Artificial intelligence

What is intelligence?

Intelligence is:

– the ability to **reason**

– the ability to **understand**

– the ability to **create**

– the ability to **Learn from experience**

– the ability to **plan and execute complex tasks**

The definition of AI according to some text book are characterized into four approaches and summarized as below :

Systems that think like humans	Systems that think rationally
"The exciting new effort to make computers think.....*machine with minds*, in the full and literal sense." (Haugeland, 1985) "[The automaton of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning....." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Systems that act like humans	**Systems that act rationally**
" The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computer do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI... is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

- Artificial: – Made as copy something like natural

“man made “ + “thinking power”

It is a branch of computer science by which we can create intelligent machine which can behave like a human think like human and able to make decisions.

- ⇨ In AI you do not need to program machine to do some work.
- ⇨ You have to create a machine with programmed algorithm which can work with own intelligence.

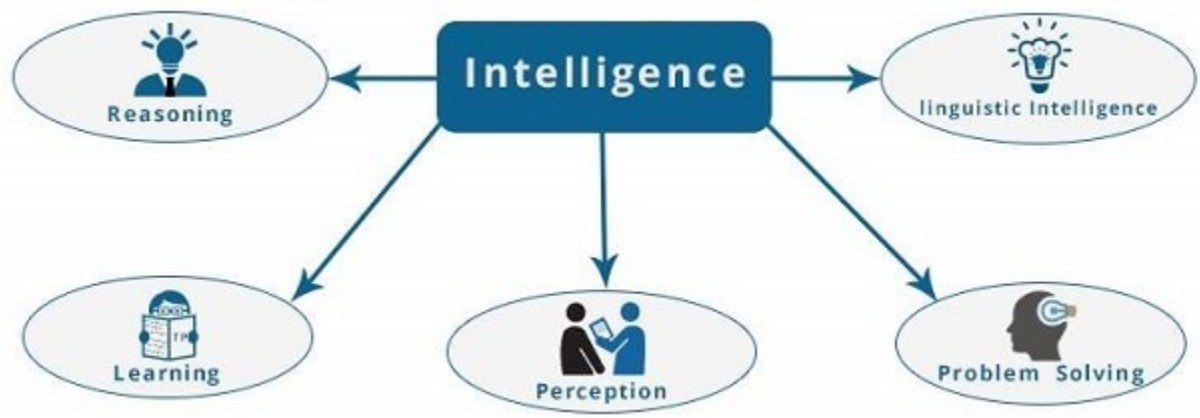
Why AI?

- ⇨ With the help of AI , we can create such software and devices which can solve real-world problems very easily and the accuracy such as health issues, marketing , traffic issues.
- ⇨ With the help of AI, you can create your personal virtual assistance, such as google assistant, siri etc.
- ⇨ With the help of AI, you can build such Robots which can work in a environment where survival of human can be at risk.
- ⇨ AI opens a path for new technologies, new devices and new opportunities.

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 :
    a. Providing theorem.
    b. Playing chess
    c. Plan some surgical operation.
    d. Driving a car in traffic.
- ⇨ Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate , explain and advise to its user.

What is intelligence composed of?



Reasoning : set of process that enables us to take judgement , making decisions, prediction.

Learning : act of gaining knowledge, experiences.

Perception: process of acquiring knowledge , interpreting and selecting and organizing sensor information.

Problem solving : working through detail of problem to reach the solution. It includes decision making too.

Linguistic intelligence : comprehend speak and write the verbal and written language. It is important in interpersonal communication.

Agents in AI

It is the study of rational agent and its environment.

⇨ The agent sense the environment.

- ⇨ The agent sense the environment through sensor and act on their environment through actuators (is a device that that cause machine to operate)
- ⇨ I am an agent and my sense organs are actuator that cause me to operate as per sensed information.
- ⇨ Ai agent can have mental properties like knowledge, belief, intention. Etc.

Day 2

1. Acting humanly : Turing Test Approaches

The Turing test, proposed by Alan Turing (1950) was designed to provide a satisfactory operational definition of intelligence.

➔ He suggested a test based on indistinguishability from undeniably intelligent entities-human beings.

➔ The test involves an interrogator which interacts with one human and one machine .

➔ Within a given time the interrogator has to find out which of the two the human is , which one the machine.

➔ A computer passes the test if a human interrogator after posing some written questions, cannot tell whether the written response come from human or not.

