PEAS Representation

- PEAS is a **type of model** on which an AI agent works upon.
- When we define an AI agent we can group its properties under PEAS representation model.
- It is made up of four words:

1. **P:** Performance measure
2. **E:** Environment
3. **A:** Actuators
4. **S:** Sensors

PEAS Representation

- Example1. "**Self driving car**" would be having following PEAS :-
- **Performance:** Safety, time, legal drive, comfort.
- **Environment:** Roads, other cars, Traffic Light, road signs.
- **Actuators:** Steering, accelerator, brake, signal, horn.
- **Sensors:** Camera, sonar, GPS, speedometer, odometer, accelerometer, engine sensors, keyboard.

PEAS Representation

- Example2: "**Medical Diagnosis System"** would be having following PEAS.
- **Performance:** Healthy, Patient, Minimize Cost
- **Environment:** Patient, Hospital, staff
- **Actuators:** Display questions, tests, diagnosis, treatments, referrals
- **Sensors:** keyboard entry of symptoms, findings, patient's answers

Types of AI Agents

Agents can be grouped into five classes.

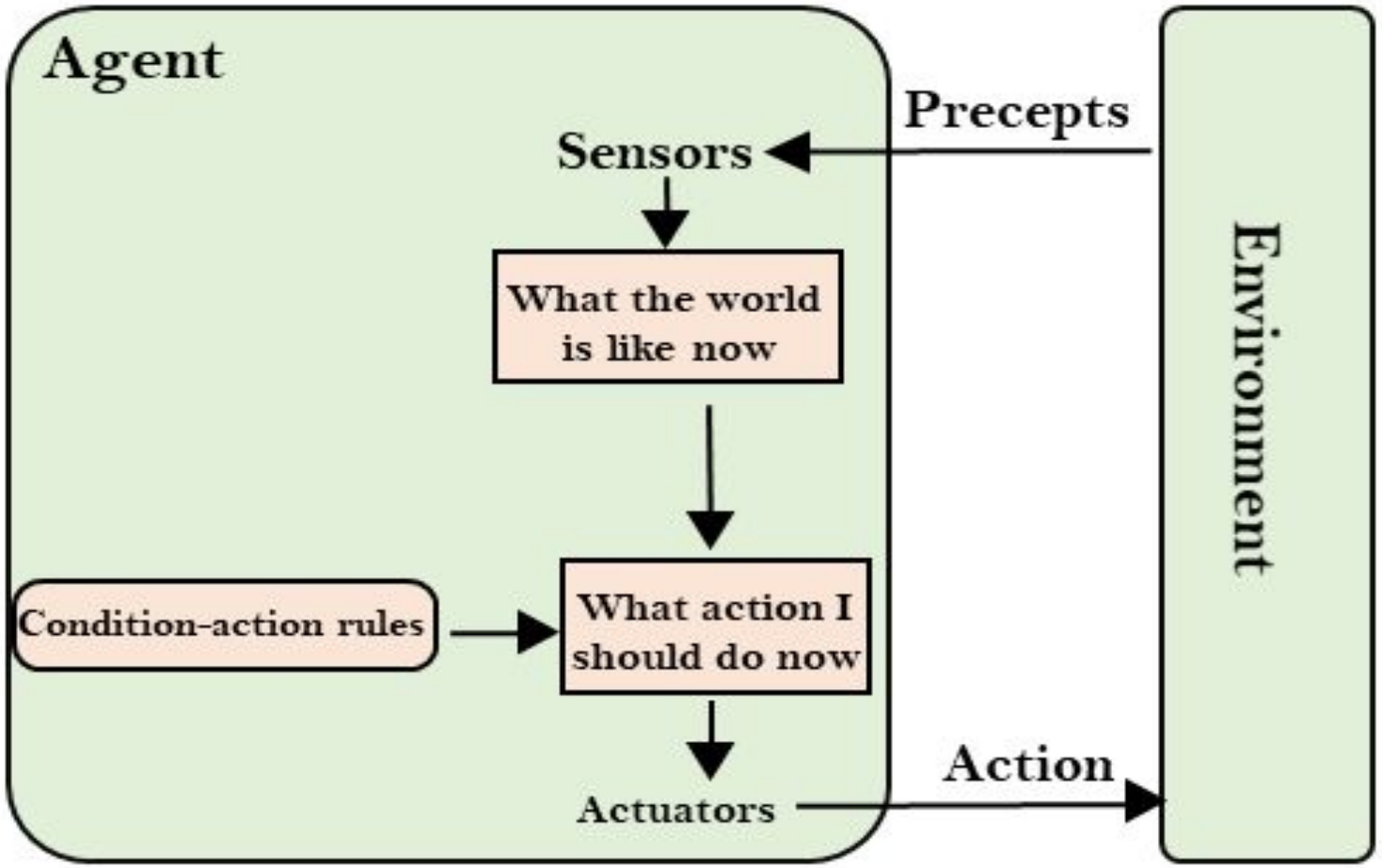
1. Simple Reflex Agent
2. Model-based reflex agent
3. Goal-based agents
4. Utility-based agent
5. Learning agent

