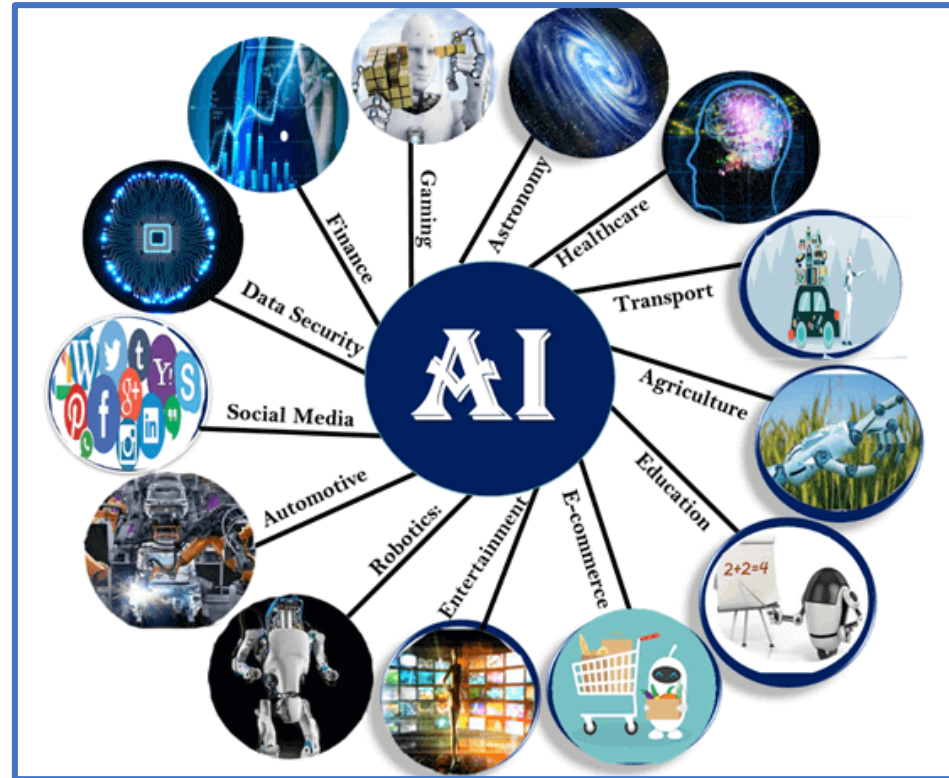


Artificial Intelligence is composed of two words Artificial and Intelligence, where Artificial defines "man-made," and intelligence defines "thinking power", hence AI means "a man-made thinking power."