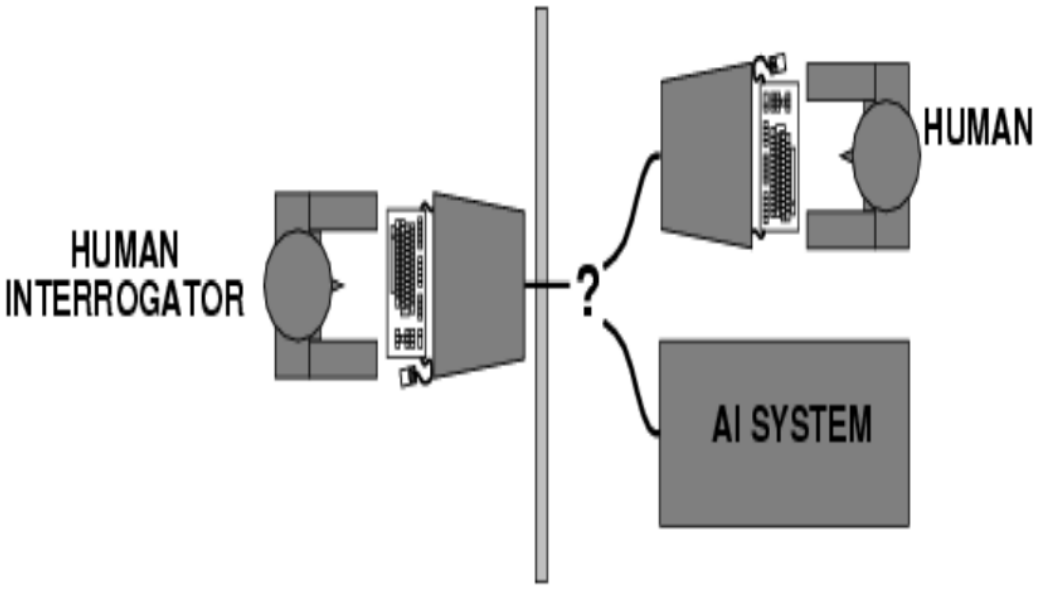


Fig: Turing Test

➔ To pass the Turing test , a computer must have following capabilities:

- ⇨ **Natural language processing** : To enable it to communicate successfully in English.
- ⇨ **Knowledge representation** : To store what it knows and hears.
- ⇨ **Automated reasoning** : To use the stored information to answer questions and to draw new conclusions.
- ⇨ **Machine learning**: To adapt to new circumstances and to detect and extrapolate patterns.

Application of Turing Test in real life :

Chinese room argument:

What do you mean by Chinese room test? Explain how it is performed?

⇨ Also known as Chinese room Argument.

⇨ Proposed by .

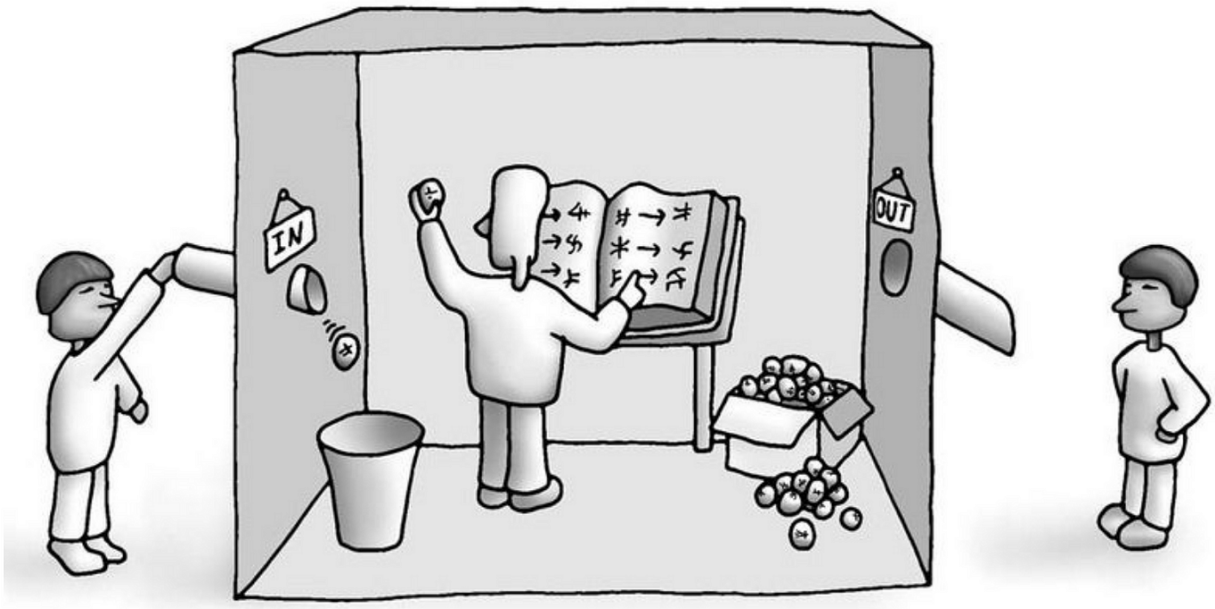
Argued that "Turing test could not be used to determine "whether or not machine is considered as intelligent"

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

i.e a person or machine can be considered as intelligent, if and only if they have understanding of what they are doing . He argued that machine could easily pass the Turing test by manipulating keywords and symbol, but they had no real understanding of language. so, it cannot be described as "thinking" capability of a machine such as a human.

Basic configuration:

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



⇨

If you see this shape, "什 麼" followed by this shape, "帶 來" followed by this shape, "快 樂"	then produce this shape, "為 天" followed by this shape, "下 式"

Cognitive approach

2. Thinking humanly: cognitive modeling approach

➔ If we are going to say that a given program thinks like a human, we must have some way of determining how human think.

