Automatic Configuration of Sequential Planning Portfolios

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Why is this interesting?

- You have:
  algorithm with many parameters
  training instances
- You want to:
  solve new similar instances

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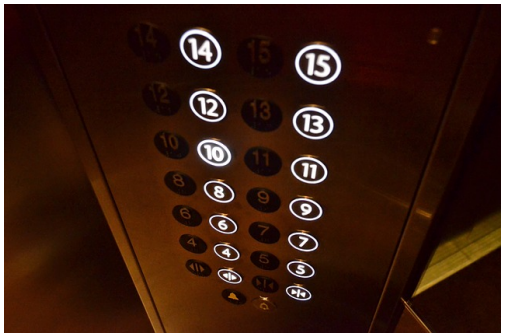
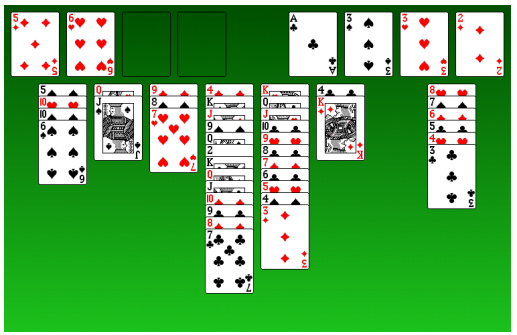
- Only planning here
- Literature pointers in the paper

Background

AI planning



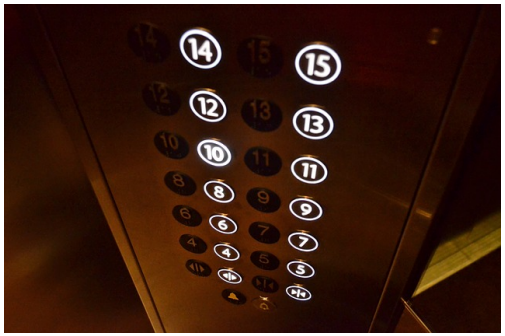


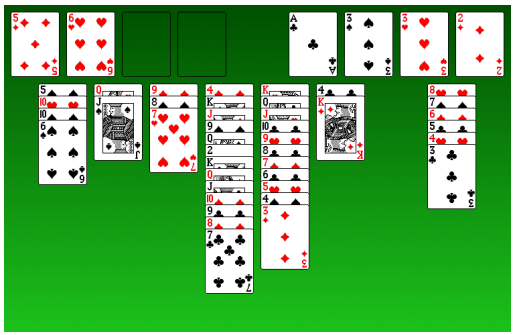
Algorithm configuration

- Takes:
  parameterized algorithm
  training instances
- Returns:
  good parameter configuration for these instances

Tools: ParamILS, GGA, irace, SMAC

How to solve new planning tasks?





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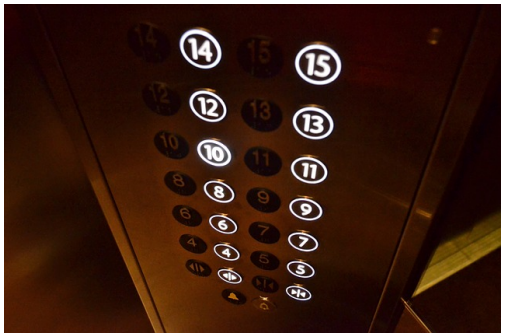
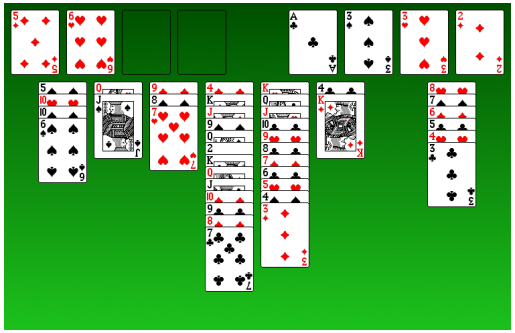
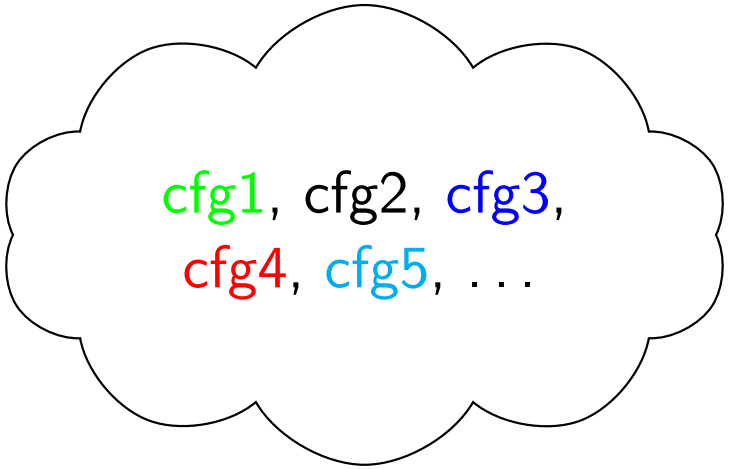




cfg1, cfg2, cfg3,
cfg4, cfg5, . . .

