Lecture 25

CS 6380 Artificial Intelligence

Introduction To Planning

Department of Computer Science and Engineering

Indian Institute of Technology Madras (IITM), India

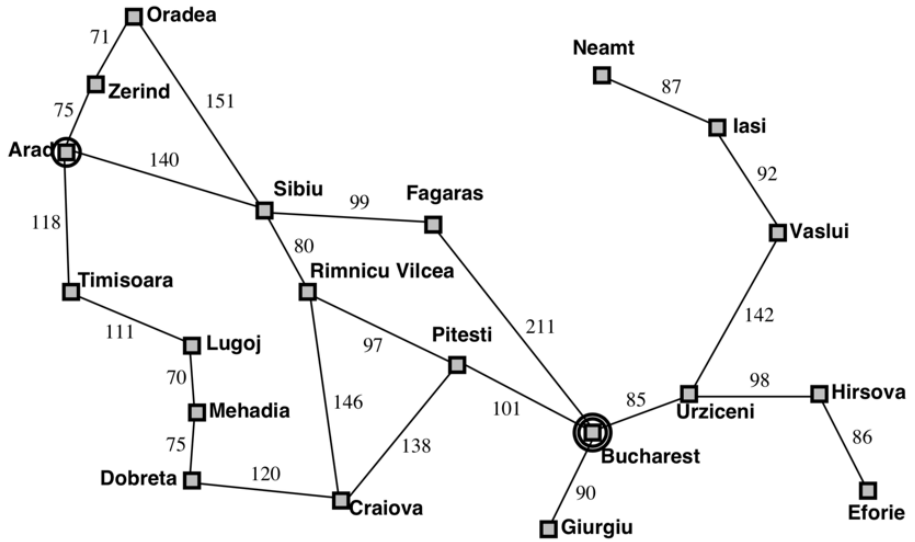


Some material is based on lecture slides for CSE 571: Artificial Intelligence by Siddharth Srivastava, ASU.

Deterministic Planning Problems

Recall search problems

- A search problem is defined by
  - set of possible states
    - Defined, but not enumerated a priori
  - $_0 \in$ □start state (~vertex)
  - set of actions
  - : → successor function
    - : × → deterministic transition function
    - ( ) = { ′: ∃ □(,) = ′}
  - : →{ , } goal test
  - : × × → ℝ+ □path cost



A **solution** to a search problem is a sequence of actions leading from s_0 to a state satisfying the goal test

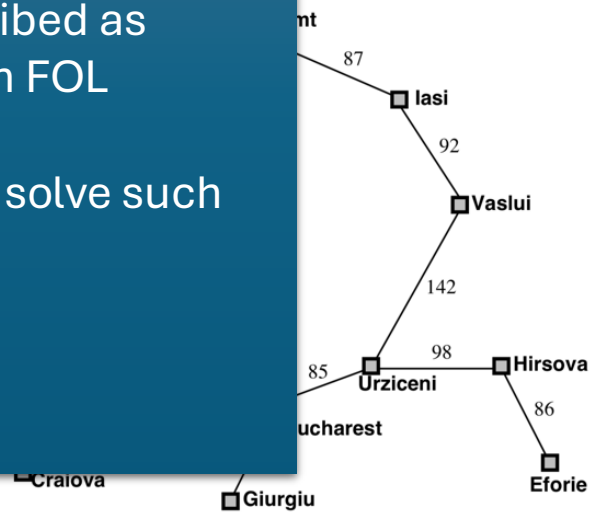
Deterministic Planning Problems

Recall search problems (lecture 3):

- A search pro
  - set of po
    - Defined,
  - $_0 \in$ sta
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  - : → s
    - : ×
    - ( ) = {
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  - : × ×

Today

- How real-world planning problems can be described as search problems using representations based on FOL
- How *informed search* algorithms can be used to solve such problems
  - Without having to write heuristics!