→We need to get inside the actual working of human minds. There are three way to do this :

- Through introspection: catch our thought while they go by

- Through psychological experiments: observing a person in action.
- Through brain imaging: observing the brain in action.

➔ Once we have precise theory of mind, it is possible to express the theory as a computer program.

➔ But unfortunately, up to now there is no precise theory about the thinking process of the human brain. Therefore, it is not possible to make machines think like the human brain.

3. Thinking rationally: The laws of thought approach

→ It is a kind of logical argument that applies deductive reasoning to arrive at a conclusion based on two or more propositions that are assumed to be true.

For example,

- Ram is man.
- All men are mortal.
- Ram is mortal.

4. Acting Rationally: The rational agent approach

→ Agent is something that acts. Computer agent is expected to have following attributes :

- Autonomous control
- Perceiving their environment
- Persisting over a prolonged period of time
- Adapting to change
- And capable of taking on another's goal.

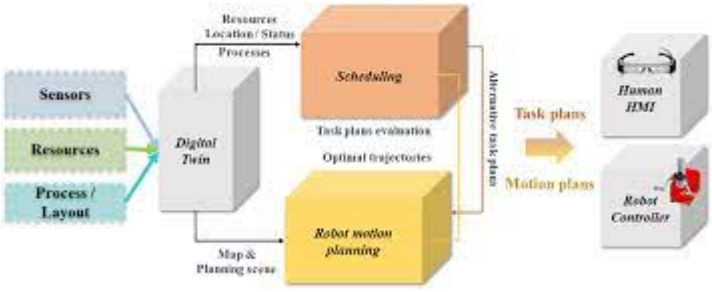
➔ Rational behavior : doing right thing.

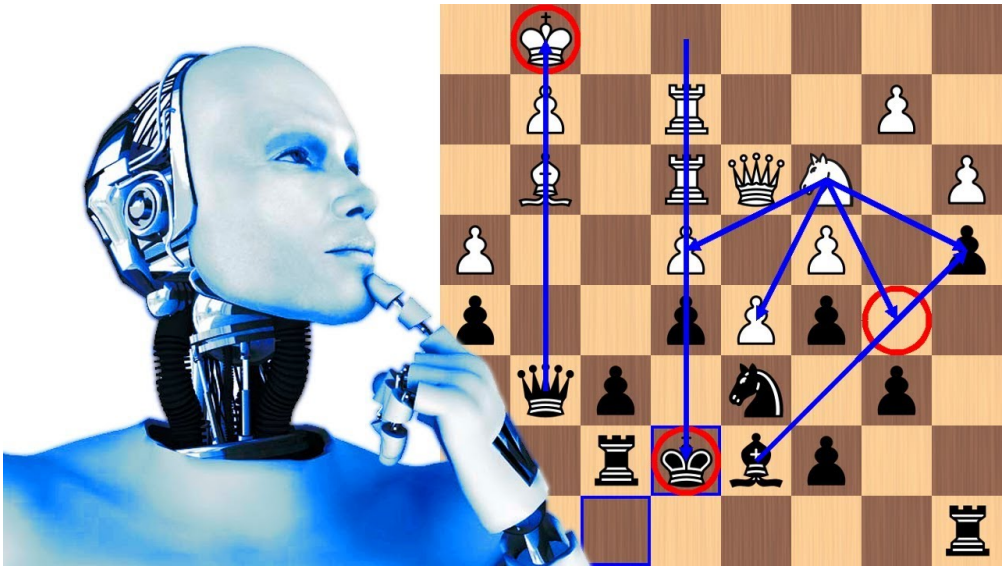
➔ The right thing: that which is expected to maximize goal achievement, given the available information.

➔ Rational agent: is one that acts so as to achieve the best outcome.

Application of AI

- Autonomous planning and scheduling
- Game playing
- Autonomous control
- Diagnosis
- Logistics planning
- Robotics
- Speech re-cogitation(language understanding and problem solving)
- Spam filtering
- Machine translation etc.



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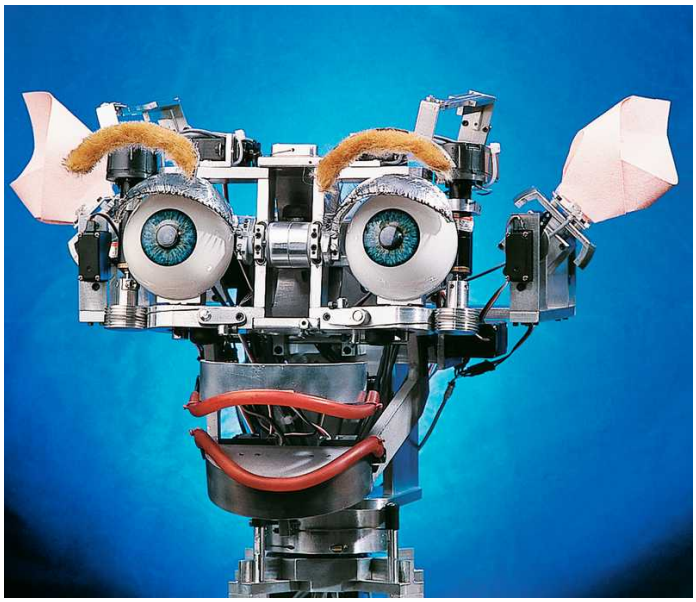