Sequential portfolios

Sequential portfolios



Choose configurations manually

Example: Fast Downward Stone Soup

- Manually select set of "good" configurations
- Calculate time slices in second step
- One first and one second place in IPC 2011

Drawbacks:

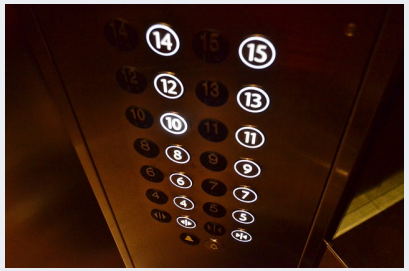
- Experts need to choose configurations
- Configurations complementary?

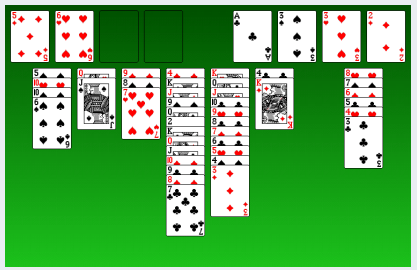
Use algorithm configuration to find configurations

Example: domain-wise

- Find configuration for each domain separately
- Assign time slices in second step


cfg4


cfg1


cfg6

Drawbacks:

- How many domains are enough?
- Configurations complementary?

Cedalion

Algorithm

Cedalion

- Use algorithm configuration to find complementary configurations
- Include time in the configuration space
- Iteratively add configuration that solves the most additional instances per time

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time:

Rem. instances:

Config. space:

cfg1:

cfg2:

cfg3:

Portfolio:

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time: 30
Rem. instances: 10
Config. space: [1,30]×{cfg1,cfg2,cfg3}

cfg1:
cfg2:
cfg3:

Portfolio:

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time: 30
Rem. instances: 10
Config. space: [1,30]×{cfg1,cfg2,cfg3}

cfg1: 8 in 4s → 2
cfg2: 3 in 6s → 0.5
cfg3: 5 in 1s → **5**

Portfolio:

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time: 30
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Portfolio: cfg3

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time:	30	29
Rem. instances:	10	5
Config. space:	[1,30]×{cfg1,cfg2,cfg3}	[1,29]×{cfg1,cfg2,cfg3}

cfg1: 8 in 4s → 2
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Portfolio: cfg3

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Rem. time:	30	29
Rem. instances:	10	5
Config. space:	[1,30]×{cfg1,cfg2,cfg3}	[1,29]×{cfg1,cfg2,cfg3}
cfg1:	8 in 4s → 2	3 in 4s → **0.75**
cfg2:	3 in 6s → 0.5	2 in 6s → 0.33
cfg3:	5 in 1s → **5**	1 in 20s → 0.05
Portfolio:	cfg3	

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time:	30	29
Rem. instances:	10	5
Config. space:	[1,30]×{cfg1,cfg2,cfg3}	[1,29]×{cfg1,cfg2,cfg3}
cfg1:	8 in 4s → 2	3 in 4s → **0.75**
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Portfolio:	cfg3	cfg3 cfg1

Cedalion by example

$$\text{maximize } \frac{|\text{newly solved instances in time } t|}{t}$$

Rem. time:	30	29	25
Rem. instances:	10	5	2
Config. space:	[1,30]×{cfg1,cfg2,cfg3}	[1,29]×{cfg1,cfg2,cfg3}	...
cfg1:	8 in 4s → 2	3 in 4s → **0.75**	...
cfg2:	3 in 6s → 0.5	2 in 6s → 0.33	...
cfg3:	5 in 1s → **5**	1 in 20s → 0.05	...
Portfolio:	cfg3	cfg3 cfg1	...

Cedalion's properties

Drawbacks:

- Only works for instances from seen domains
- Long learning time

Cedalion's properties

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Advantages:

- Needs no planning expertise
- Selects configurations and time slices together
- Operates on all instances at once
- Returns complementary configurations

Evaluation

Results

- Configuration space: Fast Downward
  45 parameters, 3×10^{13} configurations
- Benchmarks: IPC 2011 instances
- 10h/30h per iteration

Comparison to most closely related methods

Setting
satisficing
optimal
agile
learning

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Comparison to most closely related methods

Setting	**Iterations**
satisficing	48
optimal	15
agile	10
learning	2–14 (8.77)

Results

- Configuration space: Fast Downward
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Comparison to most closely related methods

Setting	Iterations	Performance
satisficing	48	slightly better than domain-wise
optimal	15	slightly worse than FD Stone Soup
agile	10	better than LAMA-2011
learning	2–14 (8.77)	better than FD-Autotune

IPC 2014 learning track

Learn on training instances $\rightarrow$ evaluate on unseen instances from same domain

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Overall best quality

1. MIPlan
2. Fast Downward Cedalion
3. Fast Downward SMAC

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Overall best quality

1. MIPlan
2. Fast Downward Cedalion
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Best learner

1. Fast Downward Cedalion
2. Eroller
3. Fast Downward SMAC

Conclusion

Summary

- Make time slices part of the configuration space
- Iteratively add configuration solving the most additional instances per time
- Competitive empirical performance

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