Problem Solving Agents

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# Problem solving in AI 人工智能中的问题求解

- ☐ **The solution** 解

    is a sequence of actions to reach the goal.

    是一个达到目标的动作序列。

- ☐ **The process** 过程

    look for the sequence of actions, which is called search.

    寻找该动作序列，称其为搜索。

- ☐ **Problem formulation** 问题形式化

    given a goal, decide what actions and states to consider.

    给定一个目标，决定要考虑的动作与状态。

- ☐ **Why search** 为何搜索

    Some NP-complete or NP-hard problems, can be solved only by search.

    对于某些NP完或者NP难问题，只能通过搜索来解决。

- ☐ **Problem-solving agent** 问题求解智能体

    is a kind of goal-based agent to solve problems through search.

    是一种基于目标的智能体，通过搜索来解决问题。

Algorithm of Simple Problem Solving Agents 简单的问题求解智能体算法

function SIMPLE-PROBLEM-SOLVING-AGENT(*percept*) **returns** an action
　　persistent: *seq*, an action sequence, initially empty
　　　　　　　　state, some description of the current world state
　　　　　　　　goal , a goal, initially null
　　　　　　　　problem, a problem formulation
　　　　　　　　action, the most recent action, initially none
　　state ← UPDATE-STATE(*state*, *percept*)
　　if *seq* is empty **then**
　　　goal ← FORMULATE-GOAL(*state*)
　　　problem ← FORMULATE-PROBLEM(*state*, *goal*)
　　　seq ← SEARCH(*problem*)
　　　if *seq* = failure **then return** a null action
　　action ← FIRST(*seq*)
　　seq ← REST(*seq*)
　　return *action*

Example: A road map of part of Romania 罗马尼亚部分公路图

Currently in Arad, leaves tomorrow to Bucharest
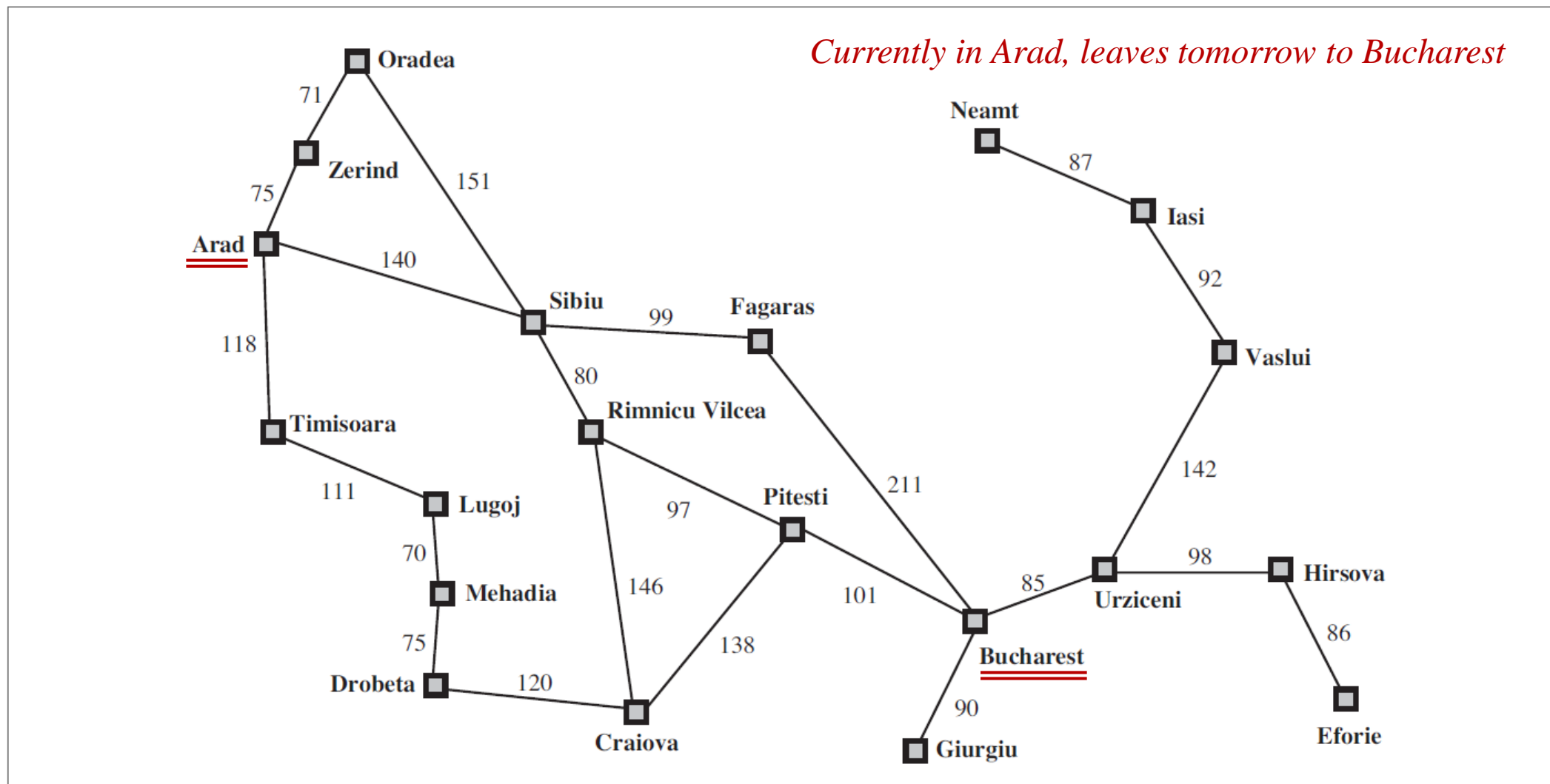
Related Terms 相关术语