i am the sutdent of bca

Did you mean: **i am the student of bca**

म bca को sutdent हुँ

Ma bca kō sutdent huṁ

Open in Google Translate • Feedback

Fig logistic planning

Differences between AI and Omniscience

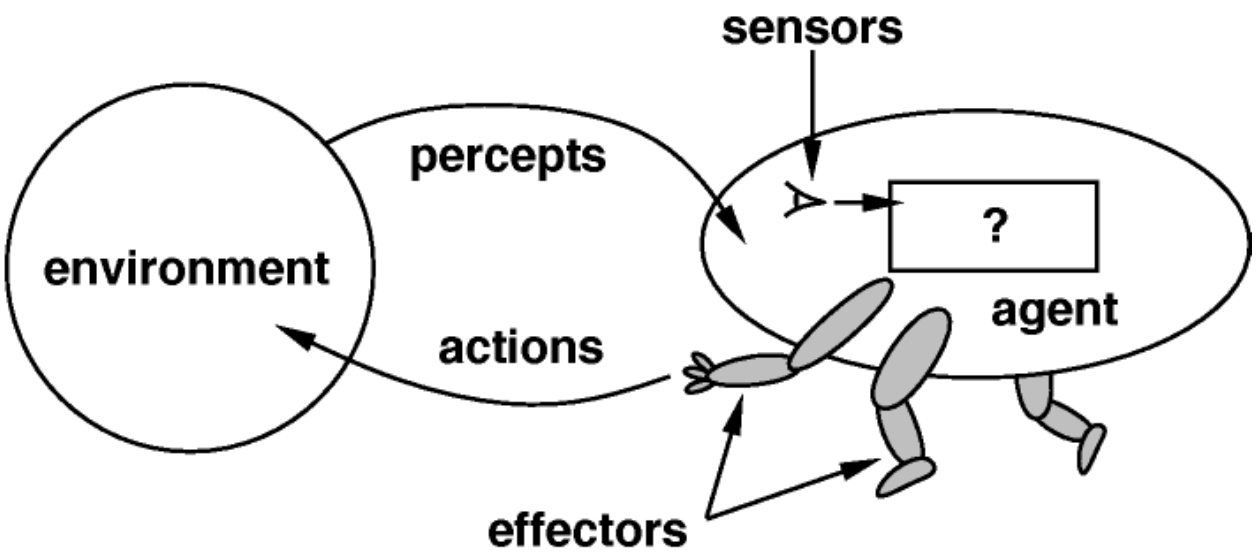
Artificial intelligence	Omniscience
Ai is simulation of human intelligence demonstrated by machines, particularly computer systems.	Omniscience refers to the capacity of knowing unlimited knowledge of all things that can be known.
The idea is to get the machine to think for themselves and make decisions based on the data being fed.	Omniscience is the state of possessing unlimited or complete knowledge about all things possible.
AI is based on algorithms created by humans to help the machines think and learn.	It is an attribute given to the god alone because in reality omniscience is impossible.
Knowledge is limited	Knowledge is unlimited.

Assignment questions:

1. **Differentiate between intelligence and artificial intelligence. What can Ai do today?**
2. **What is the Turing test? Explain its significance.**
3. **What is Searle's Chinese Room Argument? Explain in detail.**
4. **What is Ai? What are its application areas?**

9/12/2023

Unit 2: Agent and its environment



Agent: an agent is just something that acts.

Rational agent: A rational agent is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome.

i.e., one that behaves as well as possible.

→ How well an agent can behave depends on the nature of the environment; some environments are more difficult than others.

Basic terminology

Percepts: Refers to the agent's perceptual inputs at any given instant.

Percept sequence:

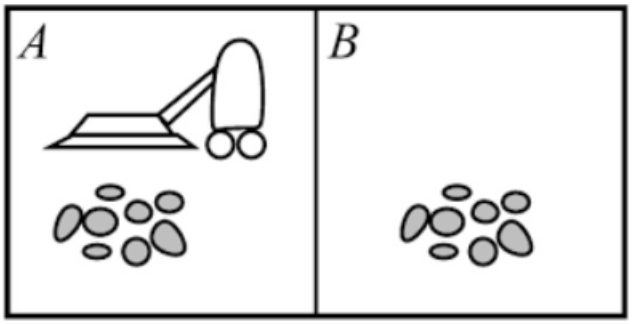
- An agent's **percept sequence** is the complete history of everything the agent has perceived.

For example:

Vacuum cleaner world:

It has two location 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**.



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
⋮	

Agent function:

-if status= dirty then return suck

-Else if location = A then return Right

-else if location = B then return Left

- In general, an agent's choice of action at any given instant can depend on the entire percept sequence observed to date.

Agent Function:

- The agent function is a mathematical concept that maps percept sequence to actions (agent's behavior).
- F:P*→A

Agent Program: The agent program is a concrete implementation of agent function, running within some physical architecture to produce f.

😊 for humans.

