Counterexample-guided Cartesian Abstraction Refinement

Jendrik Seipp, Malte Helmert

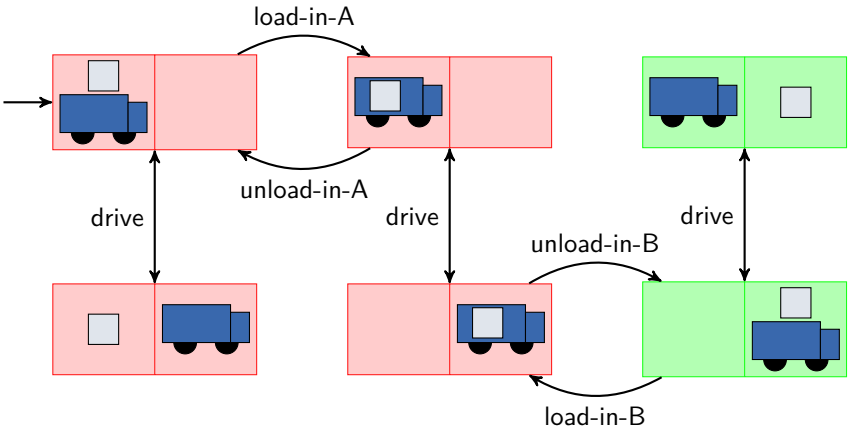
University of Basel, Switzerland

June 2013

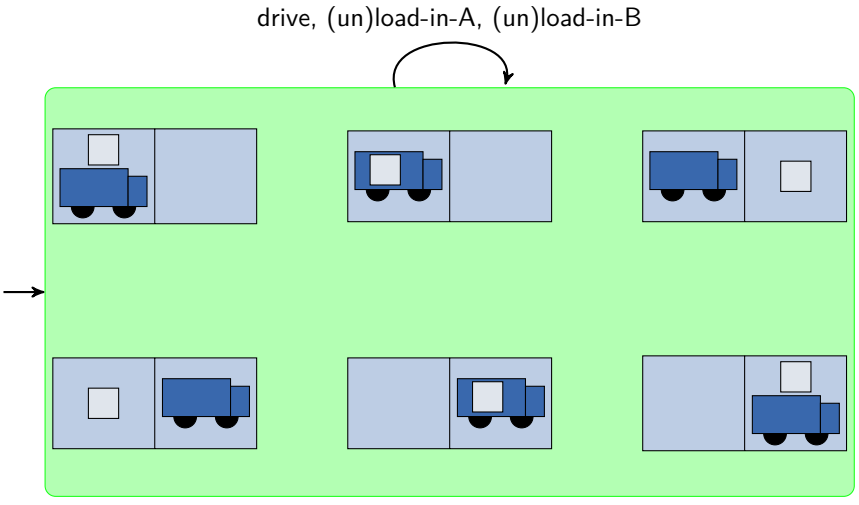
Overview

CEGAR algorithm

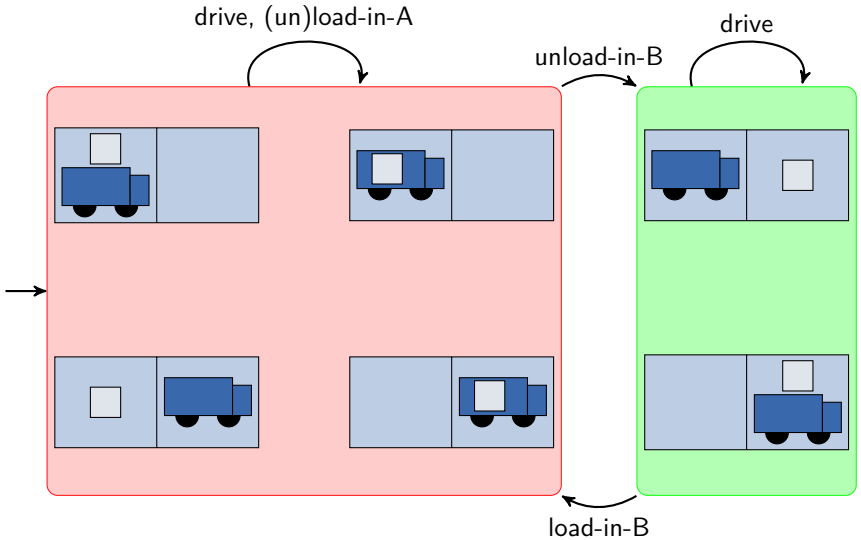