A **solution** to a search problem is a sequence of actions leading from s_0 to a state satisfying the goal test

SHAKEY

Source: https://www.youtube.com/watch?v=GmU7SimFkpU



SHAKEY and STRIPS

- Original idea behind the STRIPS system language and system
  - Express states in FOL
  - Describe actions in a reduced language

***push*(*k*, *m*, *n*)**

Precondition: **ATR(*m*) ∧ AT(*k*, *m*)**

delete list **ATR(*m*); AT(*k*, *m*)**

add list **ATR(*n*); AT(*k*, *n*) .**

STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving[1]

Richard E. Fikes
Nils J. Nilsson
Stanford Research Institute, Menlo Park, California

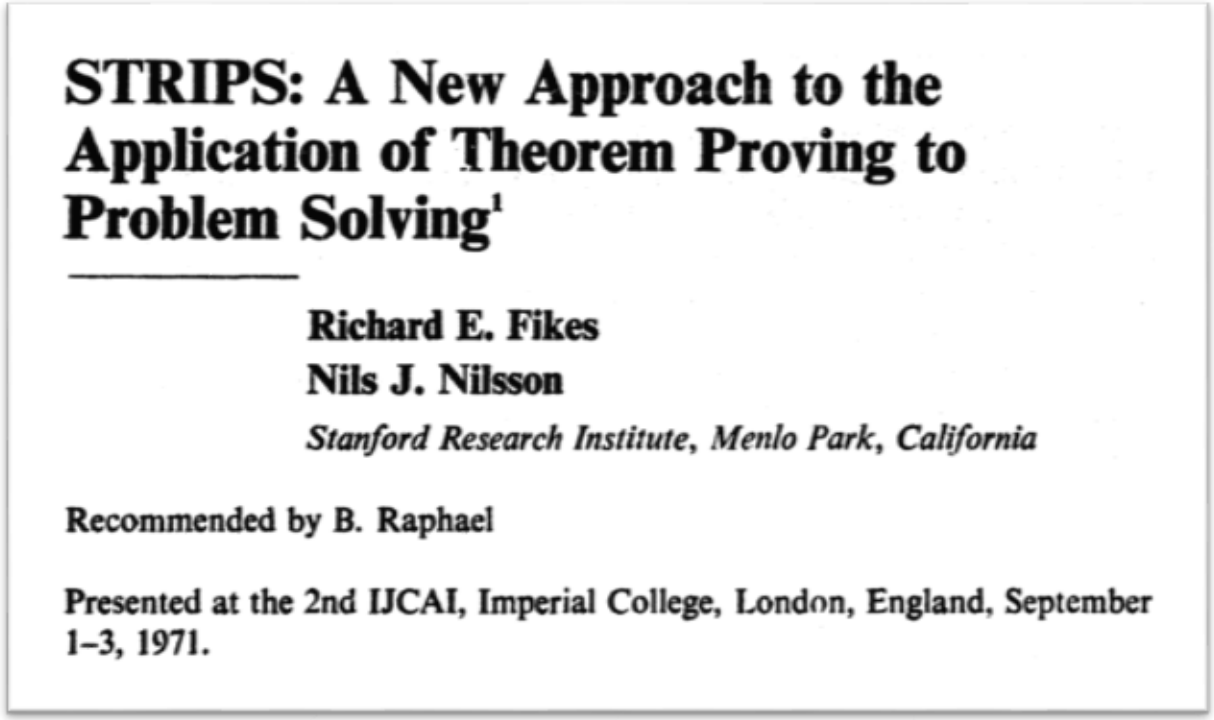
Recommended by B. Raphael

Presented at the 2nd IJCAI, Imperial College, London, England, September 1–3, 1971.

STanford Research Institute Problem Solver

SHAKEY and STRIPS

- Original idea behind the STRIPS language and planning system
  - Express states in FOL
  - Describe actions in a reduced language
  - Use a theorem prover to select actions that may be useful
- The algorithmic approach was limited in scope, scalability
- The specification language turned out to be more influential



