

# Deterministic Planning

Given:

- A description of the effects and preconditions of the actions
- A description of the initial state
- A goal to achieve

find a sequence of actions that is possible and will result in a state satisfying the goal.

**Idea:** search in the state-space graph.

- The nodes represent the states
- There is an arc  $\langle s, s' \rangle$  labeled with action  $A$  if
  - ▶  $A$  is an action that can be carried out in state  $s$  and
  - ▶  $s'$  is the state resulting from doing  $A$  in state  $s$
- A plan is a path from the state representing the initial state to a state that satisfies the goal.

# Example state-space graph

## Actions

*mc*: move clockwise

*mcc*: move counterclockwise

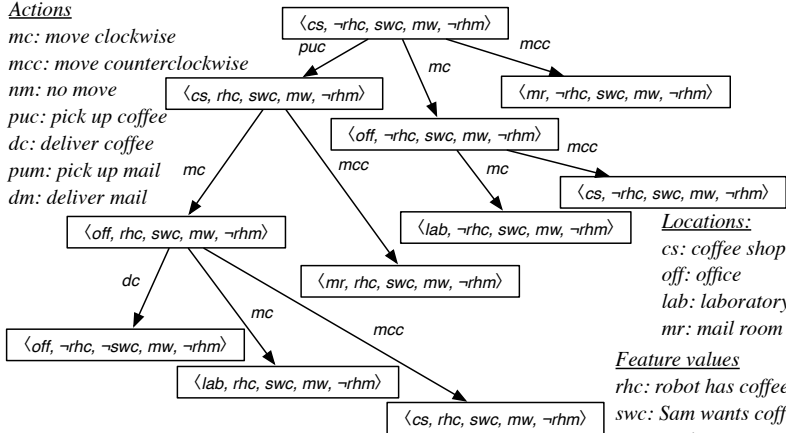
*nm*: no move

*puc*: pick up coffee

*dc*: deliver coffee

*pum*: pick up mail

*dm*: deliver mail



## Locations:

*cs*: coffee shop

*off*: office

*lab*: laboratory

*mr*: mail room

## Feature values

*rhc*: robot has coffee

*swc*: Sam wants coffee

*mw*: mail waiting

*rhm*: robot has mail

# Forward planning representation

- The search graph can be constructed on demand: you only construct reachable states.
- If you want a cycle check or multiple path-pruning, you need to be able to find repeated states.
- There are a number of ways to represent states:
  - ▶ As a map from features into their values
  - ▶ As a path from the start state

Forward search can use domain-specific knowledge specified as:

- a heuristic function that estimates the cost from a complete state description to a goal.
- domain-specific pruning of neighbors:
  - ▶ don't pick-up coffee unless Sam wants coffee.
  - ▶ unless the goal involves time constraints, don't do a "no move" action.
  - ▶ don't go to the coffee shop unless "Sam wants coffee" is part of the goal and Rob doesn't have coffee (maybe not)

