CS 730/730W/830: Intro AI

Beyond STRIPS

Hierarchy

Beyond STRIPS

- **■** Comparison
- **■** Extensions
- Setting
- Break

Hierarchy

Beyond STRIPS

Comparison

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Hierarchy

Forward: states

- - irrelevant states

Backward: sets of states

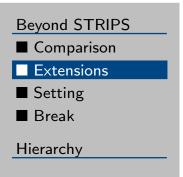
- – partial states: larger space, weaker heuristic, expressivity

Partial-order: plans

- + small space
- \blacksquare +/- least commitment
- – poor heuristics

STRIPS Extensions

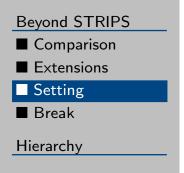
preconditions



negated goals: no problem with CWA
disjunctive precondition: for regression, just branch
conditional effects: for regression, if we need the effect, plan
for the condition
universal preconditions and effects: just ground goals and

Wheeler Ruml (UNH)

Setting



STRIPS assumes static, deterministic world, discrete time, single discrete actions.

- 1. time, resources
- 2. concurrent actions
- 3. abstraction: hierarchical planning
- 4. uncertainty: eg, disjunctive effects
- 5. temporally extended goals
- 6. execution monitoring, replanning
- 7. continuous state
- 8. multiple (self-interested) agents

Break

Beyond STRIPS Comparison Extensions Setting Break Hierarchy

- asst 8
- asst 9 Tue Apr 7
- wildcard vote Thu Apr 2

Beyond STRIPS

Hierarchy

- Hierarchy
- **■** HTNs
- HTN Example
- **■** HGNs
- HGN Example
- DAO
- Class Outline
- **■** EOLQs

Hierarchy

The Many Forms of Hierarchy

Beyond STRIPS

Hierarchy
Hierarchy
HTNs
HTN Example
HGNs
HGN Example
DAO
Class Outline
EOLQs

- task decomposition/refinement
- actions = goals for lower level
- actions = restrictions for lower level
- actions = hueristic for lower level

Hierarchical Task Networks

Beyond STRIPS

Hierarchy

■ Hierarchy

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- states, tasks, methods, actions
- actions: preconditions, effects
- methods: preconditions, subtasks
- "goal": complete decomposition into primitive actions

downward refinement: high-level guaranteed to refine into legal primitives

planning is semi-decidable, plan verification is NP-hard

SHOP2 planner

HTN Example: Logistics

Beyond STRIPS

Hierarchy

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DAO

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■ EOLQs

actions: Drive, Load, Unload

method:

MovePackageByTruck(p,s,d, t)

pre: At(p,s)

post: At(p,d)

subtasks: Drive(t, s), Load(p,t,s), Drive(t,d), Unload(p,t,d)

Hierarchical Goal Networks (IJCAI, 2013)

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- operators as in STRIPS
- goal network: partially-ordered set of DNF formulas over literals
- method: preconditions and subgoals. postconditions are last subgoal.
- subgoal: conjunction of literals

planner branches on:

- progressing state using applicable actions
- 'decomposing' problem using applicable methods applicable in state and relevant to goal

methods are only for search guidance!

HGN Example: Logistics

Beyond STRIPS

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actions: Drive, Load, Unload

method:

MovePackageByTruck(p,s,d, t)

pre: At(p,s)

subgoals: At(t, s), In(p,t), At(t,d), At(p,d)

Example: Dragon Age: Origins

Beyond STRIPS Hierarchy ■ Hierarchy **■** HTNs ■ HTN Example **■** HGNs ■ HGN Example DAO ■ Class Outline **■** EOLQs

Class Outline

Beyond STRIPS

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- 1. search: heuristics, CSPs, games
- 2. knowledge representation: FOL, resolution
- 3. planning: STRIPS, MDPs
- 4. learning: supervised, unsupervised
- 5. uncertainty: particle filters, HMMs

EOLQs

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- What question didn't you get to ask today?
- What's still confusing?
- What would you like to hear more about?

Please write down your most pressing question about AI and put it in the box on your way out.

Thanks!