



# ARTIFICIAL INTELLIGENCE

# INTRODUCTION

- **Intelligence** : Capacity to learn and solve problems.

More formal definition : It is a property of mind that encompasses many related mental abilities, such as capabilities to

- O reason

- O plan

- O solve problems

- O think abstractly

- O comprehend ideas and language

- O learn

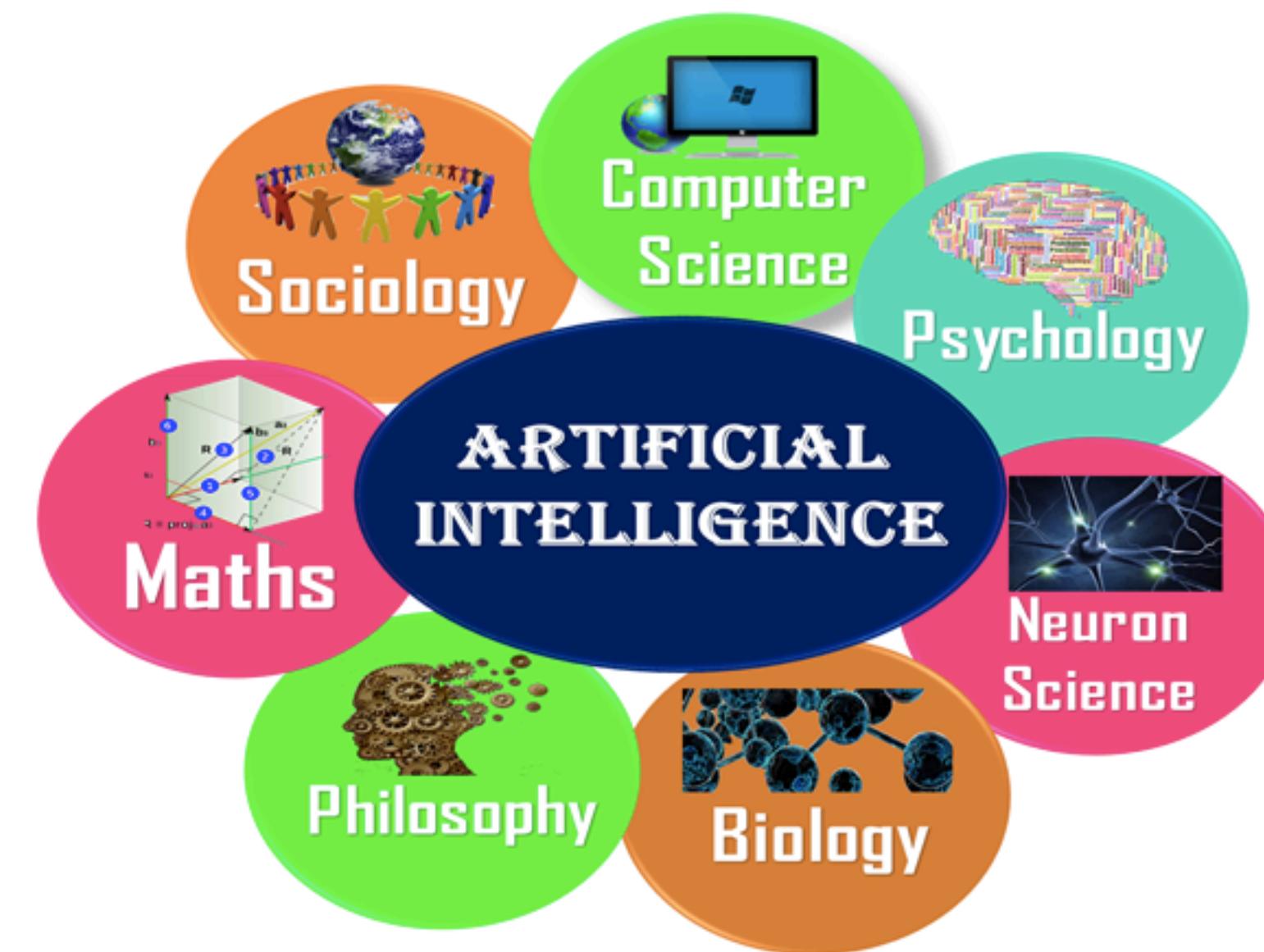
- **Artificial Intelligence** : Computers with the ability to mimic or duplicate the functions of human brain.

Formal Definition : AI is a branch of computer science which is concerned with the study and creation of computer system that exhibit

- some form of intelligence or
- those characteristic which we associate with intelligence in human behaviour.

# What Comprises to Artificial Intelligence?

- Intelligence is an intangible part of our brain which is a combination of Reasoning, learning, problem-solving perception, language understanding, etc.
- To achieve the above factors for a machine or software Artificial Intelligence requires the following discipline:



# Goals of Artificial Intelligence

1. Replicate human intelligence
2. Solve Knowledge-intensive tasks
3. An intelligent connection of perception and action
4. 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
5. Creating some system which can exhibit intelligent behaviour, learn new things by itself, demonstrate, explain, and can advise to its user.