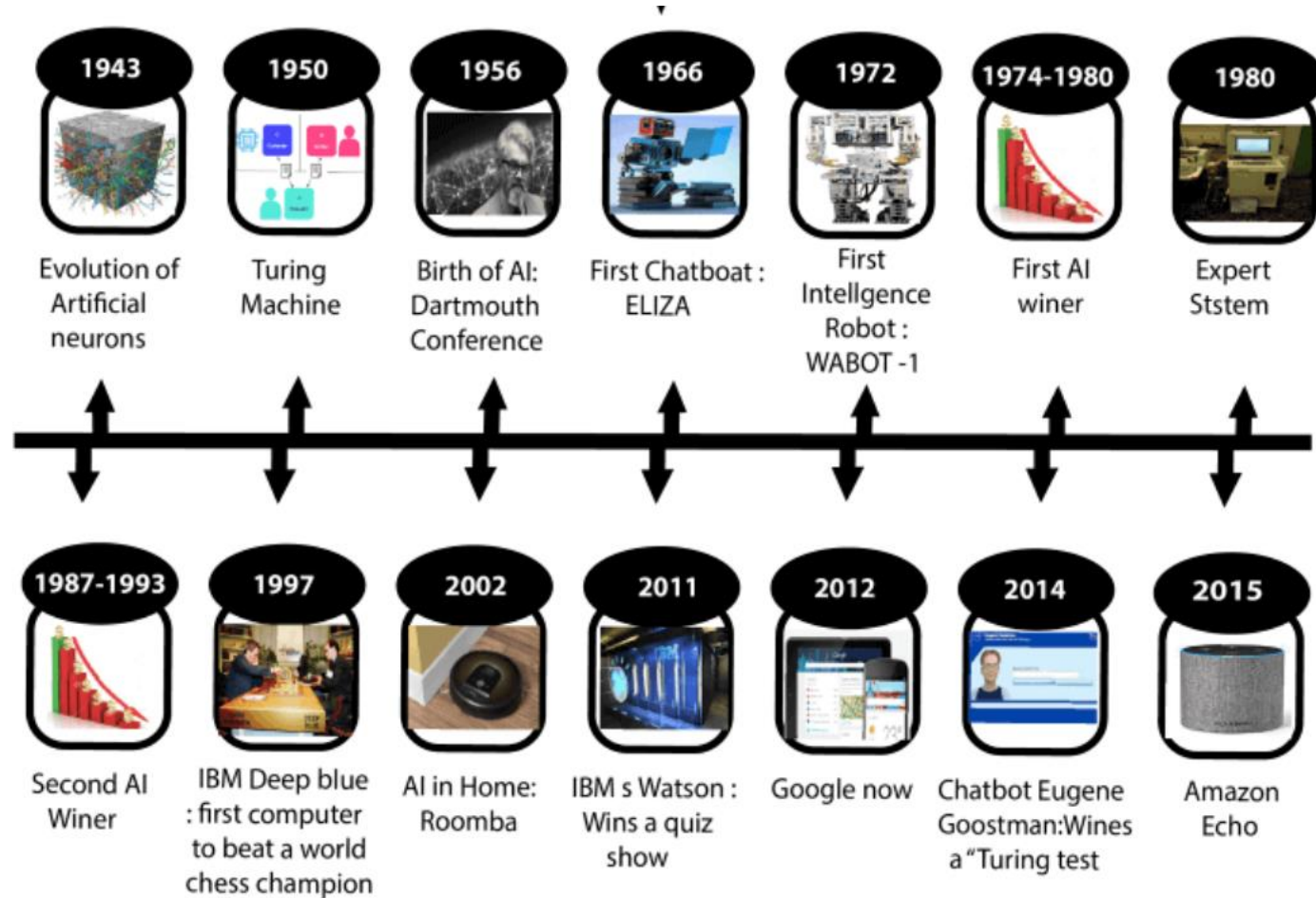


Application of AI

Year 1956

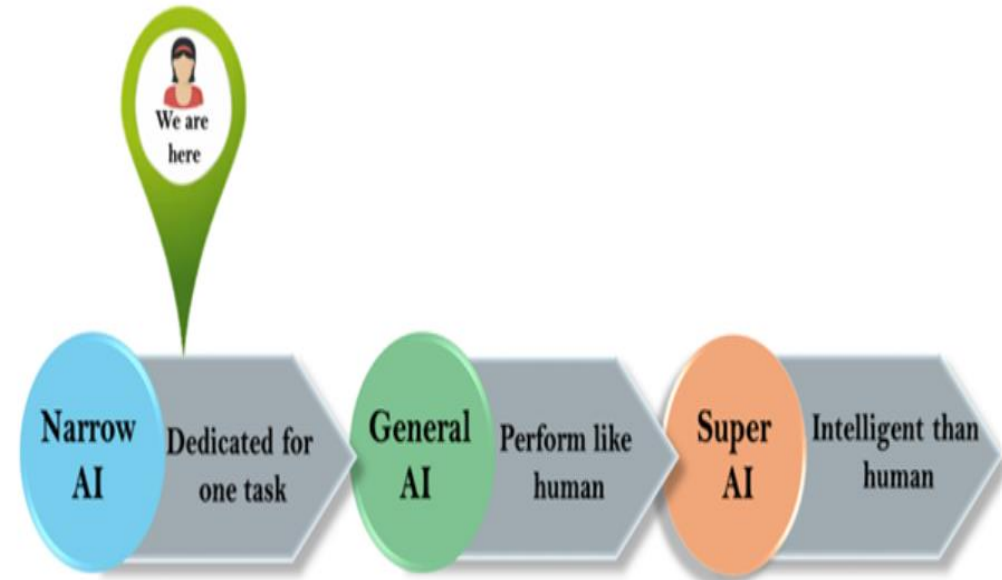
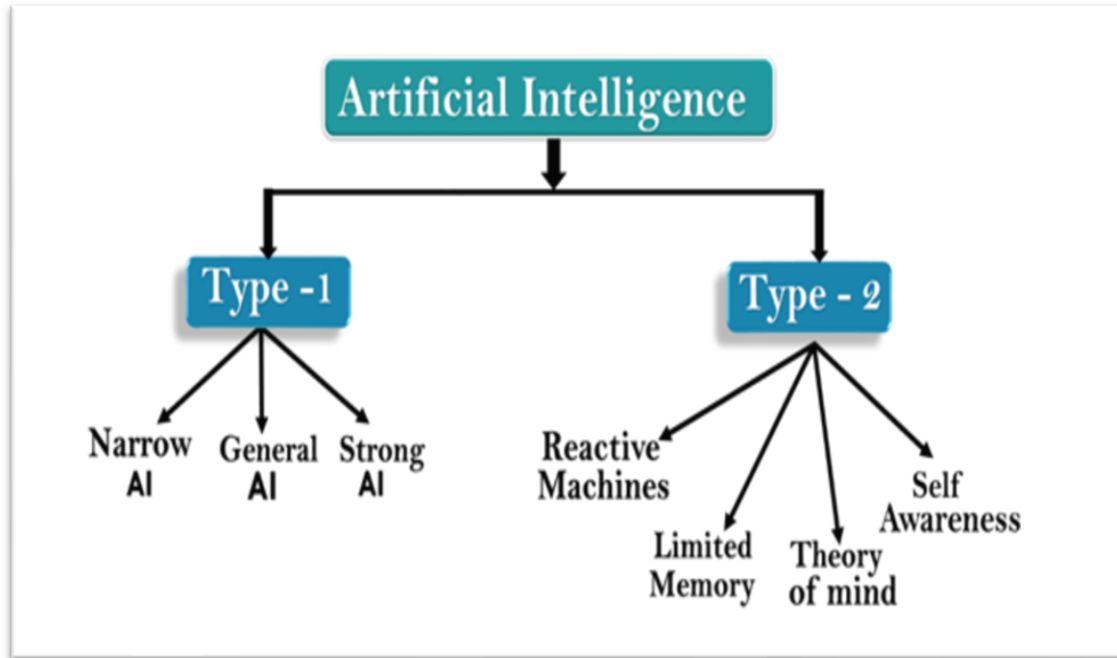
first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field.

History of Artificial Intelligence



Types of Artificial Intelligence

Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionality of AI. Following is flow diagram which explain the types of AI.



Narrow or Weak AI

Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.

Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.

General AI

- General AI 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.

Super AI

Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI.

Some key characteristics of strong AI include capability include the ability to think, to reason, solve the puzzle, make judgments, plan, learn, and communicate by its own.

Advantages of Artificial Intelligence

Following are some main advantages of Artificial Intelligence:

High Accuracy with less errors: AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.

High-Speed: AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.

High reliability: AI machines are highly reliable and can perform the same action multiple times with high accuracy.

Useful for risky areas: AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.

Digital Assistant: AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.

Useful as a public utility: AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.

Disadvantages of Artificial Intelligence

Every technology has some disadvantages, and the same goes for Artificial intelligence. Being so advantageous technology still, it has some disadvantages which we need to keep in our mind while creating an AI system. Following are the disadvantages of AI:

High Cost: The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.

Can't think out of the box: Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.

No feelings and emotions: AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.

• **Increase dependency on machines:** With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.

• **No Original Creativity:** As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Goals of Artificial Intelligence

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 a car in traffic

What is an Agent?

An agent can be anything that perceives its environment through sensors and act upon that environment through actuators. An Agent runs in the cycle of perceiving, thinking, and acting. An agent can be:

Human-Agent: A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.

Robotic Agent: A robotic agent can have cameras, infrared range finder, NLP for sensors and various motors for actuators.

