Practical term: State set representation techniques for hybrid systems

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October 21, 2015

Content

1 Organization

2 General reachability analysis for linear hybrid automata

General information

- Meeting every two weeks
- $\sim$ every week: Short report via email (achievements, problems, ...)
- Website: http://ths.rwth-aachen.de/teaching/ws15/state-set-representation-techniques-for-hybrid-systems/
  - Contains all dates and announcements
  - Slides and tasks will be made available there
- Questions can be posed any time via email (stefan.schupp@cs.rwth-aachen.de)

Withdrawal from the practical term is possible until **11.11.2015** (3 weeks from now on).

Environment

In teams you will implement state set representations being part in our C++ library HyPro.

git:
`https://srv-i2.informatik.rwth-aachen.de/scm/git/thsws15/hyproA.git`
`https://srv-i2.informatik.rwth-aachen.de/scm/git/thsws15/hyproB.git`

Trac: http://ths.informatik.rwth-aachen.de/trac/hypro

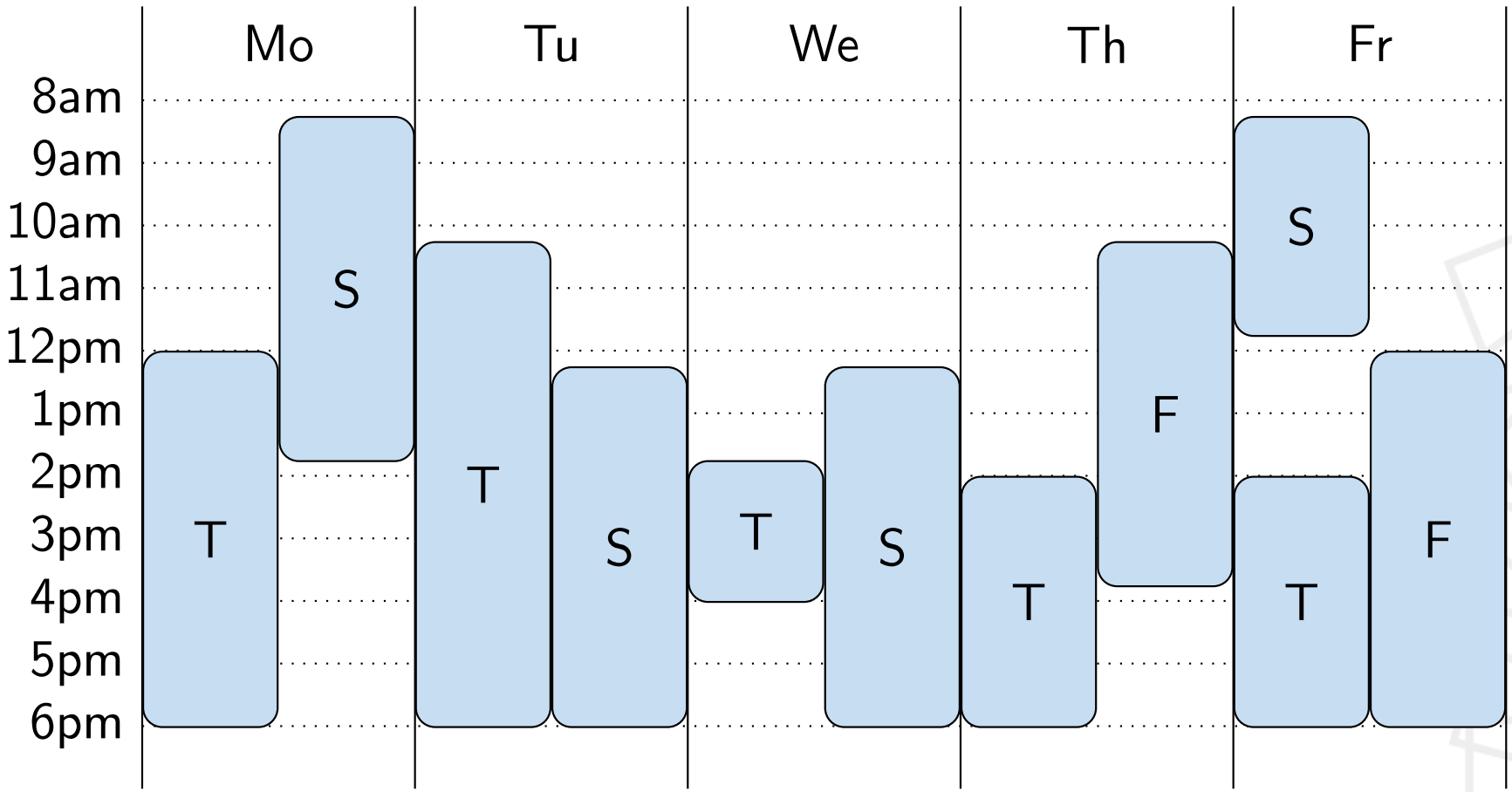
Slack: https://hypro.slack.com/

Dependencies:

- MPFR: http://www.mpfr.org/mpfr-current/
- CArL: https://github.com/smtrat/carl
- Parma Polyhedra Library (PPL): http://bugseng.com/products/ppl/download

Weekly meeting

Current available timeslots



Content

Subjects we will cover during this practical term:

- Introductory task: Boxes
- Task 1: Basic implementation of convex polytopes
- Task 2: Optimization and further implementation of convex polytopes

Each task will be described by an additional exercise sheet (website).