1.Simple Reflex agent:

- These are the simplest agents.
- These agents take decisions on the basis of the **current perception**
- Ignore the previous state (history).
- Environment should be fully observable.
- The Simple reflex agent works on **Condition-action rule**,
- **If condition true Action will be taken else Not**
- Example1: If temp>45 AC ON

Simple Reflex agent:

Example: - 2. Such as a Room Cleaner agent, it works only if there is dirt in the room.



Problems with simple reflex agent:

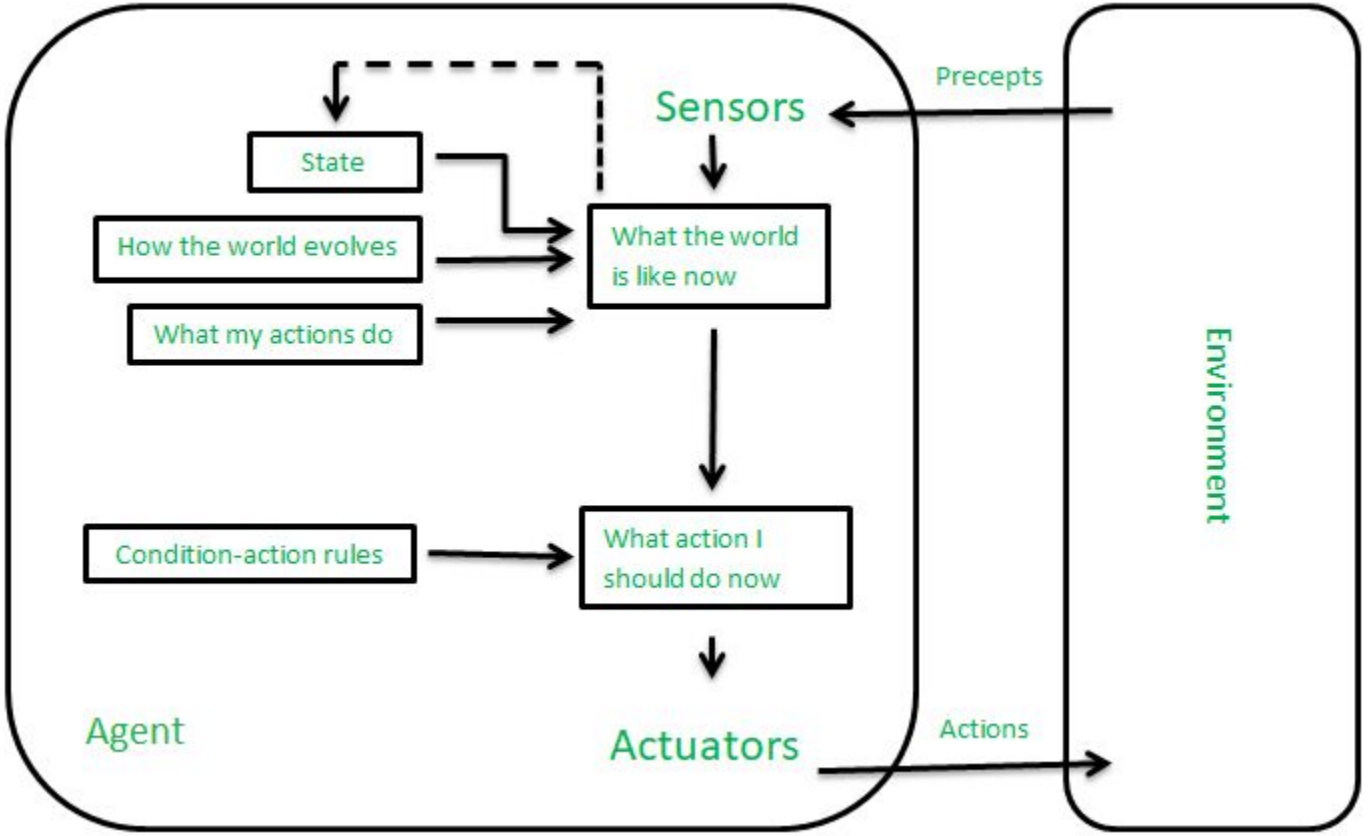
- They have very limited intelligence
- They do not have knowledge of non-perceptual parts of the current state
- Mostly too big to generate and to store.

