International Planning Competition 2023
Classical Tracks

Daniel Fišer[1] Florian Pommerening[2]

[1]Saarland University

[2]University of Basel, Switzerland

July 10, 2023

About IPC 2023

About

- Three tracks: Optimal, Satisficing, and Agile
- The same rules as the last time (2018)
- PDDL features include disjunctions, quantifiers, conditional effects, negative preconditions, and negative goal conditions.

Submission and Execution of Planners

- Submissions via Apptainer (formerly Singularity) and Github
  $\rightsquigarrow$ Worked well

Submission and Execution of Planners

- Submissions via Apptainer (formerly Singularity) and Github
  $\rightsquigarrow$ Worked well
- Compiling Planners semi-automatically
  $\rightsquigarrow$ Could have been better automated

Submission and Execution of Planners

- Submissions via Apptainer (formerly Singularity) and Github
  $\rightsquigarrow$ Worked well
- Compiling Planners semi-automatically
  $\rightsquigarrow$ Could have been better automated
- Using `runsolver` to limit resources
  $\rightsquigarrow$ Less accurate then cgroups but less work
  $\rightsquigarrow$ Apptainer also reserves memory

Submission and Execution of Planners

- Submissions via Apptainer (formerly Singularity) and Github
  ⇝ Worked well
- Compiling Planners semi-automatically
  ⇝ Could have been better automated
- Using `runsolver` to limit resources
  ⇝ Less accurate then cgroups but less work
  ⇝ Apptainer also reserves memory
- Bug-Fixing
  - Responsibility to recognize bugs outsourced to authors
    ⇝ Useful but should use stricter schedule
  - Several test rounds
    ⇝ Useful but should have more rounds with final instances
  - Unfortunatelly, there are still some bugs in planners
    ⇝ Competition is (also) a programming competition
    ⇝ Should be addressed in published images

Statistics

- 24 planner repositories
  - 65 images across all tracks
  - 34 planner abstracts
  - source size from 4 MB to 3.1 GB
  - compile times of up to 1.5 hours
- 25 Github teams
  - 47 authors
  - 19 affiliations
  - $\sim$22 first-time participants
  - 13 authors contributed to 20 or more submissions
  - One author contributed to 34 submissions (52% of all). Can you guess who?

Techniques

- Delete-relaxation heuristics
- Abstraction heuristics
- Operator-counting heuristics
- Landmark heuristics
- Cost-partitioning, Post-Hoc optimization heuristic
- Dominance pruning
- Symbolic search
- Decoupled search
- Novelty/width search
- Translations with FD, Gringo, Tarski (!)
- Lifted planning
- Merge&Shrink representation
- Portfolios in various shapes and forms

Domains

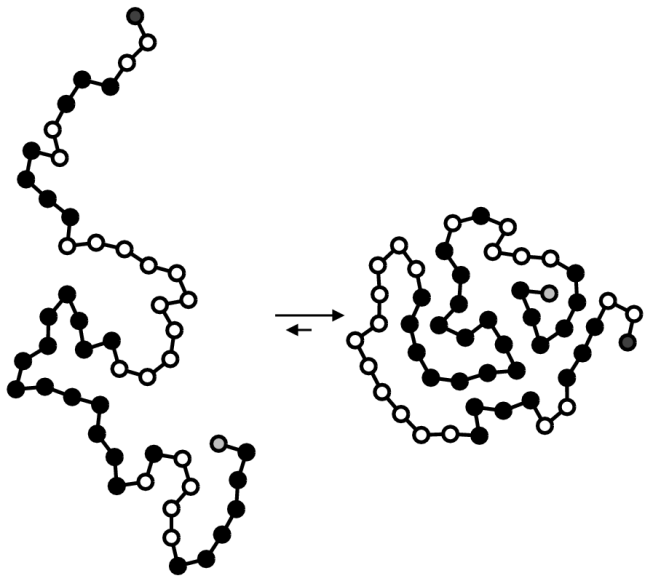
New domains

Thanks (!!) to everyone who submitted a domain

- 7 new domains
  - no domains from previous IPCs
  - 4 domains submitted
  - 3 domains adapted from ASP Competitions
- The same set of tasks used in Satisficing and Agile tracks
- Focus on PDDL features that make writing domains easier.
  - 4 domains provided also in a "normalized" form obtained via automatic translation.
  - Normalized variants will not be published, but we will publish the translator.
- All domains except one come with a generator and either optimal solver or the generator outputs a sub-optimal plan.
  - Most of them also provide visualizations

Folding

Inspired by the "Reverse folding" problem from the ASP Competition 2011.

