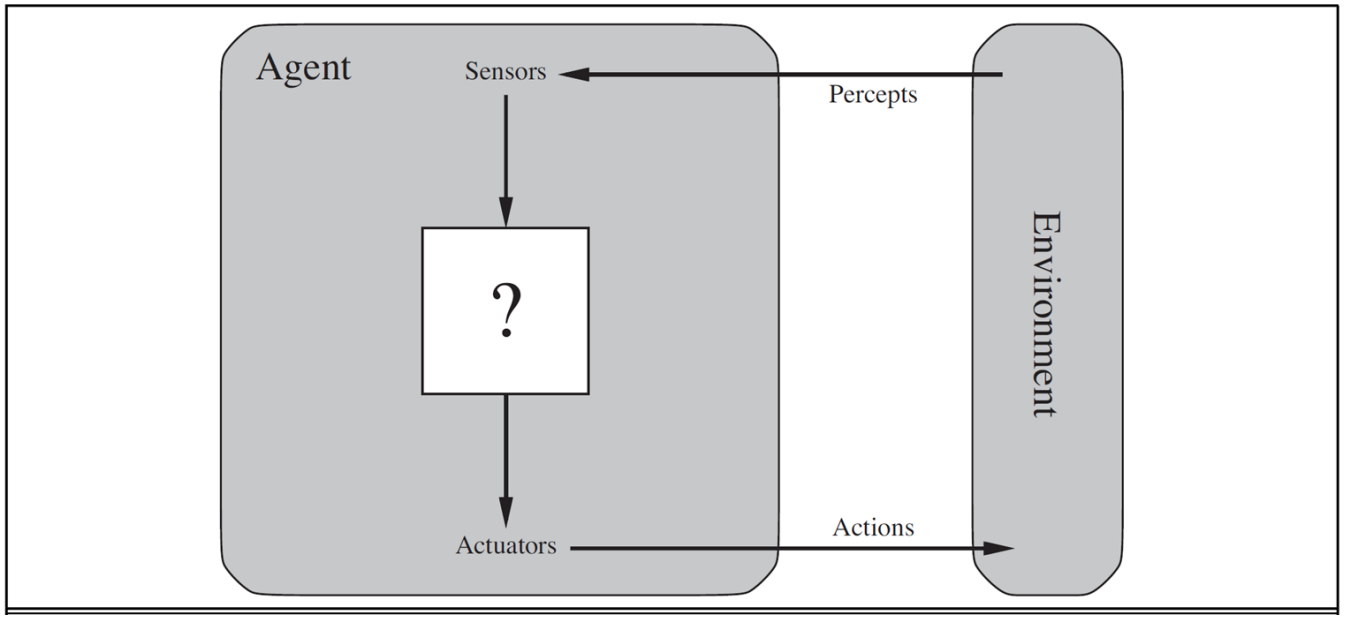
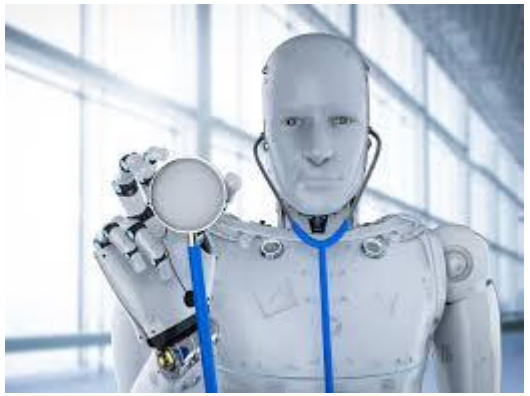
Artificial Intelligence