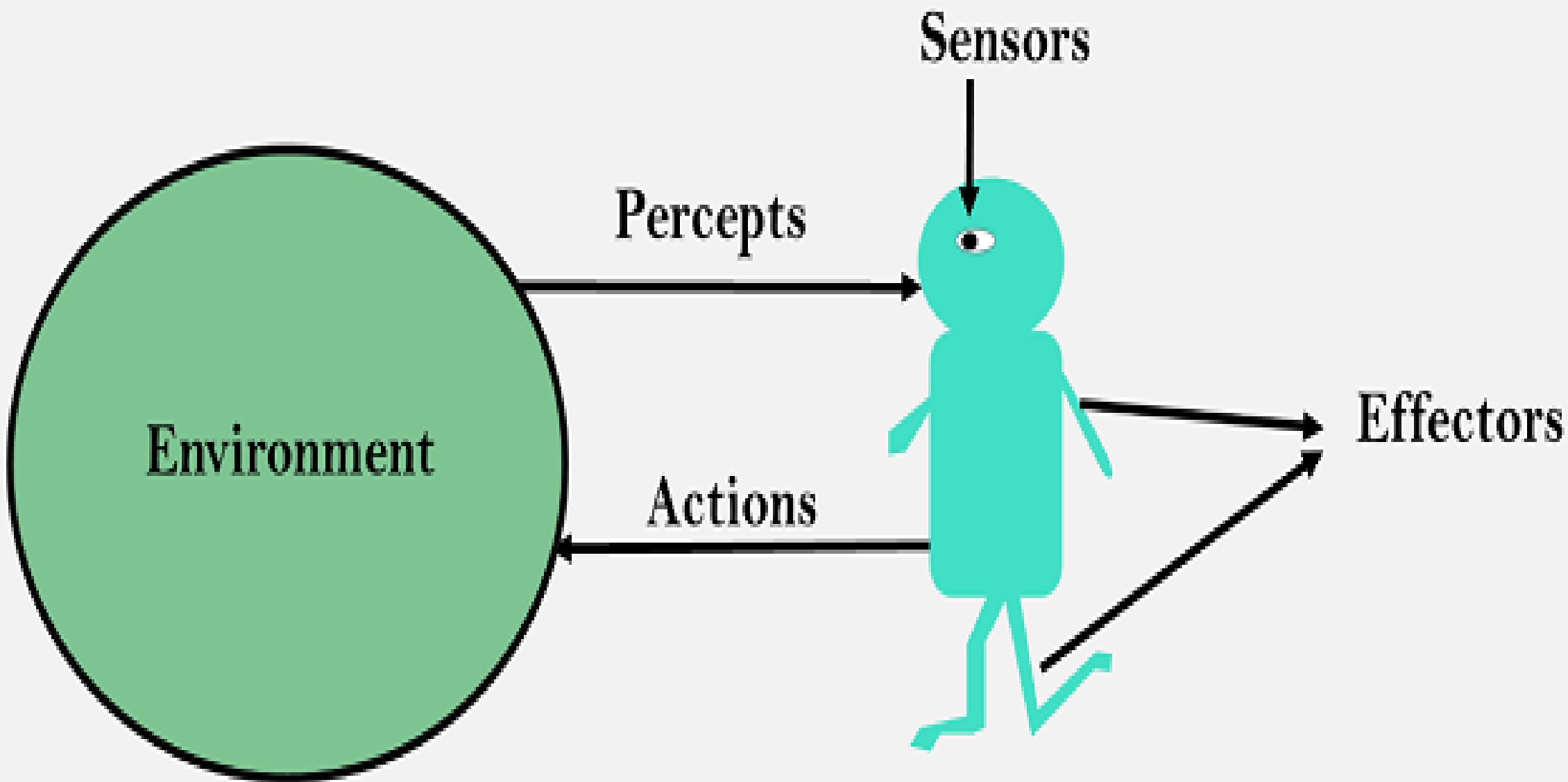
Software Agent: Software agent can have keystrokes, file contents as sensory input and act on those inputs and display output on the screen

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.



Uninformed Searching

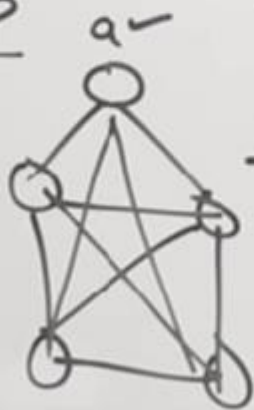
- 1) Search without Information
- 2) No knowledge
- 3) Time Consuming
- 4) More Complexity (Time, Space)
- 5) DFS, BFS, etc.



TSP

$$\frac{(n-1)!}{(5-1)!}$$

$4 = 24$



NP

$$\frac{24}{24} = 1$$

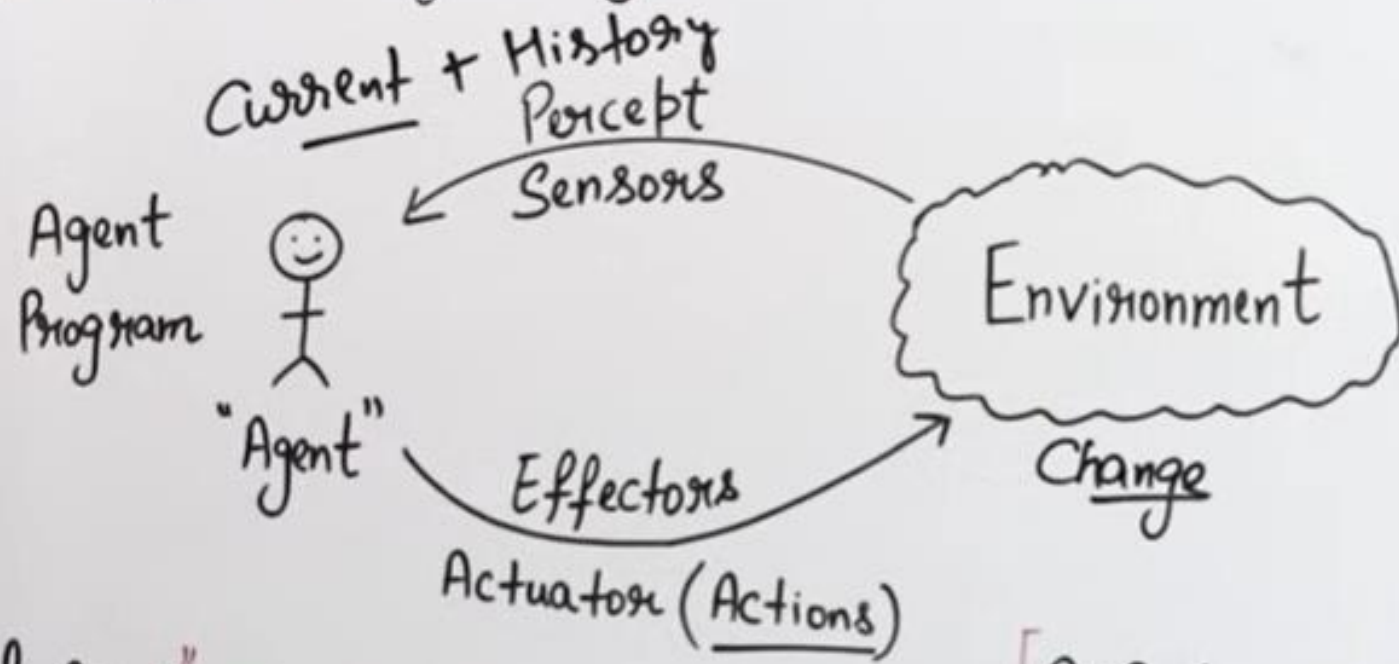
Optimality

Informed Searching

- 1) Search with information
- 2) Use knowledge to find steps to solution
- 3) Quick solution
- 4) Less Complexity (Time, Space)
- 5) A^* Heuristic DFS, Best first Search

Heuristic $h(n)$

Agents / Intelligent Agents



"Goals of Agent" → High Performance
Optimized Result
Rational Action Right

Agent → Percept → Decision → Actions

"Types"

