MACHINE INTELLIGENCE

AGENTS AND ITS TYPES

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MACHINE INTELLIGENCE

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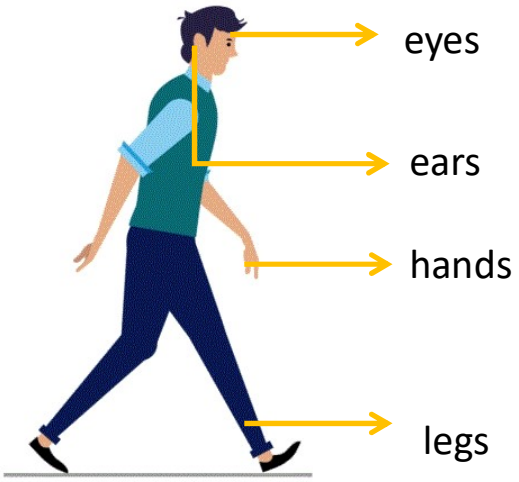
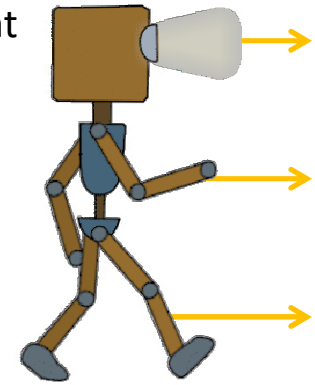
Agent- classic definition

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



HUMAN AGENT

perceives the environment and starts the action



ROBOTIC AGENT

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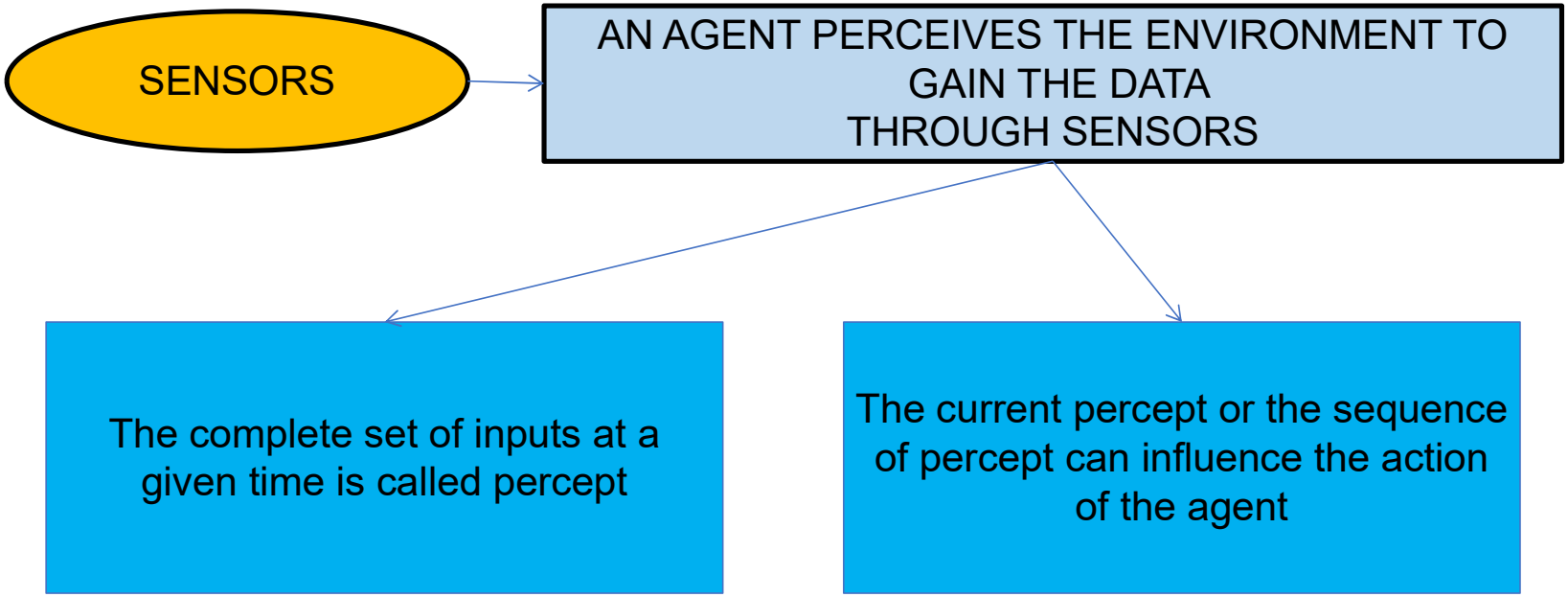
Sensors