- ☐ **State space** 状态空间
  The state space of the problem is formally defined by: Initial state, actions and transition model.
  问题的状态空间可以形式化地定义为：初始状态、动作和转换模型。

- ☐ **Graph** 图
  State space forms a graph, in which nodes are states, and links are actions.
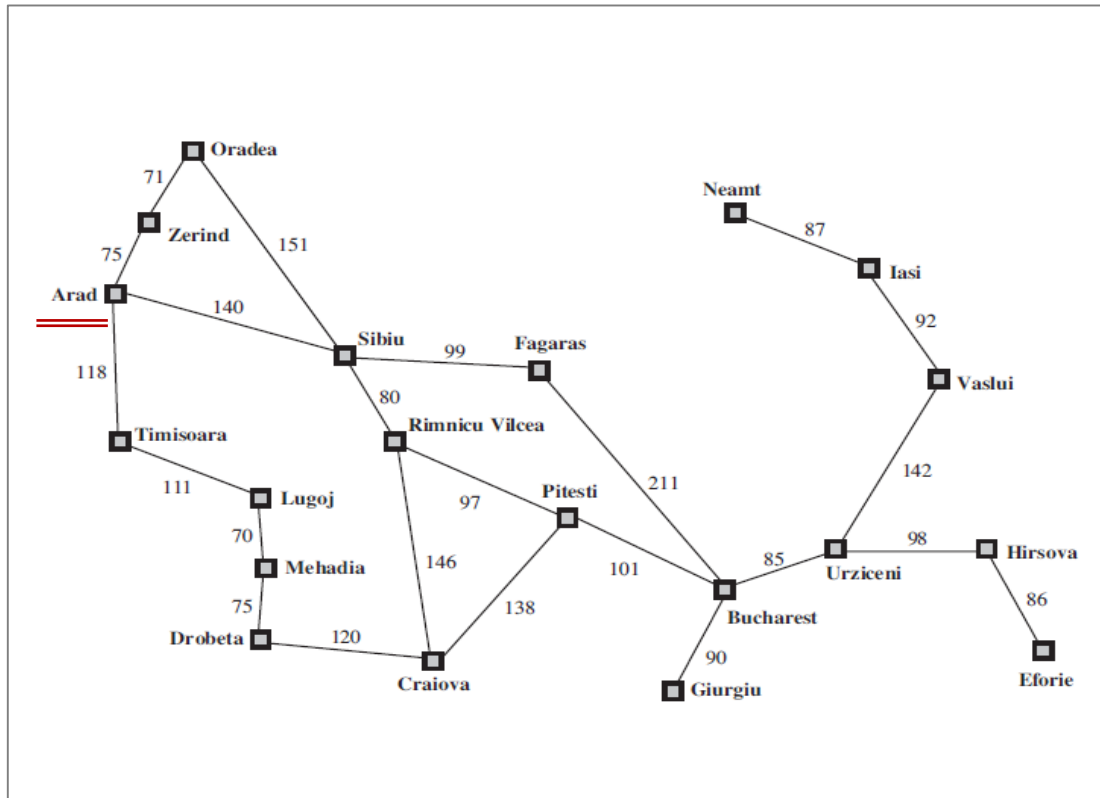 状态空间形成一个图，其中节点表示状态、链接表示动作。