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Deadlines:

- 13.11.2015 Box implementation
- 18.12.2015 Basic polytope implementation
- 12.02.2015 Final presentation

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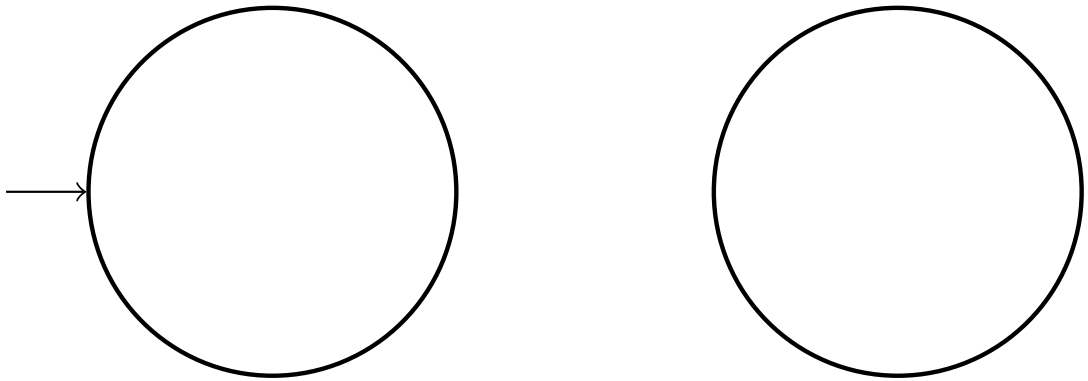
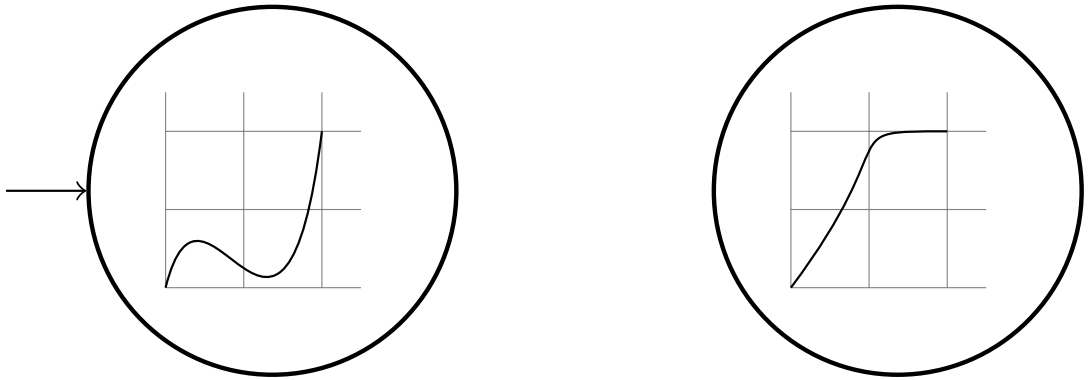
Hybrid automata



- discrete behavior is modeled via discrete locations (*modes*)

Hybrid automata



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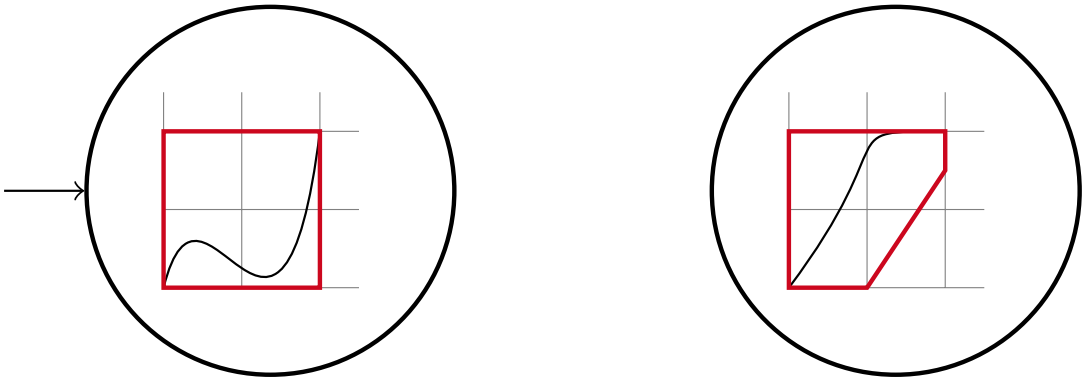
Hybrid automata



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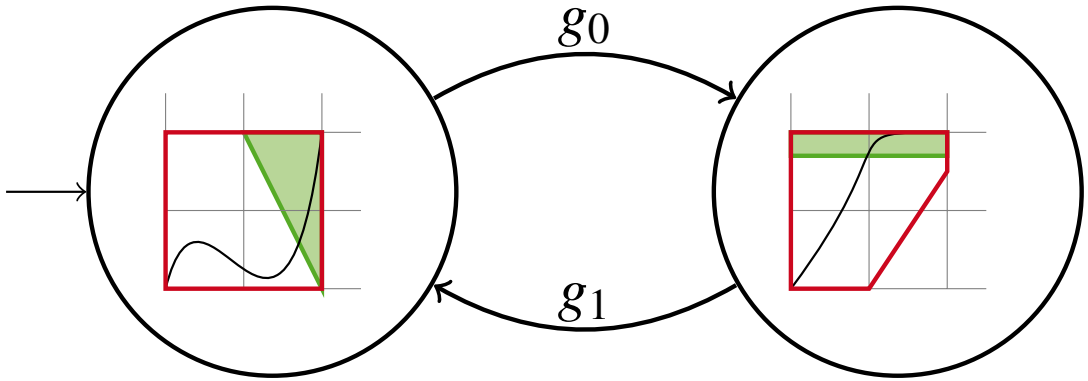