# Applications

- Medicine
- Music
- Telecommunication
- Gaming
- Banking
- Robotics and AI

# Some other applications:

- Credit granting
- Information management and retrieval
- Plant layout
- Marketing
- Satellite Control
- Network development
- Shipping
- Warehouse Optimisation

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# Advantages :

- New and improved interfaces.
  - Better handling of information
  - High Accuracy with less errors
  - High-Speed and reliability
  - Useful for risky areas
  - Digital Assistant
  - Useful as a public utility
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# Disadvantages:

- Increased cost
  - Increased dependency on machines
  - No original creativity
  - Few experienced programmers.
  - Few practical products have reached the market as yet.
  - Can't think out of the box
  - No feelings and emotions
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# Components of AI

- There are three type of component in AI
  1. Hardware components
  2. Software components
  3. Architectural Components

# AI Techniques

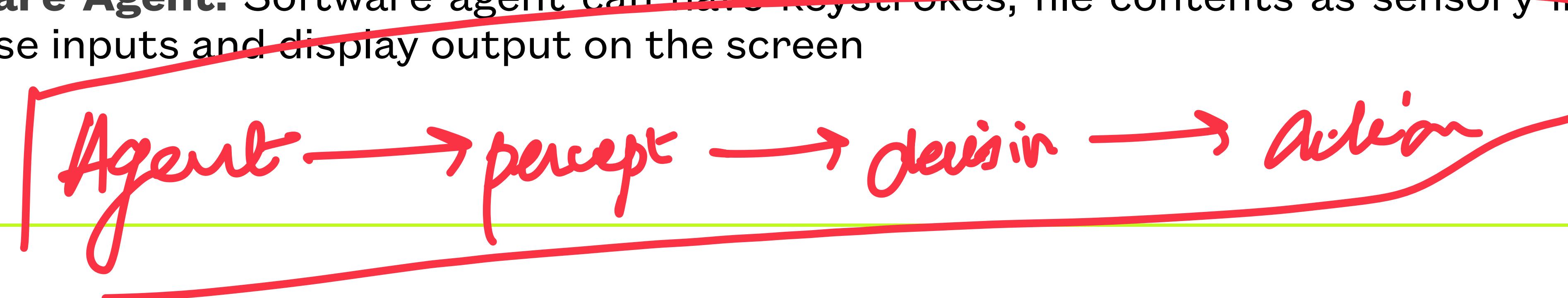
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- In the real world, the knowledge has some unwelcomed properties –
    - Its volume is huge, next to unimaginable.
    - It is not well-organised or well-formatted.
    - It keeps changing constantly.
  - AI Technique is a manner to organise and use 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.
  - AI techniques elevate the speed of execution of the complex program it is equipped with.
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# Agents

An agent can be anything that perceives 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:

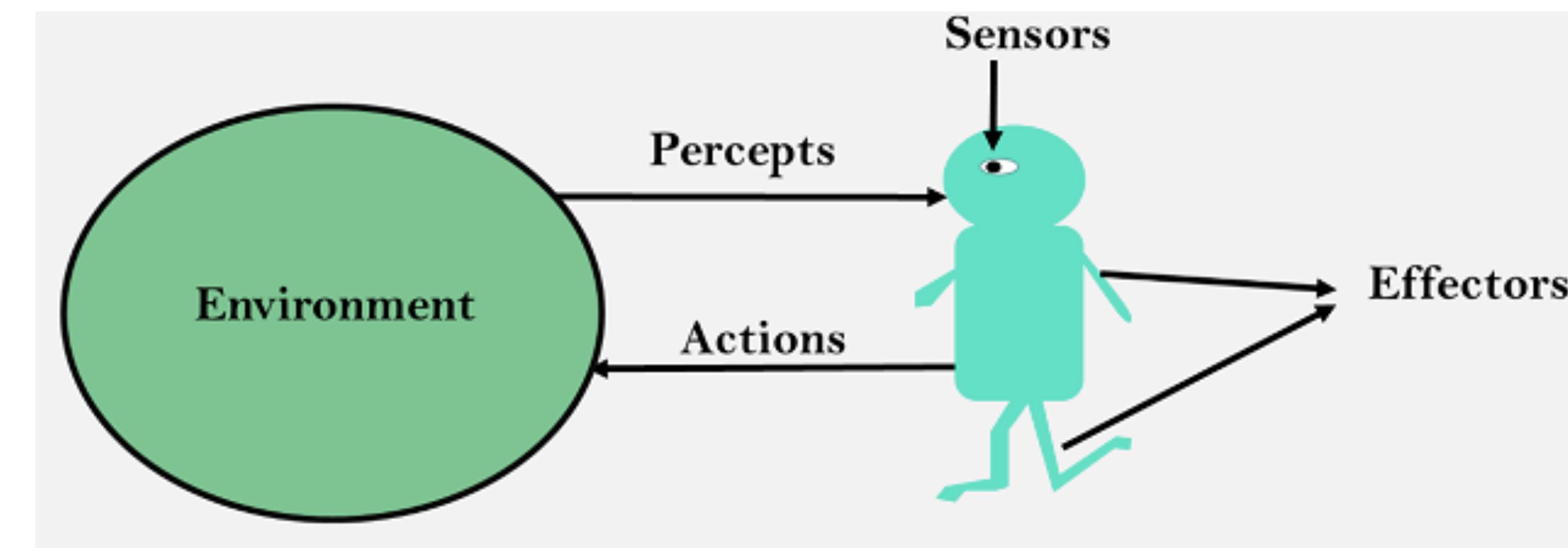
- **Human-Agent:** A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.
- **Robotic Agent:** A robotic agent can have cameras, infrared range finder, NLP for sensors and various motors for actuators.
- **Software Agent:** Software agent can have keystrokes, file contents as sensory input and act on those inputs and display output on the screen



# Intelligent Agents

- An intelligent agent is an autonomous entity which act upon an environment using sensors and actuators for achieving goals. An intelligent agent may learn from the environment to achieve their goals.
- 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.