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

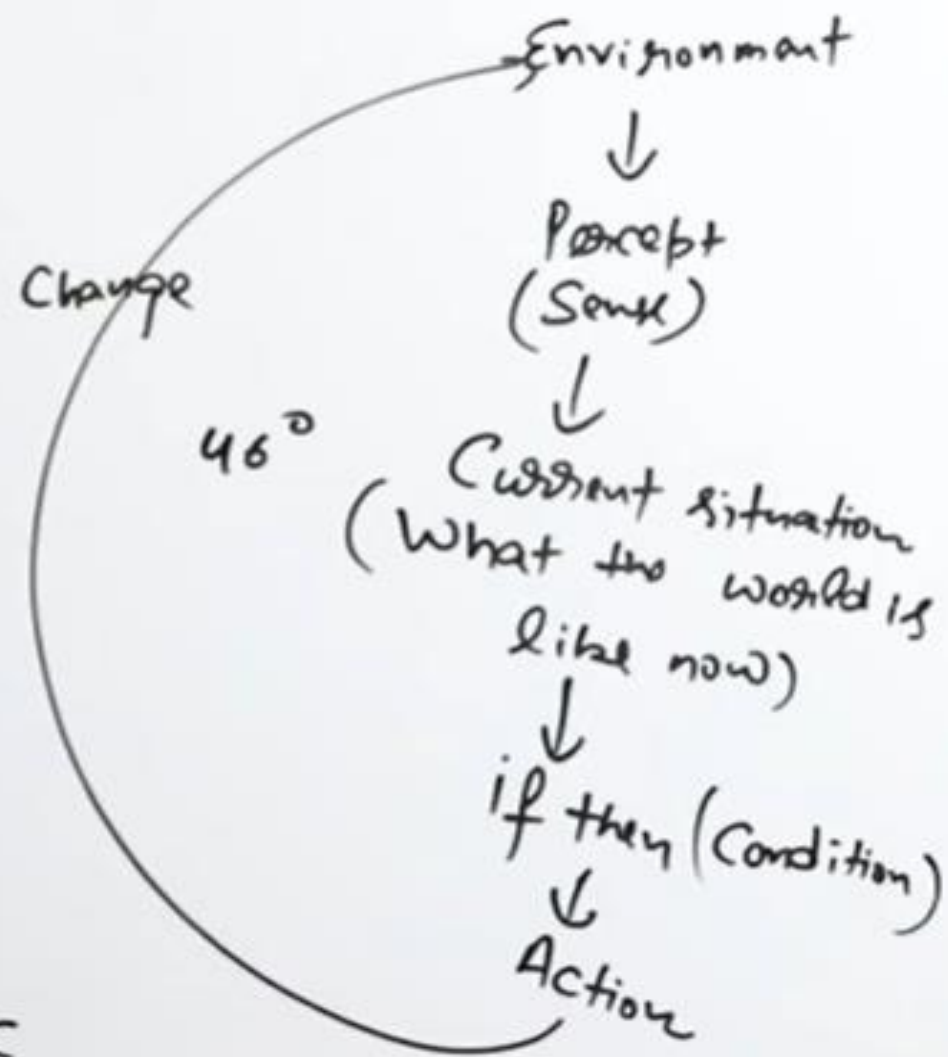
P: Performance
E: Environment
A: Actions
S: Sensors

"Simple Reflex Agents"

- ✓ Act only on the basis of current perception
- ✓ Ignore the rest of percept history
- Based on If-Then Rules
- Environment should be fully observable.
Partially "



if temp $> 45^{\circ}$
then Switch on AC
if Room is not empty



1. Simple Reflex agent:

The Simple reflex agents are the simplest agents. 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.

The Simple reflex agent does not consider any part of percepts history during their decision and action process. The Simple reflex 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.

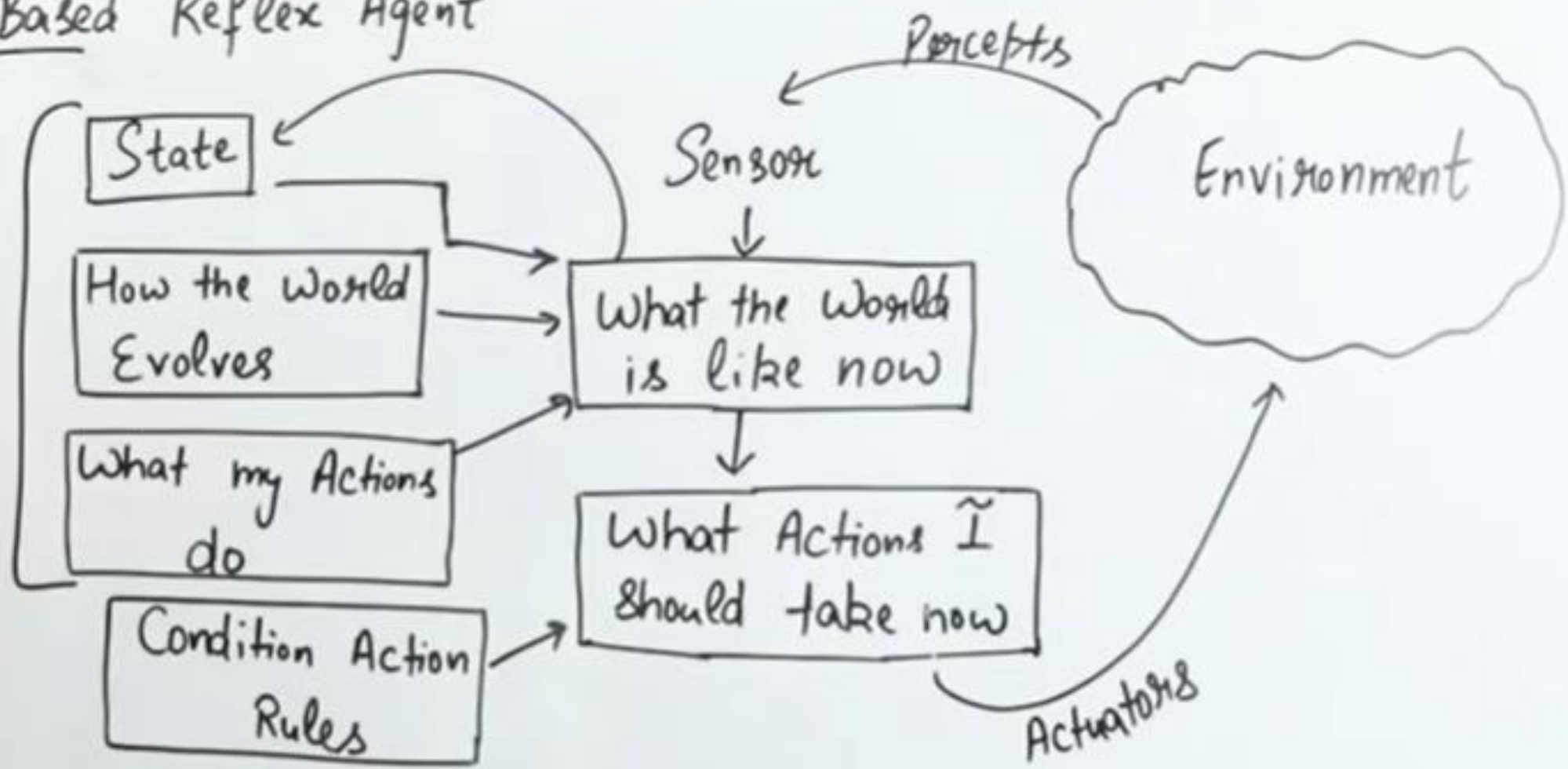
Problems for the simple reflex agent design approach:

- They have very limited intelligence

- They do not have knowledge of non-perceptual parts of the current state

- Not adaptive to changes in the environment.