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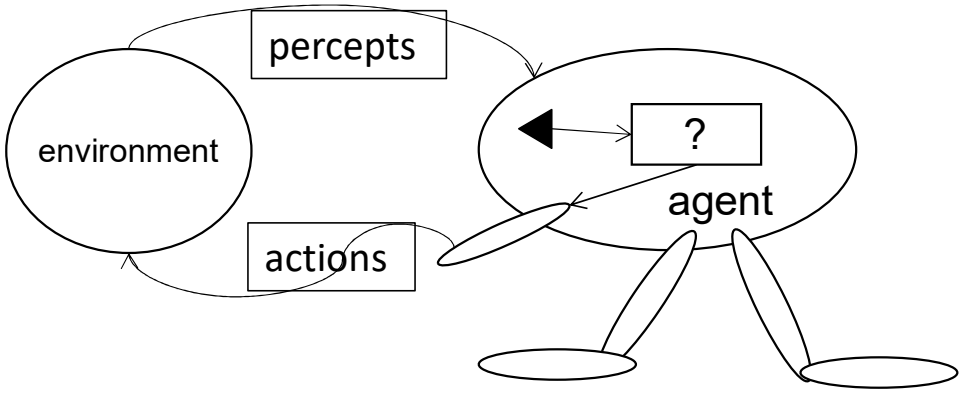
Actuator

ACTUATOR

AN AGENT CAN CHANGE THE STATE OF THE ENVIRONMENT THROUGH ACTUATOR

An operation involving an actuator is called an action

so an agent program implement mapping from percept sequences to actions



- first the agent gets input at a given time called percept
- the agent program maps the percept to an action
- the actuators performs that action to change the state of the environment

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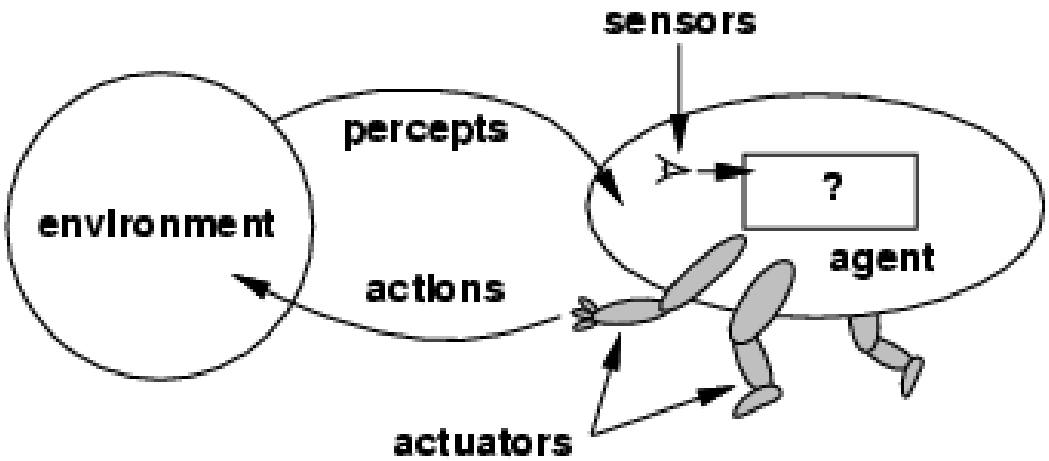
Agent -Environment Interaction



- Basically the agent maps from percept history to actions [f: P* → A]
- The agent program runs on the physical architecture to produce f
- agent = architecture + program

