Translation: Probabilistic Conformant Planning to DBN

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Overview

• Conformant Planning
  – Definition of the conformant planning task
• How people define conformant planning problems
  – Planning Domain Definition Language (PDDL)
    • Probabilistic PDDL [adds probabilistic actions to PDDL]
    • other minor extensions from PDDL [initial belief states]
  – Relational Dynamic Influence Diagram (RDDL)
• Previous Translation
  – PPDDL $\rightarrow$ DBN
• Current Translation
  – PPDDL $\rightarrow$ SAS+ $\rightarrow$ DBN
• Comparing both translations
Conformant Planning

Definition $P = <S, A, I, G>$

- $S$: set of state variables
  - grounded from first order state predicates
  - e.g. from $\text{On}(X,Y)$ we get $\text{On}(A,B)$ $\text{On}(A,C)$, ...

- $A$: set of action variables
  - grounded from first order action schemas
  - e.g. from $\text{Move}(X, Y, Z)$ we get $\text{Move}(A, B, C)$
  - action schema: list of (probability, conditional-effect) pairs
  - e.g. $[(0.5, \text{Move}(A,B,C), 0.4 \text{Move}(A, \text{Table}), 0.1 \text{Null}]$
  - weak condition vs. strong condition

- $I$: Initial belief state
  - probability distribution over the initial state variables

- $G$: Goal
  - a set of goal state

Task: Find a sequence of action that maximizes $Pr(\text{Final State is in Goal State})$
Conformant Planning

• Many variants of conformant Planning
  – classical planning + nondeterminism
    • nondeterministic → no probability distribution but logical disjunctions
    • most papers solve this problem

  – classical planning + initial belief state
    • still actions are deterministic

  – classical planning + initial belief state/ stochasitic actions
    • probabilistic planning without observation

  – Decision theoretic planning as non-observable MDP (NOMDP)
    • not popular

  – can be expressed by an Influence diagram that has no information sets
    • not popular
Translation based approaches in Classical Planning

- Translate classical planning as CNF and solve it by SAT solvers

- SatPlan
  - blackbox (STRePS to SAT from 97 to 2003)
  - SatPlan2004 (winner of IPC 2004)
  - Encoding Plans in Propositional Logic

- A Compact and Efficient SAT Encoding for Planning
  Nathan Robinson, Charles Gretton, Duc-Nghia Pham, and Abdul Sattar
  ICAPS 2008

- A Novel Transition Based Encoding Scheme for Planning as Satisfiability
  Ruoyun Huang, Yixin Chen, Weixiong Zhang AAAI 2010
SAS+ (Simplified Action Structure)

• Christer Bäckström
  – http://www.ida.liu.se/~chrba09/

• Malte Helmert (Finite Domain Representation)
  – http://ai.cs.unibas.ch/people/helmert/

  – LAMA 2011 is the winner of IPC 2011 Many planners are based on Fast Downward Planning System
Translation

• Input: PDDL based problem specification
  – PDDL/PPDDL files (what they use)

• Output: Graphical model
  – UAI files (what we use)
Translation

• Previous
  – PPDDL $\rightarrow$ DBN

• Now
  – PPDDL (with some modification) $\rightarrow$ SAS+ $\rightarrow$ DBN