ICAPS 2011

IPPC Results Presentation

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Additional domain development by Tom Walsh (ASU)
Main Objective for IPPC 2011

• More realistically motivated problems
  – PPDDL cannot represent many probabilistic domains
    • Traffic Control
    • Elevator Control
    • Mars Rovers
  – Needed
    → concurrency
    → independent exogenous effects
    → continuing processes and non-goal rewards
    → partial observability
    → distributions that are complex function of state
    → enumerated, integer, continuous variables (no competitors)
  – Required a new language
    • RDDL (new lifted DBN transition semantics)
A Brief History of (ICAPS) Time

Big Bang

ICAPS

UAI

Dynamic Bayes Nets (1989)
Dean and Kanazawa
Factored Stochastic Processes

Hoey, Boutilier, Poupart
DBN + Utility: Fact. (PO)MDP

RDDL (2010)
Sanner
PDDL 2.2 × DBN++

ADL (1987)
Pednault
Cond. Effects
Open World

STRIPS (1971)
Fikes & Nilsson
Relational

PDDL 1.2 (1998)
McDermott et al
Univ. Effects

PDDL 1.2 (2003)
Fox & Long
Numerical fluents,
Conc., Exogenous

PDDL 2.1, + (2003)
Gerevini & Long
Traj. Constraints,
Preferences

PDDL 2.2 (2004)
Edelkamp & Hoffmann
Derived Red, Temporal

PPDDL (2004)
Littmann & Younes
Prob. Effects

PDDL 3.0 (2004)
Gerevini & Long
Relational!

PDDDL history from: http://ipc.informatik.uni-freiburg.de/PddlResources
What is RDDL?

• Relational Dynamic Influence Diagram Language
  – Relational [DBN + Influence Diagram]
  – Everything is a fluent!
    • states
    • observations
    • actions
    • derived (stochastic) predicates
  – Uniform expression language
Other Objectives for IPPC 2011

- Translations to draw in different communities
  - Factored MDP / POMDP community
  - ICAPS PPDDL community
  - 11 competitors!

- Single normalized evaluation criteria
  - In previous competitions, a mix of...
    - plan length
    - goal %
    - planner time
      (skipping hard problems could improve domain averages)
RDDLSim Software

Open source & online at
http://code.google.com/p/rddlsim/
RDDL Software Overview

- BNF grammar and parser
- Simulator
- Automatic translations
  - LISP-like format (easier to parse)
  - SPUDD & Symbolic Perseus (boolean subset)
  - Ground PPDDL (boolean subset)
- Client / Server
  - Java and C/C++ sample clients
  - Evaluation scripts for log files
- Visualization
  - DBN Visualization
  - Domain Visualization – see how your planner is doing
Domains and Evaluation

- 8 domains
  - **Traffic Control**: highly exogenous, concurrent
  - **Elevator Control**: highly exogenous, concurrent
  - **Game of Life**: highly combinatoric
  - **SysAdmin**: highly exogenous, complex transitions
  - **Navigation**: goal-oriented, determinization killer
  - **Crossing Traffic**: goal-oriented, deterministic if move far left
  - **Skill Teaching**: few exogenous events
  - **Reconnaissance**: few exogenous events

- Conditions
  - 24 hours for all runs
  - 10 instances per domain, 30 runs per instance
  - No discount, finite horizon of 40

- Used average normalized score [0,1]
  - Min: max(random policy, noop policy)
  - Max: best competitor
  - Scores < 0 set to 0
Boolean Traffic
Boolean Elevators
Crossing Traffic (aka Frogger)
Navigation
(aka deteminization killer)
Competition Format

- **Amazon EC2** (Elastic Compute Cloud)
  - 11 instances on demand running for 24 hours
    - Ensures everyone has same computational power
      - Large EC2 instance (7.5Gb RAM, 2 Cores)
    - Everyone has admin access to their machines
  - Just pay for time used
    - received an Amazon EC2 grant of $1000 for competition
      MANY THANKS TO AMAZON FOR THEIR GENEROSITY!!!
    - so running it was free

→ Highly recommended for future competitions!!!
## Competitors: Boolean MDP Track