"Model Based Reflex Agent"



Partially observable Environment
Store Percept History (Internal Model)

2. Model-based reflex agent

The Model-based agent can work in a partially observable environment and track the situation.

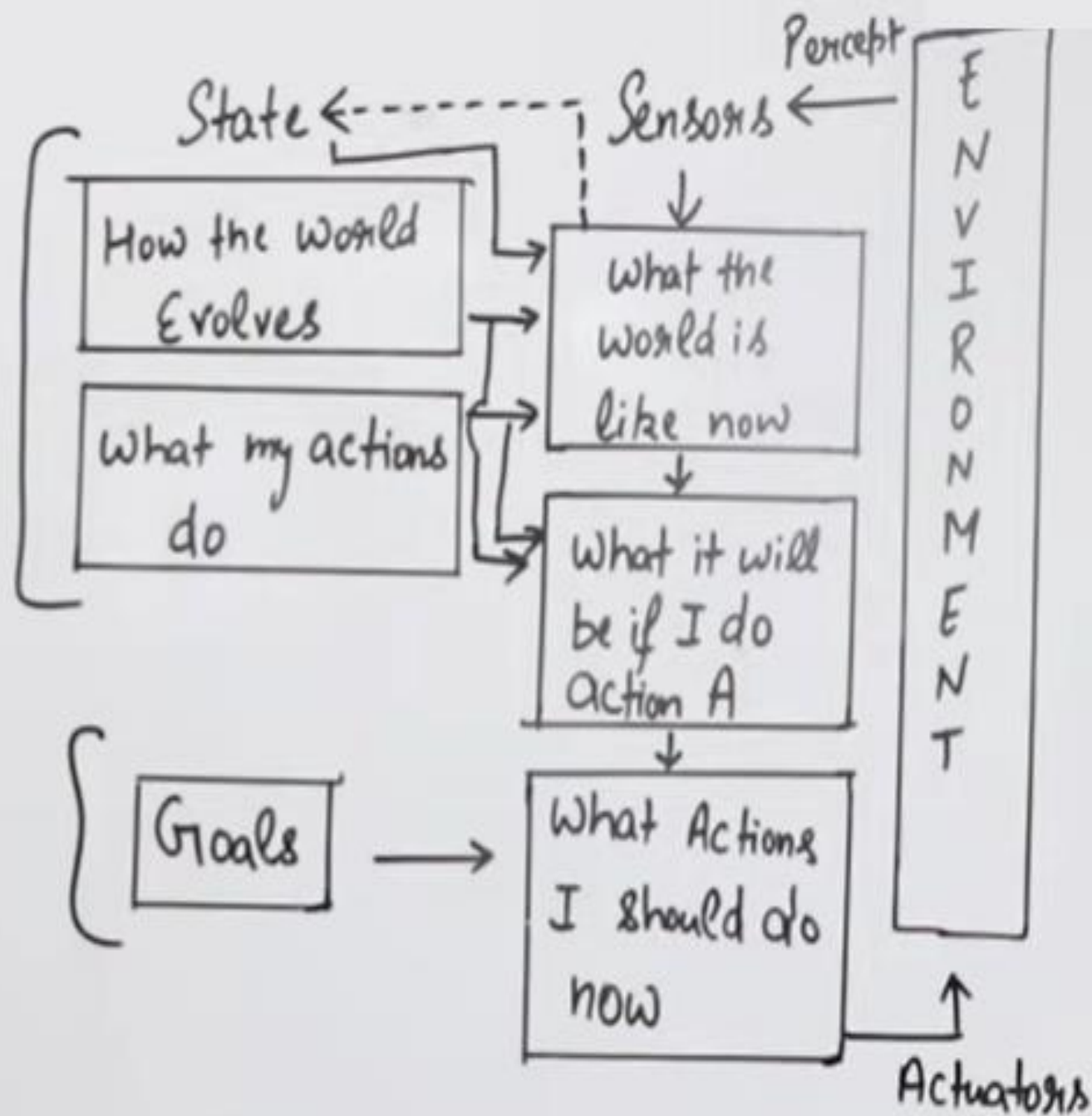
A model-based agent has two important factors:

Model: It is knowledge about "how things happen in the world," so it is called a Model-based agent.

Internal State: It is a representation of the current state based on percept history.

Goal Based Agents

- Expansion of Model Based Reflex Agents
- Desirable Situation (Goal)
- Searching and Planning



3. Goal-based agents

The knowledge of the current state environment is not always sufficient to decide for an agent to what to do.

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

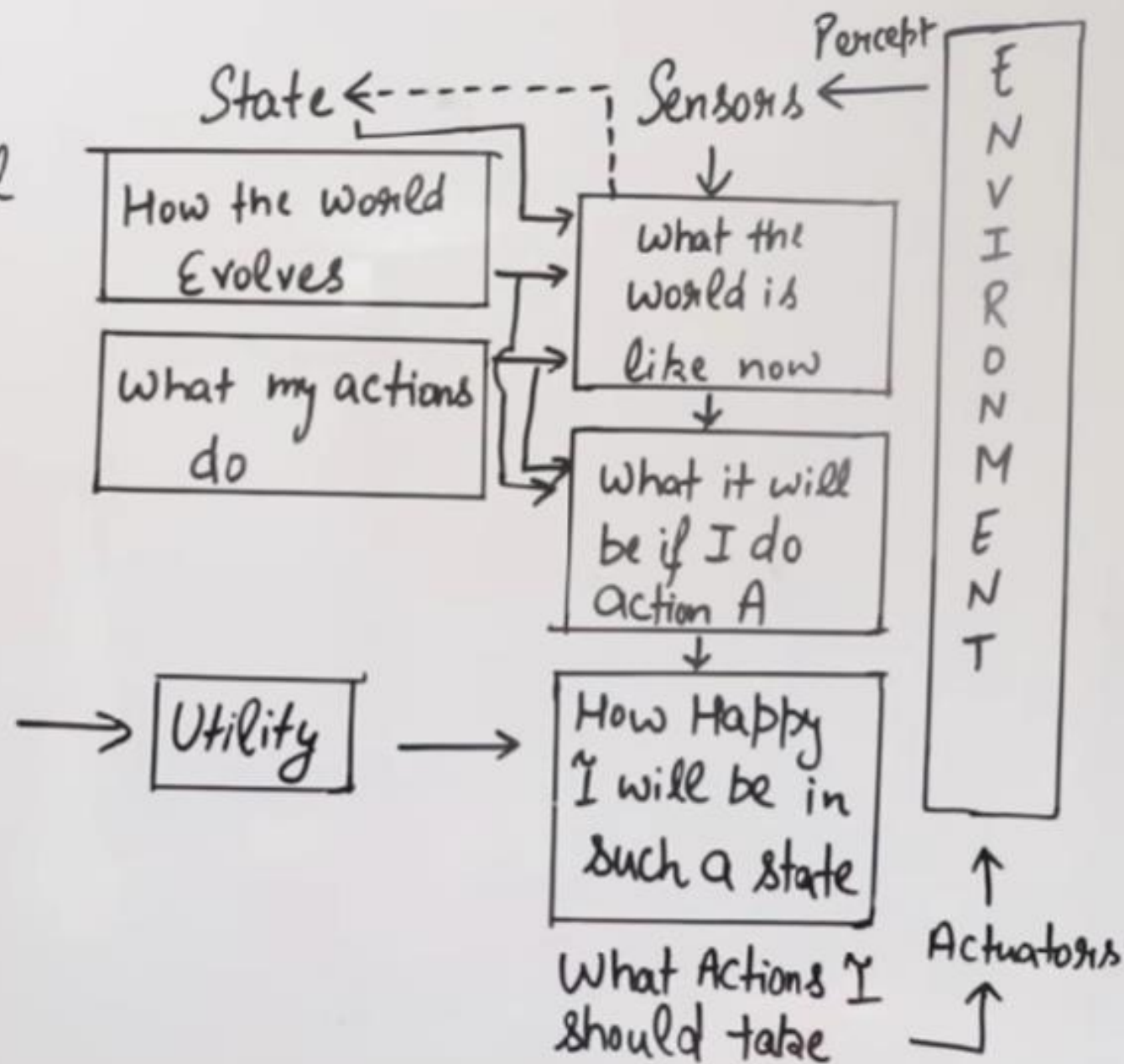
Goal-based agents expand the capabilities of the model-based agent by having the "goal" information.

