state (or sequence of states) onto a real number, which describes the associated degree of happiness.

The utility function can be used for two different cases:

First, when there are conflicting goals, only some of which can be achieved (for e.g.,speed and safety), the utility function specifies the appropriate tradeoff.

Second, when the agent aims for several goals, none of which can be achieved withcertainty, then the success can be weighted up against the importance of the goals.



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.

The **learning** task allows the agent to operate in initially unknown environments and to become more competent than its initial knowledge.

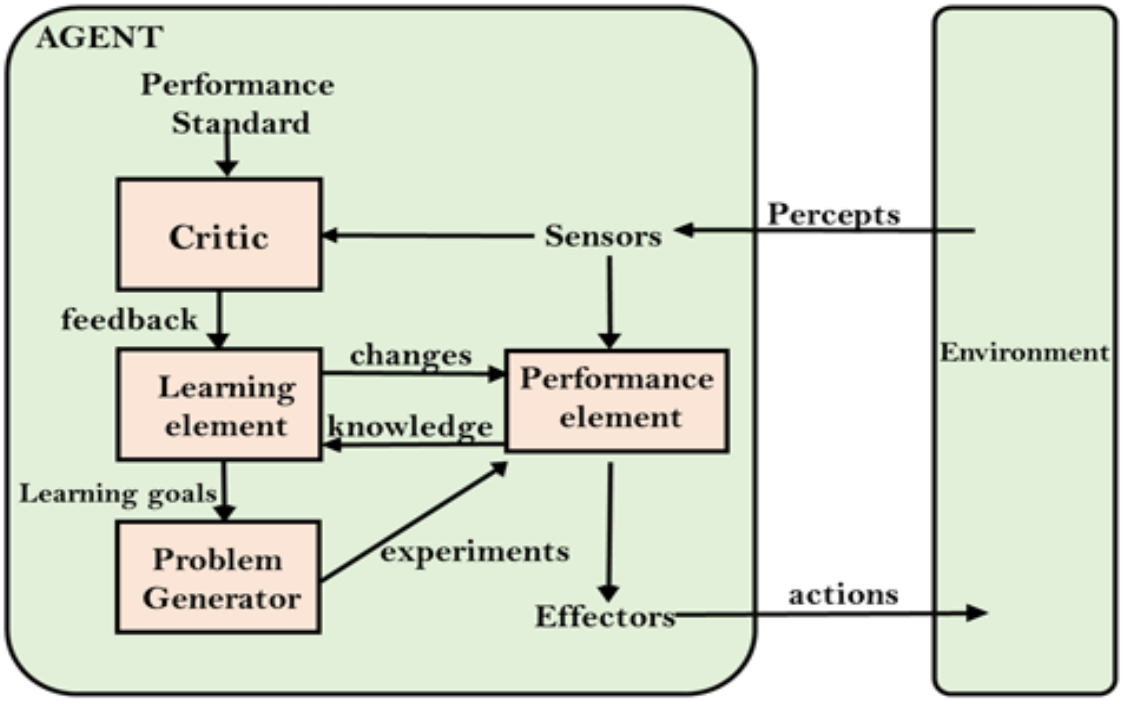
A learning agent can be divided into four conceptual components, .

Learning element – This is responsible for making improvements. It uses the feedback fromthe critic on how the agent is doing and determines how the performance element should be modified to do better in the future.

Performance element – which is responsible for selecting external actions and it is equivalent to agent: it takes in percepts and decides on actions.

Critic – It tells the learning element how well the agent is doing with respect to a fixedperformance standard.

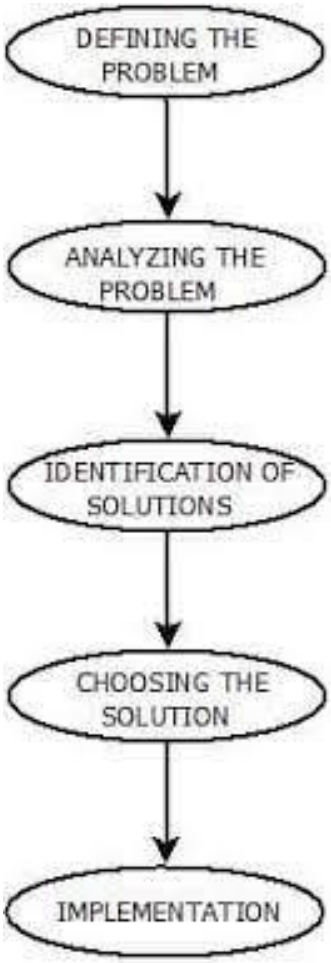
Problem generator – It is responsible for suggesting actions that will lead to new andinformative experiences.