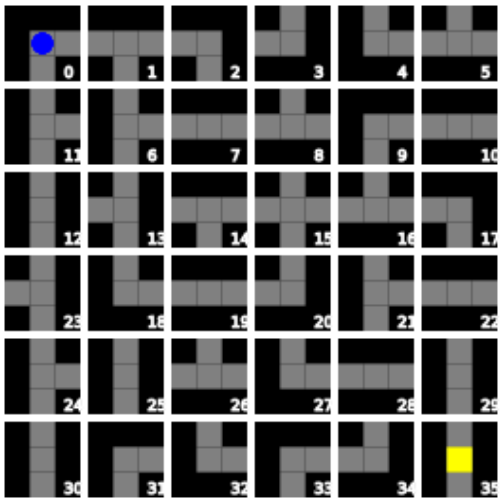


A simplification of a molecular biology problem where we look for a folding of a string of elements representing a protein.

- ⇝ Long sequences of 0-cost actions verifying correctness of the folding.
- ⇝ Disjunctions over static predicates.

Labyrinth

Submitted by: Rebecca Eifler and Daniel Fišer (Saarland University)

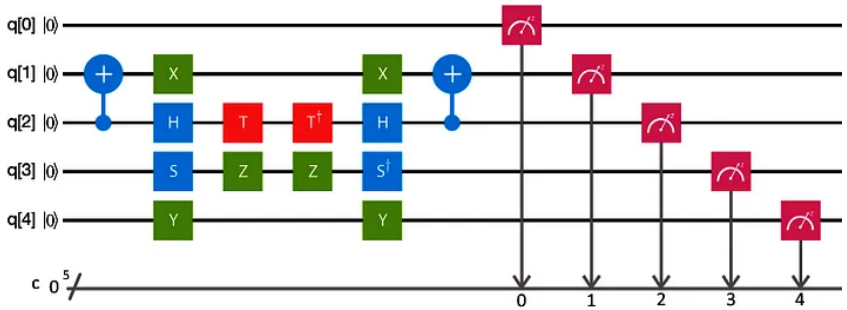


Inspired by the Ravensburger Labyrinth board game: A robot needs to escape from the labyrinth while the labyrinth itself can change.

- ⇝ Auxiliary 0-cost actions.
- ⇝ The “map” is not static.
- ⇝ Often hard to ground.

Quantum Circuit Layout Synthesis

Submitted by: Irfansha Shaik and Jaco van de Pol (Aarhus University, Aarhus, Denmark)



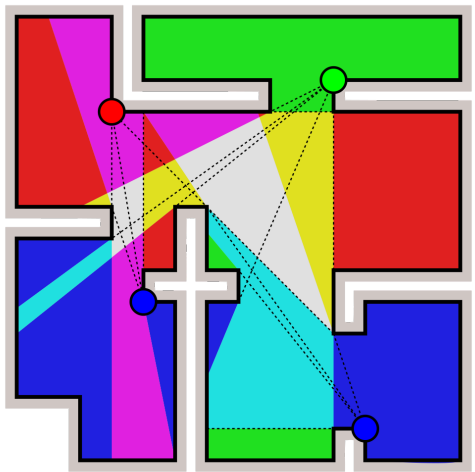
https://towardsdatascience.com/what-is-a-quantum-circuit-transpiler-ba9a7853e6f9

Solves a problem of mapping logical quantum circuits onto a physical hardware.

- ⇝ Instances are automatically generated for real-world problems.

Recharging Robots

Submitted by: Daniel Gnad and Álvaro Torralba (Linköping University and Aalborg University)

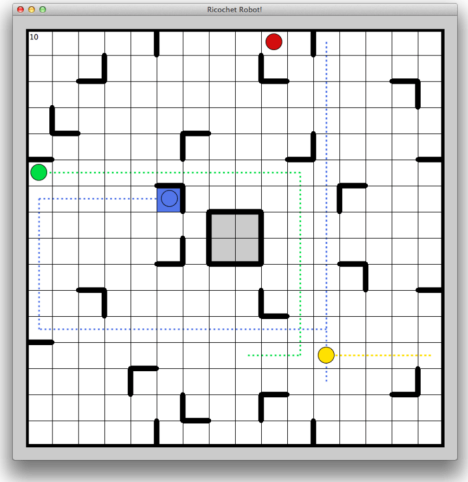


A variant of the “art gallery problem“ where multiple robots change locations to guard certain areas while they need to exchange battery charge in order to be able to move between locations.