They choose an action, so that they can achieve the goal.

These agents may have to consider a long sequence of possible actions before deciding whether the goal is achieved or not. Such considerations of different scenario are called searching and planning, which makes an agent proactive.

Utility Based Agents

- Focus on Utility not goal
- Utility function
- Deals with Happy and Unhappy ~~etc.~~



Utility-based agents

- These agents are similar to the goal-based agent but provide an extra component of utility measurement which makes them different by providing a measure of success at a given state.
- Utility-based agent act based not only goals but also the best way to achieve the goal.
- The Utility-based agent is useful when there are multiple possible alternatives, and an agent has to choose in order to perform the best action.
- The utility function maps each state to a real number to check how efficiently each action achieves the goals.

Artificial Intelligence:- AI is the study of how to make computer do things which people do better. [machine + human Intelligence]

↳ AI can cause a machine to work as human.

↳ AI → Artificial [Man-Made]
 → Intelligence [Power of thinking]

GOALS OF AI: i) Replication of Human Intelligence.
ii) Solving problems that require knowledge.
iii) Building a machine that can do human Intelligence task. [CHESS, Proving theorem, automated car driving...]

Reasons of Boost in AI:

↳ i) S/W or device can be made to solve Real-time Problems.

ii) Creation of Virtual assistant [SIRI, CORTANA]

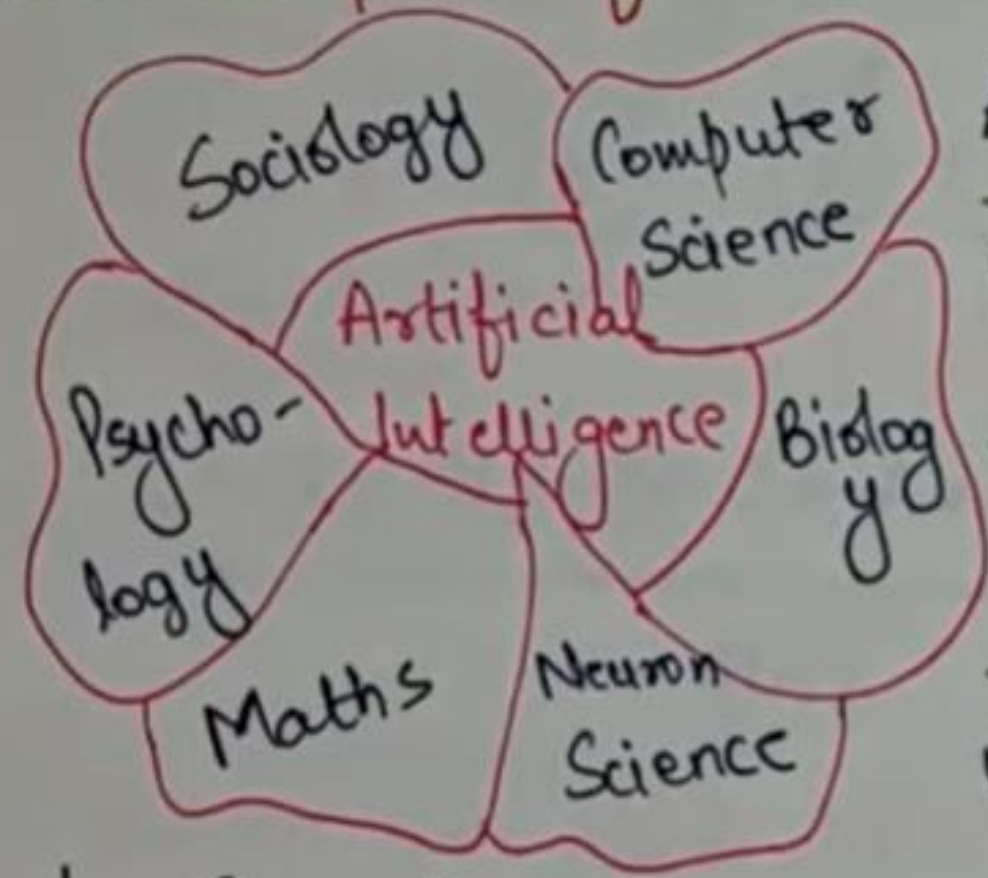
iii) Robots development. [Helps in dangerous env. condⁿ]

iv) New Job opportunities.

Applications of AI:-

- ① AI in Gaming: Chess, Poker, tic-toe.
↳ machine can think large no. of moves.
- ② AI in NLP: Natural lang. Processing
↳ Machine can understand human lang.
- ③ AI in Healthcare: Fast diagnosis
↳ Robotic Surgery.
- ④ AI in Finance: Adaptive Intelligence.
↳ automatic chatbots, algorithm trading.
- ⑤ AI in Data Security: Helps in making data/app^n more secure.
↳ AEG bot, AI2
- ⑥ Expert System: Integration of slw machine and special info^n to provide reasoning & advise.
- ⑦ Computer Vision: Understand the visual automatically by machine.
- ⑧ Speech Recognition: Extract - the meaning of sentence by human talk. [slang removal, noise rem.]
- ⑨ Robotics: Talk and behave like humans. ↳ Erica and Sophia.
- ⑩ AI in e-Commerce: Automatic recommendation of

AI is Comprised of :-



- ↳ Reasoning
- ↳ Learning
- ↳ Problem solving
- ↳ Language Understanding.

