

Unsolvability IPC Track

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Before we begin...

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- Running an IPC is hard (*now we know!*)
- Unsolvability is (thankfully still) hard
- Kudos to those who made it easier:
 - Florian Pommerening & Jendrik Seipp (& the Basel cluster admins) for **lab** and server support / consultation
 - Malte Helmert for involved FD diagnosis
 - ICAPS for sponsoring the awards
 - All who submitted planners and domains (to be mentioned below) – many who put up with very long email threads!

Motivation

~~Satisficing is too easy~~ To promote techniques that are dedicated at detecting if a planning problem is unsolvable.

Applications

- System verification / diagnosis
- Planning with avoidable deadends
- Identifying human error in encodings
- Components in cellular automata proofs

Scoring

- Primary focus was coverage on unsolvable instances
- Solver disqualified on a domain for an incorrect result

Didn't happen once!

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Ideal Benchmark Properties

- 1 Mix of solvable and unsolvable instances
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Benchmarks

Sourced from deadend states of classical problems, ~~width-based classical encodings~~, oversubscribed problems, new domains, etc.

Domains (15)

- 3 from existing set
- 12 newly submitted (or modified) domains

Planners (11+1)

- 14 teams expressed interest
- 11 teams submitted
- 4 labs represented

Reused Unsolvable Domains

- **bottleneck**: Move around a grid; never revisit a spot
- **pegsol**: Classic game – hop a peg, remove the hopped
- **sliding-tiles**: Classic game – slide tiles to open space.
Reversing two tiles causes the problem to be unsolvable

Thanks Marcel Steinmetz, Hootan Nakhost,
Jörg Hoffmann, Martin Mueller

Idea Constrains the problem via a set of tunable parameters. Most importantly for the contest, “constrainedness” < 1 makes the problem unsolvable (i.e., 0.999 is very nearly solvable)

Input Domains nomystery, tpp, rovers

Thanks Patricia Riddle and Mike Barley

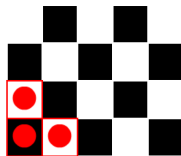
Idea Reformulates the problem using
a bagged representation

Input Domains transport, gripper, barman

- **document-transfer** (*Thanks to Jordan Douglas*): Need to deliver documents, but can also use them to fuel the travel.
- **diving** (*Thanks to Charles Gretton, Nathan Robinson, CM*): Need to photograph certain locations, but air tanks are a precious resource that aren't always there.
- **diagnosis** (*Thanks to Patrik Haslum*): Encodings of diagnosis problems for control of power plans / autonomous helicopters.

Baffling Board Games

- **tetris** (*Thanks to Mauro Vallati*): Moving tetris pieces around until the board is cleared.
- **pegsol-row5** (*Thanks to Florian Pommerening and Malte Helmert*): Must get 5 rows up on a board, but the task is mathematically impossible.
- **chessboard-pebbling** (*Thanks to Florian Pommerening*): Must clear the bottom corner of an infinite chessboard.



- **ReachLunch** (*Tomas Balyo, Martin Suda*)
6min DFS phase, followed by Property Directed Reachability
- **iProverPlan** (*Konstantin Korovin, Martin Suda*)
Theorem prover for a lifted (1st-order) SAT-as-planning encoding
- **SymPA** (*Alvaro Torralba, Jörg Hoffmann*)
Symbolic search using PDBs and perimeters
 - **irr** variant removes irrelevant operators found with M&S
- **M+S** (*Alvaro Torralba, Jörg Hoffmann*)
M&S with linear merges and perfect shrinking (optionally **irr**)

- **SimDominance** (*Alvaro Torralba, Jörg Hoffmann*)
M&S with multiple merge strategies. A* with h^1 / dominance pruning
- **DECS** (*Daniel Gnad, Alvaro Torralba, Jörg Hoffmann, Martin Wehrle*)
Decoupled search with an X-shape topology using A* and h^{max}
- **Django** (*Daniel Gnad, Marcel Steinmetz, Jörg Hoffmann*)
Performs incremental red-black search using A* and h^{max} .
- **CLone** (*Marcel Steinmetz, Jörg Hoffmann*)
DFS using Critical-Path Driven Clause Learning

- **Aidos** (*Jendrik Seipp, Florian Pommerening, Silvan Sievers, Martin Wehrle, Chris Fawcett, Yusra Alkhazraji*)
Portfolio using stubborn sets and combination of (1) DE PDBs (2) LP with potentials (3) projected “depletable resources”
 - **v1** distributes time according to experiments; **v2** distributes uniformly; and **v3** distributes to maximize coverage / time
- **h⁺⁺** (*Patrik Haslum*)
Incrementally improves lower bounds until h^+ is unsolvable
- **DE-PDB** (*Florian Pommerening, Jendrik Seipp*)
 $\frac{1}{2}$ time spent on building DE PDB and $\frac{1}{2}$ spent on DFS with pruning
- **blind**
Eager blind search using the latest FD

Results (out of 340 problems)