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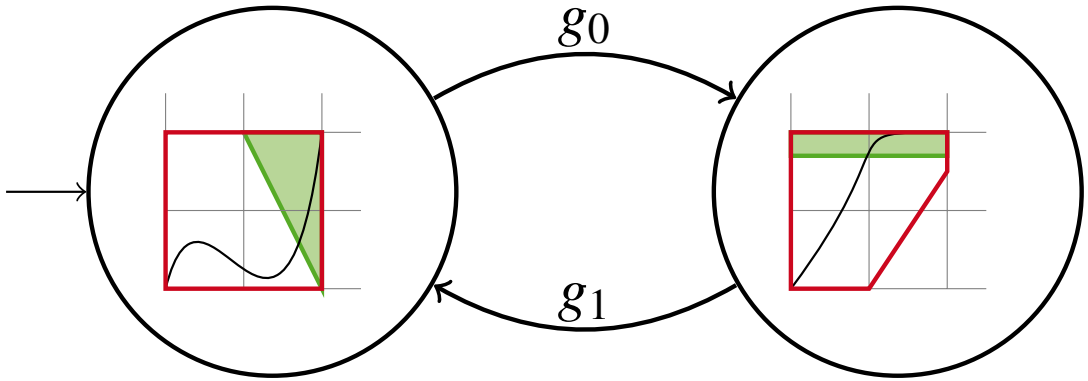

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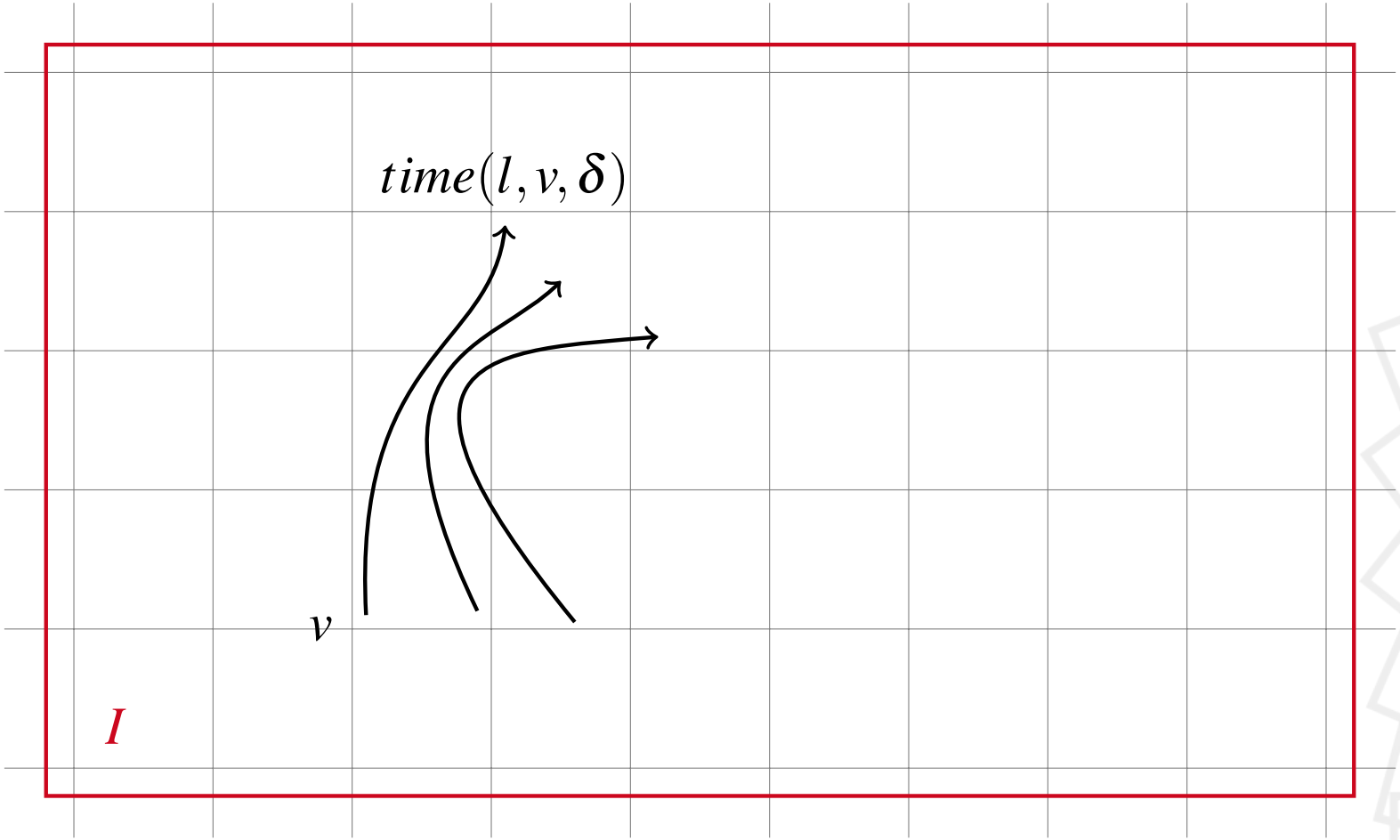
- reset functions (*reset*) modify the valuation of variables when taking transitions

Flowpipe construction



[Girard 2005, Le Guernic 2009]

