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.
Forward Planning

Idea: search in the state-space graph.

- The nodes represent the states
- The arcs correspond to the actions: The arcs from a state \( s \) represent all of the actions that are legal 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
- mac: move anticlockwise
- 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

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What are the errors?

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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 specification of the value of every feature
  - As a path from the start state
Forward search can use domain-specific knowledge specified as:

- a heuristic function that estimates the number of steps to the goal
- domain-specific pruning of neighbors:
  - don’t go to the coffee shop unless “Sam wants coffee” is part of the goal and Rob doesn’t have coffee
  - don’t pick-up coffee unless Sam wants coffee
  - unless the goal involves time constraints, don’t do the “no move” action.