Classical planning



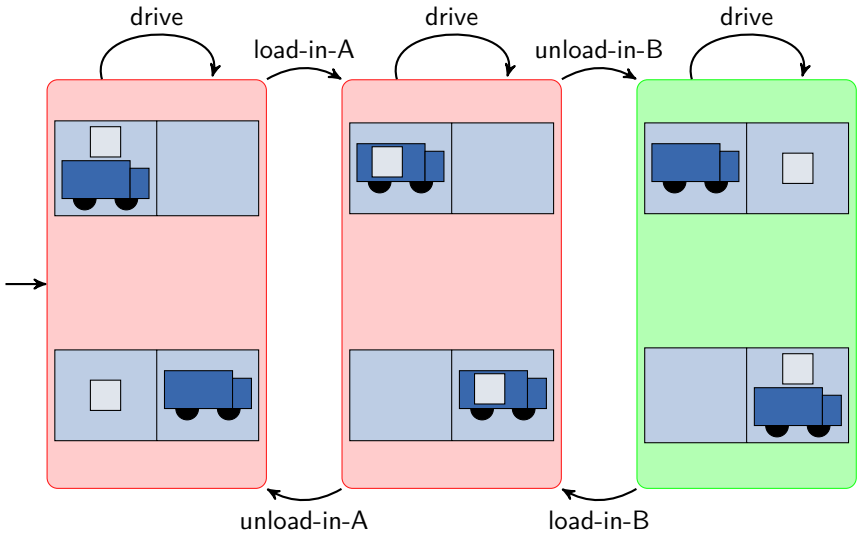
Example refinement



Example refinement



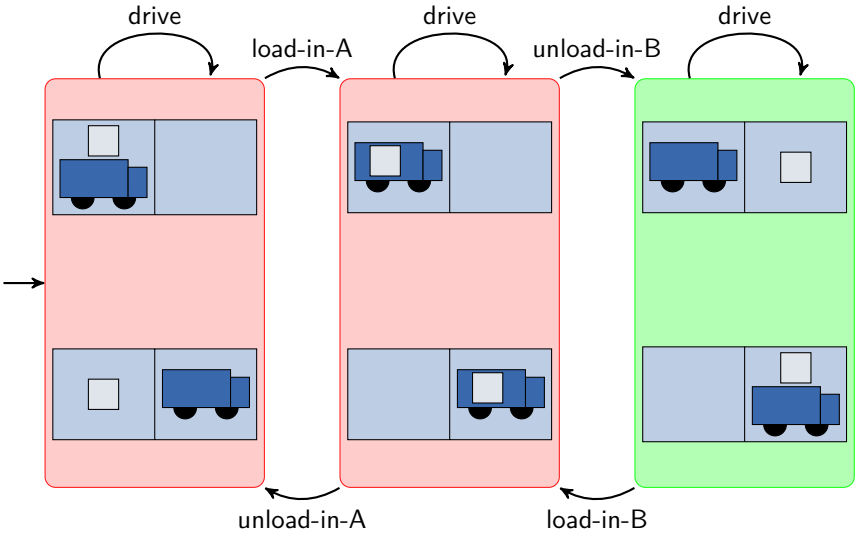
Example refinement



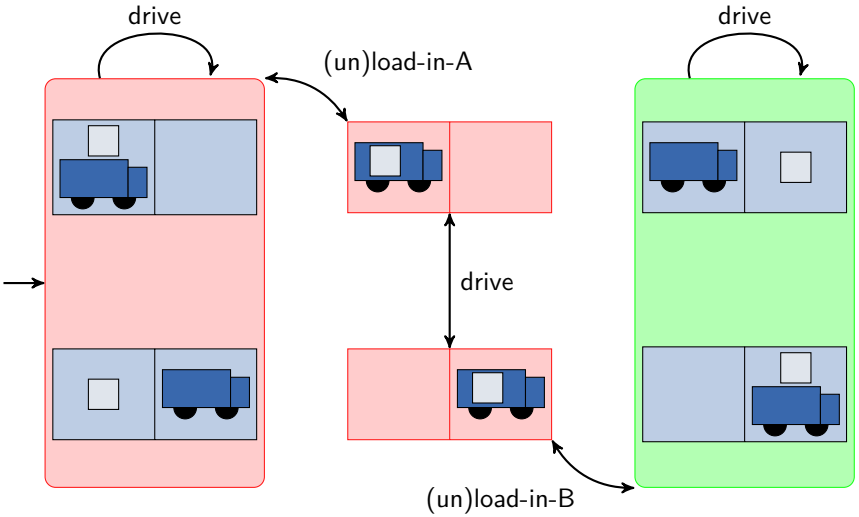
Background

- Relation to other classes of abstractions?

