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Typical Classes of Agents 智能体的主要类别

- The classification is based on their degree of perceived intelligence and capability.

该分类是基于他们感知的智能和能力的程度。

- Here we will introduce five kinds of agents that embody the principles underlying almost all intelligent systems.

这里我们将介绍5种类型的智能体，体现几乎所有智能系统的基本原理。

Simple reflex agents

■ 简单反射智能体

Model-based reflex agents

■ 基于模型的反射智能体

Goal-based agents

■ 基于目标的智能体

Utility-based agents

■ 基于效用的智能体

Learning agents

■ 学习智能体

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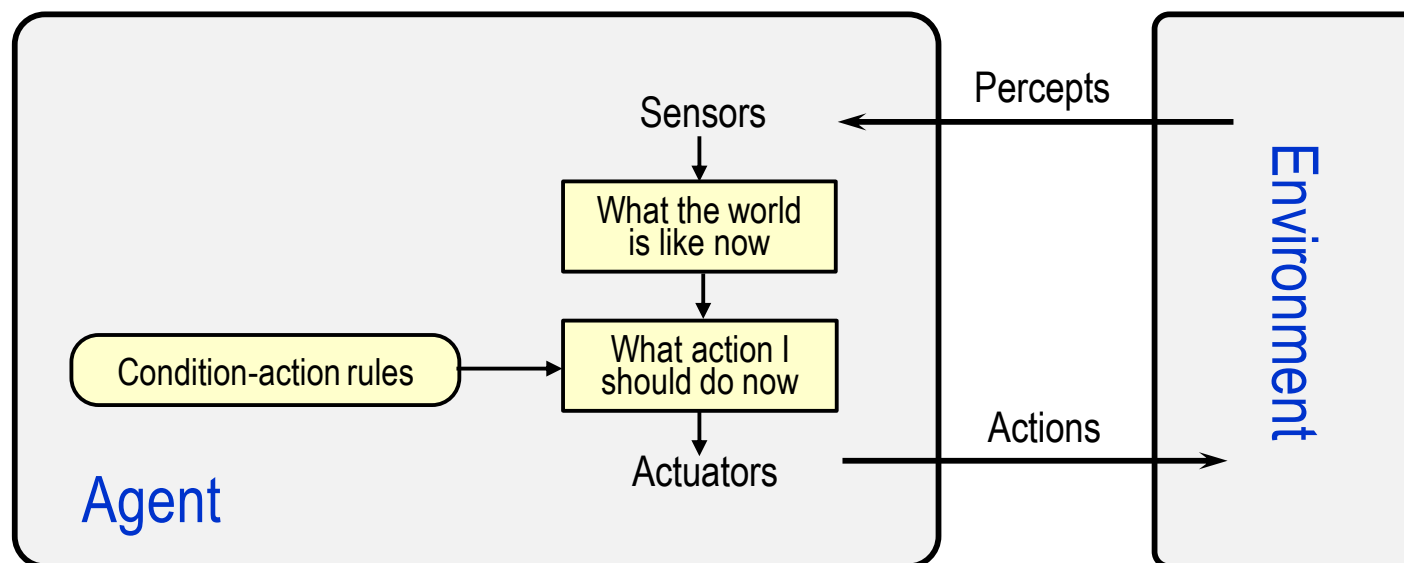
Structure of Simple Reflex Agents 简单智能体的结构

- Simple reflex agents act only on the basis of the current percept, ignoring the rest of the percept history.

简单反射智能体仅仅在当前感知的基础上动作，忽略其余的感知历史。

- Agent function is based on **condition-action rule**: *if* condition *then* action.

智能体功能是基于条件动作规则：*if* 条件 *then* 动作。



About Simple Reflex Agents 关于简单智能体

- ❑ This agent function only succeeds when the environment is fully observable.
仅当外部环境为完全可观测时，该智能体的功能才能发挥。
- ❑ Some reflex agents can also contain information on their current state which allows them to disregard conditions whose actuators are already triggered.
某些反射智能体也可以包含关于其当前状态的信息，允许它们忽视执行器已被触发的条件。
- ❑ Infinite loops are often unavoidable for agents operating in partially observable environments.
智能体在部分可观测环境下运行时，无限循环往往是无法避免的。
- ❑ Note: If the agent can randomize its actions, it may be possible to escape from infinite loops.
注意：如果智能体可以随机产生其动作，有可能从无限循环中摆脱出来。

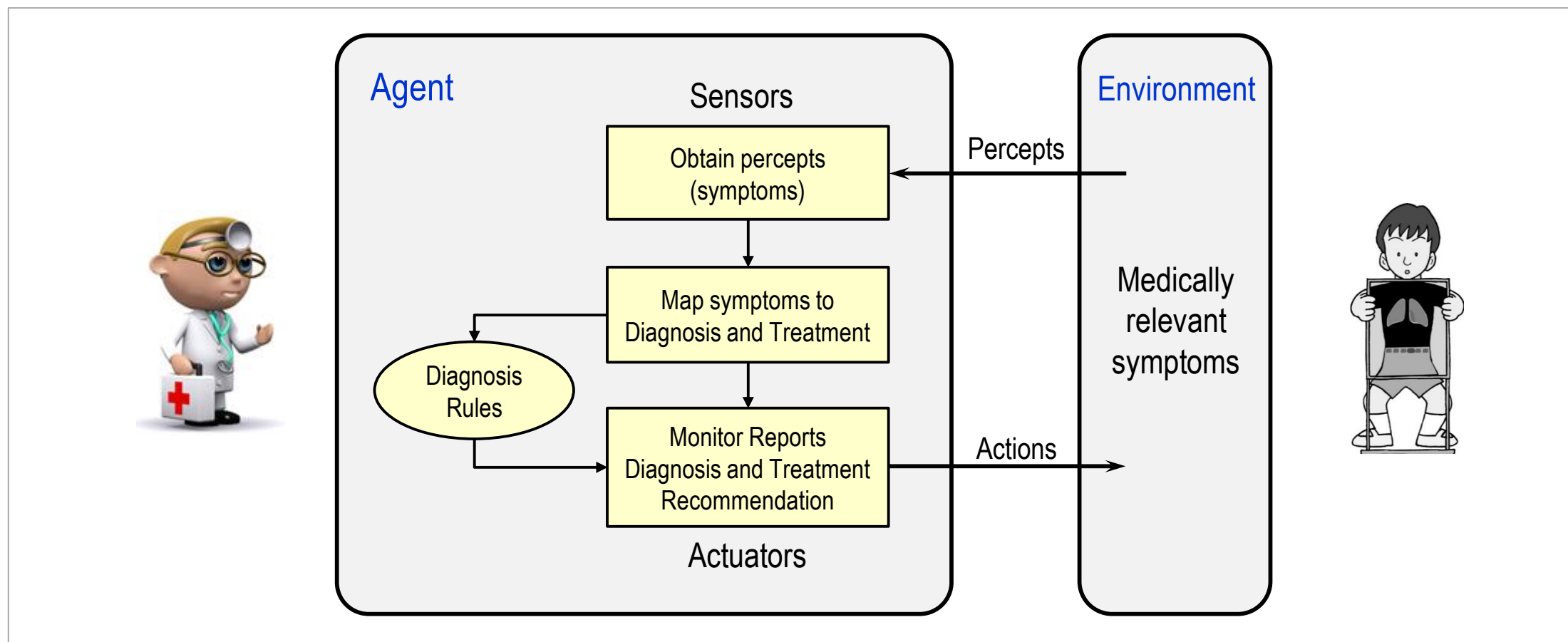
Algorithm of Simple Reflex Agents 简单智能体的算法

```
function SIMPLE-REFLEX-AGENT(percept) returns an action  
  persistent: state, the agent's current conception of the world state  
               rules, a set of condition–action rules  
               action, the most recent action, initially none  
  state  $\leftarrow$  INTERPRET-INPUT(percept)  
  rule  $\leftarrow$  RULE-MATCH(state, rules)  
  action  $\leftarrow$  rule.ACTION  
  return action
```

A simple reflex agent. It acts according to a **rule**
whose condition matches the current state, as defined by the percept.

一个简单反射智能体。它按照规则动作，其条件匹配由感知所定义的当前状态。

Example: A Simple Reflex Agent 一个简单智能体



Structure of a simple reflex agent for medical diagnosis and treatment recommendation

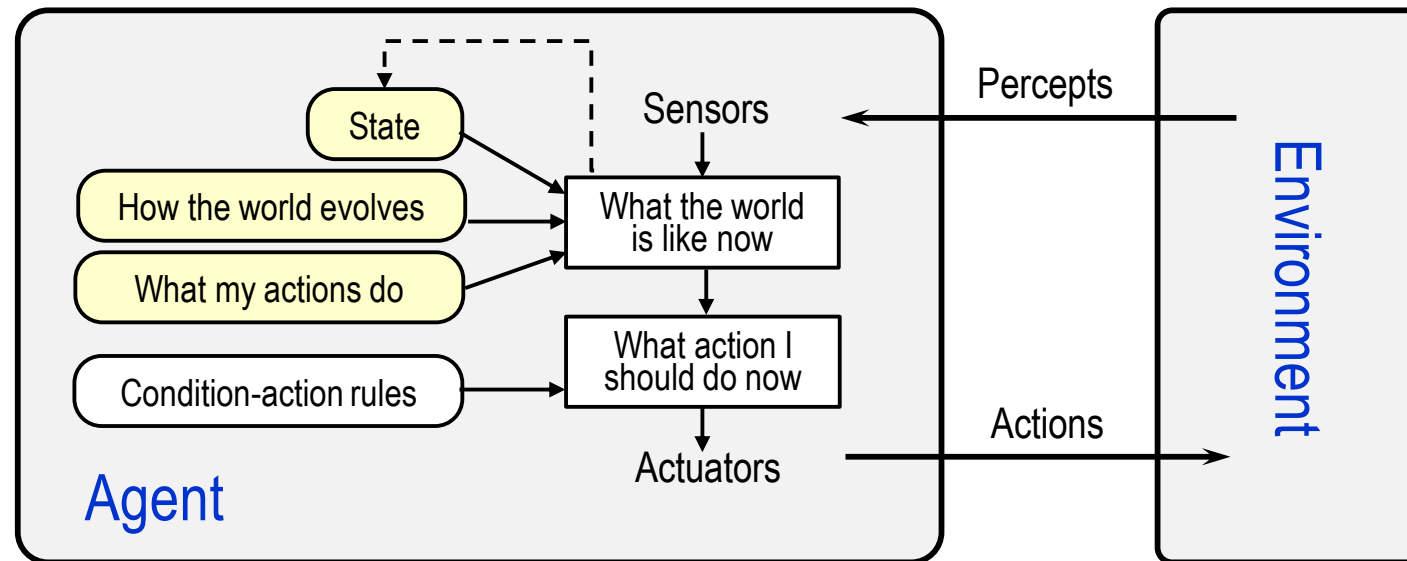
一个用于医学诊断和治疗建议的简单反射智能体结构

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Structure of Model-based Reflex Agents 基于模型反射智能体的结构

- ❑ A model-based reflex agent can handle partially observable environment.
一个基于模型的反射智能体可以处理部分可观测环境。
- ❑ Its current state is stored inside the agent maintaining some kind of structure which describes the part of the world which cannot be seen.
其当前状态存储在智能体中，维护某种结构，它描述不可见外部环境的一部分。



About Model-based Reflex Agents 关于基于模型反射智能体

- This knowledge about "how the world works" is called a model of the world, hence the name "model-based agent".
关于“外部环境如何运作”的知识被称为一个外部环境模型，由此得名“基于模型的智能体”。
- A model-based reflex agent should maintain some sort of internal model.
基于模型的反射智能体将保持某种内部模型。
- The internal model depends on the percept history and thereby reflects at least some of the unobserved aspects of the current state.
内部模型依赖于感知的历史，因此至少反射某些当前状态无法观测的方面。
- It then chooses an action in the same way as the reflex agent.
然后它作为反射智能体以某种方式选择动作。

Algorithm of Model-based Reflex Agents 基于模型反射智能体的算法

```
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
```

The algorithm of a model-based reflex agent. It keeps track of the current state of the world, using an internal model. It then chooses an action in the same way as simple reflex agent.

一个基于模型的反射智能体算法。它采用一个内部模型来保持当前外部环境状态的轨迹。
然后用等同于简单反射智能体的方式选择一个动作。

2.5. Category of Intelligent Agents

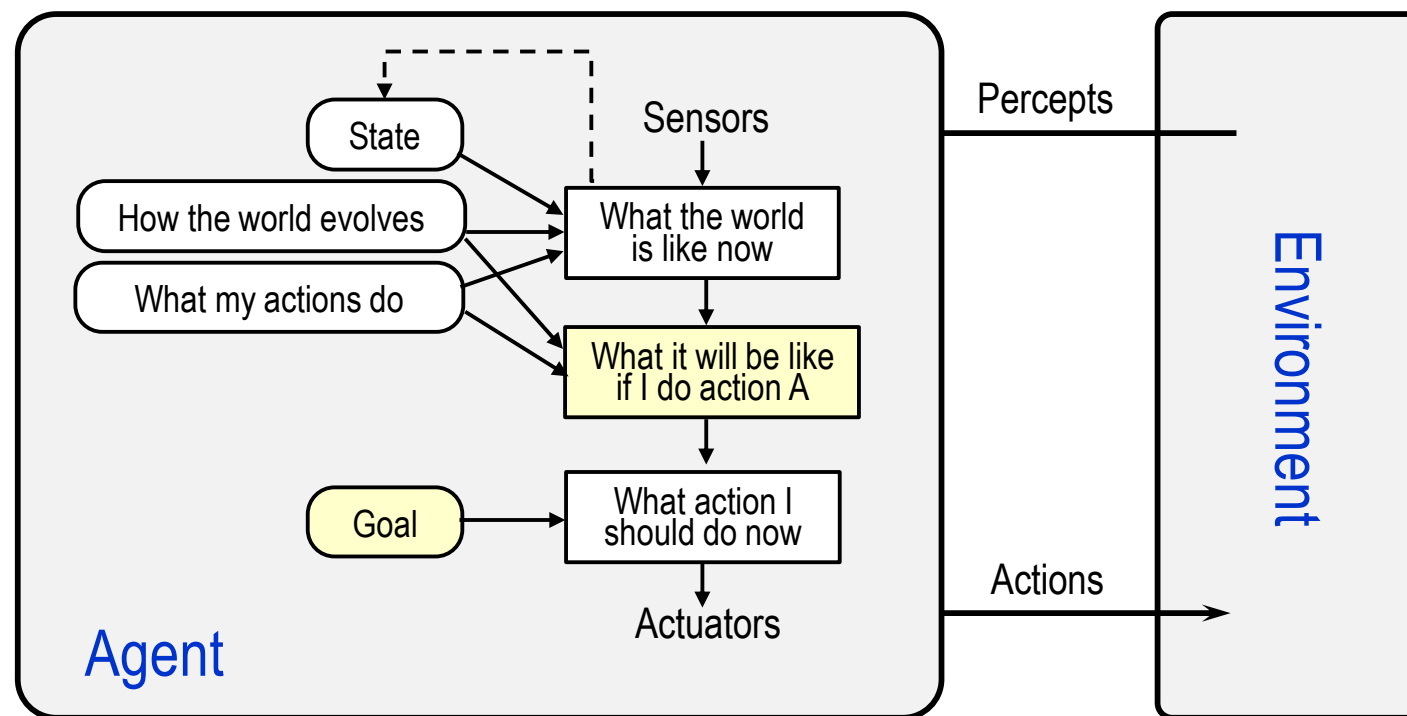
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Structure of Goal-based Agents 基于目标智能体的结构

- Goal-based agents further expand on the capabilities of the model-based agents, by using “goal” information.

通过利用“目标”信息，基于目标的智能体进一步扩展了基于模型的智能体的功能。



About Goal-based Agents 关于基于目标智能体

- ❑ Goal information describes situations that are desirable.
目标信息描述所希望的情形。
- ❑ This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state.
它允许智能体在多个可能性之间选择一种方式，挑选出达到目标状态的那一个。
- ❑ Search and planning are the subfields of artificial intelligence devoted to finding action sequences that achieve the agent's goals.
搜索和规划是人工智能的子领域，致力于发现达到智能体目标的动作序列。
- ❑ In some instances the goal-based agent appears to be less efficient.
在某些情况下，基于目标的智能体似乎不太有效。
- ❑ But it is more flexible because the knowledge that supports its decisions is represented explicitly and can be modified.
但它更灵活，因为这种支持其决策的知识明显地展示出来，并且可以被修改。

2.5. Category of Intelligent Agents

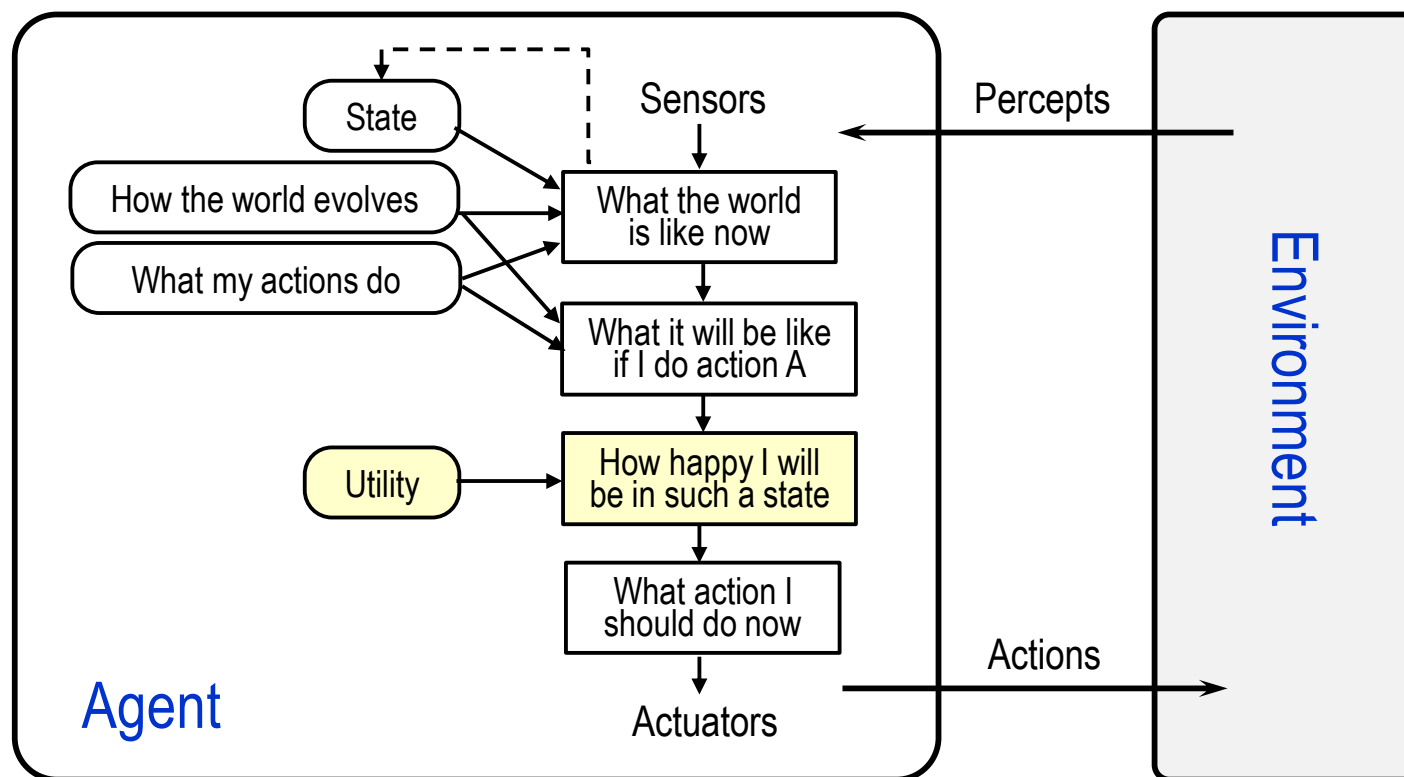
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Structure of Utility-based Agents 基于效用智能体的结构

- A particular state can be obtained by a *utility function* which maps a state to a measure of the utility of the state.

一个特殊的状态可通过一个效用函数得到，该函数将一个状态映射到一个该状态效用的度量。



About Utility-based Agents 关于基于效用智能体

- ❑ A more general performance measure should allow a comparison of different world states according to exactly how “happy” they would make the agent.
一种更通用的性能度量，应该根据他们使得智能体多么“高兴”的程度，允许对不同的外部环境状态进行比较。
- ❑ The term utility, can be used to describe how happy the agent is.
效用这个术语，可用于描述智能体是多么高兴。
- ❑ A rational utility-based agent chooses the action that maximizes the expected utility of the action outcomes.
一个理性的基于效用的智能体选择动作，将动作结果的期待效应最大化。
- ❑ A utility-based agent has to model and keep track of its environment, tasks that have involved a great deal of research on perception, representation, reasoning, and learning.
一个基于效用的智能体需要建模并记录环境、任务的轨迹，这涉及大量的感知、表征、推理、和学习的研究。

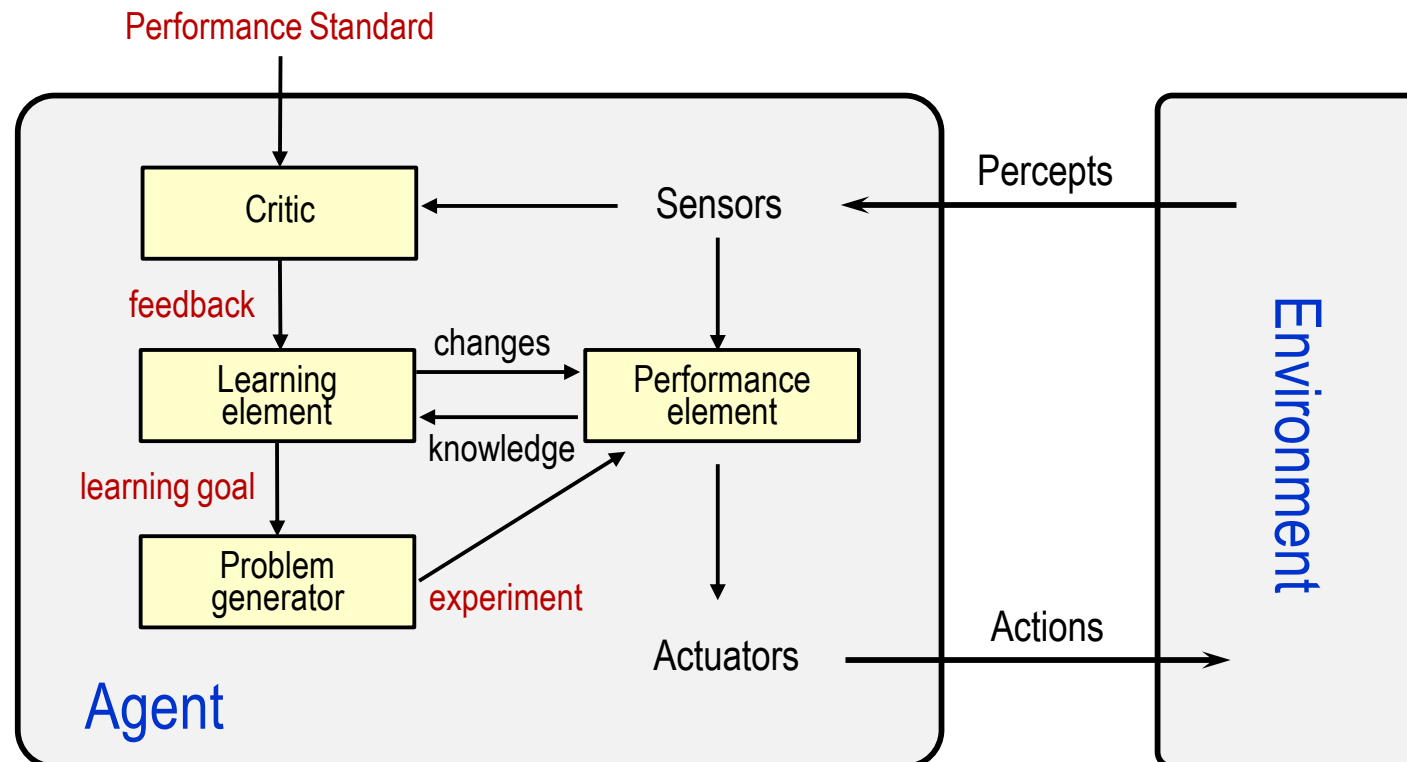
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Structure of Learning Agents 学习智能体的结构

- Learning allows the agents to initially operate in unknown environments and to become more competent than its initial knowledge.

学习允许智能体最初在未知的环境中运行，并且与其最初的知识相比，会变得越来越胜任。



About Learning Agents 关于学习智能体

□ Learning element 学习要素

It 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.

它利用评论者对智能体如何动作的反馈，然后决定应该如何修改性能要素以便未来做得更好。

□ Performance element 性能要素

It is what we have previously considered to be the entire agent: it takes in percepts and decides on actions.

它是我们曾考虑过的什么是完整的智能体：它获得感知并且决定动作。

□ Problem generator 问题发生器

It is responsible for suggesting actions that will lead to new experiences.

它对推荐的动作负责，这将形成新的经验。

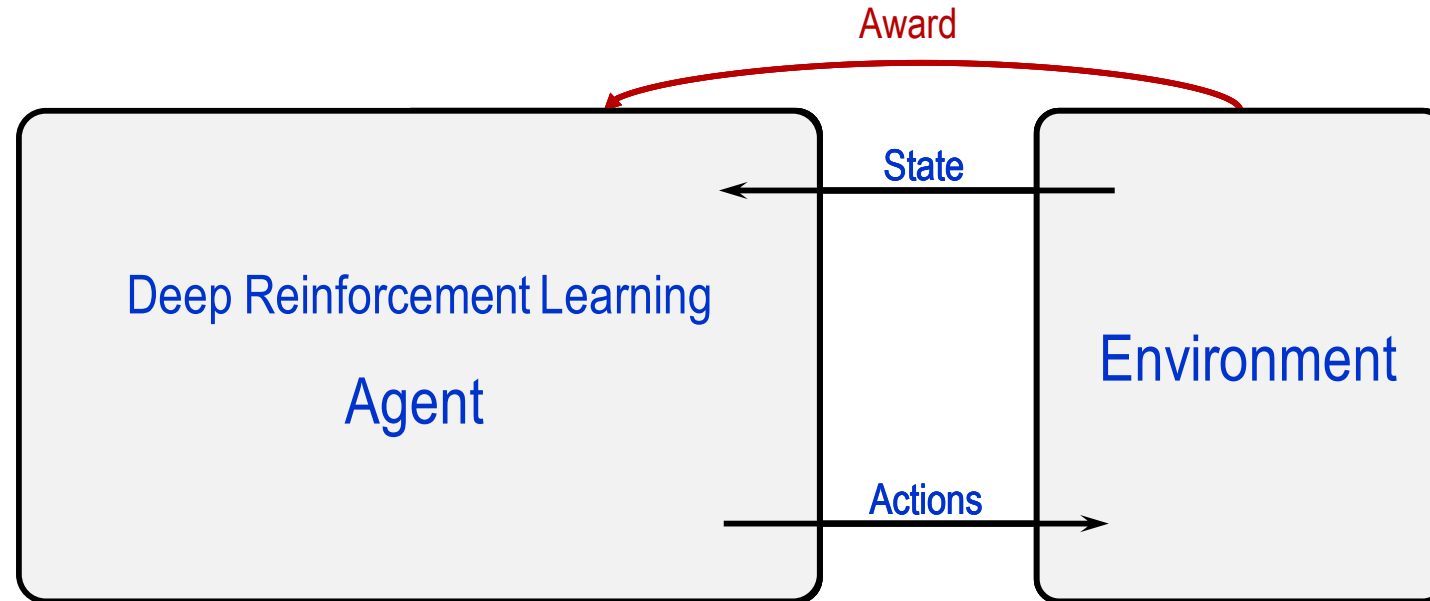
Example: Deep Reinforcement Learning 深度强化学习

- ❑ DeepMind has been getting superhuman performance on certain Atari games, by deep reinforcement learning.

DeepMind采用深度强化学习的方法，在某些Atari游戏上，已超过人类玩家的水平。

- ❑ Their new agent architecture outperforms all previous approaches.

他们新的智能体架构的性能超过了以往的所有方法。



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Other Intelligent Agents 其它智能体

Some of the sub-agents not already mentioned above may be a part of an intelligent agent or a complete intelligent agent:

前面尚未介绍的某些子智能体也许是智能体的一部分，或者是一个完整的智能体：

- **Decision Agents** 决策智能体

geared to decision making.

与决策制定相关。

- **Input Agents** 输入智能体

process and make sense of sensor inputs.

处理和理解感受器的输入。

- **Processing Agents** 处理智能体

solve a problem like speech recognition.

解决诸如语音识别的问题。

Other Intelligent Agents 其它智能体

□ Spatial Agents 空间智能体

relate to the physical real-world.

与物理现实世界相关联。

□ Temporal Agents 时间智能体

may use time based stored information to offer instructions (or data acts) to a computer program (or human being), and takes program inputs percepts to adjust its next behaviors.

可以使用基于时间的信息来提供指令（或数据动作）给计算机程序（或人类），然后接收程序输入感知来调整下一步行为。

□ World Agents 世界智能体

incorporate a combination of all the other agents to allow autonomous behaviors.

并入所有其它智能体的组合以便允许自主行为。

Other Intelligent Agents 其它智能体

❑ Believable agents 可信智能体

exhibiting a personality via the use of an artificial character (the agent is embedded) for the interaction.

可信智能体：通过利用交互的（智能体所嵌入的）人工特性展示个性。

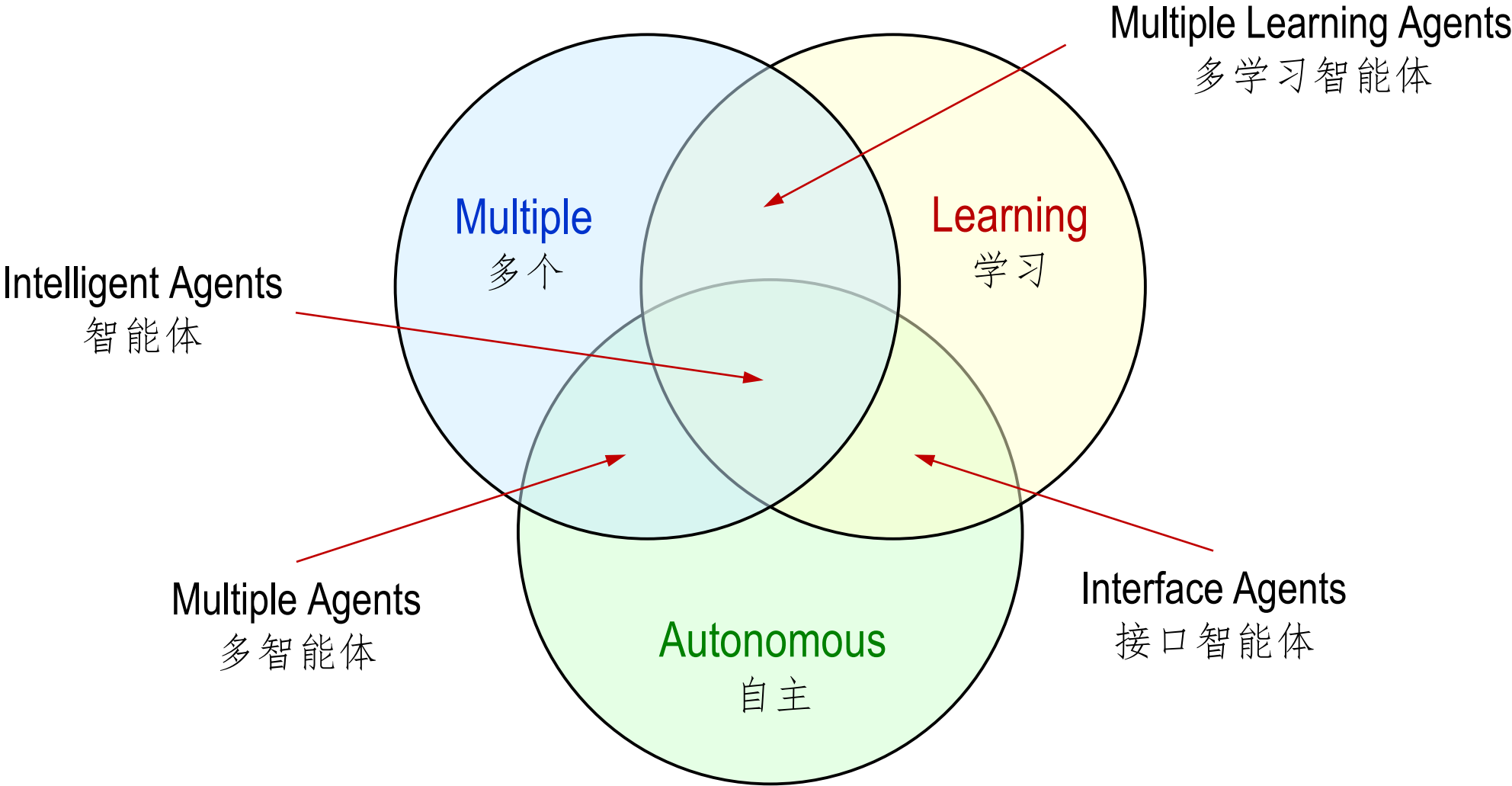
❑ Shopping Agent 购物智能体

❑ Customer Help Desk 客户服务台

❑ Personal Agent 个人智能体

❑ Data-mining Agent 数据挖掘智能体

A Perspective for Agents 智能体的视角



A Taxonomy of Agents 智能体的分类法