<table>
<thead>
<tr>
<th>Competitors</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROST</td>
<td>UCT/Single Outcome Determinization, Caching</td>
</tr>
<tr>
<td>(Eyerich, Keller – Uni. Freiburg)</td>
<td></td>
</tr>
<tr>
<td>Glutton</td>
<td>Iterative Deepening RTDP, Caching</td>
</tr>
<tr>
<td>(Kolobov, Dai, Mausam, Weld – UW)</td>
<td></td>
</tr>
<tr>
<td>MIT-ACL</td>
<td>RL / Linear Fun. Approx, Feature Discovery</td>
</tr>
<tr>
<td>(Ure, Toksoz, Redding, Gemifard – MIT)</td>
<td></td>
</tr>
<tr>
<td>Beaver</td>
<td>UCT, SPUDD Guidance</td>
</tr>
<tr>
<td>(Nadamuni, Joshi, Fern, Tadepalli – OSU)</td>
<td></td>
</tr>
<tr>
<td>SPUDD</td>
<td>SPUDD: Value Iteration with ADDS <strong>(BASELINE)</strong></td>
</tr>
<tr>
<td>(Zhu, Grzes, Hoey – Uni. Waterloo)</td>
<td></td>
</tr>
</tbody>
</table>
# Results: Boolean MDP Track

- **1\textsuperscript{st} Place:** PROST
- **2\textsuperscript{nd} Place:** Glutton

<table>
<thead>
<tr>
<th>Team</th>
<th>Score</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROST (Eyerich, Keller)</td>
<td>0.874</td>
<td>± 0.059</td>
</tr>
<tr>
<td>Glutton (Kolobov, Dai, Mausam, Weld)</td>
<td>0.795</td>
<td>± 0.066</td>
</tr>
<tr>
<td>Beaver (Nadamuni, Joshi, Fern, Tadepalli)</td>
<td>0.245</td>
<td>± 0.066</td>
</tr>
<tr>
<td>MIT-ACL (Ure, Toksoz, Redding, Gemifard)</td>
<td>0.107</td>
<td>± 0.055</td>
</tr>
<tr>
<td>SPUDD (Zhu, Grzes, Hoey)</td>
<td>COMMUNICATION BUG</td>
<td></td>
</tr>
<tr>
<td><strong>SPUDD (Zhu, Grzes, Hoey)</strong></td>
<td>0.297</td>
<td>± 0.101</td>
</tr>
</tbody>
</table>

*(Post-competition results after rddlsim server communication bugs fixed, SPUDD unchanged)*
## Competitors: Boolean POMDP Track

<table>
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<th>Competitors</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMDPX_NUS (Wu, WS Lee, D Hsu – NUS)</td>
<td>SARSOP / UCT (POMCP)</td>
</tr>
<tr>
<td>KAIST-AILAB (D Kim, K Lee, K-E Kim – KAIST)</td>
<td>Symbolic HSVI (ADDs), Symmetry Detection</td>
</tr>
<tr>
<td>HyPlanClient (Borera, Pyeatt – Texas Tech)</td>
<td>~RTDP-Bel</td>
</tr>
<tr>
<td>POND (Bryce, Olsen – USU)</td>
<td>Translation to Conf. Planning, Hindsight Opt</td>
</tr>
<tr>
<td>Symbolic Perseus (Poupart, Hoey, Morrison – Uni. Waterloo)</td>
<td>PBVI with ADDs</td>
</tr>
<tr>
<td>McGill (Png, Ong, Pineau – McGill)</td>
<td>UCT (POMCP)</td>
</tr>
</tbody>
</table>
Results: Boolean POMDP Track

- **1st Place:** POMDPX_NUS
- **2nd Place:** KAIST-AILAB

<table>
<thead>
<tr>
<th>Team</th>
<th>Score</th>
<th>±</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMDPX_NUS (Wu, WS Lee, D Hsu)</td>
<td>0.590</td>
<td>± 0.098</td>
</tr>
<tr>
<td>KAIST-AILAB (D Kim, K Lee, K-E Kim)</td>
<td>0.420</td>
<td>± 0.101</td>
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<tr>
<td>HyPlanClient (Borera, Pyeatt)</td>
<td>0.168</td>
<td>± 0.074</td>
</tr>
<tr>
<td>POND (Bryce, Olsen)</td>
<td>0.152</td>
<td>± 0.058</td>
</tr>
<tr>
<td>Symbolic Perseus (Poupart, Hoey, Morrison)</td>
<td>0.117</td>
<td>± 0.064</td>
</tr>
<tr>
<td>McGill (Png, Ong, Pineau)</td>
<td>0.034</td>
<td>± 0.031</td>
</tr>
</tbody>
</table>
Thanks to All Competitors!