- ☐ **Path** 路径
  A path in the state space is a sequence of states connected by a sequence of actions.
  状态空间的一条路径是由一系列动作连接的一个状态序列。

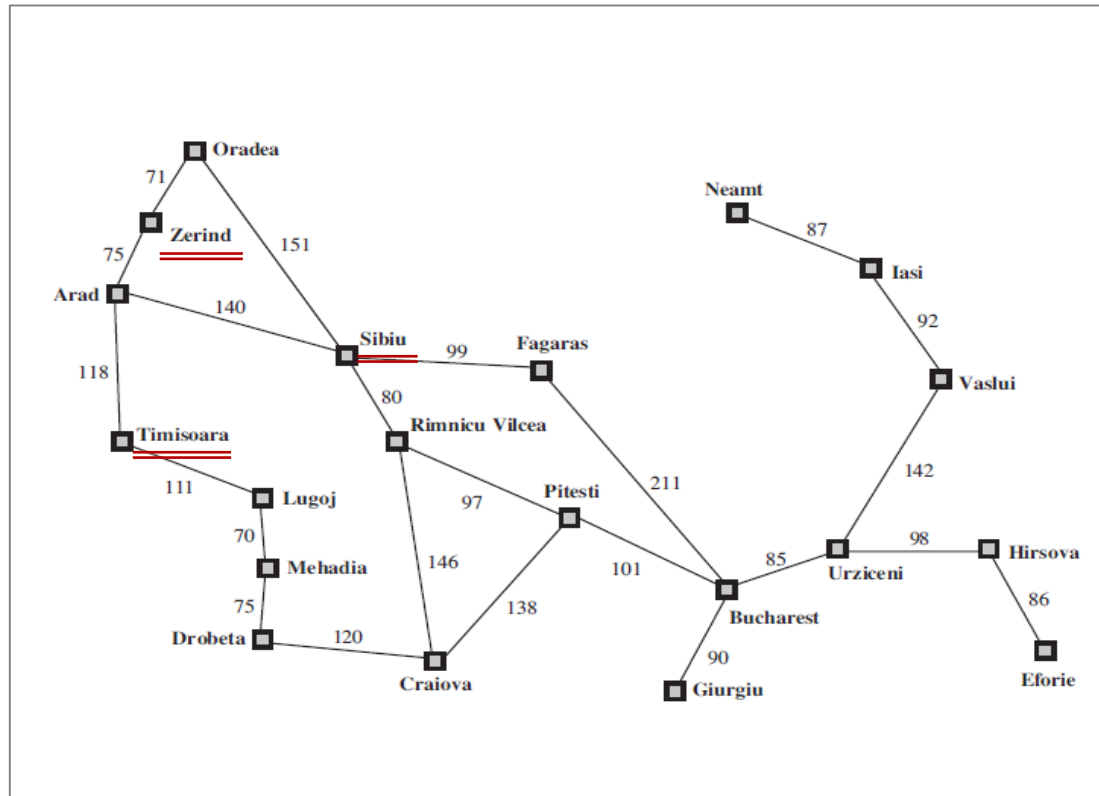# Five Items to Formulate a Problem 问题形式化的五个要素

☐ 1) Initial state 初始状态

- **The agent starts in.**

  即智能体出发时的状态。

- **E.g., the initial state for the agent in Arad may be described as:**

  例如，该智能体位于Arad的初始状态可以记作：

  $$In(Arad).$$

Five Items to Formulate a Problem:

☐ 2) Actions 动作

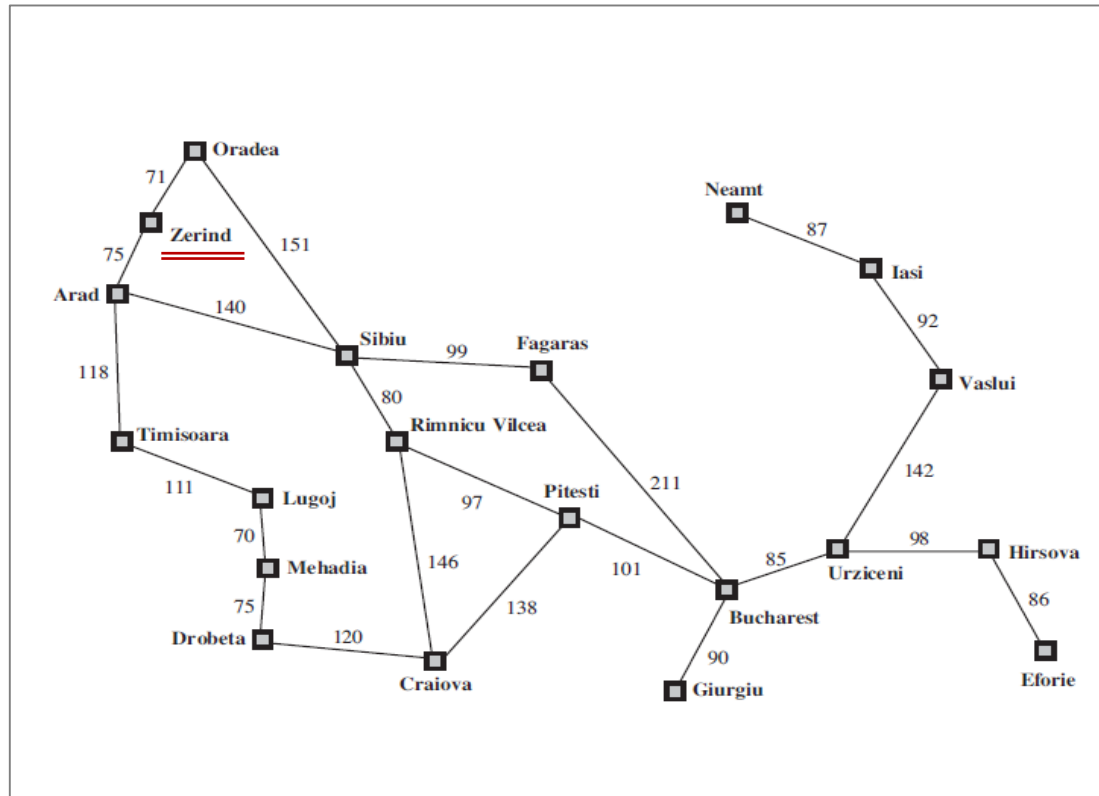- A description of the possible actions available to the agent.

  描述该智能体可执行的动作。

- ACTION(s) returns the actions that can be executed in s. E.g., ACTION(s) 返回s状态下可执行的动作序列。例如：

$$\{Go(Zerind), Go(Sibiu), \\ Go(Timisoara)\}.$$

Five Items to Formulate a Problem:
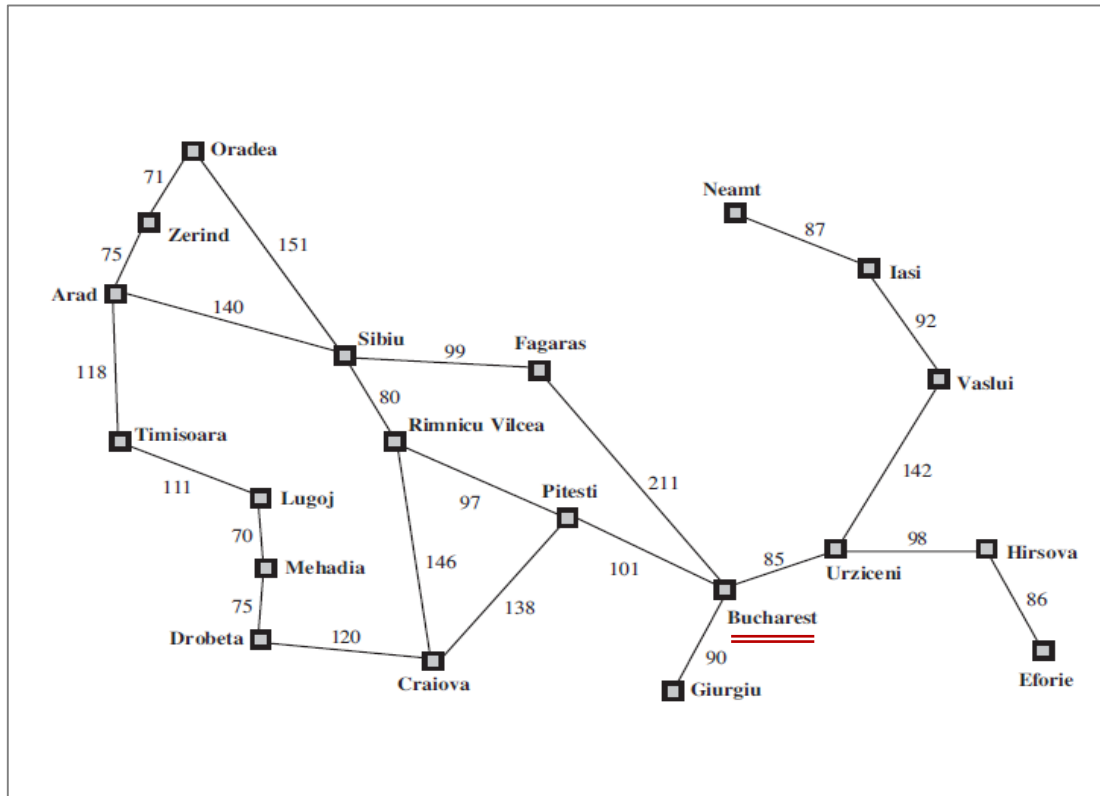
☐ 3) Transition model 转换模型