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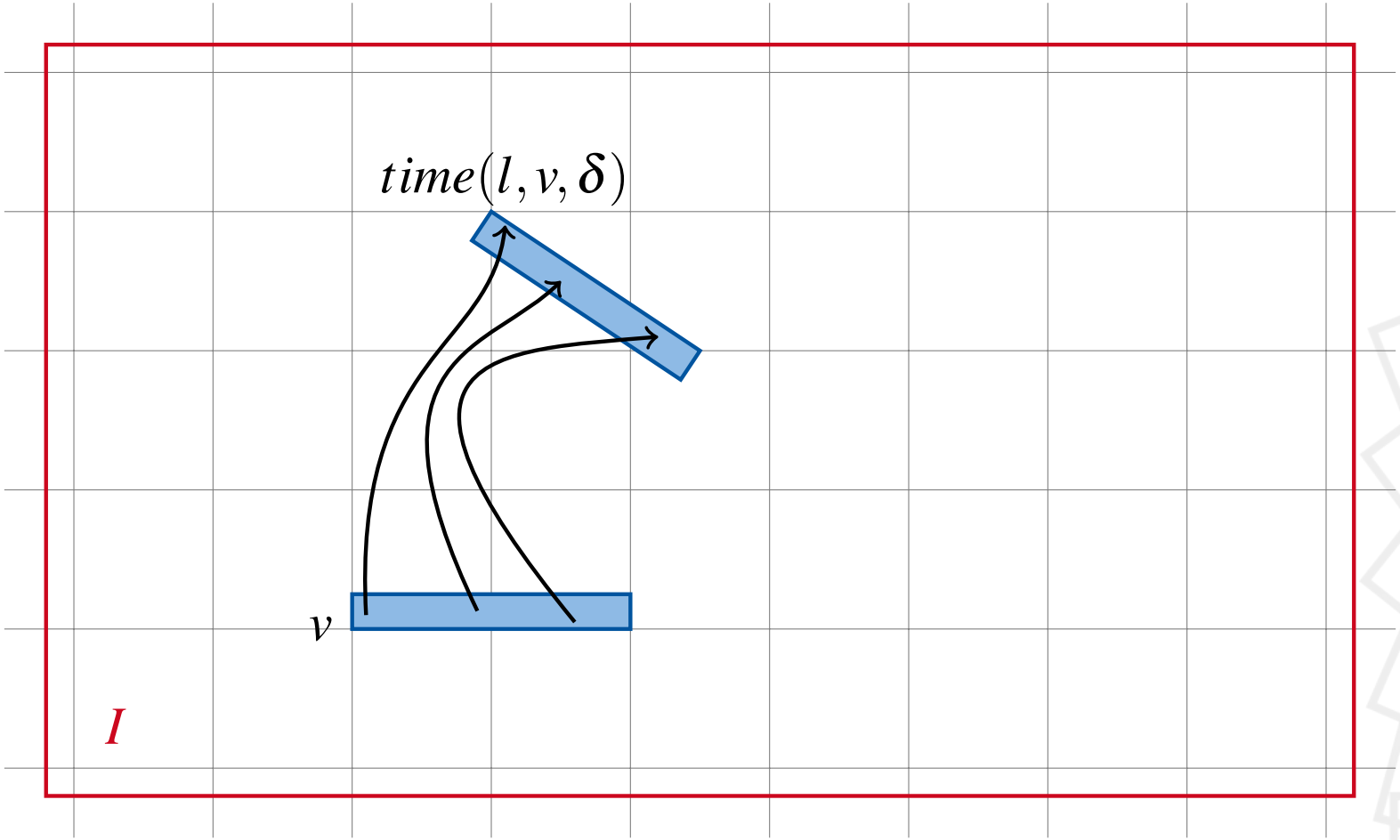

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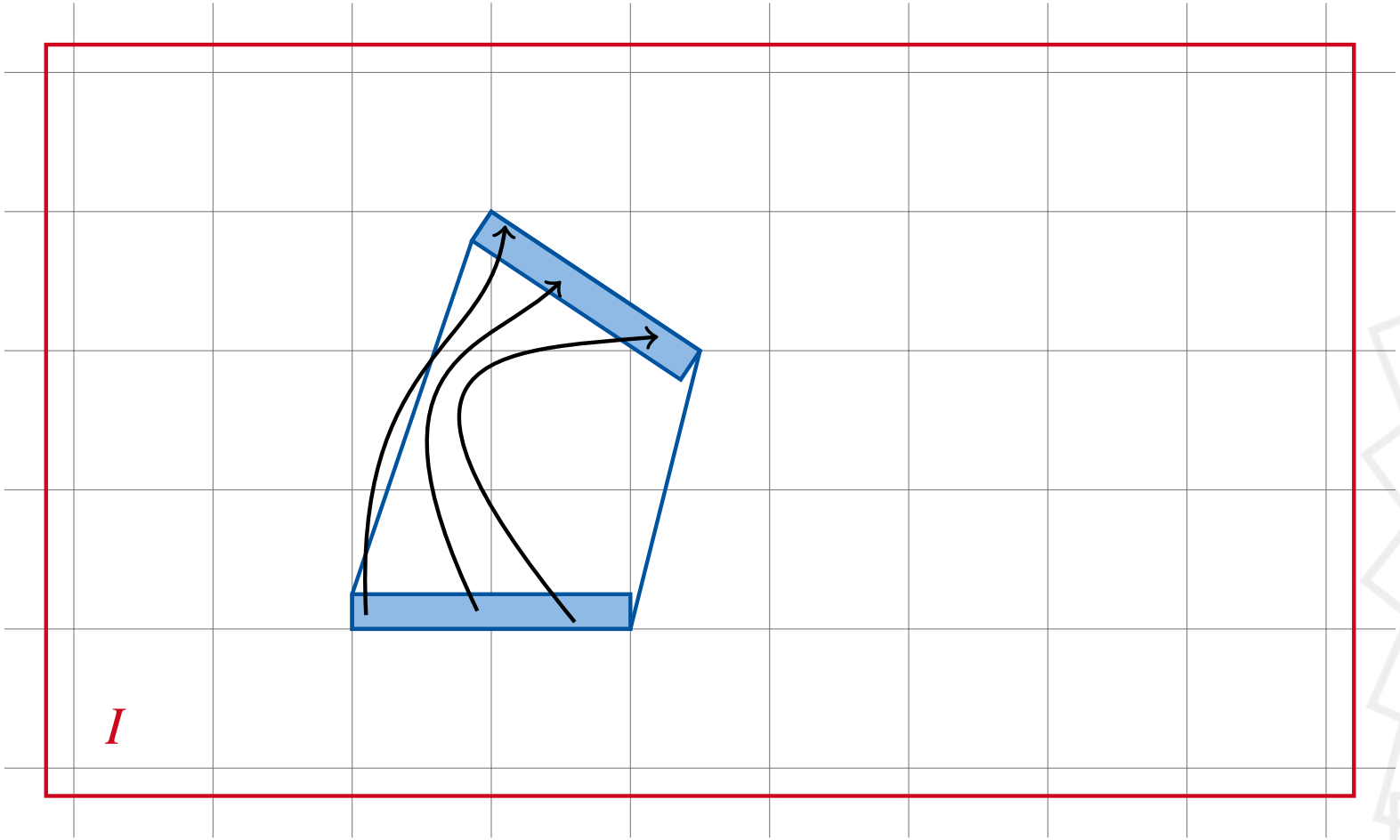