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Reactive Agent

Each behaviour continually maps perceptual input to action output

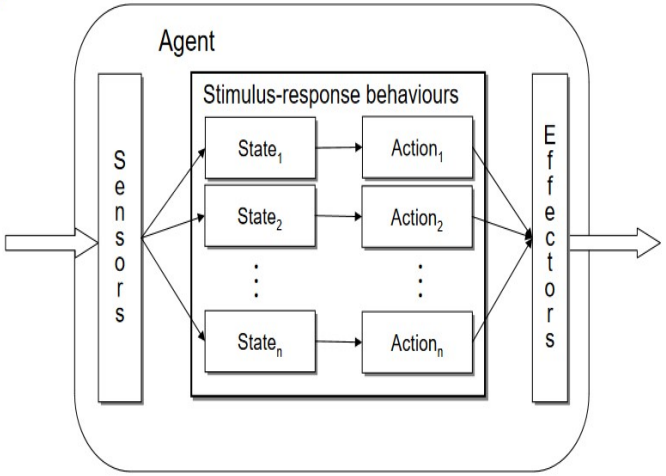
- Reactive behaviour:

  action: S -> A

  - where S denotes the states of the environment, and A the primitive actions the agent is capable of perform.

- Example:

$$\text{action}(s) = \begin{cases} \textit{Heater on}, \text{ if temperature too low} \\ \textit{Heater off}, \text{ otherwise} \end{cases}$$



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AI == building Agents???

- AI is about building rational agents
- An agent is something that perceives and acts
- A rational agent always does the right thing.
- An agent should strive to "do the right thing", based on what it can perceive and the actions it can perform. The right action is the one that will cause the agent to be most successful
- E.g., performance measure of a vacuum-cleaner agent could be amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc. – These could be success parameters

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Duties of a Rational Agent

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.

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More about Agents

- Rationality is distinct from omniscience (all-knowing with infinite knowledge) – All Knowing
- Agents can perform actions in order to modify future percepts so as to obtain useful information (information gathering, exploration) - Probing
- An agent is autonomous if its behavior is determined by its own experience (with ability to learn and adapt) - Autonomous

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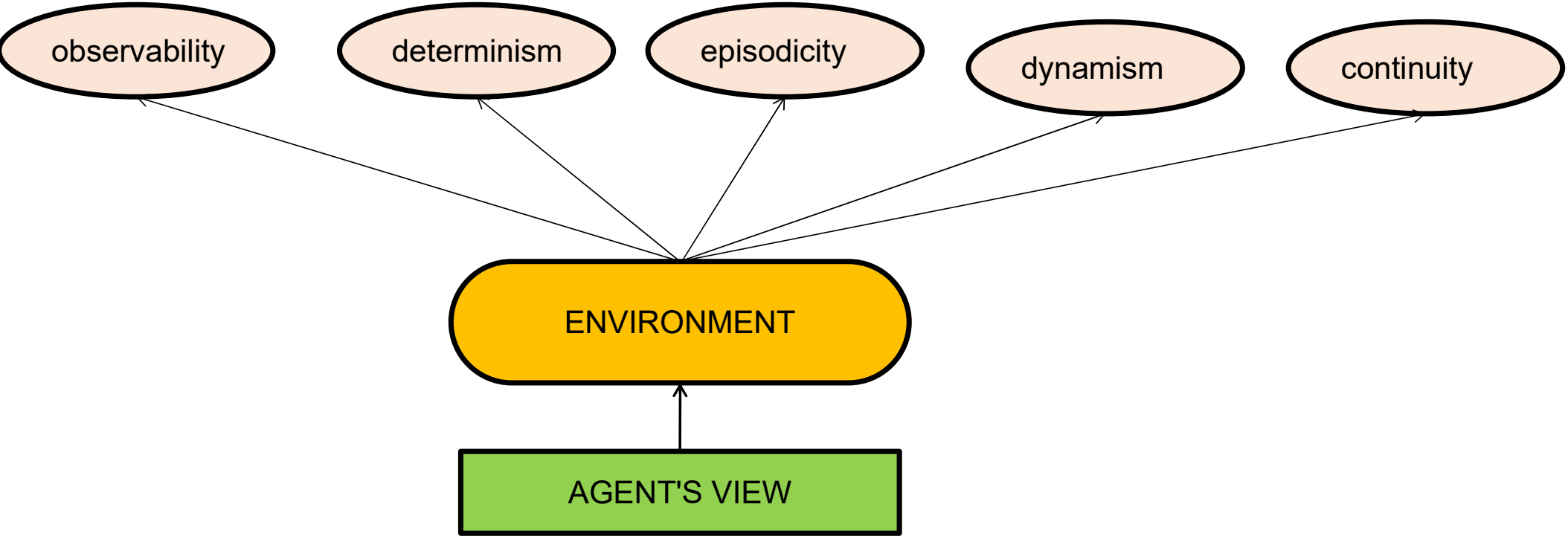
Environment from an agents view

- Environment in which agents operate can be defined in different ways
- It is helpful to view the following definitions as referring to the way the environment appears from the point of view of the agent itself.
- Environment can be classified on the following grounds from the view of an agent



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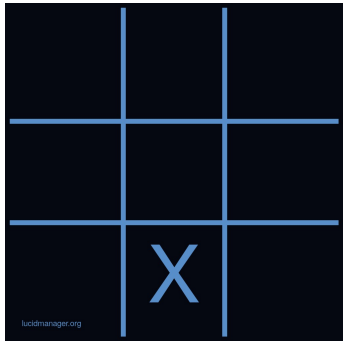
Observability

- **FULLY OBSERVABLE:-**

All of the environment relevant to the action being considered is observable.such environment are comfortable since the agent is freed from the task of keeping track of changes in the environment.

- **PARTIALLY OBSERVABLE:-**

The relevant features of the environment are only partially observable.



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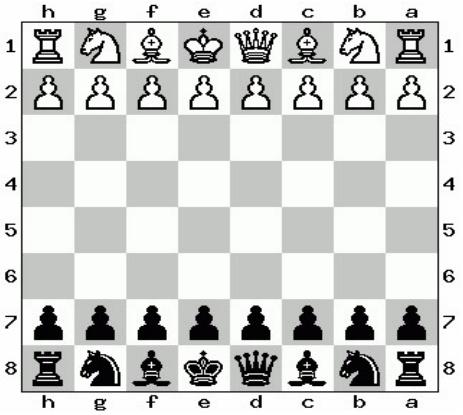
Determinism

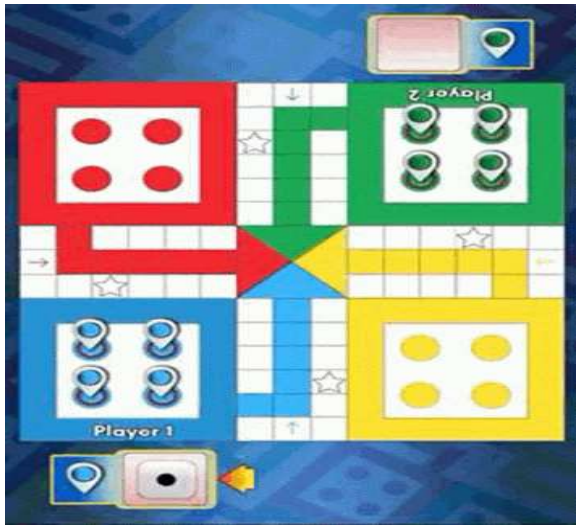
- **DETERMINISTIC:-**

The next state of the environment is completely described by the current state and the agents action

- **STOCHASTIC:-**

If an element of interface or uncertainty occurs then the environment is stochastic. A partially observable environment will appear to be stochastic to the agent





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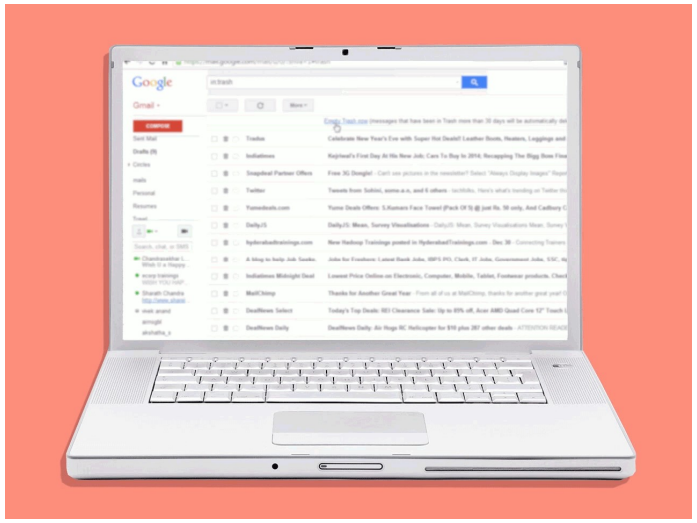
Episodicity

- **EPISODIC:-**

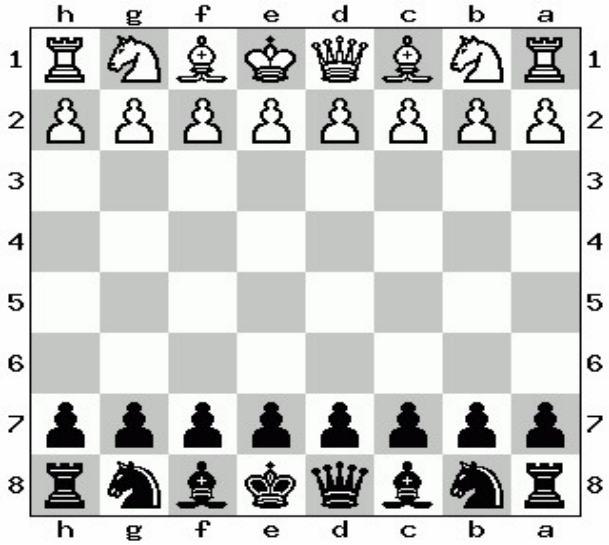
An episodic environment means that subsequent episodes do not depend on what actions occurred in previous episodes

- **SEQUENTIAL:-**

The agent engages in a series of connected episodes.



mail sorting system



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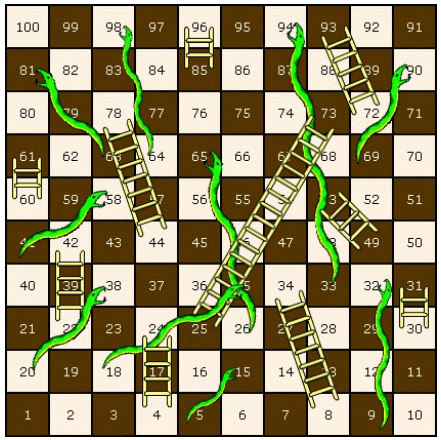
Dynamism

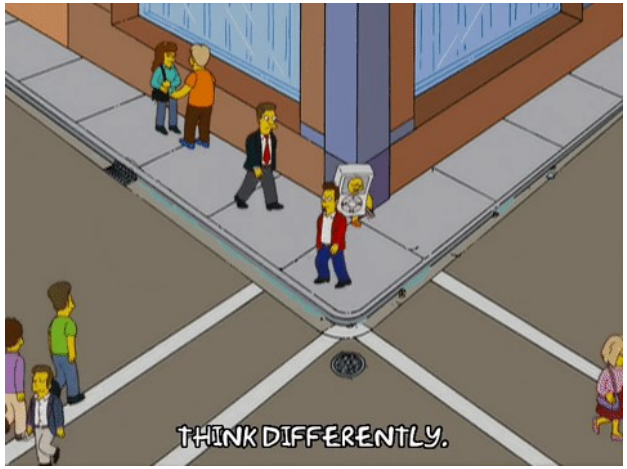
- **STATIC ENVIRONMENT:-**

Does not change from one state to next while the agent is considering its course of action.The only changes to the environment as those caused by the agent itself.

- **DYNAMIC ENVIRONMENT:-**

Changes over time independent of the actions of the agent-and thus if an agent does not respond in a timely manner,this counts as a choice to do nothing.





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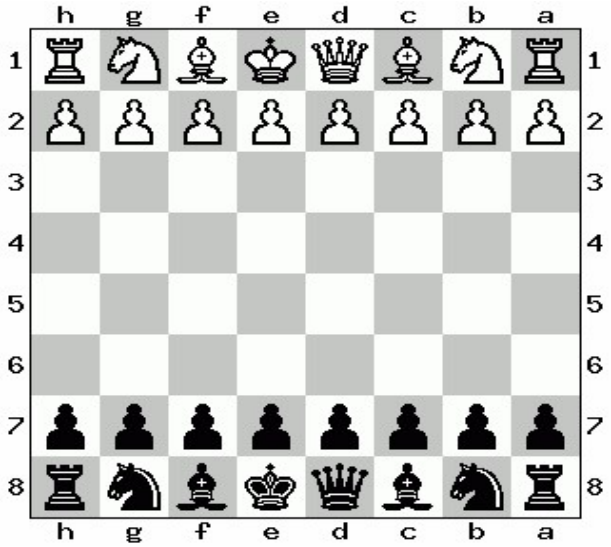
Continuity

- **DISCRETE/CONTINUOUS ENVIRONMENT:-**

If the number of distinct percepts and actions is limited,the environment is discrete,other wise continuous



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Analysis Time

- After these discussion lets try to analyse few environment

What kind of environment is this?

- FULLY OBSERVABLE
- DETERMINISTIC
- SEQUENTIAL
- STATIC

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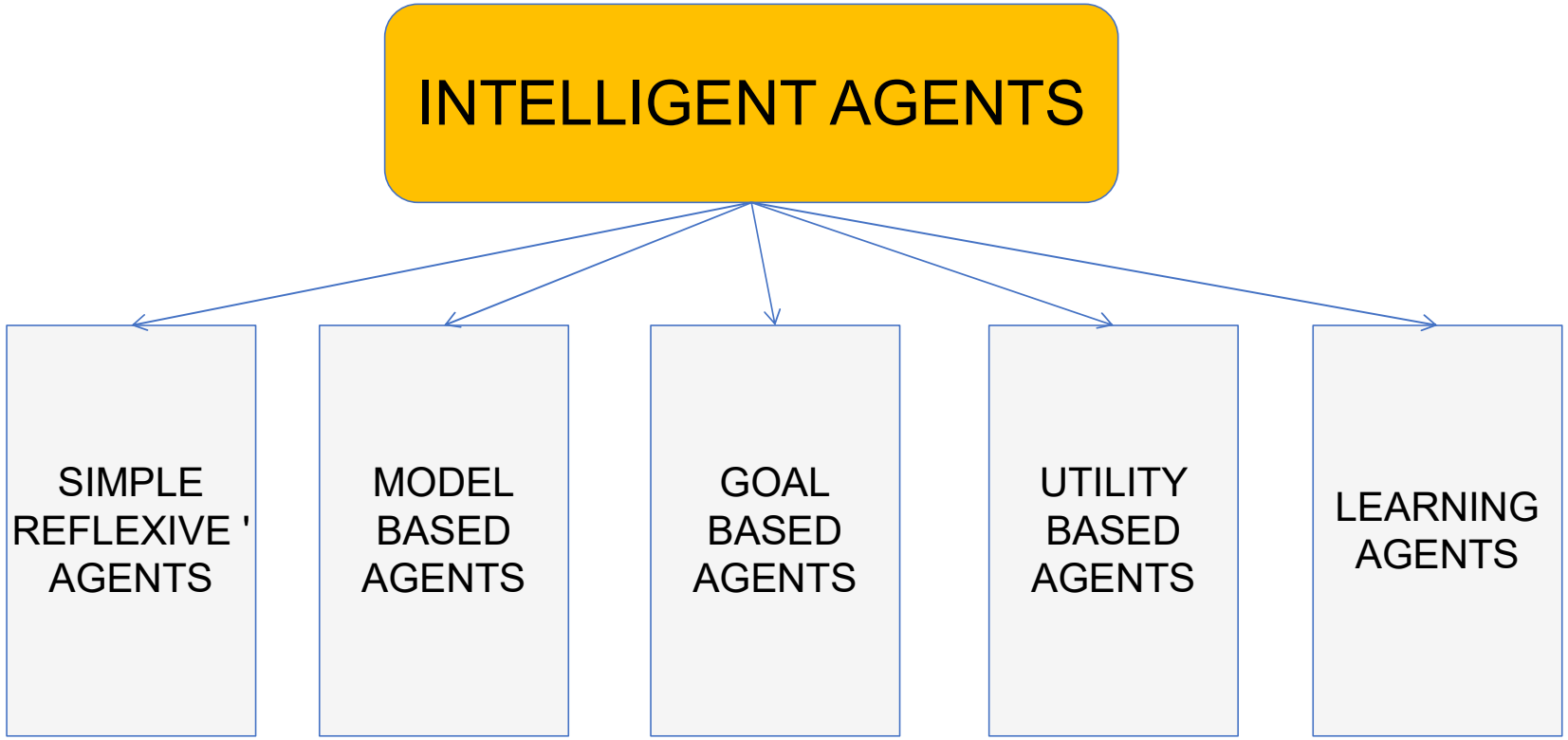
Classes of Intelligent Agent

- Intelligent agents are grouped in to five classes based on their degree of perceived intelligence and capability.



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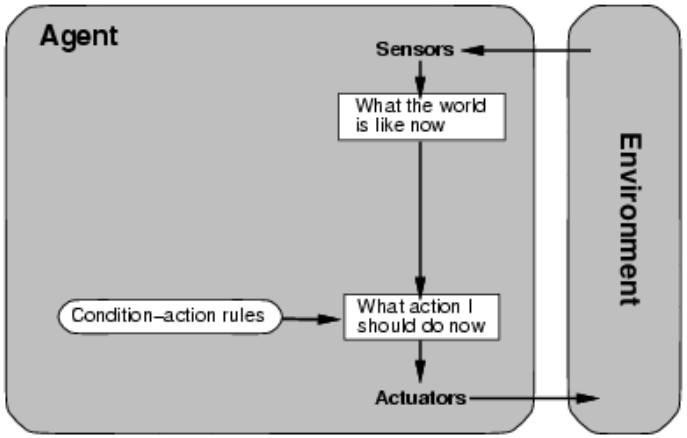
Simple Reflex Agent

- Simple reflex agents act only on the basis of the current percept ,ignoring the rest of the percept history. the agent function is based on the condition-action rule: **if condition then action**
- succeeds when the environment is fully observable
- some reflex agents can also contain info on their current state which allows them to disregard conditions




```
function SIMPLE-REFLEX-AGENT(percept) returns an action
  persistent: rules, a set of condition–action rules

  state ← INTERPRET-INPUT(percept)
  rule ← RULE-MATCH(state, rules)
  action ← rule.ACTION
  return action
```

example : metal-detector

it doesn't matter if the previous input detected the metal ,the agent only alerts based on current percept.

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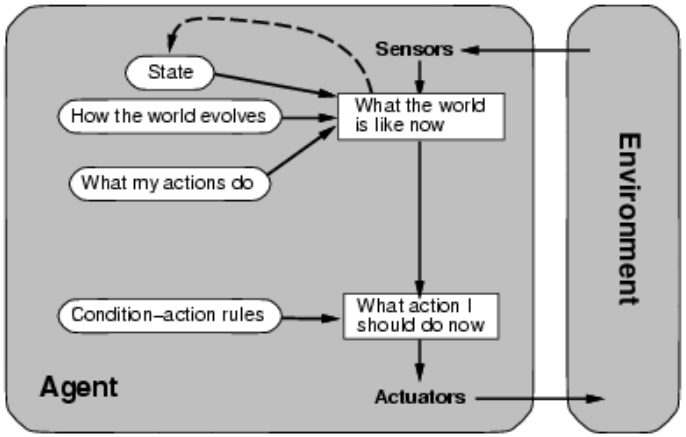
Model Based Reflex Agent

- A model-based agent can handle a partially observable environment.
- Its current state is stored inside the agent, maintaining some kind of structure which describes the part of the world which cannot be seen.
- This knowledge about “how the world evolves” is called a model of the world,hence the name “model-based agent”



function MODEL-BASED-REFLEX-AGENT(*percept*) **returns** an action
  persistent: *state*, the agent's current conception of the world state
    model, a description of how the next state depends on current state and action
    rules, a set of condition–action rules
    action, the most recent action, initially none

  state ← UPDATE-STATE(*state*, *action*, *percept*, *model*)
  rule ← RULE-MATCH(*state*, *rules*)
  action ← *rule*.ACTION
  return *action*

Model Based Reflex Agent- example

example : self driving cars

lets us consider one scenario

if the car in front of our agent shows red light

using condition action rules would make our agent to stop immediately ,but what if he is trying to slow down,

using model reflex agents it would remember that instead of bringing its speed to zero it should slow down else try to change the lane.