- **A description of what each action does.**

  描述每个动作做什么。

- $\text{RESULT}(s, a)$ returns the state from doing action a in s. E.g.,

  $\text{RESULT}(s, a)$ 返回在s下动作a之后的状态。例如：

  $\text{RESULT}(In(Arad), Go(Zerind))$
  $= In(Zerind)$

Five Items to Formulate a Problem:

☐ 4) Goal test 目标测试

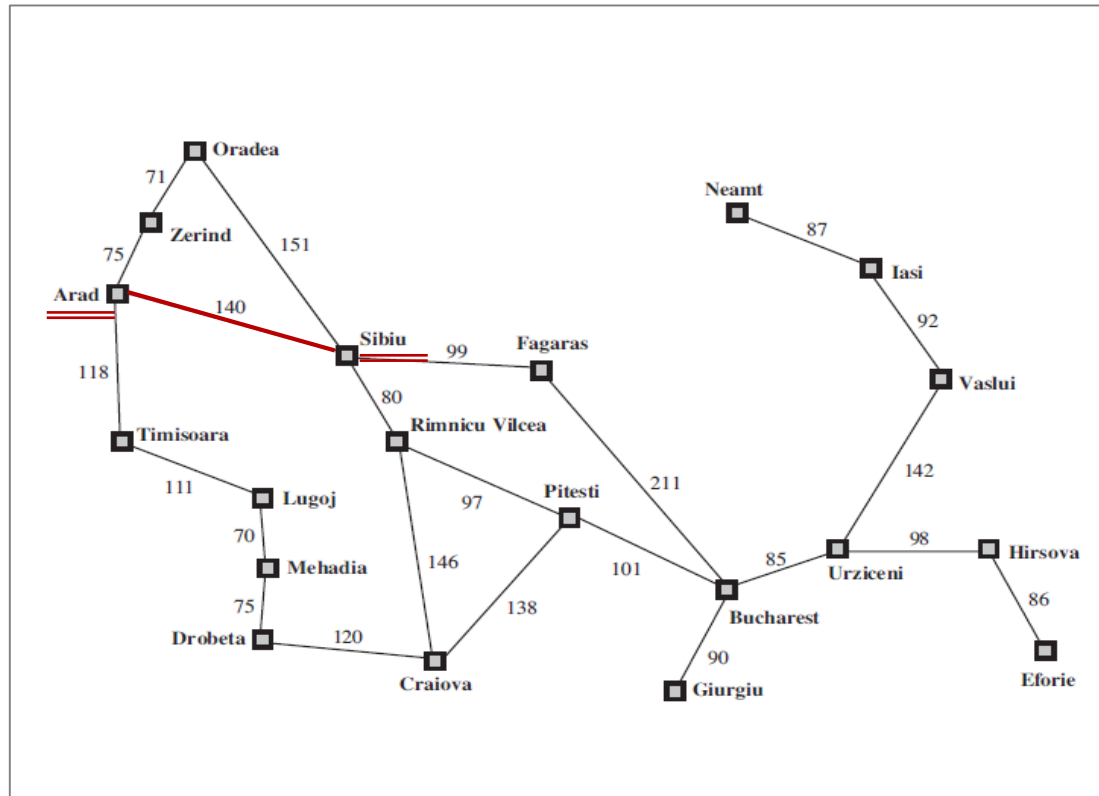- ■ To determine whether a given state is a goal state.

  确定一个给定的状态是否是目标状态。

- ■ E.g., the agent's goal in Bucharest is the singleton set:

  例如：智能体在Bucharest的目标是单元素集合：

$$\{In(Bucharest)\}.$$

Five Items to Formulate a Problem:

☐ 5) Path cos 路径代价

- **To assign a numeric cost to each path.**

  即每条路径所分配的一个数值代价。

- **E.g., step cost of taking action a in state s to reach state s' is denoted by:**

  例如：状态s下执行动作a到达状态s'的步骤代价表示为：

  $$c(s, a, s').$$

Thank you for your attention !

PoAI