Runner Up

Winner

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Runner Up – **SymPA**

irr	239	Alvaro Torralba
base	227	Jörg Hoffmann

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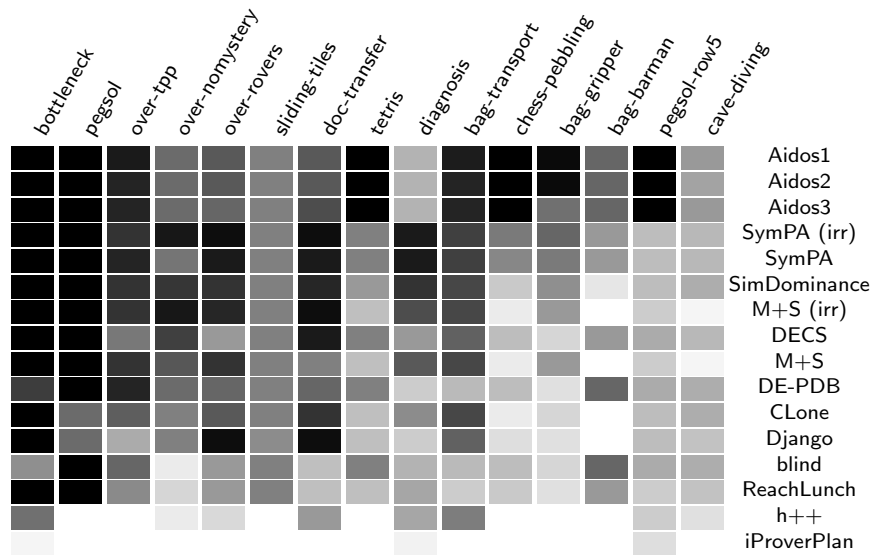
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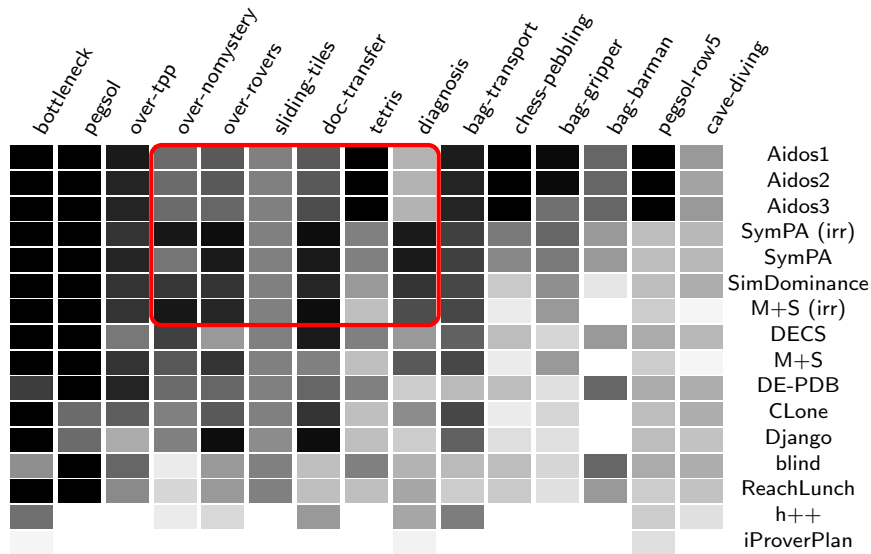
Winner – **Aidos**

v1	262	Jendrik Seipp
v2	259	Florian Pommerening
v3	250	Silvan Sievers
		Martin Wehrle
		Chris Fawcett
		Yusra Alkhazraji

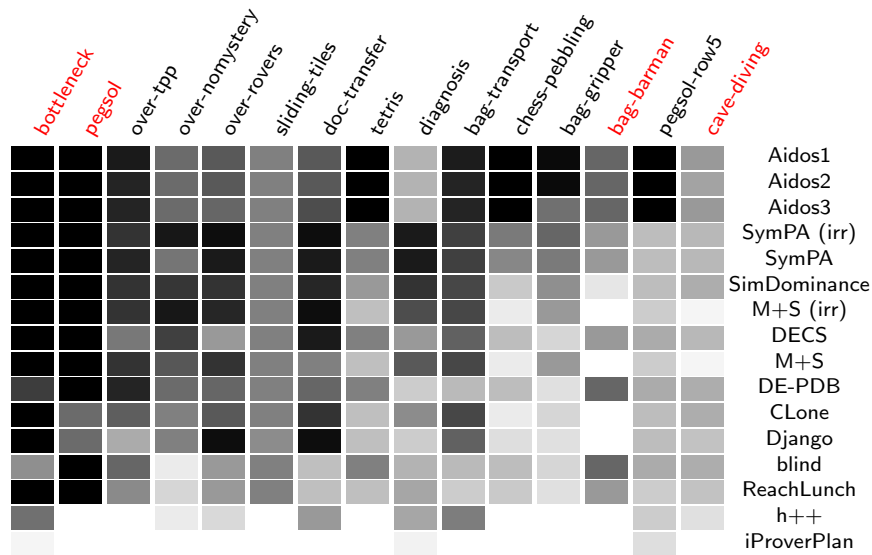
Results



Results



Results



Unknown Known Results

Domain Team	SymPA (irr)	SimDominance	SymPA	CLone	DECS
document-transfer	5	1	0	0	0
diagnosis	2	3	3	2	2
TOTAL:	7	4	3	2	2

Table: Unknowns solved (Part 1)

Domain Team	Aidos3	Aidos2	Aidos1	Django	M+S (irr)
document-transfer	0	0	0	0	1
diagnosis	1	1	1	1	0
TOTAL:	1	1	1	1	1

Table: Unknowns solved (Part 2)

To be released on `unsolve-ipc.eng.unimelb.edu.au`

- Git repo of solvers / domains / eval setup / etc
- DataJoy project of all the statistics / analysis
- Planner descriptions (extended abstracts)

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Any takers?

Thanks again to all who participated, submitted domains, provided server support, played devil's advocate¹, encouraged the endeavour, etc.

¹if LAMA doesn't solve in 30min; return "unsolvable"