- ⇝ Disjunctions, universal quantifiers, conditional effects, and “imply” formulas; all easy to compile away.

Ricochet Robots

Re-formulation from the ASP Competition 2015 with a substantial contribution by Rebecca Eifler (Saarland University).



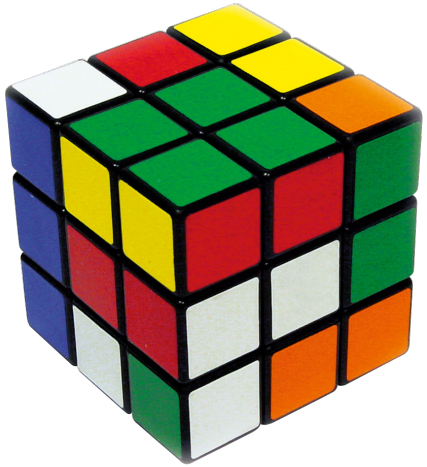
https://www.michaelfogleman.com/projects/ricochet-robot/

A puzzle board game where robots must reach certain locations, but when they start moving they can stop only by hitting a wall or another robot.

$\rightsquigarrow$ Auxiliary 0-cost actions.

Rubik's Cube

Submitted by: Bharath Muppasani, Biplav Srivastava, Clemens Büchner and Patrick Ferber (University of South Carolina and Basel University)

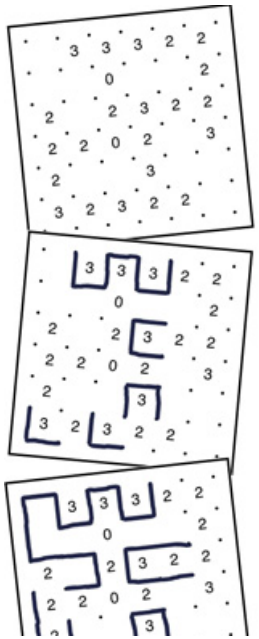


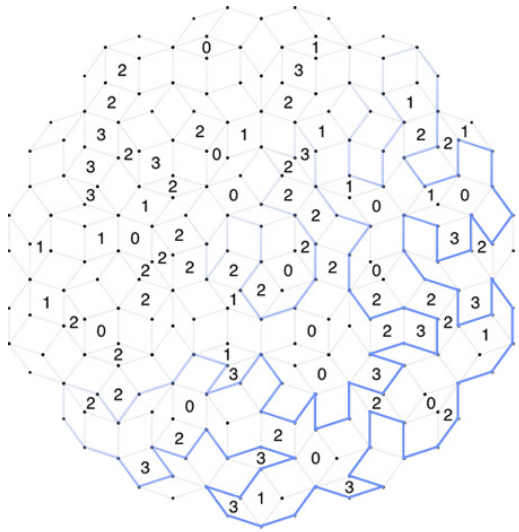
Everybody knows Rubik's Cube ...

- ⇝ Formulation with many conditional effects that are impossible to compile away.

Slitherlink

Re-formulation from the ASP Competition 2011.





Domain modelling the logic puzzle called Slitherlink or Generalized slitherlink.

- ⇝ A single solution, but multiple plans that are permutations of each other, i.e., every plan is an optimal plan.
- ⇝ Negative goal conditions.

Outstanding Domain Submission Award

Outstanding Domain Submission Award

Irfansha Shaik and Jaco van de Pol
for the domain submission of
"Quantum Circuit Layout Synthesis"

- Solves a practical problem of mapping logical quantum circuits onto physical devices.
- Perfect submission with a set of real-world tasks with good (often optimal) bounds.

Results

Results

Please, do not interpret the results as "winners are the state of the art, others are not" and do not automatically assume all papers from now on should compare to the winners in this competition.