- **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.



# Types of Agents

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

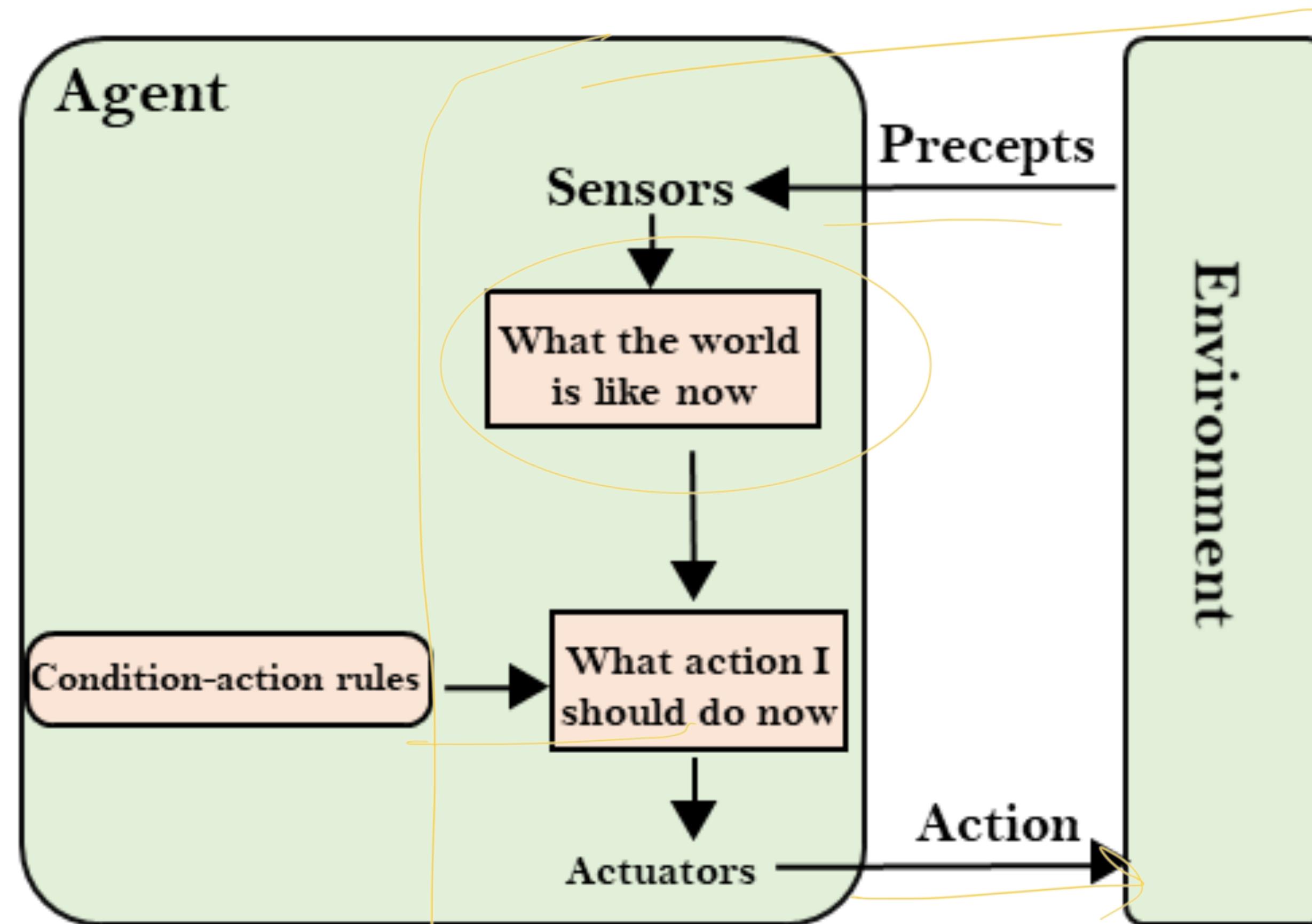
# Simple Reflex Agent

*work spontaneously*

- 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.