2.Model-based reflex agent

- It work by finding a rule whose condition matches the current situation.
- It can work on **Partially observable** environment.
- Take decision/Action according to history.
- A model-based agent has two important factors:

1. **Model:** It is knowledge about "**how things happen in the world,"** so it is called a Model-based agent.
2. **Internal State:** It is a representation of the current state based on percept history.

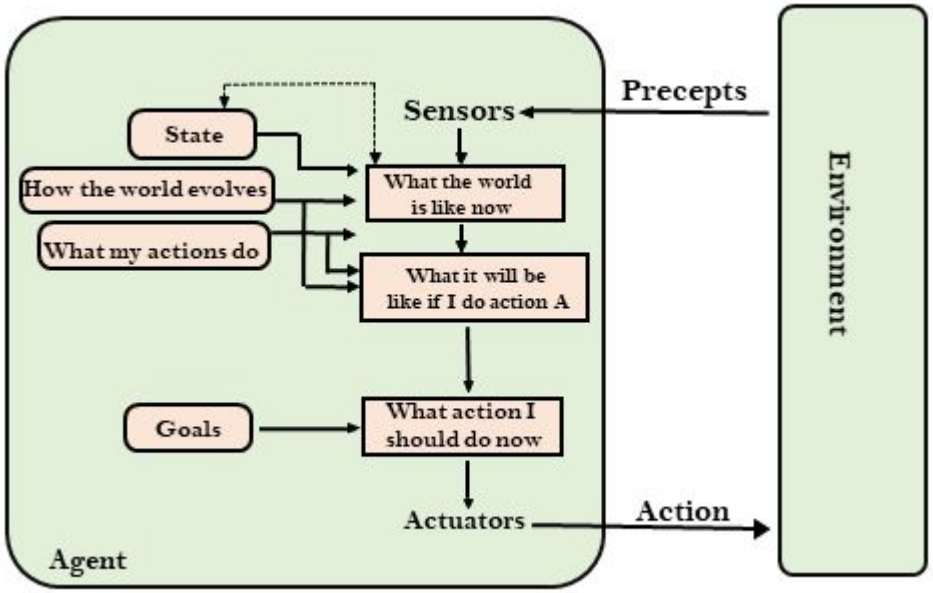
Model-based reflex agent



3.Goal-based agents

- This is Expansion of Model based Agent.
- These kind of agents take decision based on how far they are currently from their **goal Sate.**
- This agent choose **multiple possibilities** and selecting the one which reaches a goal state. This scenario is called **searching and planning**.
- Example “Plan a tour”

