ICAPS 2004
International Planning
Competition 2004 (IPC-4)
First Probabilistic Track

Organizers:
Michael L. Littman (Rutgers University)
Håkan L. S. Younes (Carnegie Mellon)

Participants

Group C. UMass
Participants: Zhengzhu Feng (Univ. of Massachusetts)
Eric A. Hansen (Mississippi State Univ.)
Description: Symbolic heuristic search.

Group E. Dresden ("FCPlanner")
Participants: Eldar Karabaev (Dresden Univ. of Tech.)
Olga Skvortsova
Description: First-order value iteration in fluent calculus; domain-specific.

Special Thanks
Organizing Group Members (Rutgers)
- John Asmuth
- David Weissman
- Paul Batchis
Sven and Shlomo
IPC-4 Organizers
NSF
The (very) active participants: ideas, suggestions, hard work
Group G. ANU ("NMRDPP")
Participants: Charles Gretton
David Price (The Australian National U.)
Sylvie Thiébaux
Descriptions:
G1: Planner that exploits non-Markovian rewards.
G2: NMRDPP augmented with control knowledge.

Group J. Purdue
Participants: SungWook Yoon (Purdue University)
Alan Fern
Robert Givan
Descriptions:
J1: Human-written policy in Classy’s policy language (“Purdue-Humans”).
J2: Offline policy iteration by reduction to classification, automatically acquiring a domain-specific policy (“Classy”).
J3: Deterministic replanner using FF (“FF-rePlan”).

Group P. Simón Bolívar ("mGPT")
Participants: Blai Bonet (Universidad Simón Bolívar)
Héctor Geffner (Univ. Pompeu Fabra)
Description: Labeled RTDP with lower bounds extracted from the problem description.

Q. Michigan Tech ("Probapop")
Participants: Nilufer Onder (Michigan Tech. Univ.)
Garrett C. Whelan
Li Li
Description: POP-style planner (no sensing).
R. CERT
Participants: Florent Teichteil-Königsbuch
Patrick Fabiani
Description: Explicit state enumeration and DBNs, producing value functions.

Probabilistic Features
Main differences from the classical track:
• Actions can have uncertain effects.
• Even optimal plan may sometimes fail.
• Value is action cost plus goal reward.
• No durative actions, derived predicates or functions.
• No separate “optimal”.
• Didn’t separate plan/execution.
• No unified execution environment.

PPDDL Example
(define (domain bomb-and-toilet)
 (:requirements :conditional-effects :probabilistic-effects)
 (:predicates (bomb-in-package ?pkg) (toilet-clogged) (bomb-defused))
 (:action dunk-package
  :parameters (?pkg)
  :effect (and (when (bomb-in-package ?pkg) (bomb-defused))
    (probabilistic 0.05 (toilet-clogged)))))

(define (problem bomb-and-toilet)
 (:domain bomb-and-toilet)
 (:requirements :negative-preconditions)
 (:objects package1 package2)
 (:init (probabilistic 0.5 (bomb-in-package package1)
    0.5 (bomb-in-package package2))
 (:goal (and (bomb-defused) (not (toilet-clogged)))))

Evaluation
Participants were presented with twenty problems in PPDDL format.
To evaluate each problem:
• Connect to server (at CMU or Rutgers).
• Get initial state, provide action.
• Iterate until goal or quit.
• Value: Action costs (if any) & 500 for goal.
• Repeat 30 times in 15 minutes and average.
**Blocksworld**

**Objects:** Table and blocks.
**Actions:** Pick up and put down blocks.
**Goal:** Make a predetermined stack.
**Noise:** Blocks may slip onto table when moved.
**Costs:** Goal version (none) or unit per action.
**Notes:** Generator provided in advance.
**Problems:** 5, 8, 11, 15, 18, 21 blocks & goal version.
**Policy:** Unstack & stack, repeating failed acts.

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**Colored Blocksworld**

**Objects:** Table and blocks with colors.
**Actions:** Pick up and put down blocks.
**Goal:** Make a stack described by color sequence.
**Noise:** Blocks may slip onto table when moved.
**Costs:** Goal version (none) or unit per action.
**Notes:** Generator provided in advance.
**Problems:** 5, 8 & 11 blocks & goal version in 3 colors.
**Policy:** Unstack & stack, repeating failed acts.