*on  
if-else condition*

If temp > 45°  
then  
switch on the AC



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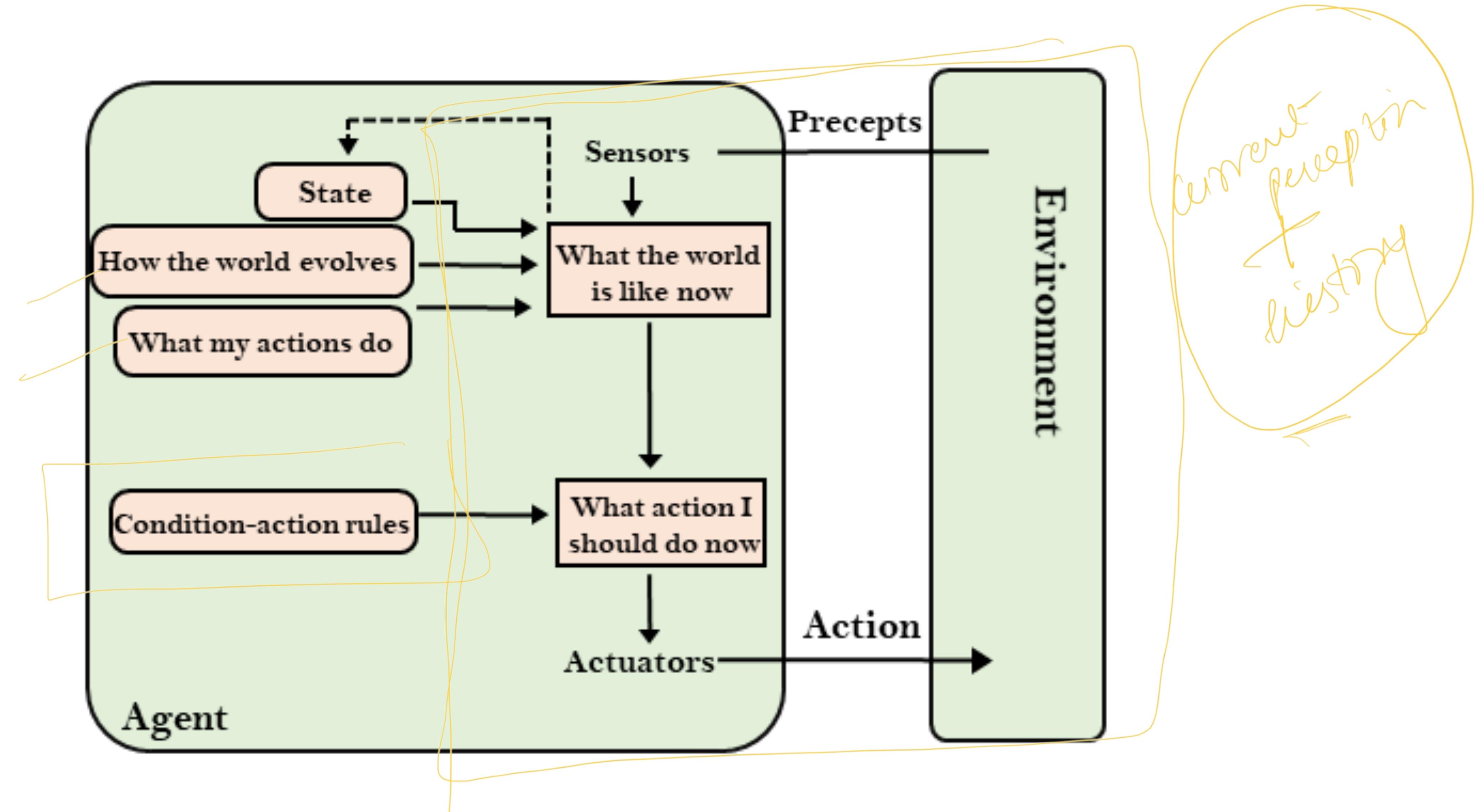
Problems for the simple reflex agent design approach:

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

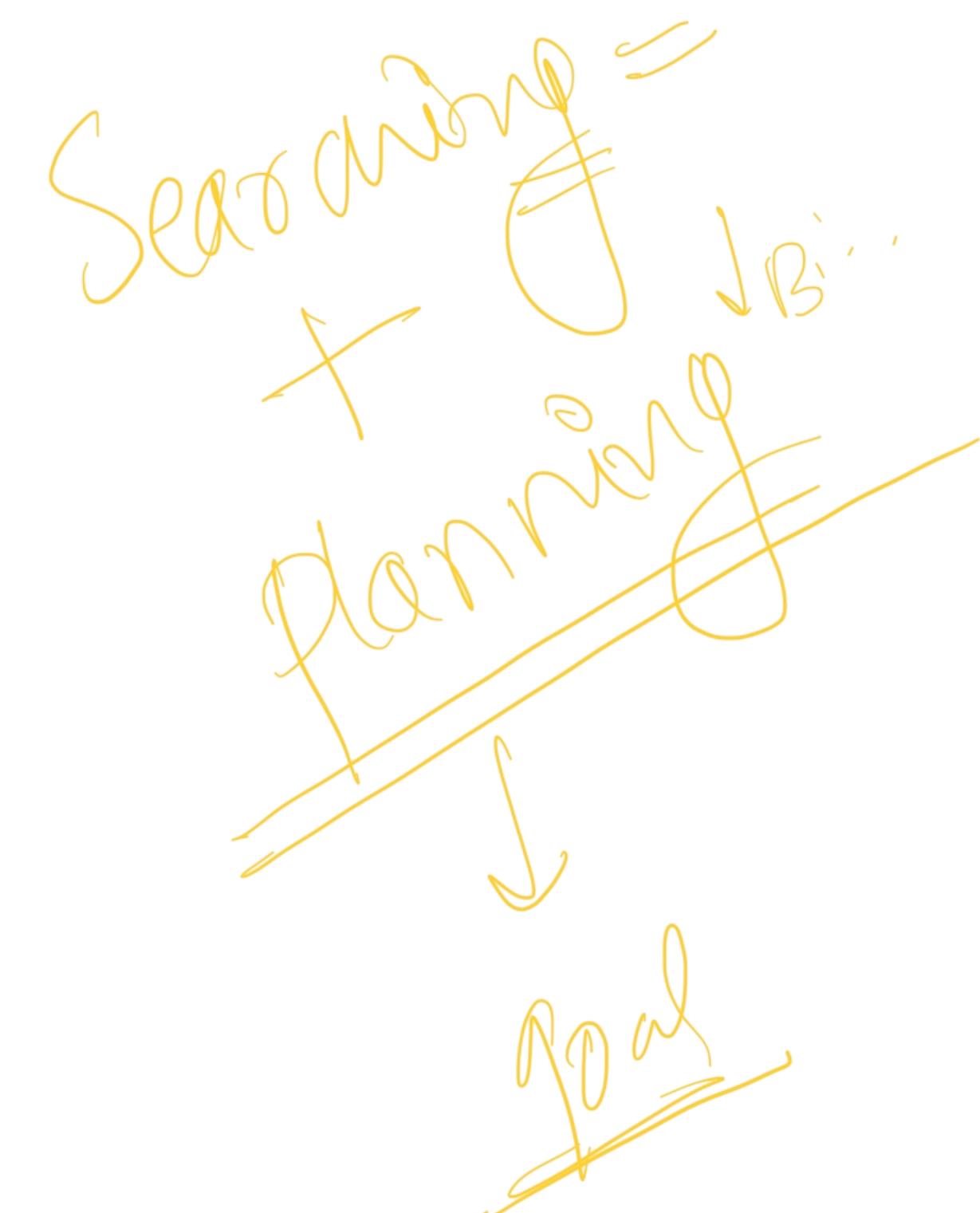
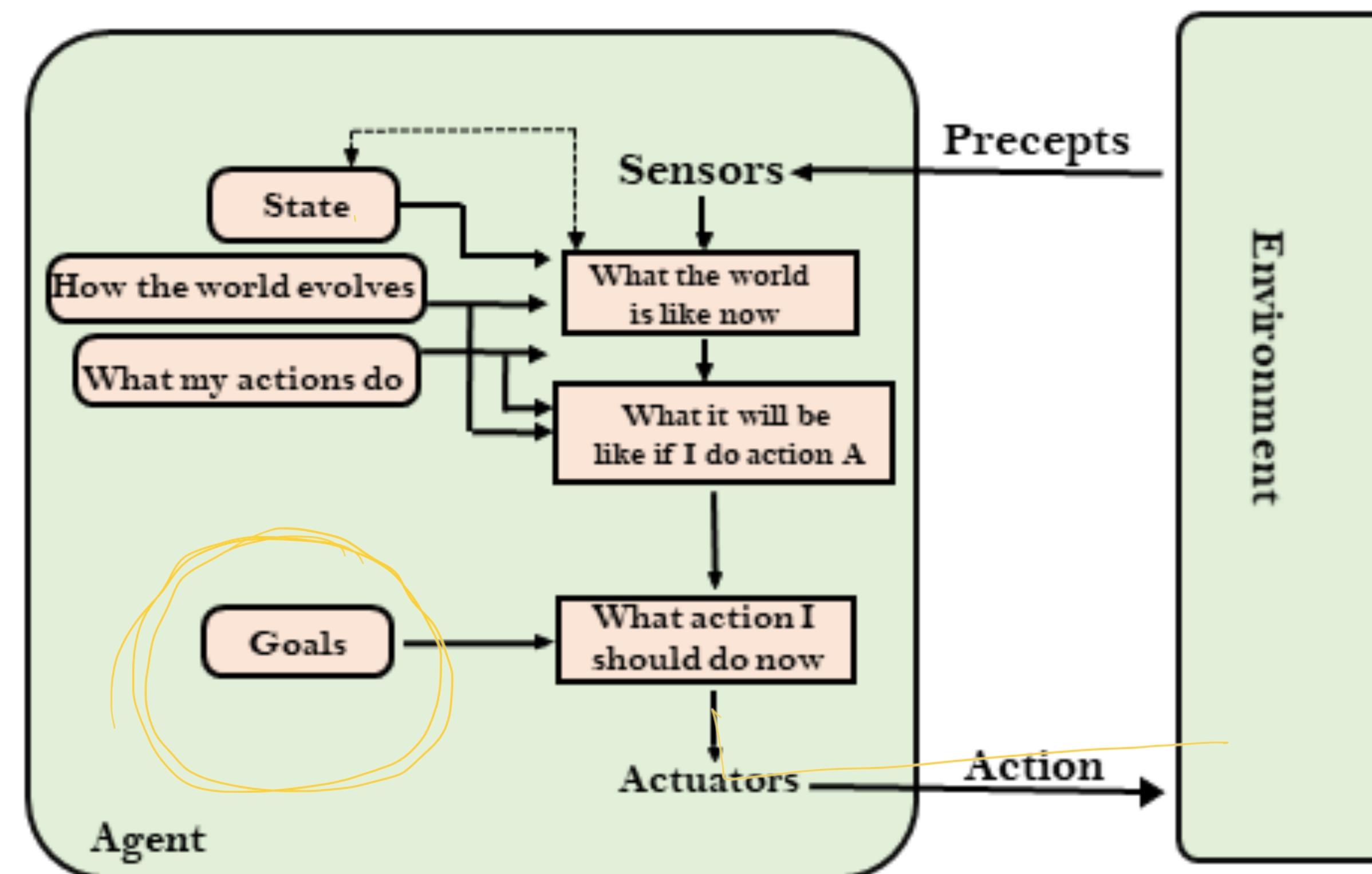
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# Model-based reflex agent

- 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.
- These agents have the model, "which is knowledge of the world" and based on the model they perform actions.
- Updating the agent state requires information about:
  - How the world evolves
  - How the agent's action affects the world.