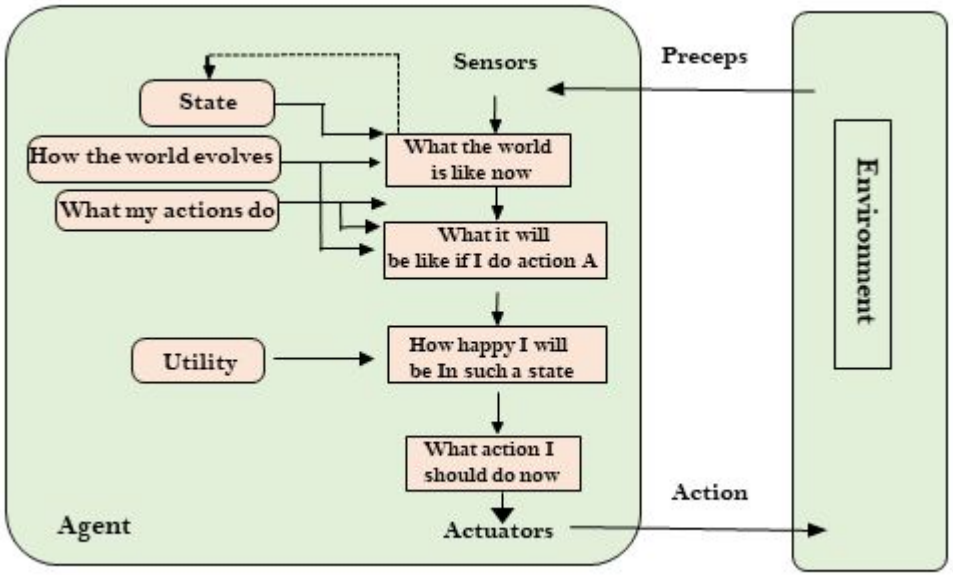
Goal-based agents



4. Utility-based agents

- It work on Partially Observable Environment.
- Utility-based agent act based not only goals but also the **best way** to achieve the goal.
- These agent is useful when there are **multiple possible alternatives**, and an agent has to choose in order to perform the best action.
- Deals with **happy** and **unhappy state.**
- Example : use GPS system by user