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**Boxworld**

**Objects:** Packages and cities (graph).
**Actions:** Drive or fly, depending on edge.
**Goal:** Transfer packages to their destinations.
**Noise:** Get lost driving and go to wrong neighbor.
**Costs:** Goal version (none) and unit per action.
**Notes:** Generator provided in advance.
**Problems:** 10 boxes, 5/10/15 cities (reward, goal).
**Policy:** Standard, repeating failed acts.

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**Exploding Blocksworld**

**Objects:** Table and blocks.
**Actions:** Pick up and put down blocks.
**Goal:** Make a predetermined stack.
**Noise:** First put down may trigger explosion, irretrievably destroying object it was placed on.
**Costs:** Goal, may become unreachable.
**Notes:** Must plan ahead to avoid dead end.
**Problems:** 11 blocks.
**Policy:** Use “sacrificial” blocks to preserve stack.
**File World**

**Objects:** Folders and files.
**Actions:** Check destination, get/put folder, put in file.
**Goal:** Put all files in proper folders.
**Noise:** Destination chosen randomly when checked.
**Costs:** Getting folder expensive, filing cheap.
**Notes:** Reason about the need to gain information.

**Problem:** 5 folders, 30 files.

**Policy:** Get folder, put in all appropriate files.

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**Tire World**

**Objects:** Cities and spare tires.
**Actions:** Drive, replace flat, pick up spare.
**Goal:** Reach destination.
**Noise:** Tire may go flat, requiring replacement.
**Costs:** Unit costs, high cost for “call AAA”.
**Notes:** Must construct contingent plan to do well.

**Problem:** 30 cities, reward & goal version (get stuck).

**Policy:** Drive on longer route, always get a spare!

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**Towers of Hanoise**

**Objects:** Disks and rods.
**Actions:** Single, double disk moves.
**Goal:** Move all disks to Rod 3 from Rod 1.
**Noise:** Disk may slip and be lost; for doubles, slip probability depends on location of Disk 5.
**Costs:** Goal, with dead ends.
**Notes:** Weigh success probability of different paths.

**Problem:** 5 disks.

**Policy:** Singles, then doubles after largest disk moved.

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**Zenotravel**

**Objects:** Plane and cities.
**Actions:** Fly, zoom.
**Goal:** Reach destination.
**Noise:** Different geometric distributions for actions.
**Costs:** Goal only.
**Notes:** Adapted from IPC-3, a simple variant.

**Problem:** 2 cities.

**Policy:** Repeating any flying action until successful.
Evaluation Tracks: Overall

• Used goal-reward versions of all domains (goal only counted as 500).
• Domains: Blocksworld (7), Colored Blocksworld (2), Boxworld (5), Exploding Blocksworld, File World, Tire World (2), Towers of Hanoise, Zenotravel

Goal-based Domains

• For planners that did not use reward, ignored action costs (maximize probability of reaching goal) with same domains as Overall track.
• Domains: Blocksworld (7), Colored Blocksworld (2), Boxworld (5), Exploding Blocksworld, File World, Tire World (2), Towers of Hanoise, Zenotravel

Overall, Non-Blocks/Box

• Blocksworld and Boxworld dominated the full set and we wanted to see how subtler problems were handled.
• Domains: Exploding Blocksworld, File World, Tire World (2), Towers of Hanoise, Zenotravel

Domain-specific

• “Domain-specific” allowed human tuned rules; “Domain-specific, No Tuning” did not.
• Generated domains: Blocksworld (8), Colored Blocksworld (6), Boxworld (5)
"Blind" Planner

- Planners must produce straightline plans.

Analysis

Some participants only produced results on a subset of problems (due to problem size, language features):

But don't count the other ones as failures, count them as valiant efforts met with less success then they otherwise might have been :)

Encourage sharing: handling of language features.

Wishlist: Next Time?

- Better security, logging on server.
- More focus on interesting domains (simply adding noisy action failures to a deterministic domain not enough); would like to see successful planners in non-Blocksworld domains.
- Natural source of problems—"winner" quite different depending on mix.

Awards/Certificates

Eldar Karabaev and Olga Skvortsova
- Group E. Dresden ("FCPlanner")
- Participation

Charles Gretton, David Price and Sylvie Thiébaux
- Group G1. ANU ("NMRDPP")
- 2nd Place, Overall, Non-Blocks/Box
- Group G2. ANU ("NMRDPP + control knowledge")
- 2nd Place, Domain-specific
- Group C. UMass
- Zhengzhu Feng and Eric A. Hansen
- 1st Place, Overall, Non-Blocks/Box

SungWook Yoon, Alan Fern and Robert Givan