- **Sensors**:

  Eyes (vision), ears (hearing), skin (touch), tongue (gestation), nose (olfaction).

- **Percepts**:

  At the lowest level- electrical signals from these sensors.

  After preprocessing- objects in the visual field, auditory streams.

- **Effectors**:

  Limbs, digits, eyes, tongue, …..

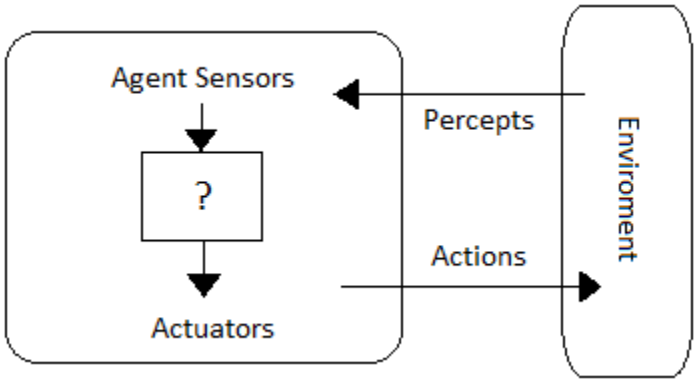
- **Actions**:

  Lift a finger, turn left , walk , run, carry an object

Agent and Environment

- An agent is just something that acts.

- To act an agent perceives its environment via sensors and acts rationally upon that environment with its effectors (actuators).
- This simple idea is illustrated in the following figure.



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An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through Actuators.

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Environment in AI

➔ 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.

Features of environment:

a. Fully observable vs partially observable.

b. Static vs dynamic.

c. Discrete vs continuous.

d. Deterministic vs stochastic
e. Single vs multiagent.
f. Episodic vs sequential
g. Known vs unknown.
h. Accessible vs inaccessible.

Fully observable vs partially observable

If an agent sensor can sense a complete environment at each point of time then it is a fully observable environment else partially observable environment. Ex: self-driving car is fully observable.

Deterministic vs stochastic

➔ If an agent current state and selected action can completely determine the next state of environment, then such environment is called deterministic. Ex: google map application.

➔ A stochastic environment is random in nature and cannot be determined completely by an agent.

Episodic Vs sequential

➔ In episodic environment, there is a series of one slot of actions, and only the current percept is required for the action.

➔ In sequential, an agent requires money of past action to determine the next best action.

➔ Conclusion

	Fully vs Partially Observable	**Episodic vs Sequential**
Playing Cards	Partially	Sequential
Playing	Partially	Sequential
Autonomous Vehicles	Fully	Sequential

Order in Restaurant	Fully	Episodic

Single vs multi agent:

➔ In only one agent is involved in an environment and operating by itself then such an environment is called single agent.

➔ If multiple agents are operating in an environment, then such an environment is called multi agent.

➔ Real-life Example: Playing tennis against the ball is a single agent environment where there is only one player. If two or more agents are taking actions in the environment, it is known as a multi-agent environment. Real-life Example: Playing a soccer match is a multi-agent environment.

Static vs dynamic

➔ If environment can change itself while an agent is deliberating then such environment is called dynamic. Else it is called static.

➔ Taxi driving is an example of dynamic and cross word puzzles are examples of static.

Agent structure can be defined as “architecture” + “program”.

➔ Simple reflex agent

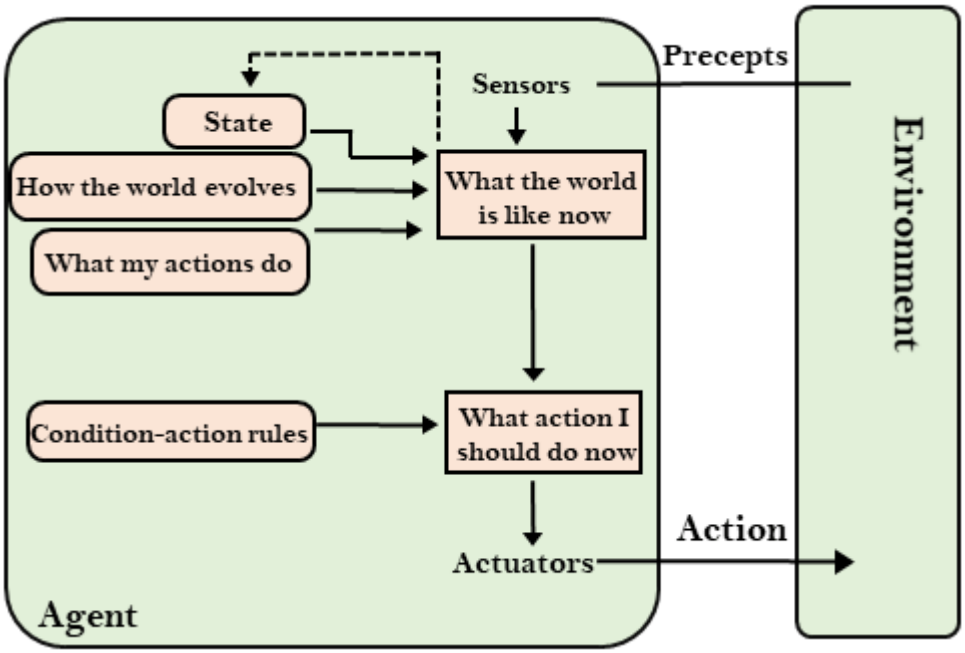
➔ Model based reflex agent.