Utility-based agents

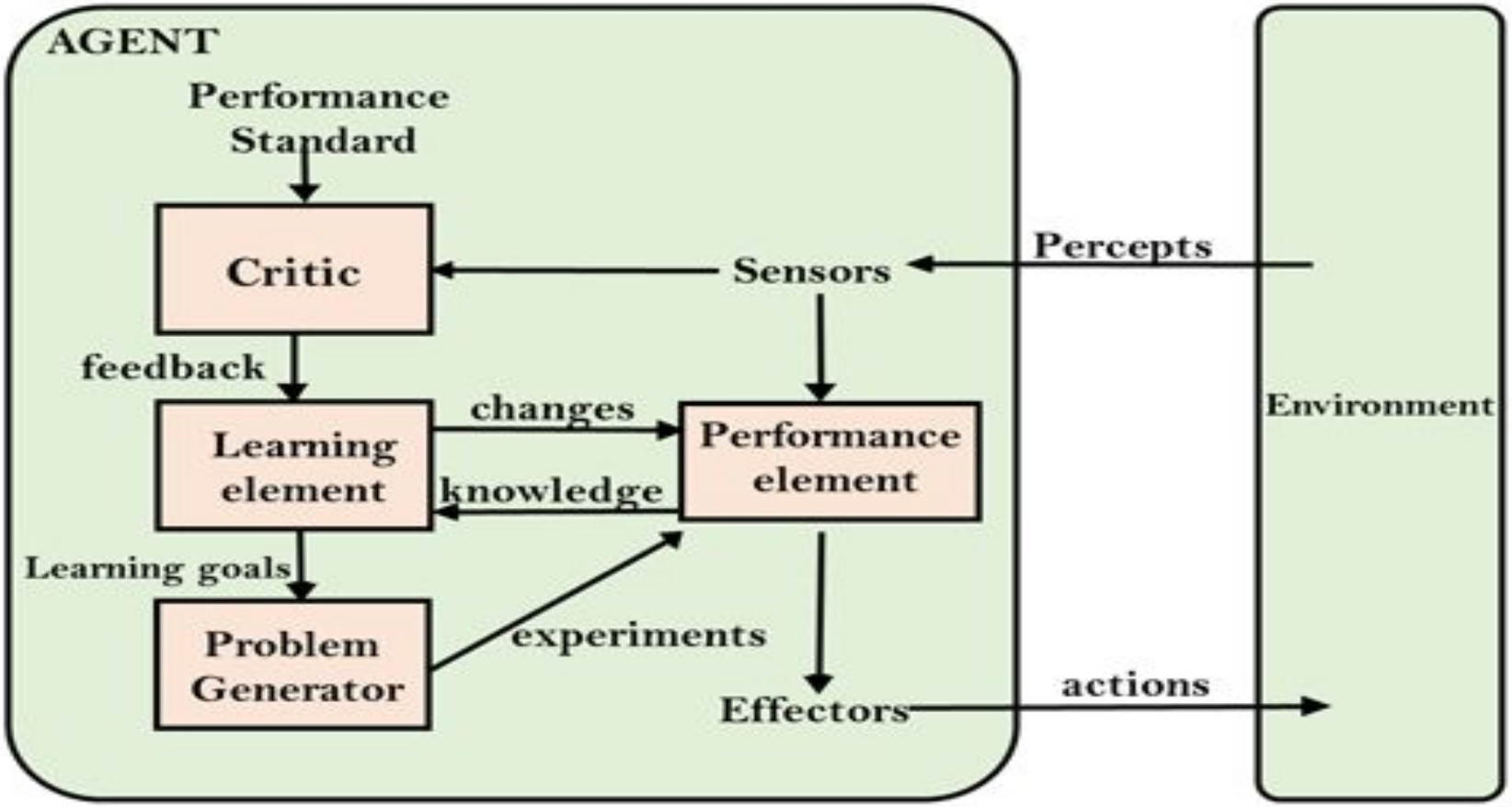


5. Learning Agents

- This agent can learn from its past experiences or it has learning capabilities.
- A learning agent has mainly four conceptual components, which are:

1. **Learning element :**It is responsible for making improvements by learning from the environment
2. **Critic:** It give **feedback** to learning element with respect to a fixed **performance standard.**
3. **Performance element:** It is responsible for selecting external action.
4. **Problem Generator:** This component is responsible for **suggesting new ideas/actions** that will lead to new and informative experiences.

Learning Agents



Intelligent Agents:

- An intelligent agent is a **program that can make decisions** or perform a service based on its environment, user input and experiences.
- An intelligent agent is an independent entity which acts upon an environment using sensors and actuators for achieving goals.

For Example: Air-condition,

AI assistants, like **Alexa** is **examples of intelligent agents** as they use sensors to perceive a request made by the user and the automatically collect data from the internet without the user's help.

Rational Agent:

- A rational agent could be anything which makes decisions, as a person, firm, machine, or software
- A rational agent is an agent which takes the **right action for every perception.**
- **By** doing so, it **maximizes the performance measure**, which makes an agent be the most successful.
- Rational agents to use for game theory and decision theory for various real-world scenarios.

Rationality:

- **Rationality** is nothing but status of being reasonable, sensible, and having good sense of judgment.
- **Rationality** is concerned with expected actions and results depending upon what the agent has perceived.
- Rationality can be judged on the basis of following points:

1. Performance measure which defines the criterion of success for an agent.
2. Agent prior knowledge of its environment.
3. Best possible actions that an agent can perform.
4. The sequence of percepts.

Agent Environment in AI

- It is everything in the world which **surrounds the agent.**
- It is not a part of an agent itself.
- It is a **situation in which an agent is present**
- The agent takes input from the environment through sensors and delivers the output to the environment through actuators.