Problem-solving agents: Problem-solving agents are a type of artificial intelligence that helps automate problem-solving. They can be used to solve problems in natural language, algebra, calculus, statistics, and machine learning. A Problem solving agent is one which decides what actions and states to consider in completing a goal. Some of the most popularly used problem solving with the help of AI are:

- ✓ Chess
- ✓ Travelling Salesman Problem
- ✓ Towers of Hanoi problem
- ✓ Water Jug Problem
- ✓ N-Queen Problem

Problem Searching: In general searching refers to as finding information one needs. Searching is the most Commonly used technique of problem solving in Artificial intelligence. The process of solving a problem consists of 5 steps:

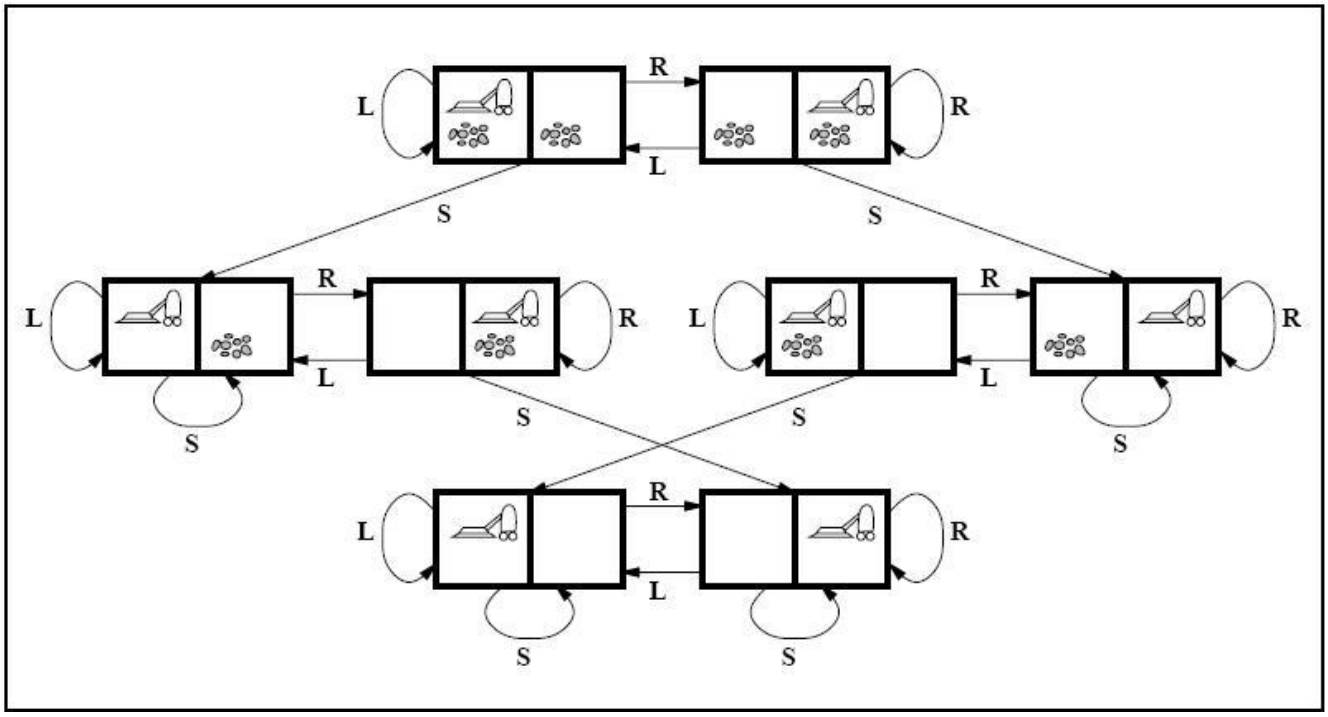


Problem Formulation: The problem should be something you can solve or give answer to . A conclusion in a report is always the answer to the problem formulation.

Here in Artificial Intelligence the problem can be defined into 5 components:

- **Initial state:** This is the state that the agent starts.
- **Possible actions:** All the actions performed by that agent.(change environment)
- **Transition mode:** Agent move from one state to another based on actions performed.
- **Goal test:** Determine if a given state is goal state.
- **Path cost :** It assigns a numeric cost (for each state/path).

EXAMPLE: VACCUM WORLD



States?? Two locations with or without dirt:2 X2 = 8 states.

Initial state?? Any state can be initial

Actions??{ Left, Right, Suck}

Goal test?? Check whether squares are clean.

Path cost?? Number of actions to reach goal.