Unsolvability IPC Track

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Before we begin...

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- Unsolvability is (thankfully still) hard

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- 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!

Unsolvability IPC Track

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

Details

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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2. No syntactic distinction between them
3. At least some solvable problems are hard

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Benchmarks

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

Submissions

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

Over-subscribed Set

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

Bagged Problems

Thanks	Patricia Riddle and Mike Barley
Idea	Reformulates the problem using a bagged representation
Input Domains	transport, gripper, barman

Documents, Diving, and Diagnostics

- **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.

Planners (1/3)
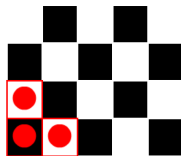
- **ReachLunch** (*Tomas Balyo, Martin Suda*)
  6min DFS phase, followed by Property Directed Reachability

- **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**)

Planners (2/3)

- **SimDominance** (*Alvaro Torralba, Jörg Hoffmann*)
  M&S with multiple merge strategies. A* with h^1 / dominance pruning

- **DECS** (*Daniel Gnad, Jörg Hoffmann*)
  Decoupled search with an X-shape topology using A* and h^{max}

- **Django** (*Daniel Gnad, Jörg Hoffmann*)
  Performs incremental red-black search using A* and h^{max}.

- **CLone** (*Marcel Steinmetz, Jörg Hoffmann*)
  DFS using Critical-Path Driven Clause Learning

Planners (3/3)

- **Aidos** (*Martin Wehrle, Jendrik Seipp,*
    Florian Pommerening, 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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Runner Up – SymPA

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Winner – Aidos

v1	262	Martin Wehrle
v2	259	Jendrik Seipp
v3	250	Florian Pommerening
		Yusra Alkhazraji
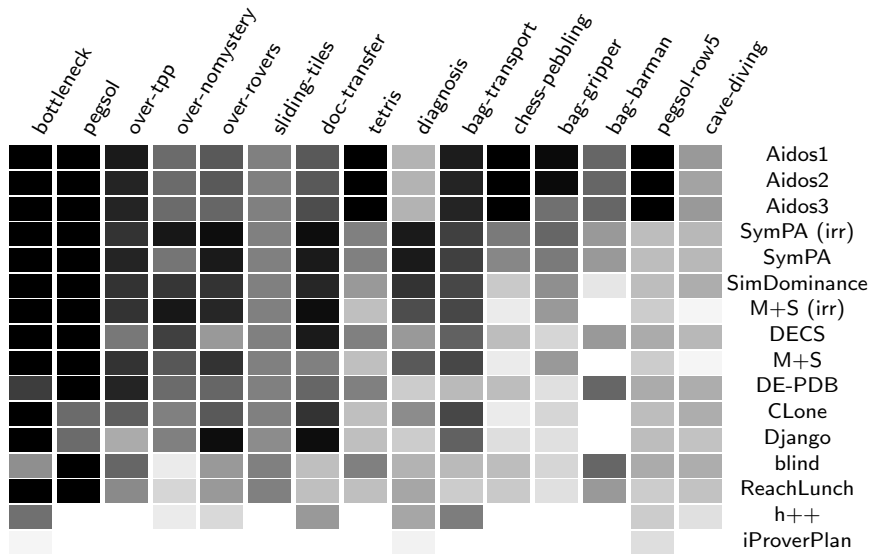
Results
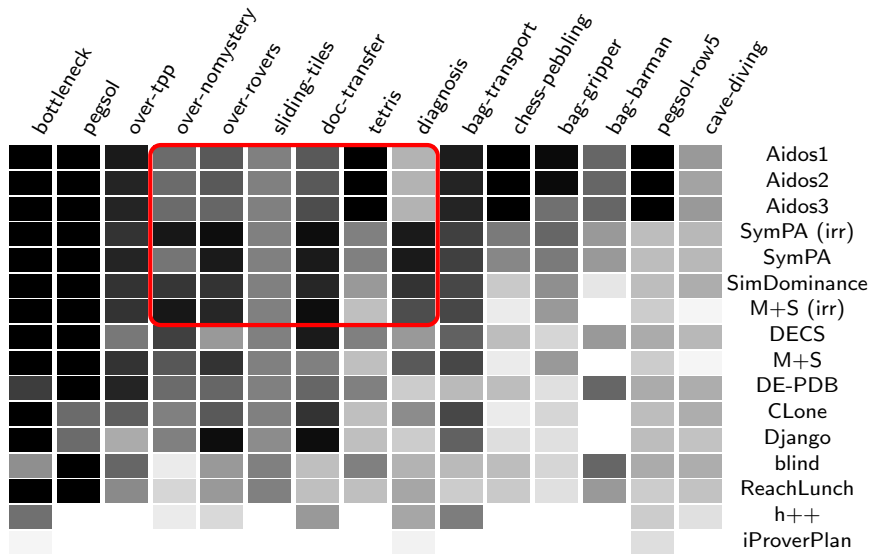
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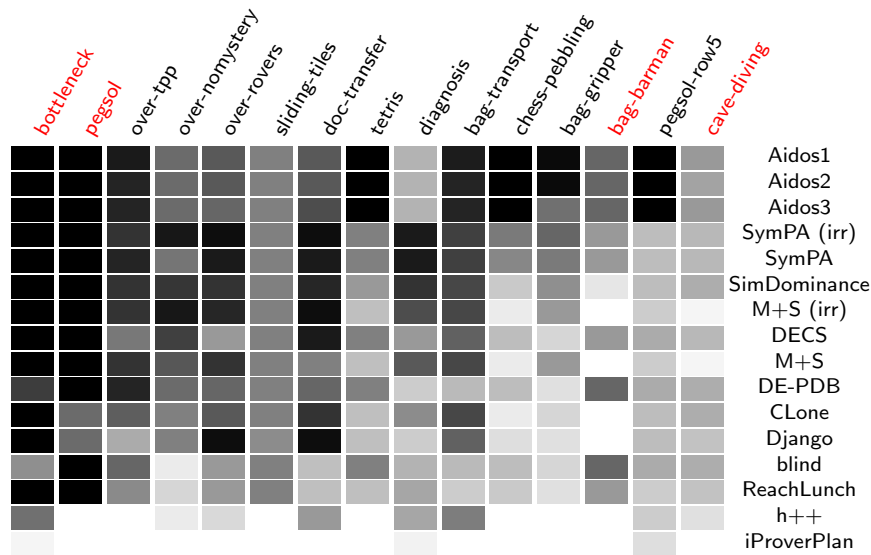
Unknown Known Results

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)

Next Steps

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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Unsolve-IPC-2018

Any takers?

Thanks again to all who participated, submitted domains, provided server support, played devil's advocate[1], encouraged the endeavour, etc.

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