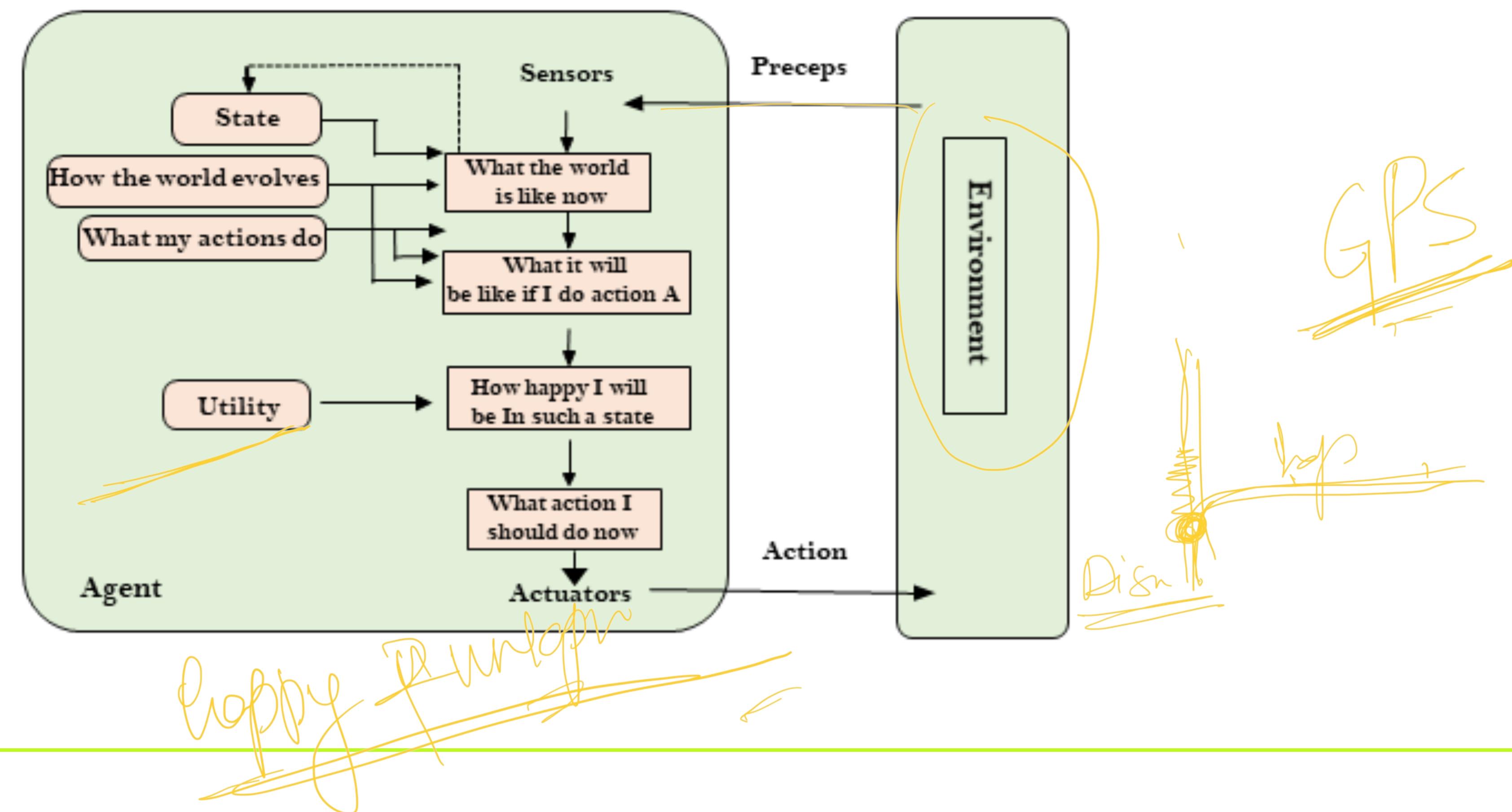


# Goal based agents



- 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.

