Advanced Search: STRIPS and Property Space representation

Day 1 of Advanced Search

Material in part from http://www.cs.cmu.edu/~awm/tutorials

Property Space Representation

- Reasoning about sets of states in lieu of individual states
  - Relevance
  - Computational tractability
  - Conditional applicability

Property Space Representation

- Literals as properties identifying a subset of the set of all states S
  - Relevance can now be context-specific to the property being considered
  - So, properties are partitions
  - Intersection denotes arbitrary subsets

Property Space Representation

- Planning/Search transforms to reasoning about properties
  - How do actions impact properties describing current conditions of the world?
  - Challenge example: Making French Toast

STRIPS

Stanford Research Institute Problem Solver

- A simplified property-based planning representation and solver
  - \(< P, O, I, G >\)
    - \( P \) properties or conditions
    - \( O \) operators of form \(<\text{preconditions}, \text{postconditions}>\)
    - \( I \) initial conditions (initial state set)
    - \( G \) goal conditions (goal state set)
  - BlocksWorld example on board
  - Extensions: variable introduction
Shakey... the movie

Shakey

HARDWARE
- 2-wheel differential drive with two casters
- whiskers, camera, optical rangefinder
- transmission of TV signal off-board computer!

5 layers:
1) robot – PDP-15
2) LowLevelActions: (LISP) (roll) (tilt) (iristo)
3) Intermediate Level Actions (push) (go to) – contain error-handling to some degree!
4) STRIPS planner: construction of sequences of ILA’s
5) PLANEX (plan executor)

Example in Blocks World
- Literals that describe partitions of state space:
  - Table(a) block a is touching the table
  - On(a,b) block a is on top directly of b
  - Clear(b) block b has no blocks atop it

Example of an initial condition:
<table(a), on(b,a), clear(b)>

STRIPS
- Stanford Research Institute Problem Solver
- Limitations? (discussion)
- Property Space representation revisited: explicit uncertainty management has become more prevalent, but properties have power!

Blocks world: operators
- Actions are defined in terms of transformation of properties, or literals.
- stack(a,b) – stack a onto the top of b
- This only works under certain conditions because of the robot’s “limitations” so:
  - Preconditions for stack(a,b)
    - table(a), clear(b), clear(a)
  - Postconditions for stack(a,b)
    - on(a,b), not (table(a)), not(clear(b))
The Midterm Returns

- Average: 80
- Standard deviation: 13
- Top score: 103
- Advice…