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Waymo -Self Driving Car

source: youtube

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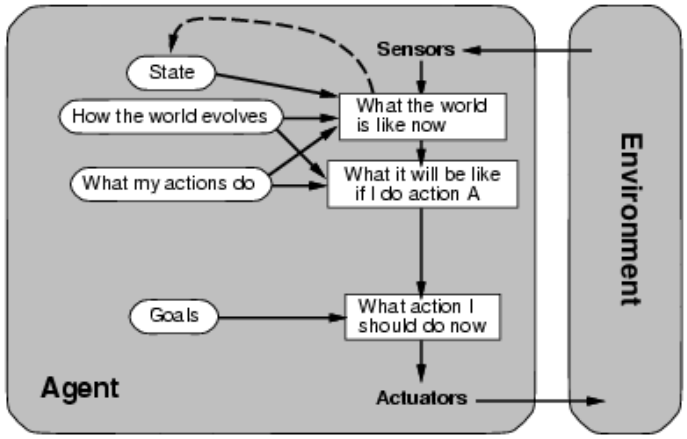
Goal Based Agent

- Goal-based agents further expand on the capabilities of the model-based agents, by using “goal” information.
- Goal information describes situations that are desirable. This allows the agent a way to choose among multiple possibilities,selecting the one which reaches a goal state.
- search and planning are the sub fields of artificial intelligence devoted to finding action sequences that achieve the agents goals.



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Inside Alibaba's Warehouse

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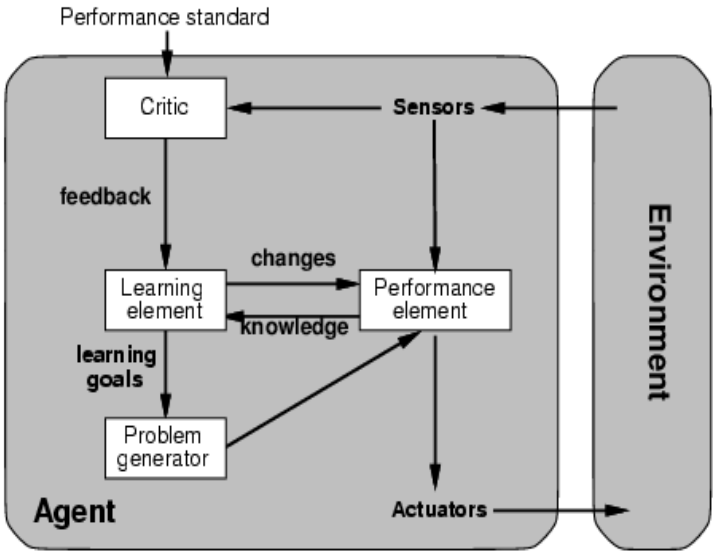
Goal Based Agent

- Goal-based agents only distinguish between goal states and non-goal states
- it is possible to define a measure of how desirable a particular state is. This measure can be obtained through the use of utility function which maps a state to measure of the utility of the state
- A more general performance measure should allow a comparison of different world states accordingly to exactly how happy they would make the agent.



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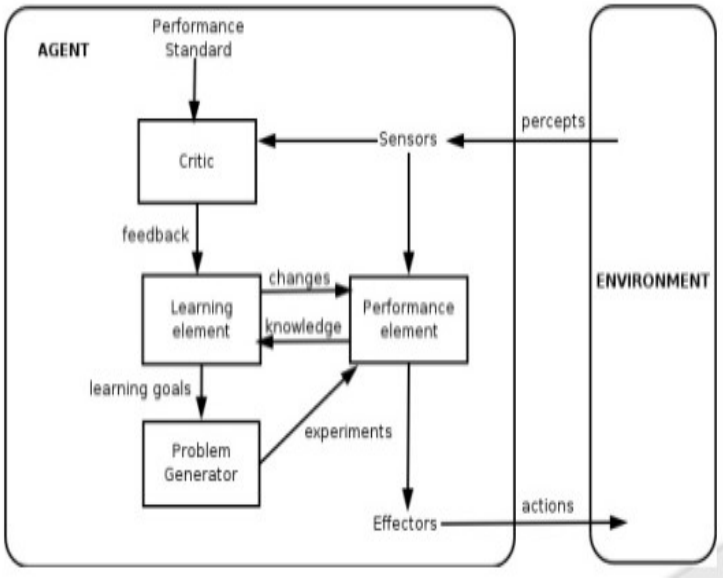
Learning Agent

- Learning has an advantage that it allows the agents to initially operate in unknown environments and to become more competent that its initial knowledge alone might allow.
- the most important distinction is between the “learning element” which is responsible for making improvements and the “performance element” which is responsible for selecting external actions.
- The learning element uses feedback from the critic on how the agent is doing and determines how the performance element should be modified to do better in the future
- 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.



THANK YOU

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