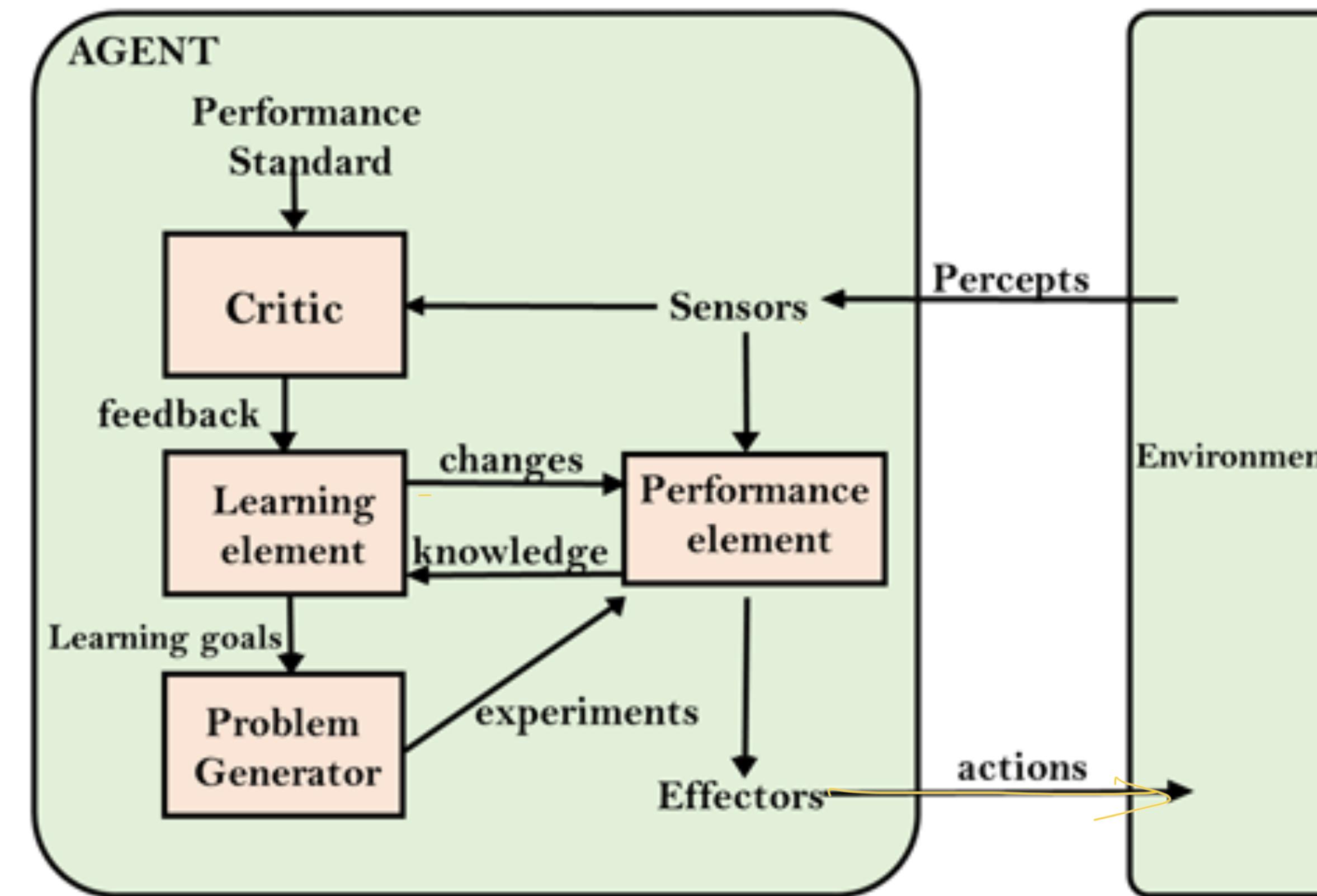
# Utility based agents



- 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.

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# Learning agents



- A learning agent in AI is the type of agent which can learn from its past experiences, or it has learning capabilities.
- It starts to act with basic knowledge and then able to act and adapt automatically through learning.
- A learning agent has mainly four conceptual components, which are:
  1. **Learning element:** It is responsible for making improvements by learning from environment
  2. **Critic:** Learning element takes feedback from critic which describes that how well the agent is doing 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 actions that will lead to new and informative experiences.
- Hence, learning agents are able to learn, analyze performance, and look for new ways to improve the performance.

# Structure of an AI agent

- The task of AI is to design an agent program which implements the agent function. The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as:

Agent = Architecture + Agent program



- Following are the main three terms involved in the structure of an AI agent:
  1. **Architecture:** Architecture is machinery that an AI agent executes on.
  2. **Agent Function:** Agent function is used to map a percept to an action.
  3. **Agent program:** Agent program is an implementation of agent function.