Intelligent AI Agents

Intelligent Agent

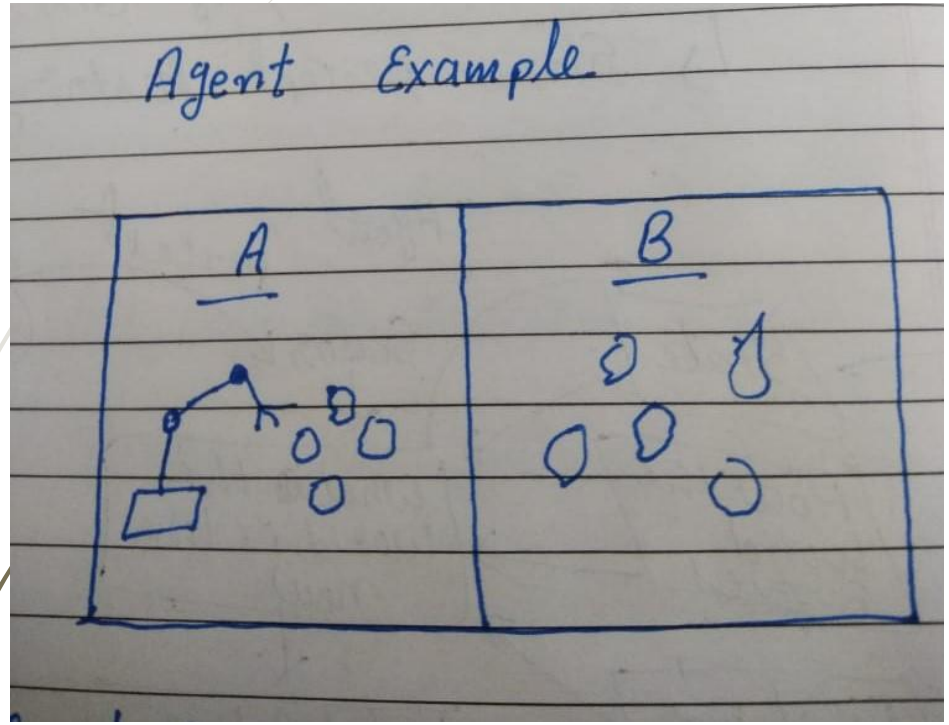
- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.





An agent's choice of action at any given instant can depend on the entire **percept sequence** observed to date, but not on anything it hasn't perceived

Intelligent Agent Example



Percept Sequence	Action
[A, O.F.]	PickUP, Remain in A for other obj.
[A, O.NF.]	Move to B
[B, O.NF.]	Remain, find another obj.
[B, O.NF.]	Move to A
[A, O.F.]	Remain, find another obj.

OF – Object Found
O NF – Object Not Found

Rational Agent

- A rational agent is one that does the right thing—conceptually speaking, every entry in the table for the agent function is filled out correctly.
- If the sequence is desirable, then the agent has performed well. This notion of desirability is captured by a **performance measure** that evaluates any given sequence of environment states.
- 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.
- 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.

Specifying the Task Environment: PEAS Description for Taxi Driver

- PEAS (Performance, Environment, Actuators, Sensors)

Agent Type	Performance Measure	Environment	Actuators	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

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- Make PEAS description for the Object recognition by a robot?

Properties of task environments

- **Fully observable vs. partially observable**
- If an agent's sensors give it access to the complete state of the environment at each point in time.
- A task environment is effectively fully observable if the sensors detect all aspects that are relevant to the choice of action.
- An environment might be partially observable because of noisy and inaccurate sensors or because parts of the state are simply missing from the sensor data.

Properties of task environments

- **Single agent vs. Multiagent**
- An agent solving a crossword puzzle by itself is clearly in a single-agent environment.
- Chess is a **competitive** single agent environment.

Single agent vs. Multiagent

- Taxi-driving environment, on the other hand, avoiding collisions maximizes the performance measure of all agents, so it is a **partially cooperative** multiagent environment.
- It is also **partially competitive** because, for example, only one car can occupy a parking space.

Properties of task environments

- **Episodic vs. Sequential**

- In an episodic task environment, the agent's experience is divided into atomic episodes. In each episode the agent receives a percept and then performs a single action.
- An agent that has to spot defective parts on an assembly line bases each decision on the current part, regardless of previous decisions; moreover, the current decision doesn't affect whether the next part is defective.

Properties of task environments

- **Episodic vs. Sequential**

- In sequential environments, on the other hand, the current decision could affect all future decisions.
- Chess and taxi driving are sequential.
- Short-term actions can have long-term consequences.

Properties of task environments

- **Static vs. Dynamic:**
- If the environment can change while an agent is deliberating, then we say the environment is dynamic for that agent; otherwise, it is static.

Properties of task environments

- **Discrete vs. continuous:**
- The discrete/continuous distinction applies to the state of the environment, to the way time is handled, and to the percepts and actions of the agent.
- The chess environment has a finite number of distinct states.
- Taxi driving is a continuous-state and continuous-time problem: the speed and location of the taxi.

Internet Shopping Agent

P:?

E:?

A:?

S:?

Internet Shopping Agent

P:price, quality, appropriateness, efficiency

E: current and future WWW sites, vendors, shippers

A:display to user, follow URL, ll in form

S:HTML pages (text, graphics, scripts)

	Agent		
Environment Type	Solitaire	Internet Shopping	Vacuum Cleaner
Observable??			
Deterministic??			
Episodic??			
Static??			
Discrete??			
Single-agent??			