➔ Goal based agents.

➔ Utility based agent

➔ Learning agents

Simplex reflex agent



A reflex agent is the simplest of all the agent programs. Decisions or actions are taken based on the current percept, which does not depend on the rest of the percept history. These agents react only to the predefined rules. It works best when the environment is fully observable.

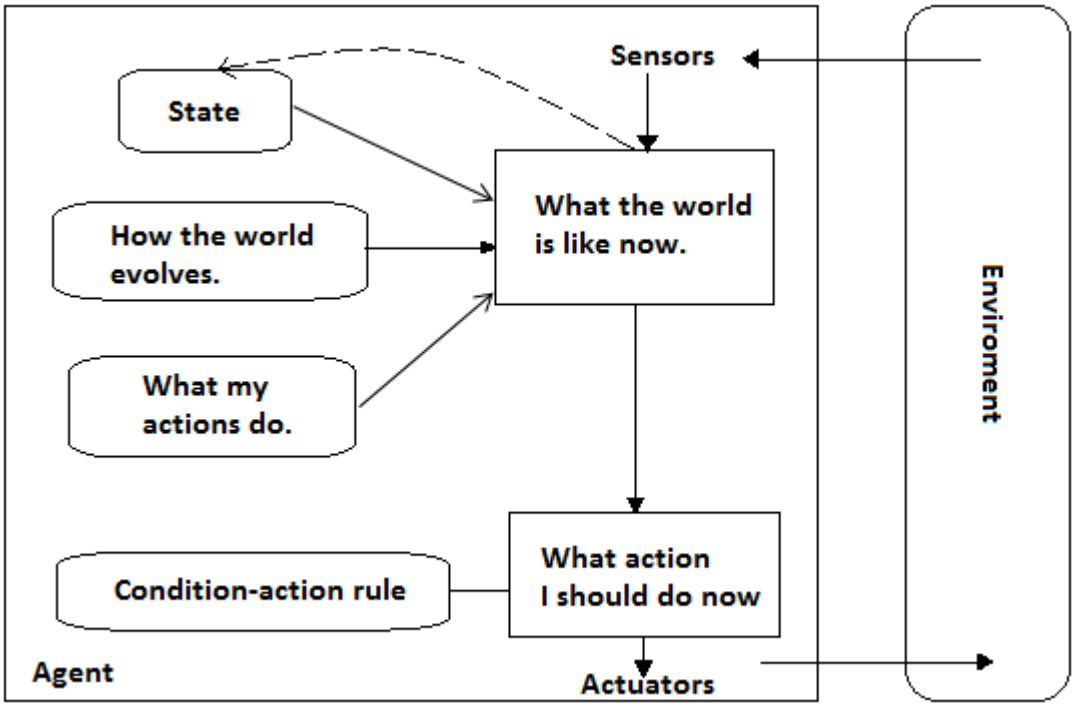
Limitations:

a. Very less intelligent agent.

b. Can get itself stuck in loop. .

The vacuum agent is a simple reflex agent because the decision is based only on the current location, and whether the place contains dirt.

Model based reflex agent



Model based reflex agents are made to deal with partial accessibility; they do this by keeping track of the part of the world it can see now. It does this by keeping an internal state that depends on what it has seen before so it holds information on the unobserved aspects of the current state.

Advantage:

a. Can work in partially observable environment.

b. Also consider previous input while performing actions.