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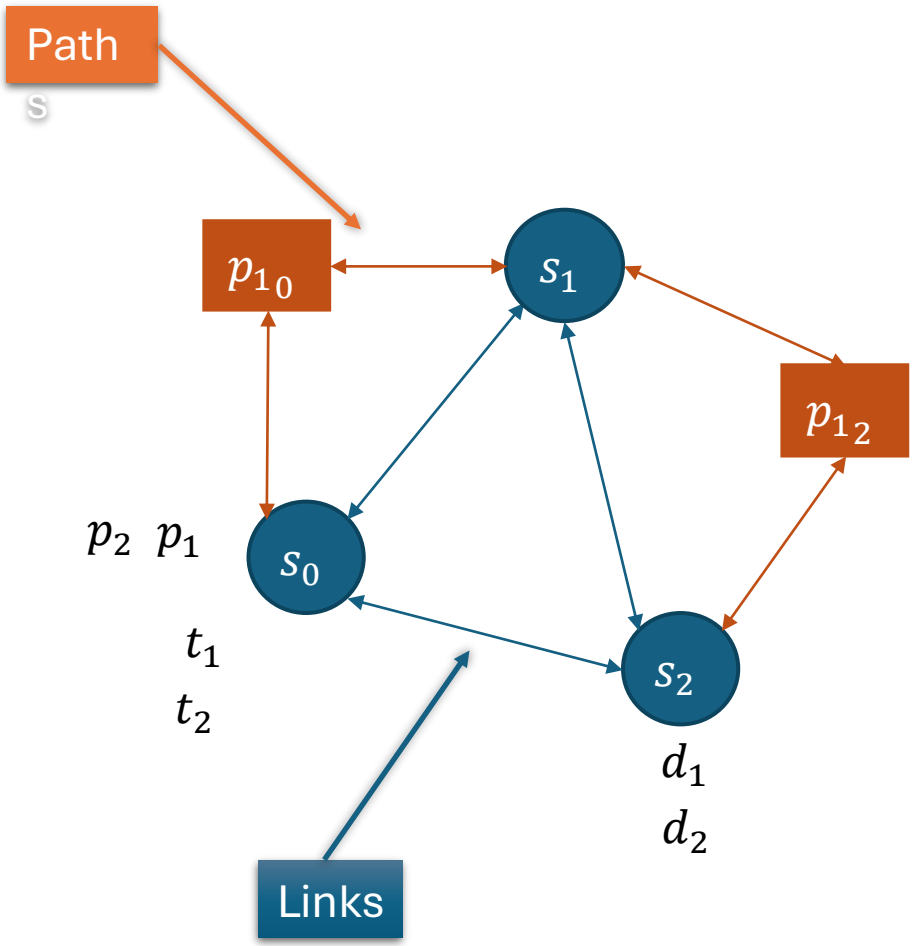
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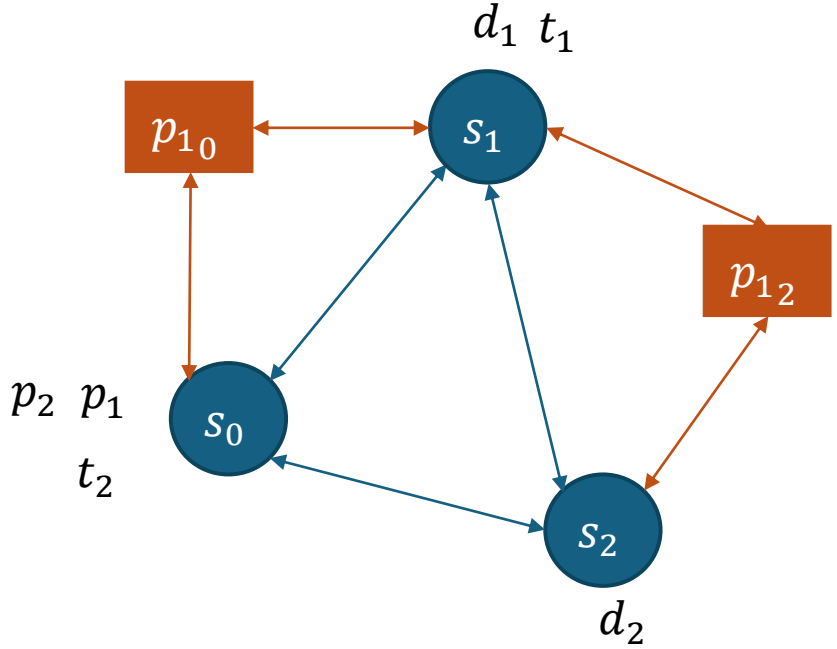
STanford Research Institute Problem Solver

Example Problem

Initial State



Goal State



Lower bound on #states: 3 possible locations for trucks, packages
7 possible locations for drivers
$3^4 \times 7^2 = 3969$ … "state explosion"