# PEAS representation

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

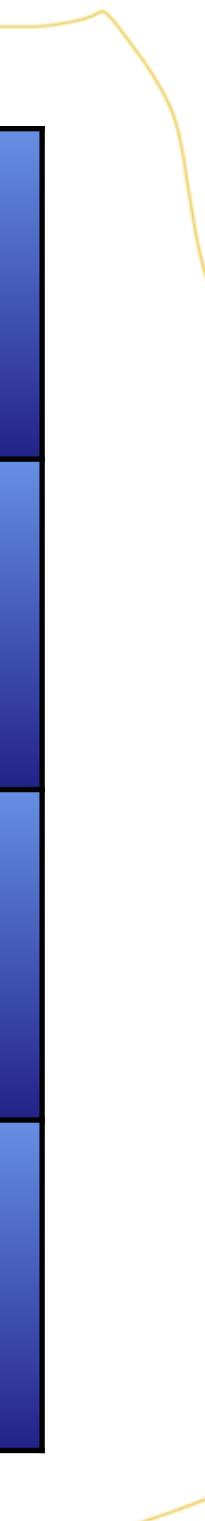
P	PERFORMANCE
E	ENVIRONMENT
A	ACTUATORS
S	SENSORS

# Example :

- Self driving car

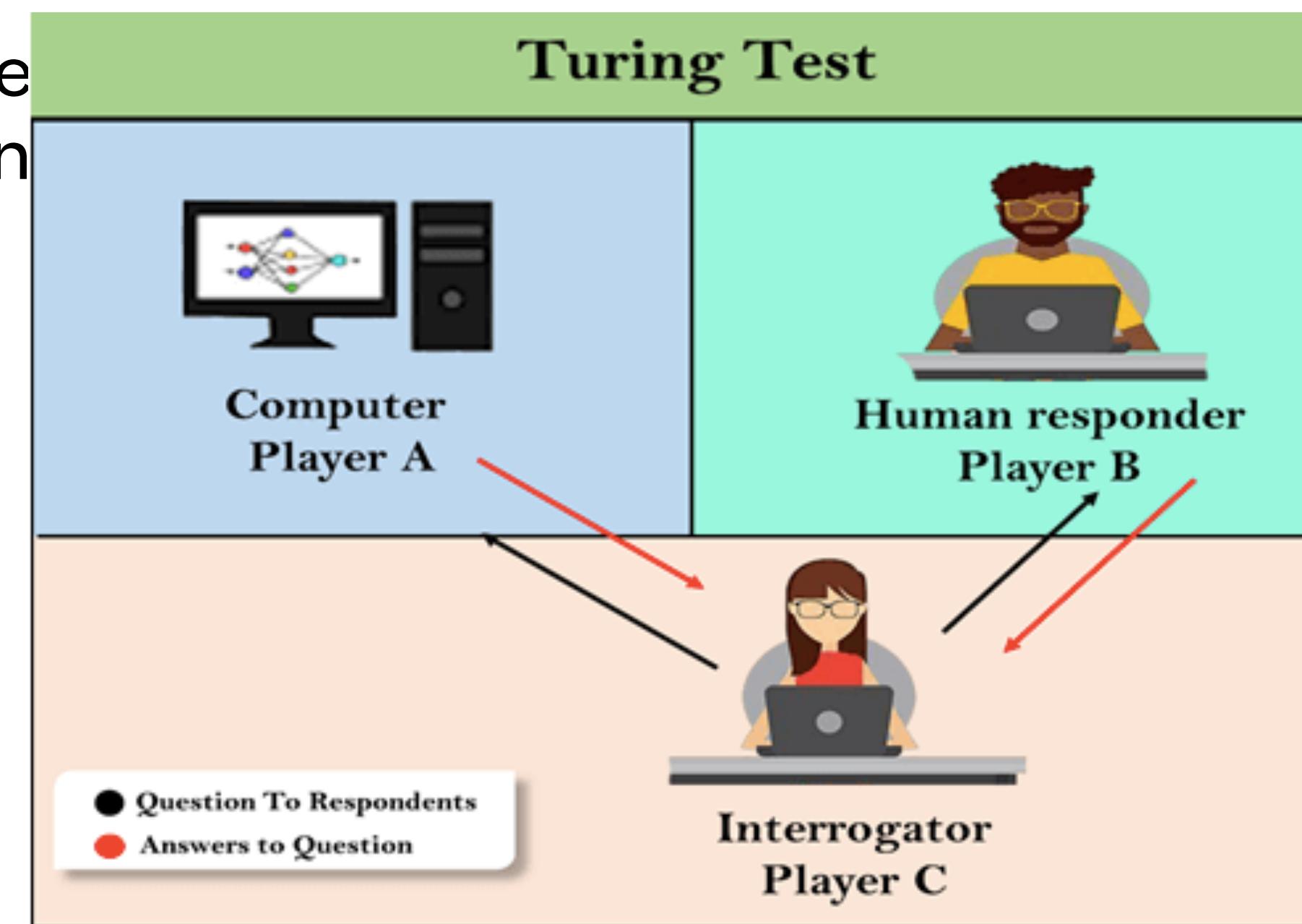
P	Safety, time, legal drive, comfort
E	Roads, other vehicles, road signs, pedestrian
A	Steering, accelerator, brake, signal, horn
S	Camera, GPS, speedometer, odometer, accelerometer

4 types



# Turing Test

- The **Turing test** was developed by Alan Turing(Computer scientist) in 1950.
- He proposed that “Turing test” can determine if computer(machine) can think intelligently like human



- The Turing test is based on a party game "Imitation game," with some modifications. This game involves three players in which one player is Computer, another player is human responder, and the third player is a human Interrogator, who is isolated from other two players and his job is to find that which player is machine among two of them.
- Consider, Player A is a computer, Player B is human, and Player C is an interrogator.
- Interrogator is aware that one of them is machine, but he needs to identify this on the basis of questions and their responses.
- The conversation between all players is via keyboard and screen so the result would not depend on the machine's ability to convert words as speech. The test result does not depend on each correct answer, but only how closely its responses like a human answer. The computer is permitted to do everything possible to force a wrong identification by the interrogator.
- The questions and answers can be like:

**Interrogator:** Are you a computer?

PlayerA (Computer): No

**Interrogator:** Multiply two large numbers such as (256896489\*456725896)

**Player A:** Long pause and give the wrong answer.

- In this game, if an interrogator would not be able to identify which is a machine and which is human, then the computer passes the test successfully, and the machine is said to be intelligent and can think like a human.