	Agent		
Environment Type	Solitaire	Internet Shopping	Vacuum Cleaner
Observable??	Yes		
Deterministic??	Yes		
Episodic??	No		
Static??	Yes		
Discrete??	Yes		
Single-agent??	Yes		

	Agent		
Environment Type	Solitaire	Internet Shopping	Vacuum Cleaner
Observable??	Yes	No	
Deterministic??	Yes	Partly	
Episodic??	No	No	
Static??	Yes	Semi	
Discrete??	Yes	Yes	
Single-agent??	Yes	Yes	

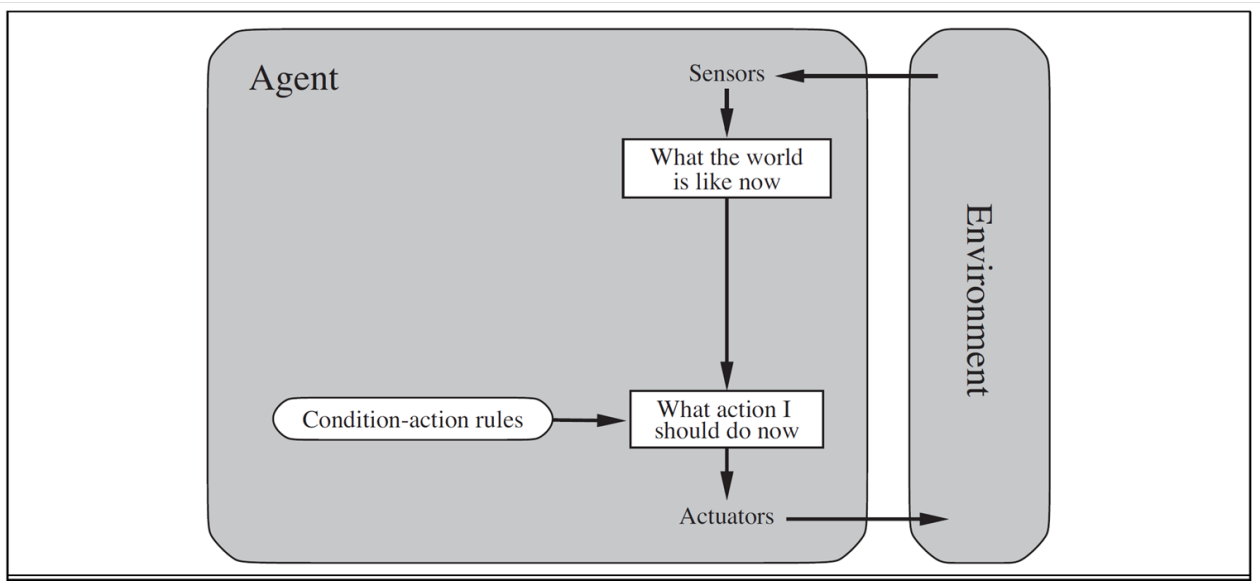
	Agent		
Environment Type	Solitaire	Internet Shopping	Vacuum Cleaner
Fully Observable??	Yes	No	Yes
Deterministic??	Yes	Partly	Yes
Episodic??	No	No	No
Static??	Yes	Semi	Yes
Discrete??	Yes	Yes	Yes
Single-agent??	Yes	Yes	Yes

Types of agents

Simple reflex agents

- These agents select actions on the basis of the current percept, ignoring the rest of the percept history.
- For example, the vacuum agent is a simple reflex agent, because its decision is based only on the current location and on whether that location contains dirt.