Optimal Track

- Goal: Find an optimal plan
- Metric: number of plans solved

Optimal Track Awards

Winner

Dominik Drexler, Daniel Gnad, Paul Höft, Jendrik Seipp,
David Speck, and Simon Ståhlberg
with
"Ragnarok"

Runner-Up

Jendrik Seipp
with
"Scorpion 2023"
and
Dominik Drexler, Jendrik Seipp, and David Speck
with
"Odin"

Coverage	folding	labyrinth	quantum.	recharg.	ricochet.	rubiks	slither.	SUM
ragnarok	8	**8**	13	**14**	**17**	10	**7**	77
scorpion-2023	8	5	**14**	**14**	**17**	10	6	74
odin	8	5	13	**14**	**17**	10	6	73
dofri	8	5	13	13	**17**	10	4	70
cegarplusplus	**9**	5	13	**14**	**17**	0	**7**	65
hapori-stonesoup-opt	7	2	13	**14**	9	**11**	6	62
fdss-2023-opt	7	3	13	13	12	9	4	61
hapori-mip2-opt	7	1	13	**14**	9	10	6	60
hapori-ibacop2-opt	6	1	13	12	15	7	4	58
hapori-greedy-opt	5	1	13	11	9	10	**7**	56
baseline-blind	7	1	7	12	11	8	4	50
decstar-opt	6	1	12	11	8	8	4	50
hapori-delfi-opt	5	2	12	12	8	0	2	41
complementary	5	1	12	13	3	0	3	37
decabstar	2	1	12	10	7	0	5	37
symk	3	1	9	13	4	0	**7**	37
fts-ms-opt	1	1	12	13	2	0	**7**	36
baseline-lmcut	2	1	12	8	5	0	6	34
hapori-epslr-opt	2	1	9	6	4	10	2	34
SymBD-2023-opt	2	1	9	13	1	0	6	32
dom-opt	2	1	12	6	4	0	6	31
hapori-epsdt-opt	1	0	9	6	4	7	4	31
dalai-opt	2	1	11	7	4	0	4	29
fts-sbd-opt	1	0	4	13	0	0	4	22

Satisficing Track

- Goal: Find a plan with high quality
- Metric: $C^\star/C$
  - same as in 2008 and 2018 but different from 2011, 2014
  - reference plans by many different means

Satisficing Track Awards

Winners

Augusto B. Corrêa, Guillem Francès, Markus Hecher,
Davide Mario Longo, and Jendrik Seipp
with
"Scorpion Maidu" and "Levitron"

- Levitron is a portfolio of Scorpion Maidu and Powerlifted.

Runner-Up

Clemens Büchner, Remo Christen, Augusto Blaas Corrêa,
Salomé Eriksson, Patrick Ferber, Jendrik Seipp, and Silvan Sievers
with
"Fast Downward Stone Soup 2023"

Sat score	folding	labyrinth	quantum.	recharg.	ricochet.	rubiks	slither.	SUM
maidu-sat	6.80	0.00	19.60	13.94	11.36	**14.16**	**6.00**	71.86
levitron-sat	8.66	0.00	19.60	13.94	11.44	**14.16**	4.00	71.79
fdss-2023-sat	8.95	0.00	19.49	13.80	8.51	14.13	**6.00**	70.88
baseline-lama	**9.70**	1.00	17.86	13.19	9.83	12.18	5.00	68.76
hapori-ibacop2-sat	8.69	3.91	17.07	13.46	7.37	11.22	**6.00**	67.72
disco-sat	8.58	0.00	17.78	**13.95**	9.14	11.77	5.00	66.24
cerberus-sat	6.39	0.00	18.03	10.43	12.73	10.93	**6.00**	64.52
spock	5.83	0.00	**19.67**	13.94	5.01	13.90	**6.00**	64.36
decstar-sat	5.40	0.00	17.33	13.29	8.41	12.42	**6.00**	62.85
tftm-argmax-sat	6.73	0.00	16.74	9.55	12.73	9.98	**6.00**	61.73
tftm-co1-sat	6.67	0.00	15.84	10.43	12.65	10.10	**6.00**	61.68
hapori-mip2-sat	5.64	3.91	18.86	13.28	5.04	10.00	4.00	60.74
dalai-sat	4.84	4.00	17.29	13.00	8.82	5.00	3.00	55.95
ApxNoveltyAnytime	5.00	0.00	18.31	8.00	**15.32**	5.00	4.00	55.63
hapori-stonesoup-sat	7.69	3.91	18.44	12.32	4.17	4.00	4.00	54.52
NoveltyFBAnytime	1.00	0.00	18.31	8.00	13.80	5.00	4.00	50.12
opcount4sat-sat	2.00	3.76	13.32	10.11	6.15	0.00	4.00	39.34
hapori-epsdt-sat	7.40	**14.14**	0.00	5.38	0.62	6.03	0.00	33.57
hapori-delfi-sat	3.81	0.00	12.52	8.85	2.35	4.00	1.00	32.54
FSM	3.03	0.00	6.60	8.22	3.00	6.00	3.00	29.84
powerlifted-sat	9.69	0.00	16.71	0.00	0.00	0.00	2.00	28.40
hapori-epslr-sat	1.00	0.00	0.00	3.45	0.00	11.00	5.00	20.45
hapori-greedy-sat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Agile Track