Pattern database



Cartesian Abstraction



Classes of abstractions

- Pattern databases
  Refinement at least doubles number of states
- Cartesian abstractions
  Allow fine-grained refinement
- Merge-and-shrink abstractions
  Preimage of abstract states not efficiently computable

Evaluation

Experiments
Setup

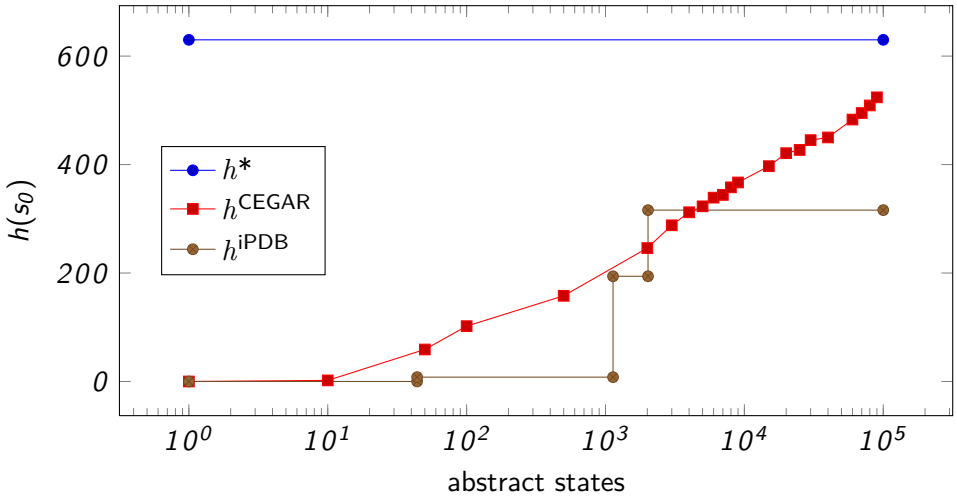
- 30 minutes, 2 GB
- 15 minutes refinement

Experiments
Results

Coverage	h^0	h^{iPDB}	$h^{\text{m\&s}}_1$	$h^{\text{m\&s}}_2$	h^{CEGAR}
elevators-08 (30)	11	**20**	1	12	16
miconic (150)	50	45	50	**74**	55
mprime (35)	19	22	23	11	**27**
mystery (30)	18	22	19	12	**24**
...	...	...	...	...	...
Sum (1116)	397	**450**	391	449	441
Worse than h^0	0	30	68	40	**1**

Experiments

Results – $h(s_0)$ on transport #23



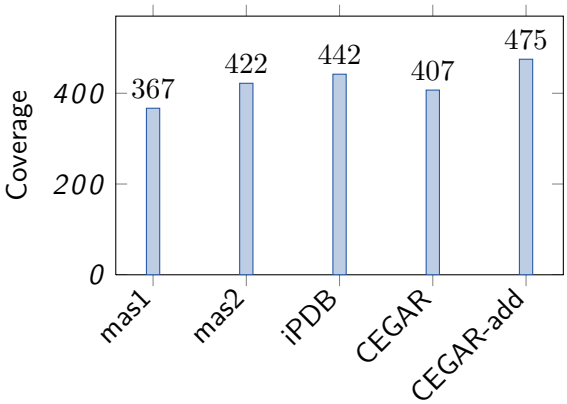
Ongoing research

Current work

- Break all optimal solutions
- Additive abstractions (AAAI-LBP 2013)

Current work

- Break all optimal solutions
- Additive abstractions (AAAI-LBP 2013)



Future work

- How to select flaws?
- Better termination criterion for refinement loop

Conclusion

- CEGAR for classical planning
- New admissible heuristic
- Robust performance

- Contact: jendrik.seipp@unibas.ch