Advantages of AI

Accuracy \uparrow & Error \downarrow

Fast Decision Making.

Reliability is more

usefulness in Risky Area.

Digital Assistant

Disadvantages of AI

COST \uparrow

Can't think beyond the limits.

No feeling & emotions

more dependency on machines \uparrow .

No original thinking

Classification of AI:-

Narrow AI

WEAK AI: Able to perform dedicated task with Intelligence. [Not concerned with How]
↳ Can't perform beyond its field or limitations.

↳ Example:-

- Flying machine
- Using logics
- Apple SIRI
- Playing chess

Evolutionary AI: It is the study and design of machines that simulate simple creatures and attempt to evolve.

↳ Example: Ants, Bees etc.

Strong AI: It is the study and design of machines that simulate human mind to perform intelligent tasks.

↳ i) Borrowing ideas from psychology and neuroscience

↳ ii) Forgetting things, Genetics, Language.

Super AI:- Hypothetical concept.
machine > Human.
[machine ↔ machine]

Difference between Informed and Uninformed Search in AI

Informed

- **Use of Heuristics** – informed search algorithms use heuristics, or additional information, to guide the search process and prioritize which nodes to expand.
- **More efficient** – informed search algorithms are designed to be more efficient than uninformed search algorithms, such as breadth-first search or depth-first search, by avoiding the exploration of unlikely paths and focusing on more promising ones.
- **Goal-directed** – informed search algorithms are goal-directed, meaning that they are designed to find a solution to a specific problem.
- **Cost-based** – informed search algorithms often use cost-based estimates to evaluate nodes, such as the estimated cost to reach the goal or the cost of a particular path.
- **Prioritization** – informed search algorithms prioritize which nodes to expand based on the additional information available, often leading to more efficient problem-solving.
- **Optimality** – informed search algorithms may guarantee an optimal solution if the heuristics used are admissible (never overestimating the actual cost) and consistent (the estimated cost is a lower bound on the actual cost).

Examples of informed search algorithms include A* search, Best-First search, and Greedy search. Example: Greedy Search and Graph Search.

Uninformed Search in AI

Algorithms have no additional information on the goal node other than the one provided in the problem definition.

uninformed search algorithms in AI:

- **Systematic exploration** – uninformed search algorithms explore the search space systematically, either by expanding all children of a node (e.g. BFS) or by exploring as deep as possible in a single path before backtracking (e.g. DFS).
- **No heuristics** – uninformed search algorithms do not use additional information, such as heuristics or cost estimates, to guide the search process.
- **Blind search** – uninformed search algorithms do not consider the cost of reaching the goal or the likelihood of finding a solution, leading to a blind search process.
- **Simple to implement** – uninformed search algorithms are often simple to implement and understand, making them a good starting point for more complex algorithms.
- **Inefficient in complex problems** – uninformed search algorithms can be inefficient in complex problems with large search spaces, leading to an exponential increase in the number of states explored.

Ques:- Differentiate b/w blind and heuristic Search.

Blind Search:- It is also known as unknown/uninformed Search.

↳ There is no infoⁿ about the Searching.

↳ No Knowledge of where the GOAL.

↳ Eg:- Depth first, Breadth first Search

↳ Efficiency is low

↳ Slower than Heuristic

Heuristic Search:- It is a method of solving problems more easily and fast. They have Knowledge of where goal or finish of the graph. (Informed Search)

Eg:- Hill climbing, A^* , AO^*

↳ Highly efficient $\begin{cases} \text{less time} \\ \text{less cost} \end{cases}$

↳ finds solⁿ quickly.

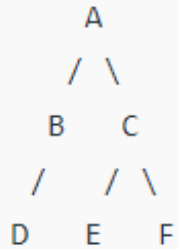
Difference between BFS and DFS

Breadth-First Search

BFS, Breadth-First Search, is a vertex-based technique for finding the shortest path in the graph. It uses a Queue data structure that follows first in first out. In BFS, one vertex is selected at a time when it is visited and marked then its adjacent are visited and stored in the queue. It is slower than DFS.

Example:

Input:



Output:

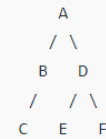
A, B, C, D, E, F

Depth First Search

DFS, Depth First Search, is an edge-based technique. It uses the Stack data structure and performs two stages, first visited vertices are pushed into the stack, and second if there are no vertices then visited vertices are popped.

Example:

Input:



Output:

A, B, C, D, E, F

S. No.	Parameters	BFS	DFS
1.	Stands for	BFS stands for Breadth First Search.	DFS stands for Depth First Search.
2.	Data Structure	BFS(Breadth First Search) uses Queue data structure for finding the shortest path.	DFS(Depth First Search) uses Stack data structure.
3.	Definition	BFS is a traversal approach in which we first walk through all nodes on the same level before moving on to the next level.	DFS is also a traversal approach in which the traverse begins at the root node and proceeds through the nodes as far as possible until we reach the node with no unvisited nearby nodes.
4.	Technique	BFS can be used to find a single source shortest path in an unweighted graph because, in BFS, we reach a vertex with a minimum number of edges from a source vertex.	In DFS, we might traverse through more edges to reach a destination vertex from a source.
5.	Conceptual Difference	BFS builds the tree level by level.	DFS builds the tree sub-tree by sub-tree.
6.	Approach used	It works on the concept of FIFO (First In First Out).	It works on the concept of LIFO (Last In First Out).

What is the other name of informed search strategy?

- a) Simple search
- b) Heuristic search
- c) Online search
- d) None of the mentioned

Uninformed search strategies are better than informed search strategies.

- (A). True
- (B). False
- (C). Partially true
- (E). None of these

Which of the following strategy is commonly known as a blind search?

- (A). Simple reflex search
- (B). Informed search
- (C). Uninformed search
- (D). All of these
- (E). None of these

Best-First search can be coded with the help of which of the following data structure.

- (A). Queue
- (B). Stack
- (C). Linked list
- (D). All
- (E). None of these

Which of the following is the search strategy the uses a not problem specific knowledge?

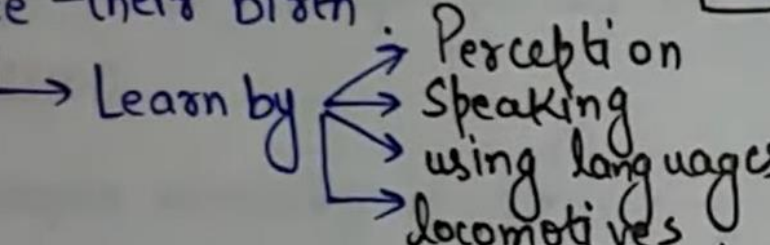
Which of the following is the search strategy the uses a not problem specific knowledge?

- (A). Informed Search
- (B). A* algorithm
- (C). Uninformed search
- (D). All of these
- (E). None of these

which of the following uninformed search provides optimal solution?