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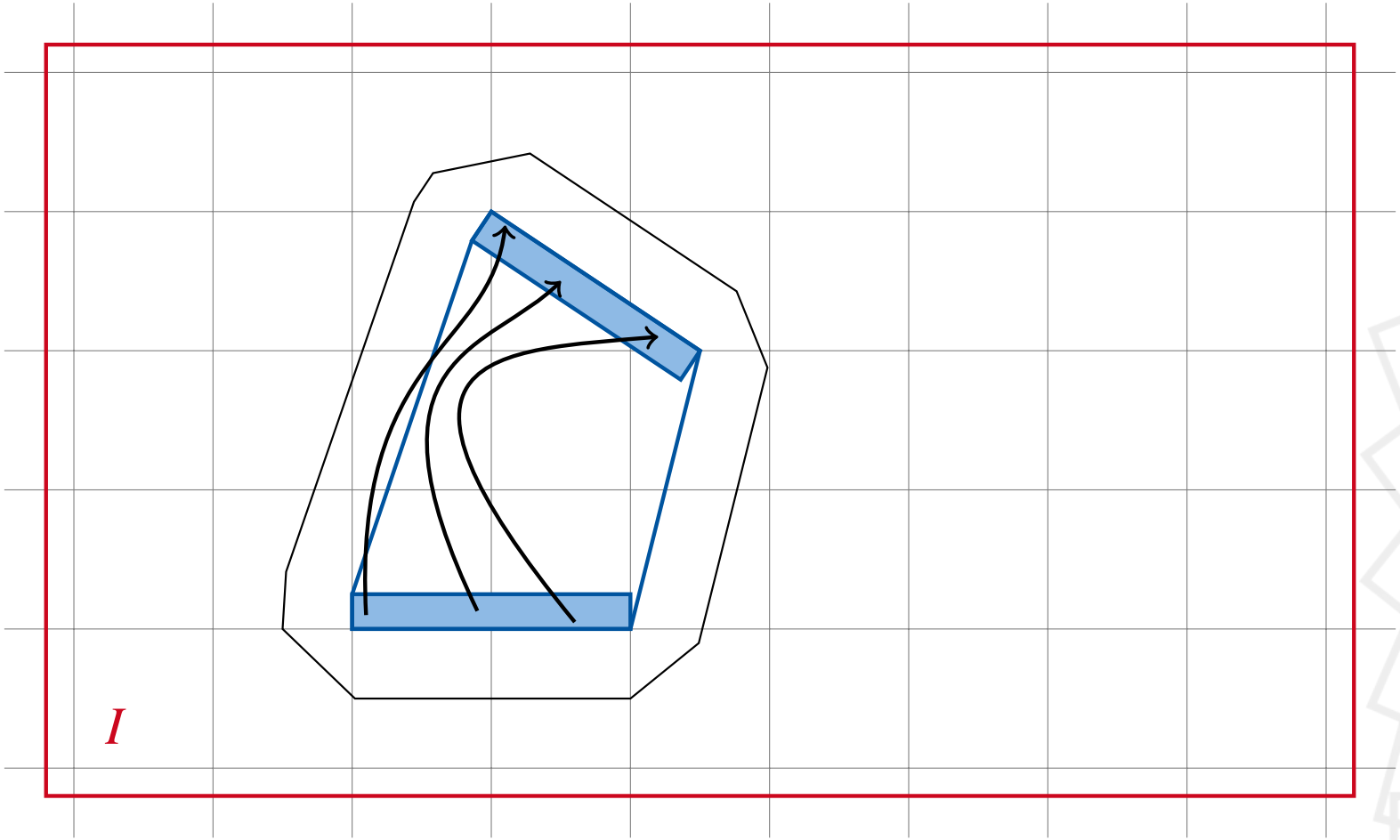

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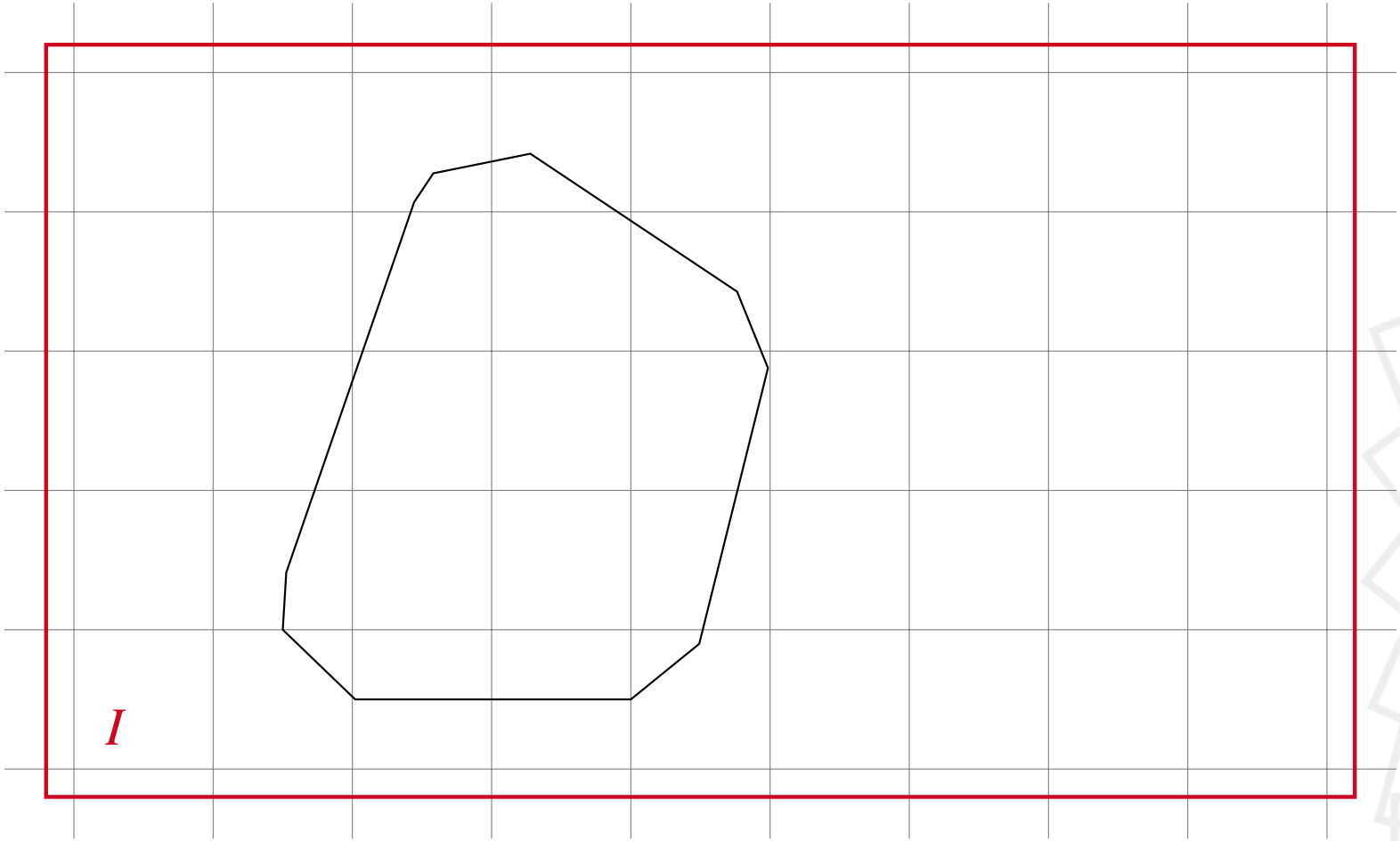

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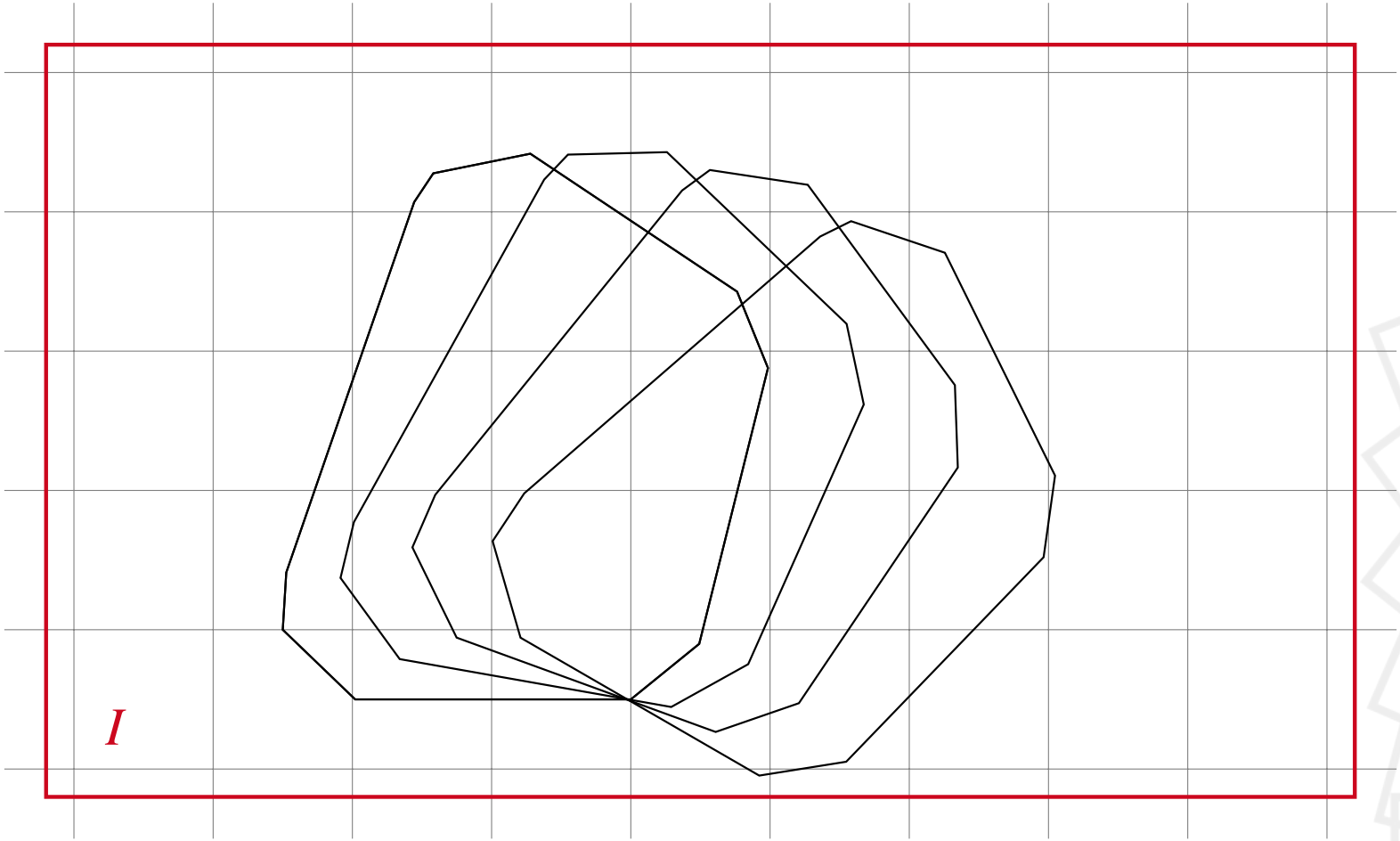

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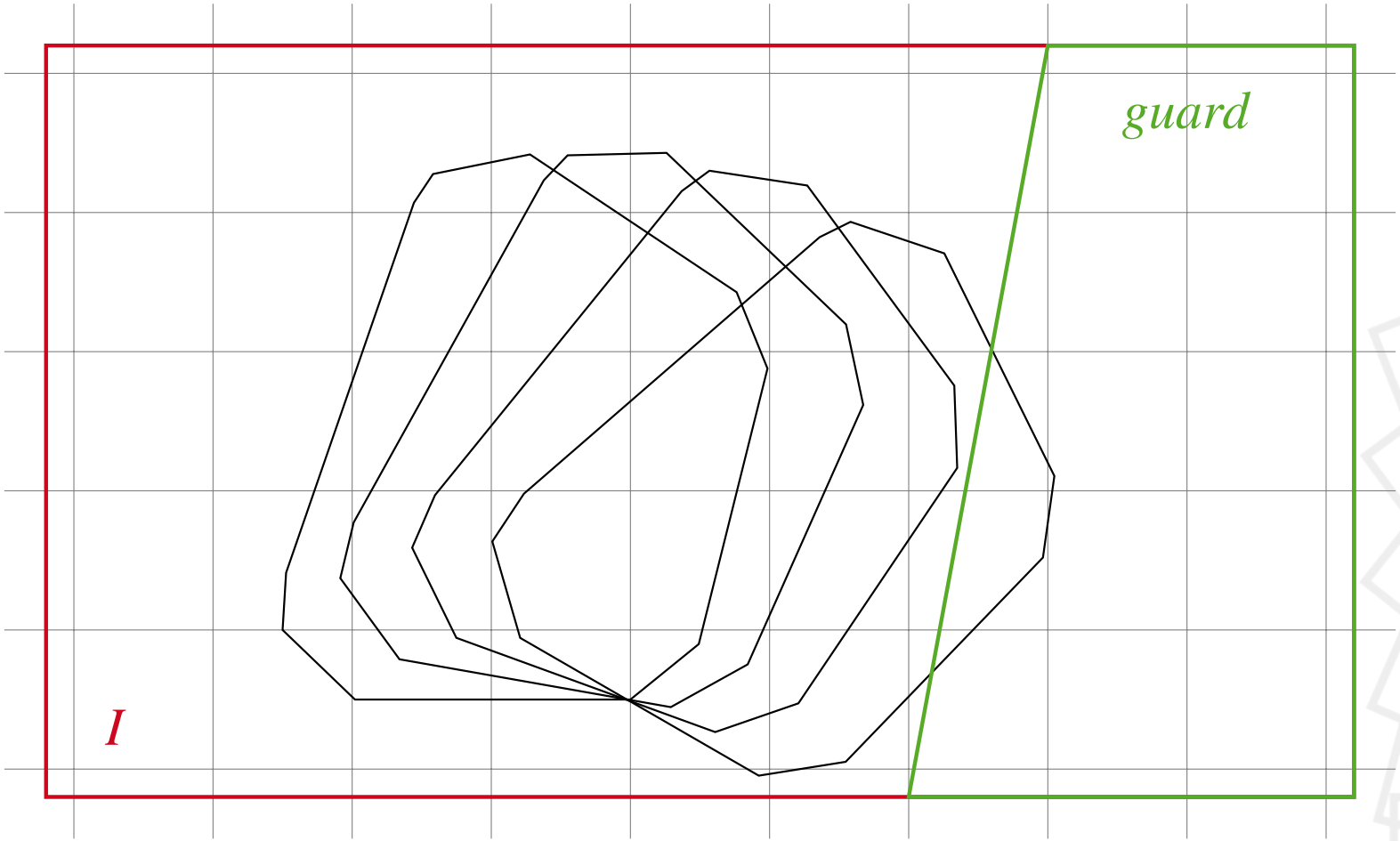

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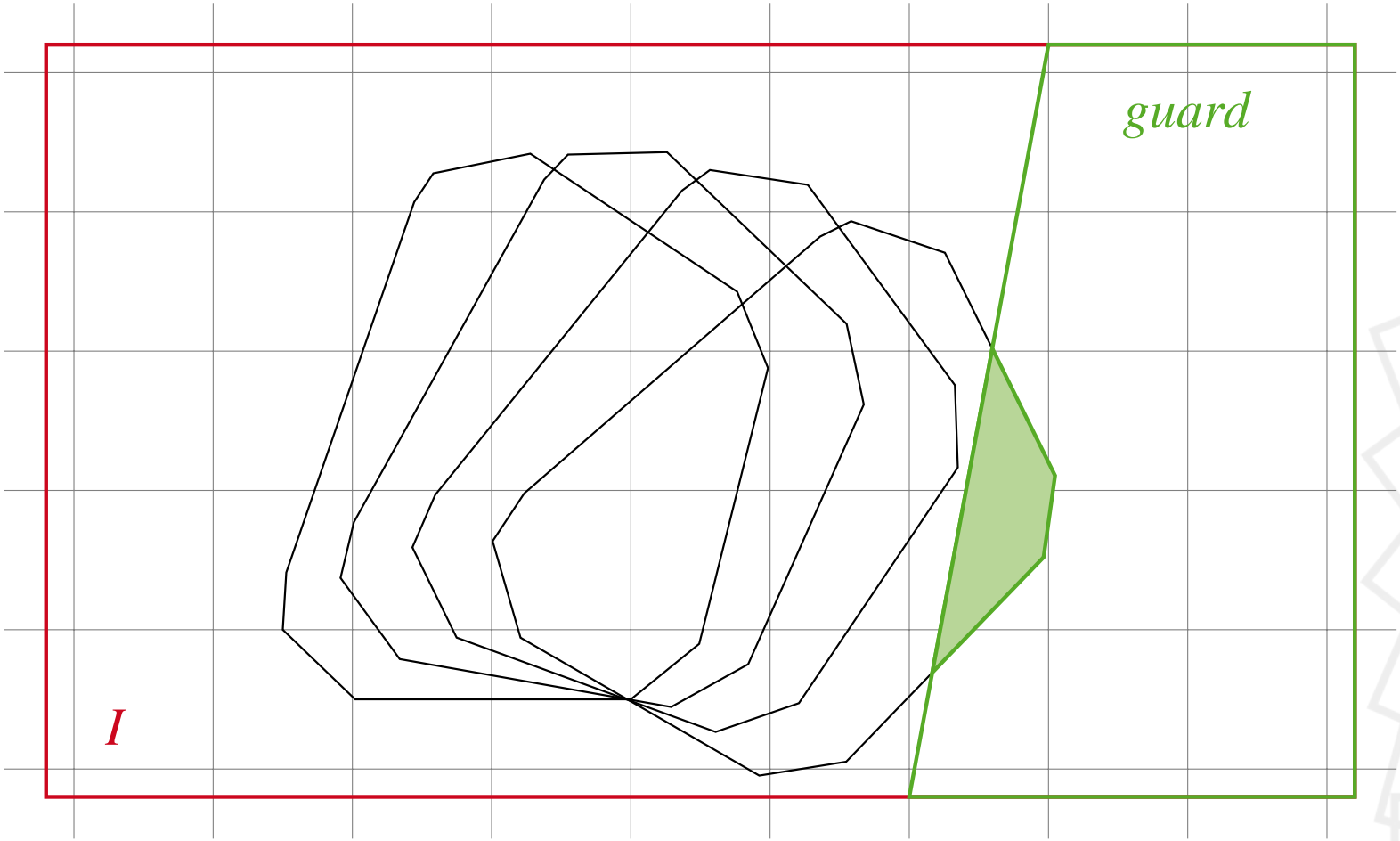