Properties of Environment

- Fully observable vs Partially Observable
- Static vs Dynamic
- Discrete vs Continuous
- Deterministic vs Stochastic
- Single-agent vs Multi-agent
- Episodic vs sequential
- Accessible vs Inaccessible

Properties of Environment

- **Fully observable vs Partially Observable: -** If an agent sensor can sense or access the complete state of an environment at each point of time then it is **a fully observable** environment, else it is **partially observable**.
- For example, ***chess*** *is a fully observable environment*

Self driving Car is a Partially observable environment

- 2.**Static vs Dynamic:-** If the environment does not change while an agent is acting, then it is static; otherwise it is dynamic.
- Example: writing question paper(Static)
- Playing tennis against the wall(Dynamic)

Properties of Environment

- 3. **Discrete vs Continuous:** 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 continuous environment.
- A **chess game** comes under discrete environment as there is a finite number of moves that can be performed.
- A **self-driving car** is an example of a continuous environment. Their actions are driving, parking, etc. which cannot be numbered.

Properties of Environment

- 4.**Deterministic vs. Stochastic:-** If an agent's **current state completely determine the next state of the environment**, then such environment is called a deterministic environment.
- It is **fully observable environment.**
- **Agent** does **not need to worry about uncertainty.**
- Example **: Chess**
- Stochastic environment is **random in nature** which is not unique and **cannot be completely determined** by the agent.
- Example: **- Self Driving Cars –** the actions of a self driving car are not unique, it **varies time to time**

Properties of Environment

- 5. **Single-agent vs Multi-agent**
- If only one agent is involved in an environment, and operating by itself then such an environment is called single agent environment.
- However, if multiple agents are operating in an environment, then such an environment is called a multi-agent environment.
- Example:1.Playing tennis against the wall(**single**)
- 2.The game of football is (**multi agent)**

Properties of Environment

- 6. **Episodic vs sequential:-**
- Also called the **non-sequential** environment
- There is only the **current perception** is required for the action.

Example:-Drink water,

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

Example :Playing tennis against the wall

Properties of Environment

- 7.**Accessible vs Inaccessible** :If an agent can obtain complete and accurate information about the state's environment, then such an environment is called an Accessible environment else it is called inaccessible.

An **empty room** whose state can be defined by its temperature is an example of an **accessible environment.**

- Information about an event on earth is an example of **Inaccessible environment**

Properties of Environment Example

	Deterministic vs Stochastic	Episodic vs Sequential	Static vs Dynamic	Discrete vs Continuous	Fully observable vs Partially observable	Single agent vs Multi-agent
Playing Football	Stochastic	Sequential	Dynamic	Continuous	Partially observable	Multi-agent
Brushing our teeth						
Playing a tennis match						
Playing tennis against the wall						
Deciding what item to take at hostel lunch						

Problem-solving in AI:

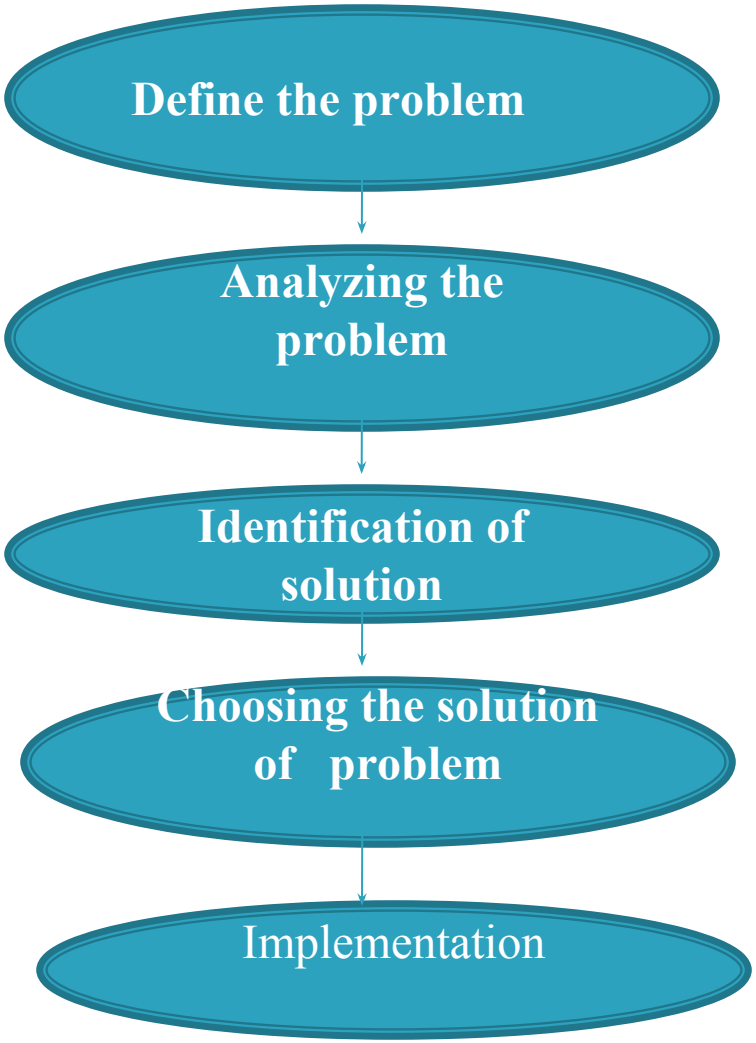
- Problem solving is an area to deal with finding answer for some unknown situations.
- Definition:

1. According to psychology, "*a problem-solving refers to a **state where we wish to reach to a definite goal** from a present state or condition.*"
2. According to computer science, *a problem-solving is a part of artificial intelligence which includes a number of techniques such as* a tree, B-tree , *heuristics algorithms to solve a problem.*

Problem Solving Process:

Problem solving is a process of generating solutions for a given situation.

- The process of solving a problem consists of 5- steps:-
- **Define the problem**
- Analyzing the problem
- Identification of solution
- Choosing the Solution
- Implementation


Define the problem
Analyzing the problem
Identification of solution
Choosing the solution of problem
Implementation

Problem Formulation:-

- It decides that what action should be taken to achieve the formulated goal.
- This is core part of AI which consisted of the following components.

1. **Initial State:** It is the starting state or initial step of the agent towards its goal.
2. **Action:** It is the description of the possible actions/steps available to the agent.
3. **Transition:** A description of what each action do.
4. **Goal test:** It is a function which observe the current state and returns whether the goal state is achieved or not.

   Whenever the goal achieves stop the action and forward into the next stage to determine the cost to achieve the goal.
5. **Path costing:** It is a function which assigns a numeric cost to each path. It require H/W ,S/w and human working cost.

Characteristics of AI Problems:

- **1.Problem Decomposability**: Can it is possible that problem can be broken into small sub problem?
- **2.Ignorable or undone step**: Can the problem solution method can ignore the steps or atleast undone if method cannot prove the problem.
- **3.Predictability:** Can the problem outcome is universally certain or uncertain?
- **4.Absolute or Relative Solutions**: can problem solution method provides the good
- **5.Solution is a state or path:** Can the problem solution method provides the well defined steps or path to provide the desired output.?
- **6.Role of Knowledge :**Is knowledge required to solve the problem.?

Types of Problem

1.Toy Problem:

- These problems are not Real-world Problem.
- These are generated for Fun.
- These problems easily convert into computer program
- Example: 8-**Puzzle, Tic-Tac-Toe**

2. Real-world Problem: It is real-world based problems which require solutions.

- **Example: - Traveling salesperson problem (TSP):**

1.Tic-Tac -Toe Problem:

- **It is well known game for two players also** known as Noughts and Crosses or Xs and Os,
- The player needs to take turns marking the spaces in a 3x3 grid with their own marks,
- if 3 consecutive marks (**Horizontal**, **Vertical**, **Diagonal**) are formed then the player who owns these moves get won.

Assume,

Player 1 - X
Player 2 - O

1.Tic-Tac -Toe Problem: