2. Intelligent Agents

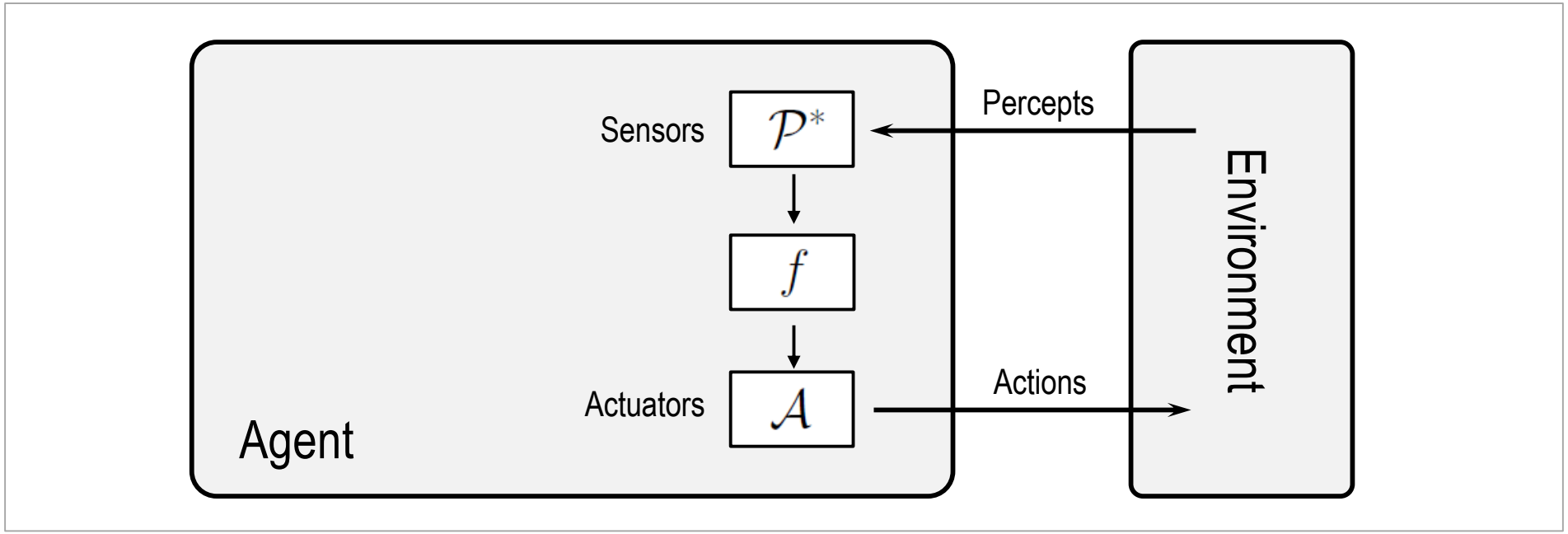
Contents:

The Structure of Agents 智能体的结构

- An agent's behavior can be described mathematically by an agent function which maps every percepts to a action.

  一个智能体的行为可以数学上被描述为一个智能体函数，将每个感知映射为动作。

$$f : \mathcal{P}^* \rightarrow \mathcal{A} \qquad \text{where} \qquad \mathcal{P}^* = \sum_{t=1}^{T} |\mathcal{P}|^t$$



Agent Function 智能体函数

- The agent function is an abstract concept, it could incorporate various principles of decision making:

  智能体函数是一个抽象的概念，它可以包含将各种决策制定的原则：

  - calculation of utility of individual options,

    单个选项的效用计算

  - deduction over logic rules,

    贯穿逻辑规则的推论

  - fuzzy logic,

    模糊逻辑

  - lookup table,

    查找表

  - etc.

Agent Programs 智能体程序

- It implements an agent function. It take the current percept as input from the sensors, and return an action to the actuators.

  实现一个智能体功能。它将感受器的输入作为当前的感知，然后返回一个动作给执行器。

```
function TABLE-DRIVEN-AGENT(percept) returns an action
    persistent: percepts, a sequence, initially empty
                table, a table of actions, initially fully specified
                action, the most recent action, initially none
    append percept to the end of percepts
    action ← LOOKUP(percepts, table)
    return action
```

The agent program returns an action by lookup table each time.

该智能体程序通过查找表返回一个动作。

The Structure of Agents 智能体的结构

$$\begin{aligned} Agent &= platform + agent\ program \\ platform &= computing\ device + sensors + actuators \\ agent\ program &\supset agent\ function \end{aligned}$$

Hierarchies of agents 智能体的层次

- Intelligent agents today are normally gathered in a hierarchical structure containing many "sub-agents".
  智能体通常表现为一个分层的结构，它包含许多“子智能体”。
- Intelligent sub-agents process and perform lower level functions.
  子智能体处理和执行较低级的功能。
- Intelligent agent and sub-agents create a complete system that can accomplish difficult tasks with behaviors and responses.
  智能体和子智能体构建一个完整的系统，它可以通过行为和反应来完成艰巨的任务。

Three ways to represent states for an agent 表征智能体状态的三种方式

- **Atomic** 原子式

  each state is a black box with no internal structure.

  每个状态是个黑盒子，没有内部结构。

- **Factored** 因子式

  each state consists of a fixed set of attributes and values.

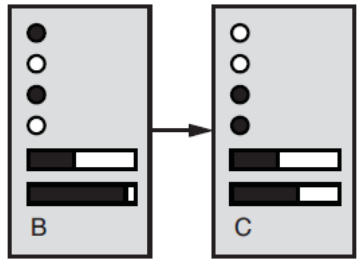
  每个状态由一组固定的属性和值组成。

- **Structured** 结构式

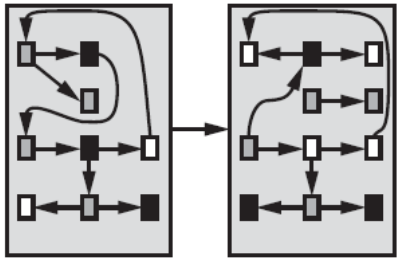
  each state includes objects, each has attributes and relationships to other objects.

  每个状态包含对象，每个具有属性以及与其它对象的关系。

Atomic



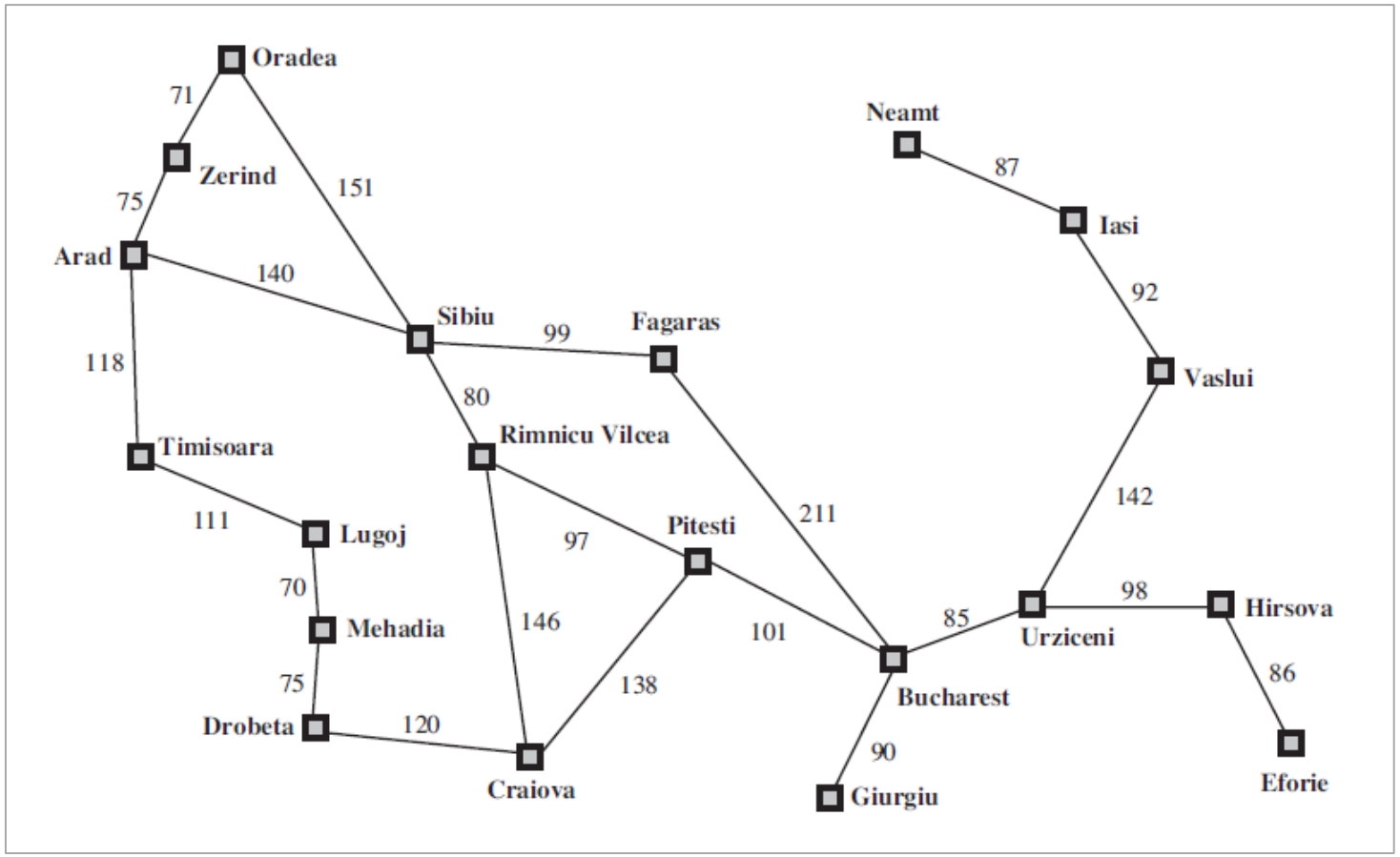
Factored



Structured

a) Atomic representation 原子式表征

- Each state is a black box with no internal structure.
  每个状态是个黑盒子，没有内部结构。
- E.g. the problem of finding a driving route from one end of a country to the other via some sequence of cities.
  例如，寻找驾驶路径问题，从某个国家的一端到另一端，经过一系列城市。

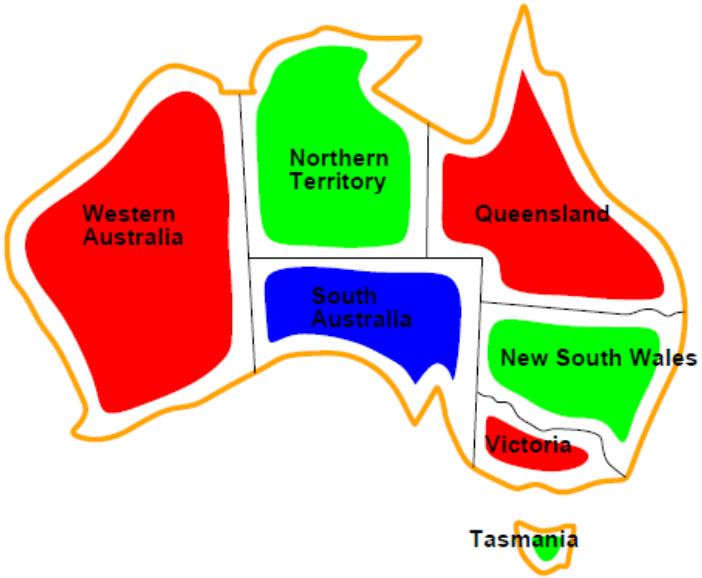


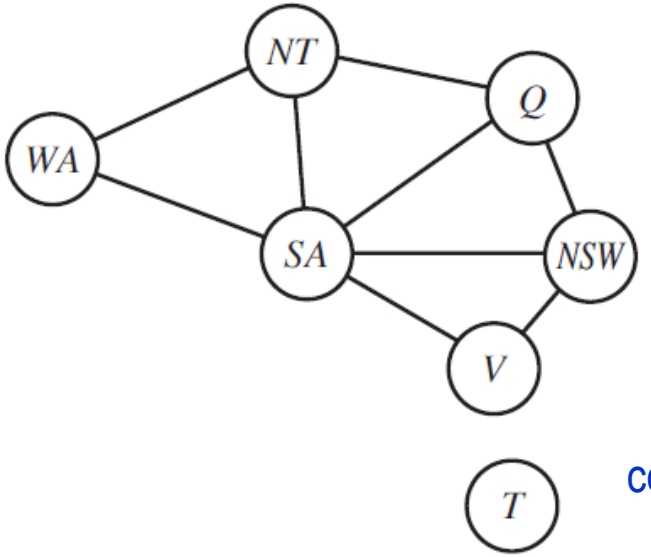
A simplified road map of part of Romania.
一个简化的罗马尼亚部分公路交通图

b) Factored representation 因子式表征

- Each state consists of a fixed set of attributes and values.

  每个状态由一组固定的属性和值组成。





constraint graph

约束图

Many possible solutions to this problem, e.g.,

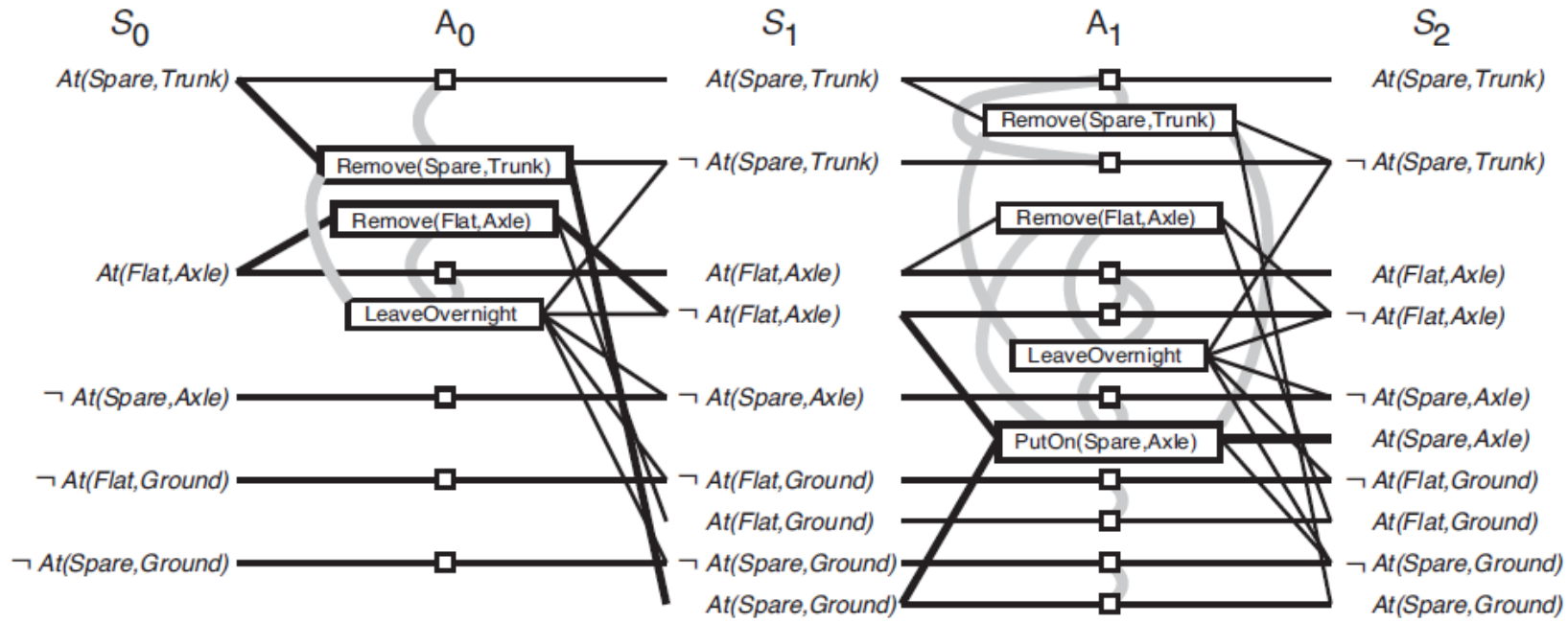
该问题可能的解决方案，例如：

$$\{WA = red, NT = green, Q = red, NSW = green, V = red, SA = blue, T = red\}.$$

c) Structured representation 结构式表征

- Each state includes objects, each object has attributes and relationships to other objects.

  每个状态包含对象，每个对象具有属性和与其它对象的关系。



A sample of structured representation of states

一个状态结构化表示的示例