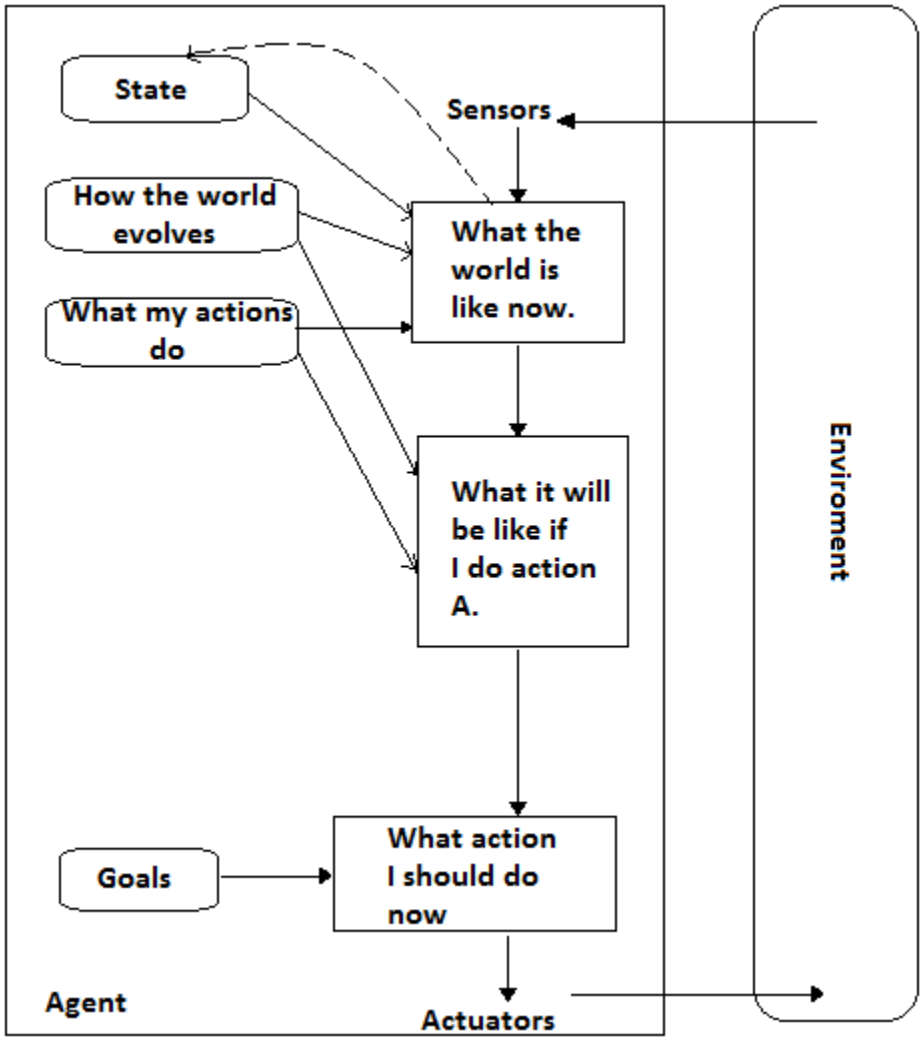
Self-driving cars are a great example of a model-based reflex agent. The car is equipped with sensors that detect obstacles, such as car brake lights in front of them or pedestrians walking on the sidewalk. As it drives, these sensors feed percepts into the car's memory and internal model of its environment

Goal based agent

Knowing about the current state of the environment is not always enough to decide what to do.

Example: At a road junction, the taxi can turn left, turn right, or go straight on. The correct decision depends on where the taxi is trying to get to. In another words, as well as a current state description, the agent needs some sort of goal information that describes situations that are desirable.

Limitations: Once the goal is fixed, all the actions are taken to fulfill it. Because of this agent loses flexibility to change its action according to the current state.



In life, in order to get things done we set goals for us to achieve, this pushes us to make the right decisions when we need to. A simple example would be the shopping list; our goal is to pick up every thing on that list. This makes it easier to decide if you need to choose between milk and orange juice because you can only afford one. As milk is a goal on our shopping list and the orange juice is not we chose the milk.

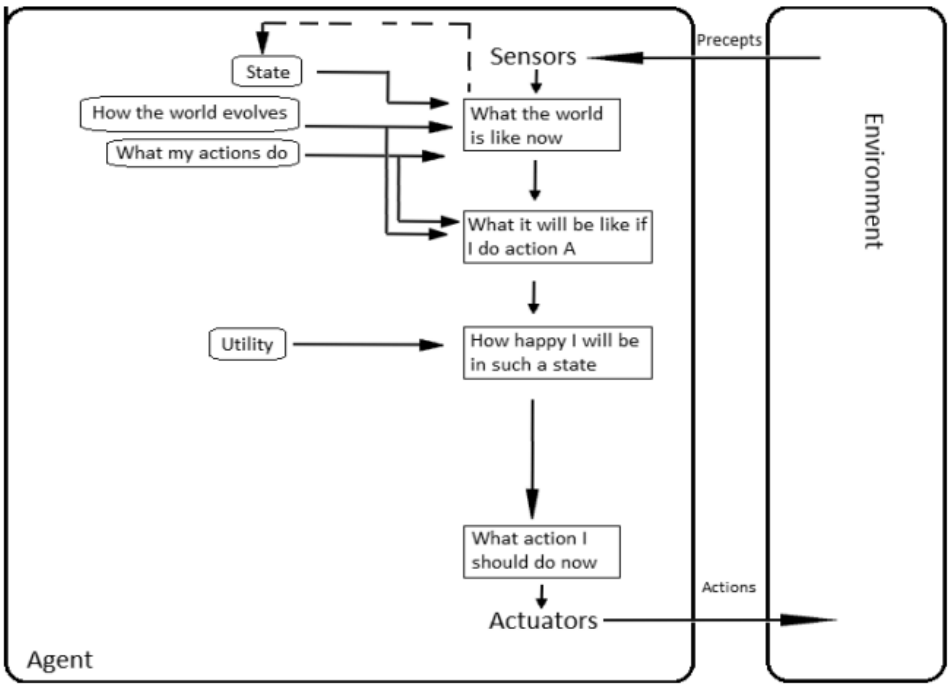
Utility based agent:

- Goal based agent only distinguishes between goal state and non -goal states.

- it is possible to define a measure of how desirable a particular state is.

This measure c. an be obtained through the use of a utility function which maps a state to a measure of the utility of the state.