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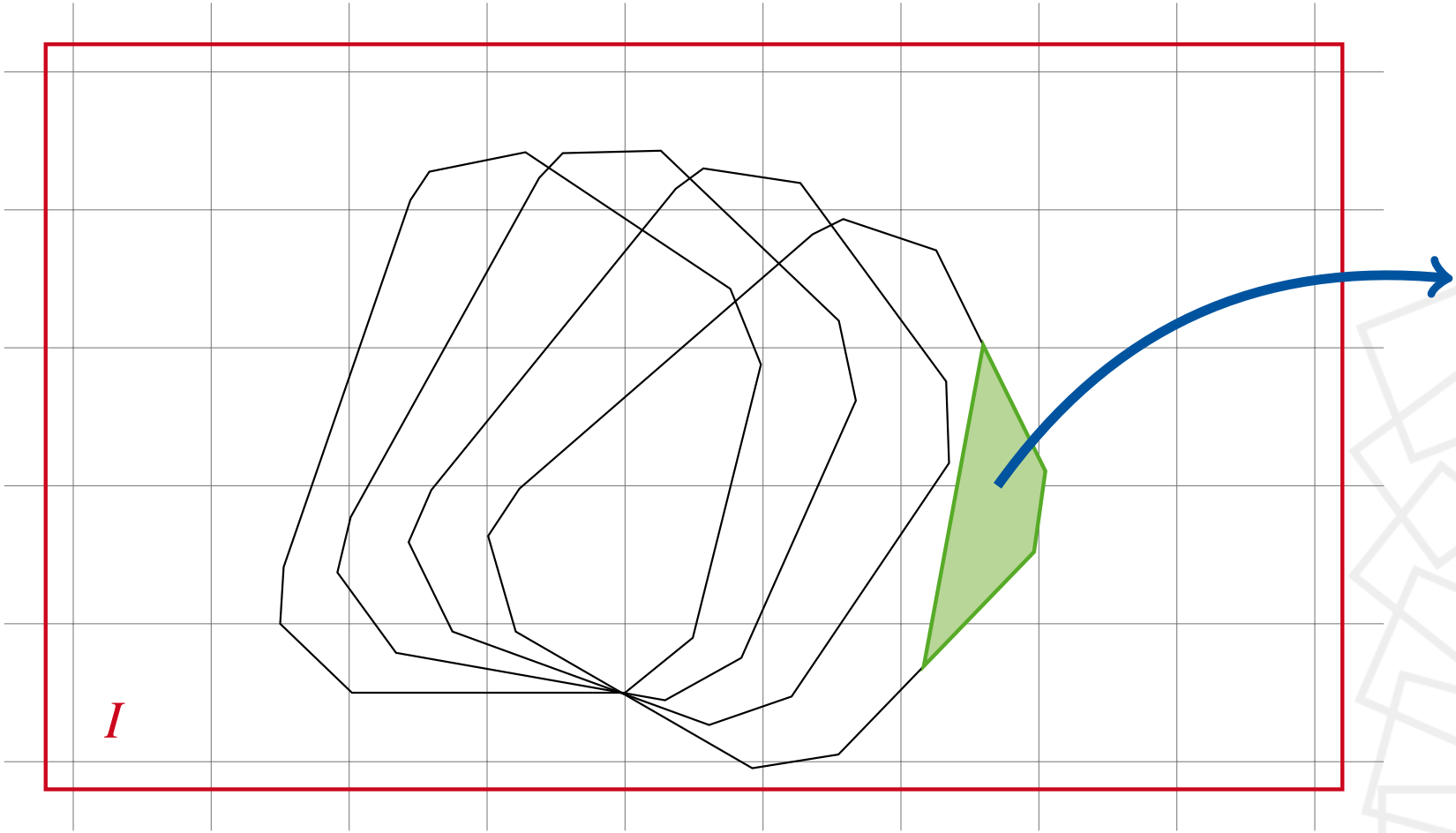

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Required operations

In conclusion, for reachability analysis of linear hybrid systems we require at least the operations

- union,
- intersection,
- linear transformation,
- test for emptiness and
- Minkowski sum.

In this practical term you will implement those operations for the state set representations *boxes* and *convex polyhedra*.