Simple reflex agents

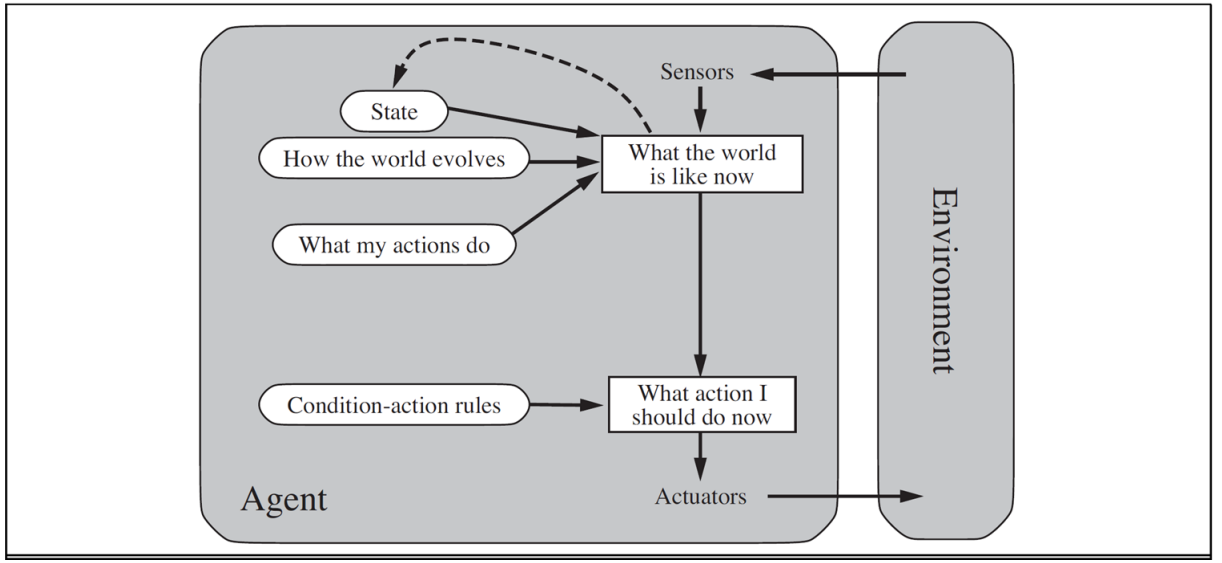


- The agent will work only if the correct decision can be made on the basis of only the current percept—that is, only if the environment is fully observable.
- **if** *car-in-front-is-braking* **then** *initiate-braking*.

Model-based reflex agents

- The most effective way to handle **partial observability** is for the agent to keep track of the part of the world **it can't see now**.
- That is, the agent should maintain some sort of **internal state** that depends on the percept history.

Model-based reflex agents



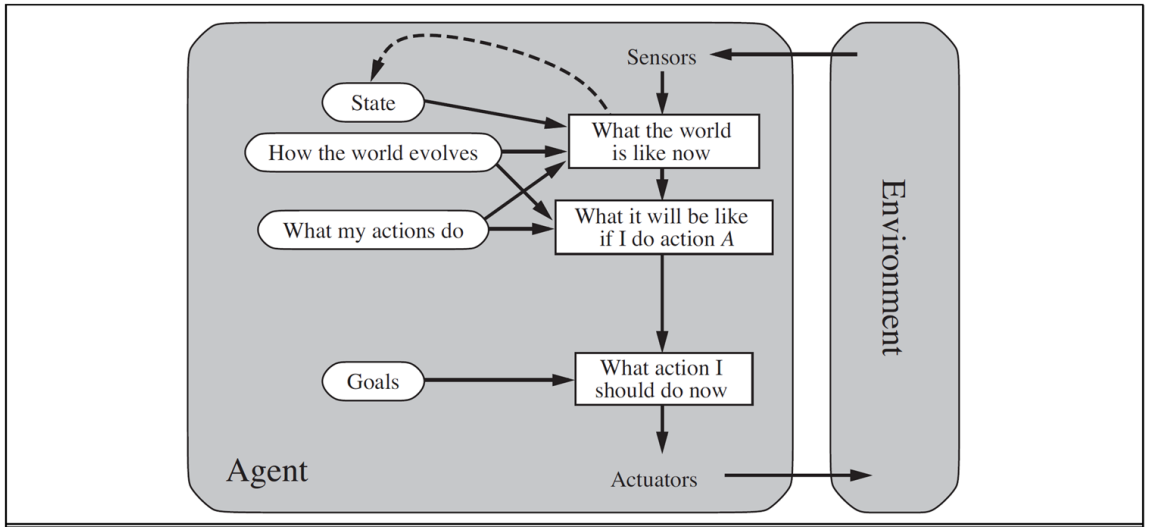
- Updating this internal state information as time goes by requires two kinds of knowledge to be encoded in the agent.
  - We need some information about how the world evolves independently of the agent. (overtaking car now closer than a moment ago)
  - We need some information about how the agent's own actions affect the world. (the agent turns the steering wheel clockwise, the car turns to the right)

Goal-based agents

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

Goal-based agents

- In other words, as well as a current state description, the agent needs some sort of goal information that describes situations that are desirable.



- Agent keeps track of the world state as well as a set of goals it is trying to achieve, and chooses an action that will (eventually) lead to the achievement of its goals.

Utility-based agents

- A model-based, utility-based agent. It uses a model of the world, along with a utility function that measures its preferences among states of the world.