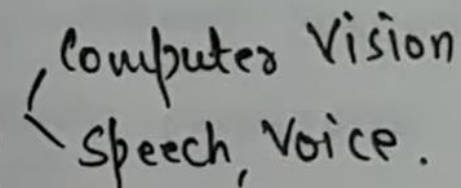
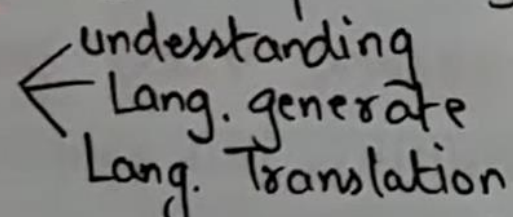
- a) Breadth First search
- b) Depth First search
- c) A star
- d) None of the mentioned

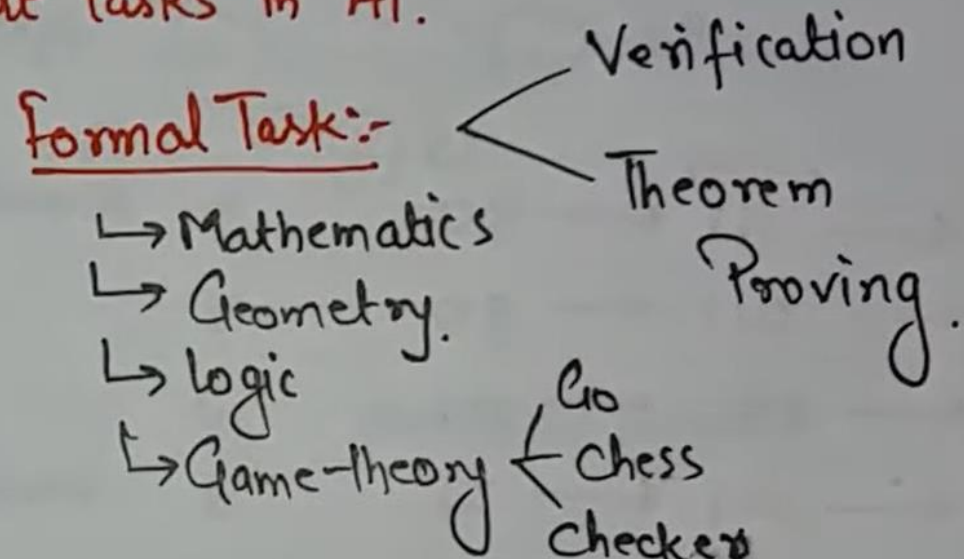
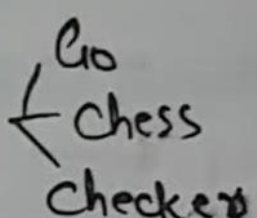
Ques:- Explain Formal, Mundane and Expert tasks in AI.

Humans Learn Mundane (Ordinary) tasks
Since - their birth
↳ Learn by  Perception
Speaking
using languages
locomotives
↳ Easiest to learn.

Formal and Expert task are learn later in the order.

Mundane:-

- ① Perception  Computer Vision
Speech, Voice.
- ② NLP  understanding
Lang. generate
Lang. Translation.
- ③ Reasoning
- ④ Robotics (locomotive)

Formal Task:-  Verification
Theorem Proving.
↳ Mathematics
↳ Geometry.
↳ Logic
↳ Game-theory  Go
Chess
Checkers

Expert Task:- Engineering,
↳ Manufacturing
↳ Monitoring
↳ Scientific, financial, Medical.

Ques:- what do you mean by Chinese Room Test? BASIC CONFIGURATION:-

Explain how it can be performed?

↳ Also known as Chinese Room Argument.

↳ Proposed by Mr. John Searle in 1980.

↳ Argued that "Turing Test could not be used to determine whether or not machine is considered as intelligent".

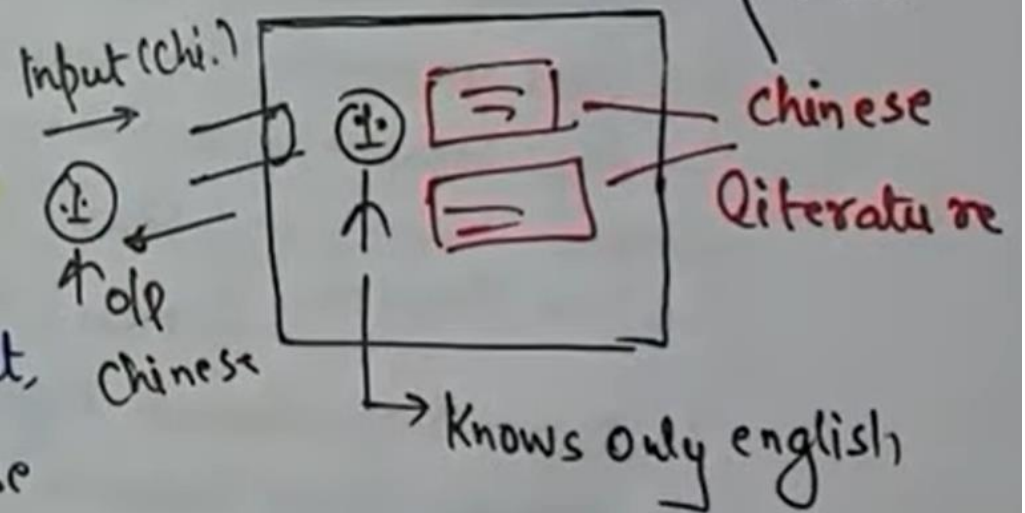
According to John Searle a machine could pass Turing Test simply by manipulating symbols, without any understanding of those symbols.

↳ A person/machine can be considered as intelligent, if and only if they have understanding of what they are doing.

↳ A person knowing English not Chinese sits in room with huge volume of Chinese literature.

↳ Chinese symbol Φ , return Ψ . } Rules
↳ " " " $\Phi\Psi$, return Ξ . }

↑ rules



Ques:- what do you mean by uncertainty?

why uncertainty arises?

Uncertainty is defined as - the lack of exact infoⁿ or knowledge that helps us to find correct conclusion.

definition.

Uncertainty may be caused by problems with data such as:-

- ↳ ① Missing / unavailable data
- ② Unreliable / ambiguous data
- ③ Imprecise / Inconsistent refⁿ of data
- ④ Guess based

data.

Sources of Uncertainty:-

- ↳ ① Uncertain Inputs
 - ↳ Missing Data
 - ↳ Noisy data
- ② Uncertain Knowledge
 - ↳ multiple causes leads to multiple effects.
 - ↳ Incomplete knowledge of causality in domain.
- ③ Uncertain outputs
 - ↳ Abduction, induction are uncertain
 - ↳ Default reasoning
 - ↳ Incomplete deduction, inference.

Medical Diagnosis system is example of which task domain in artificial intelligence.

a) Mundane Task b) Expert task c) Formal Task d) Categorical Task

Which of the following is not a task domain in artificial intelligence?

a) Mundane Task

b) Expert task

c) Formal Task

d) Categorical Task

