Artificial Intelligence

Lecture-6

Intelligent Agents

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Lecture Outlines

- …
  - Types of Agents
    - Simple Reflex Agent
    - Model-Based Reflex Agents
    - Goal-Based Agents
    - Utility-Based Agents
    - Learning Agents
  - Examples of Intelligent Agents
  - …

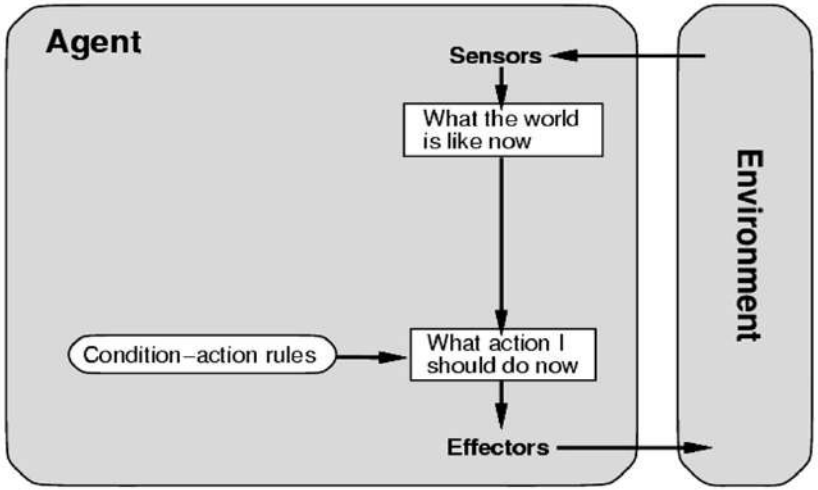
Types of Agents

- Types of intelligent agents are defined by their range of capabilities and degree of intelligence:
  - **Simple Reflex Agents**
    - These agents function in a current state, ignoring past history. Responses are based on the event-condition-action rule where a user initiates an event and the agent refers to a list of pre-set rules and pre-programmed outcomes. Reactive: No memory
  - **Model-Based Reflex Agents**
    - These agents choose an action in the same way as a reflex agent, but they have a more comprehensive view of the environment. A model of the world is programmed into the internal system that incorporates the agent's history. Thus, the agent should maintain some sort of internal states that depends on the percept history.
  - **Goal-Based Agents**
    - Knowing about the current state of the environment is not always enough to decide what to do. These agents expand upon the information model-based agents store by also including goal information, or information about desirable situations.
  - **Utility-Based Agents**
    - These agents are similar to goal-based agents but provide an extra utility measurement which rates each possible scenario on its desired result and chooses the action that maximizes the outcome.
  - **Learning Agents**
    - These agents have the ability to gradually improve and become more knowledgeable about an environment over time through an additional learning element. The learning element will use feedback to determine how performance elements should be changed to improve gradually.

A Simple Reflex Agent

- Simple reflex agents ignore the rest of the percept history and act only on the basis of the **current percept**.
- Percept history is the history of all that an agent has perceived till date.
- The agent function is based on the **condition-action rule**. A condition-action rule is a rule that maps a state i.e, condition to an action. If the condition is true, then the action is taken, else not.
- This agent function only succeeds when the environment is fully observable.
- Problems with Simple reflex agents are :
  - Very limited intelligence.
  - No knowledge of non-perceptual parts of state.
  - Usually too big to generate and store.
  - If there occurs any change in the environment, then the collection of rules need to be updated.

A Simple Reflex Agent



function Simple-Reflex-Agent(*percept*) **returns** action
static: *rules*, a set of condition-action rules

state ← Interpret-Input(*percept*)
rule ← Rule-Match(*state, rules*)
action ← Rule-Action[*rule*]
return *action*

Example: Simple Reflex Vacuum Agent

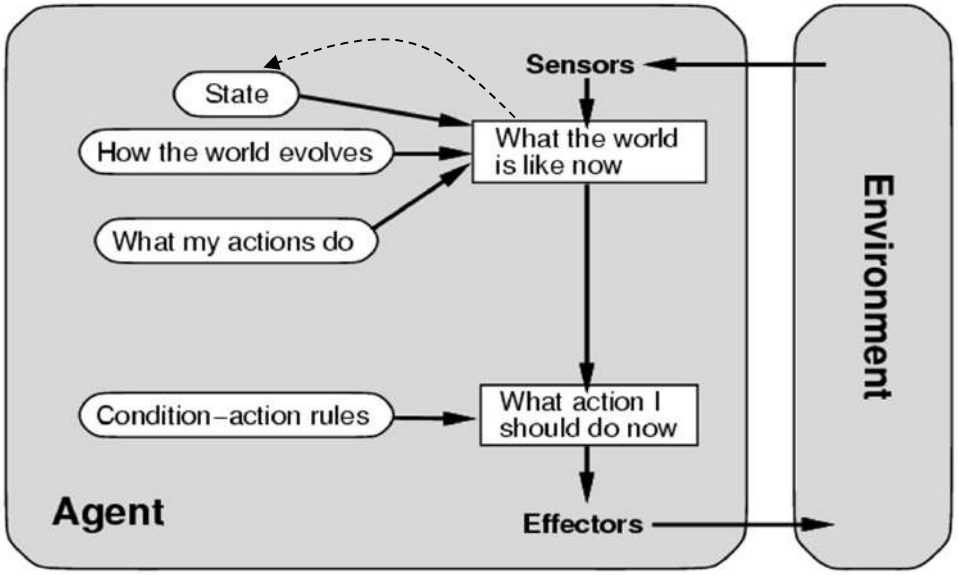
function REFLEX-VACUUM-AGENT([*location*,*status*]) returns an action

if *status* = *Dirty* then return *Suck*
else if *location* = *A* then return *Right*
else if *location* = *B* then return *Left*

Model-based Agents

- It works by finding a rule whose condition matches the current situation.
- A model-based agent can handle **partially observable environments** by use of model about the world.
- The agent has to keep track of **internal state** which is adjusted by each percept and that depends on the percept history.
- The current state is stored inside the agent which maintains some kind of structure describing the part of the world which cannot be seen.
- Updating internal state requires two kinds of encoded knowledge
  - knowledge about how the world changes (independent of the agents' actions)
  - knowledge about how the agents' actions affect the world
- But, knowledge of the internal state is not always enough
  - how to choose among alternative decision paths?
  - Requires knowledge of the **goal** to be achieved

Model-based Agents



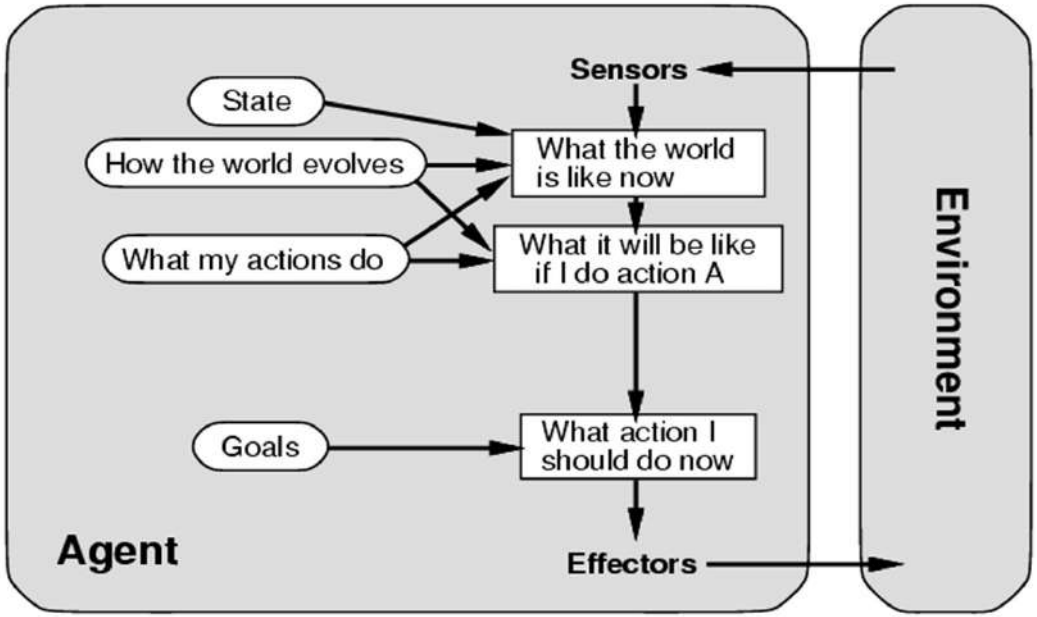
function Reflex-Agent-With-State(*percept*) **returns** action
static: *rules*, a set of condition-action rules
state, a description of the current world

state ← Update-State(*state*, *percept*)
rule ← Rule-Match(*state, rules*)
action ← Rule-Action[*rule*]
state ← Update-State(*state*, *action*)
return *action*

Goals-based Agents

- These kind of agents take decision based on how far they are currently from their **goal**(description of desirable situations).
- Their every action is intended to reduce its distance from the goal. This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state.
- The knowledge that supports its decisions is represented explicitly and can be modified, which makes these agents more flexible.
- They usually require search and planning. The goal-based agent's behavior can easily be changed.

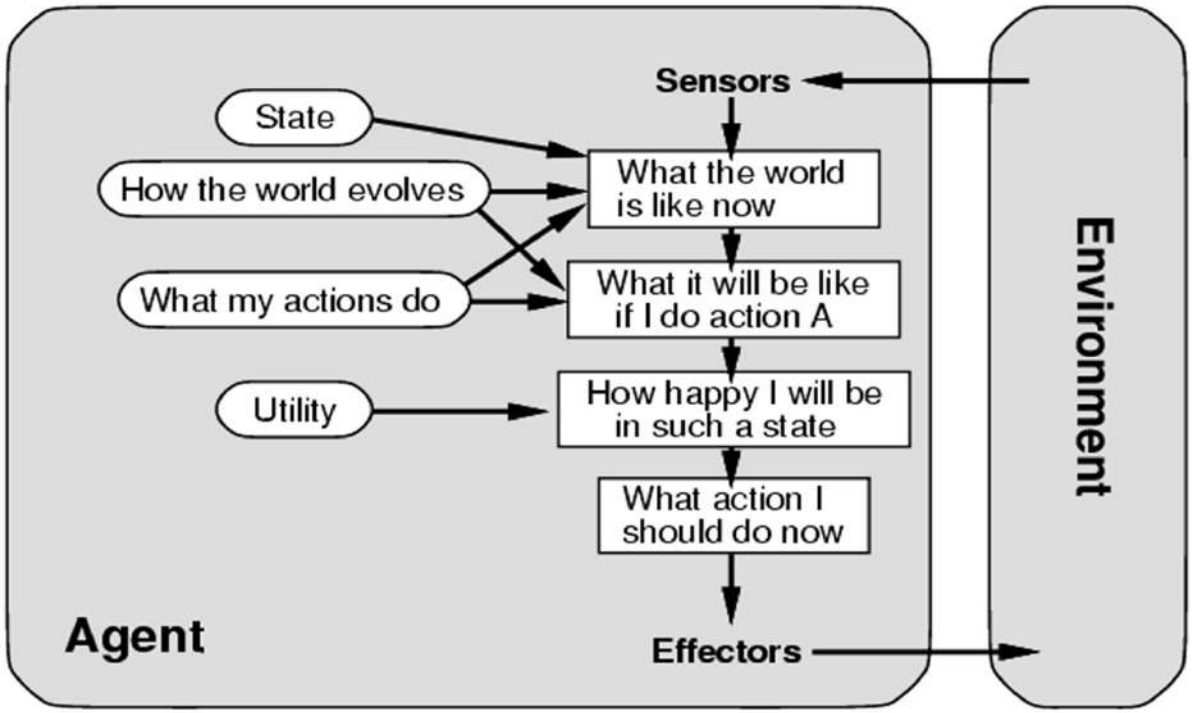
Goals-based Agents



A Complete Utility-Based Agent

- 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. Sometimes achieving the desired goal is not enough. We may look for a quicker, safer, cheaper trip to reach a destination.
- Agent happiness should be taken into consideration. Utility describes how **"happy"** the agent is. Because of the uncertainty in the world, a utility agent chooses the action that maximizes the expected utility.
- A **utility function** maps a state onto a real number which describes the associated degree of happiness.

A Complete Utility-Based Agent

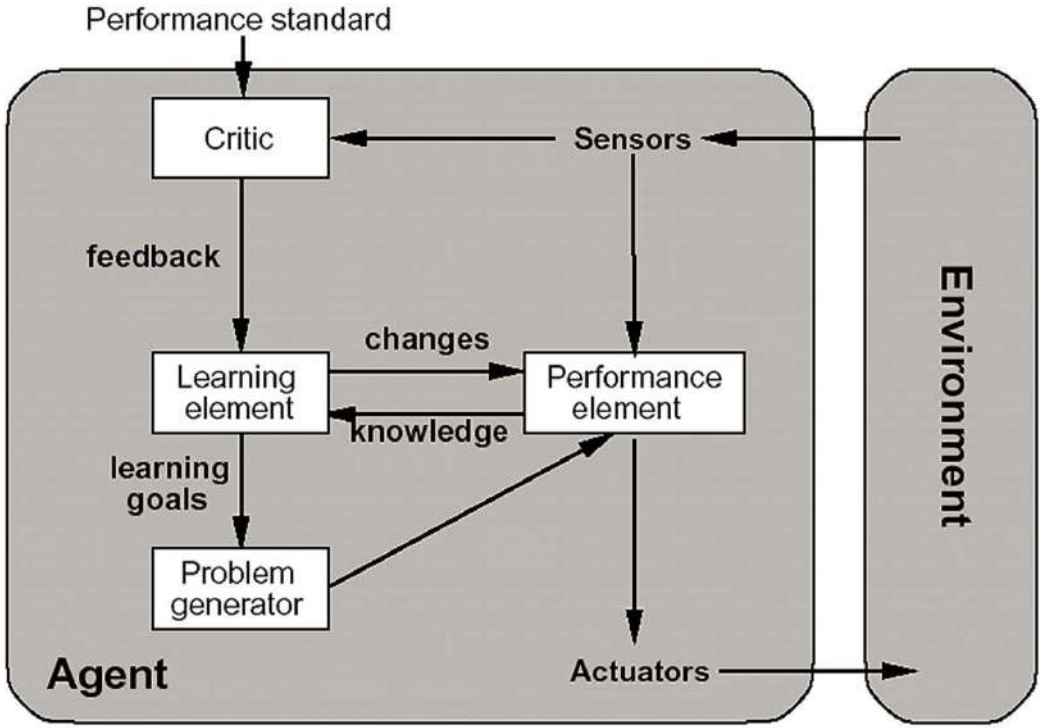


- Preferred world state has higher utility for agent = quality of being useful
- Utility function: state ==> U(state) = measure of happiness
- Search (goal-based) vs. games (utilities).

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:
  - **Learning element :**It is responsible for making improvements by learning from the environment
  - **Critic:** Learning element takes feedback from critic which describes how well the agent is doing with respect to a fixed performance standard.
  - **Performance element:** It is responsible for selecting external action
  - **Problem Generator:** This component is responsible for suggesting actions that will lead to new and informative experiences.

Learning Agents



Examples of Intelligent Agents

- **AI assistants**, like **Alexa** [Alexa Voice Service (AVS)] and **Siri** [Apple's voice-controlled personal assistant], are examples of intelligent agents as they use sensors to perceive a request made by the user and the automatically collect data from the internet without the user's help. They can be used to gather information about its perceived environment such as weather and time.
- **Infogate** is another example of an intelligent agent, which alerts users about news based on specified topics of interest.
- **Autonomous vehicles** [self-driving car (sometimes called an autonomous car or driverless car)] could also be considered intelligent agents as they use sensors, GPS and cameras to make reactive decisions based on the environment to maneuver through traffic.

Intelligent Agents

TO BE CONTINUED…