-The agents which are developed having their end uses as building blocks are called utility-based agents. When there are multiple possible alternatives, then to decide which one is best, utility-based agents are used. They choose actions based on a preference (utility) for each state.



Learning agent:

a learning agent can be divided into four conceptual components:

-learning elements which is responsible for making improvements . when to do what? is decided by learning agent.

-performance element which is responsible for selecting external actions i.e it takes in percepts and decides on actions. It decides how to do everything.

-the learning element uses **feedback** from the "critic" on how the agent is doing and determine how the performance element should be modified to do better in the future.

-critic gets information through sensors and it reduces error.

-the last component of the learning agent is the "**problem generator**". It is responsible for suggesting actions that will lead to new and informative experiences.

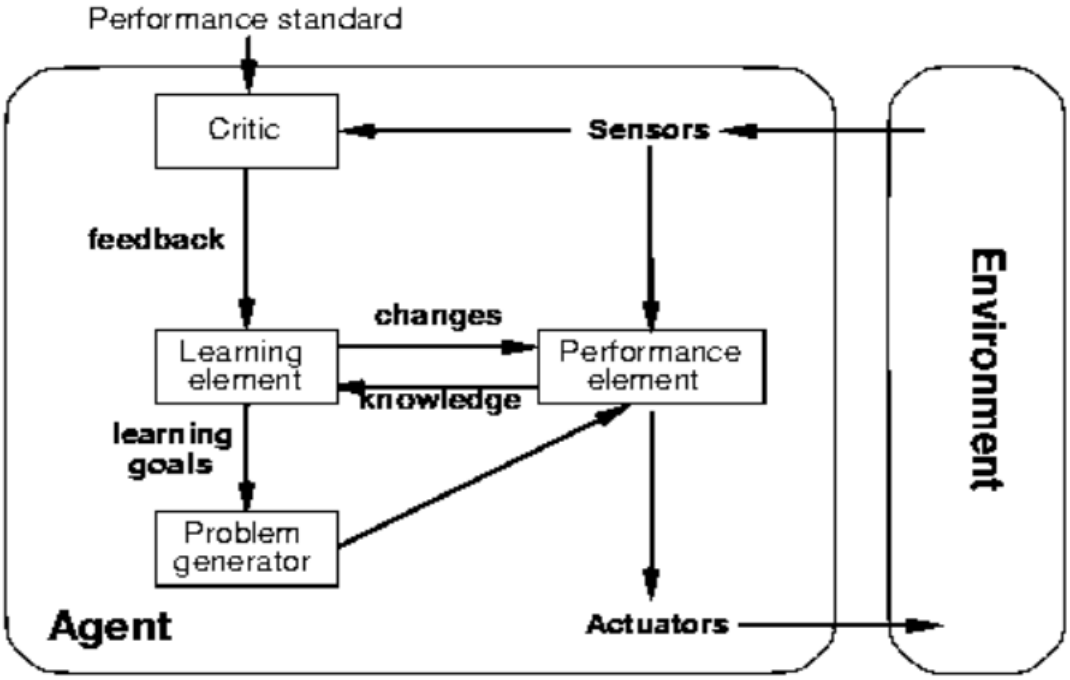


Fig: Learning base agent

Applications of agents

-intelligent agents are applied as automated online assistants, where they function to perceive the needs of customers in order to perform individualized customer service.

-such an agent may basically consist of a dialog system, as well as an expert system to provide specific expertise to the user.

-they can also be used to optimize coordination of human group online.

PEAS representation: Grouping of all AI agents.

Is used to group similar type of agent together .

P: performance measure: → result or o/p we get from an agent .

E: environment: → all surrounding things and conditions.

A: Actuators: → Devices , hardware, software through which agent performs action on environment.

S: sensors:→ Devices from which agent perceives observation from environment.

Consider, eg , the task of designing an automated taxi driver:

- **P**erformance measure: safe , fast , legal , comfortable trip, maximize profits .
- **E**nvironment: Roads, other traffic, pedestrians, customers .
- **A**ctuators: steering wheel, accelerator, brake, signal , horn
- **S**ensors: Cameras, sonar, speedometer, GPS, odometer, engine sensors, keyboard.

Agent	Performance measure	Environment	Actuator	Sensor
Hospital management system	Patient's health, admission process, payment	Hospital, Doctors , Patients	Prescription, Diagonosis, Scan report	Symptoms, patients response
Automated car Drive	The comfortable trip, safety Maximum distance	Road, Traffic, vehicle	Steering wheel, accelerators, brake, mirror	Camera, GPS, odometer
Subject tutoring	Maximize score improvement in students	Classroom, desk , chair, board, staff, students	Smart displays, corrections	Eyes, ears, Notebooks
Part-picking robot	Percentage of parts in correct bins	Conveyor belt with parts: bins	Jointed arms and hand	Camera, joint angle sensors.

Questions :

1. **Why understanding of environment is necessary to an agent to perform well? Give the PEAS description for the agents for a medical diagnosis system that can diagnosis a patient as an expert doctor. [5]**
2. **Explain learning agent with block diagram. [5]**
3. **Define sequential environment. [1]**
4. **Why is learning important for an agent? How it learns ? explain [5]**