- Goal: Find a plan quickly
- Metric: $1 - \log(t)/\log(300)$, or 1 if solved in first second
  - same as 2018
- Instance selection:
  - Same instances as in satisficing track

Agile Track Awards

Winner

Daniel Gnad, Álvaro Torralba, and Alexander Shleyfman
with
"DecStar-2023"

Runner-Up

Clemens Büchner, Remo Christen, Augusto Blaas Corrêa, Salomé Eriksson, Patrick Ferber, Jendrik Seipp, and Silvan Sievers
with
"Fast Downward Stone Soup 2023"

Agile score	folding	labyrinth	quantum.	recharg.	ricochet.	rubiks	slither.	SUM
baseline-lama-first	3.35	0.00	16.86	3.79	0.94	**13.16**	2.19	40.28
decstar-agl	2.62	0.00	15.26	5.01	2.72	12.95	1.70	40.25
fdss-2023-agl	2.96	1.07	15.31	4.47	0.56	11.07	2.39	37.82
ApxNoveltyTarski	1.91	**2.66**	19.53	3.92	3.41	3.13	1.80	36.35
disco-agl	**3.39**	0.00	16.82	6.47	1.08	6.30	1.91	35.96
maidu-agl	2.52	0.28	15.57	4.41	1.57	9.64	1.93	35.93
levitron-agl	2.49	0.34	15.64	4.11	1.00	9.48	2.55	35.61
ApxNovelty	1.43	0.00	**19.64**	3.03	3.41	4.00	1.81	33.32
cerberus-agl	2.74	0.00	13.47	2.38	1.83	7.79	2.64	30.84
dalai-agl	3.05	0.34	13.64	**6.57**	**3.54**	2.67	1.01	30.81
hapori-stonesoup-agl	0.87	0.74	16.70	3.89	0.81	3.86	1.62	28.49
hapori-mip2-agl	0.37	0.77	13.60	2.47	0.82	7.12	**2.67**	27.82
tftm-argmax-agl	2.73	0.00	12.15	2.45	1.74	6.01	2.64	27.73
tftm-co1-agl	2.56	0.00	12.26	2.37	1.89	6.01	2.61	27.70
NoveltyFB	0.14	0.00	18.88	0.83	1.18	4.00	0.48	25.50
fts-ff-agl	0.00	0.00	9.61	5.19	0.55	0.00	1.97	17.31
hapori-epsdt-agl	1.84	2.65	0.00	2.82	0.51	5.20	0.00	13.03
hapori-epslr-agl	0.01	0.00	0.00	2.48	0.00	7.46	0.98	10.94
hapori-delfi-agl	0.68	0.00	5.06	2.40	1.53	0.64	0.52	10.83
opcount4sat-agl	0.00	0.04	3.04	6.28	0.00	0.00	0.74	10.10
FSM	0.00	0.00	0.82	0.95	0.24	3.17	0.09	5.26
powerlifted-agl	0.73	0.00	0.00	0.00	0.00	0.00	0.07	0.80
hapori-greedy-agl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Dissemination

Dissemination of results

Experimental Results

- logs and parsed properties available to authors
- Let us know if you want access to logs of other planners and we will be happy to provide them

Domains

- tasks, reference plans, and bounds available
- also available on planning.domains

Planners

- repositories available on Github
- repository with Apptainer recipes
- planner abstracts available online

All linked on `https://ipc2023-classical.github.io`

Results Analysis

Reminder

- planner abstracts have to be extended with results analysis
- source code used in the competition in branch `ipc2023-classical`,
  bug fixes in branch `latest`.
  We encourage authors to fix bugs!
- deadline: end of August

Thank You!