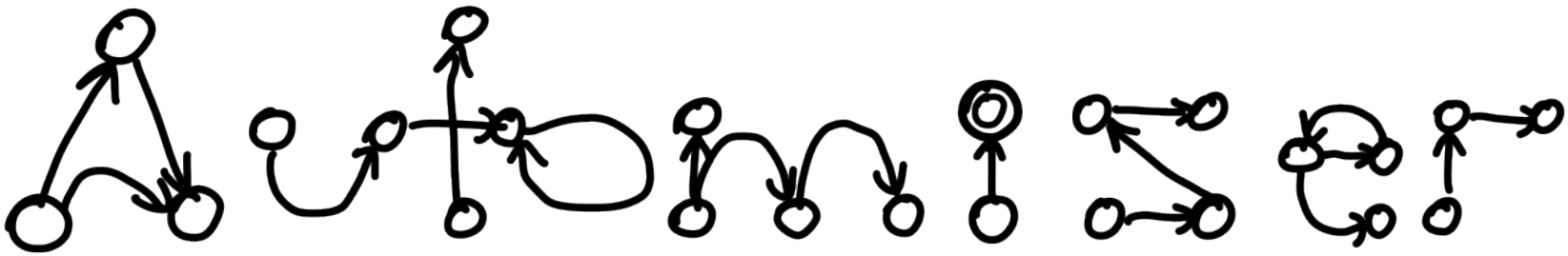
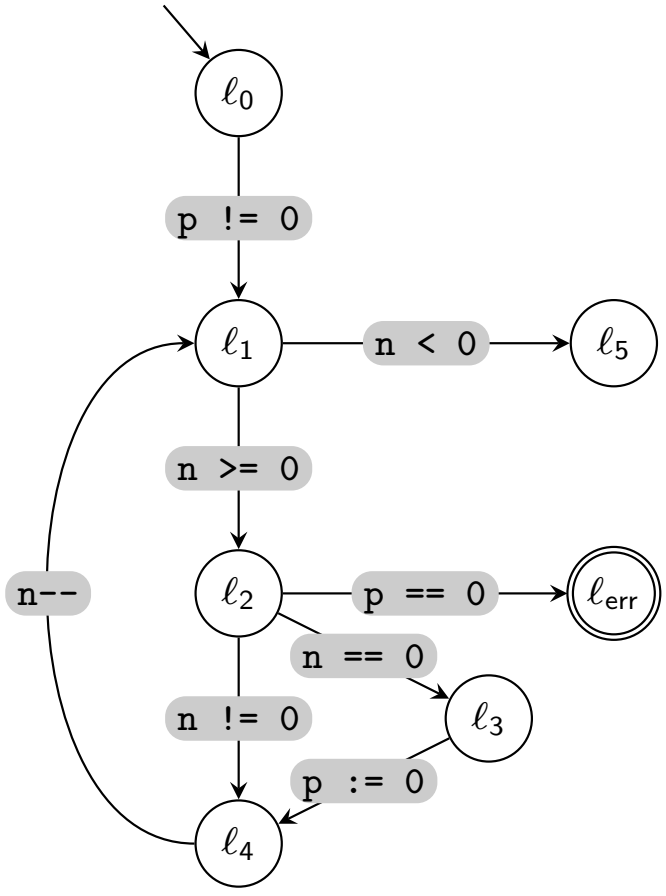
Ultimate



with Unsatisfiable Cores

Matthias Heizmann, Jürgen Christ, Daniel Dietsch, Jochen Hoenicke, Markus Lindenmann, Betim Musa, Christian Schilling, Stefan Wissert, Andreas Podelski

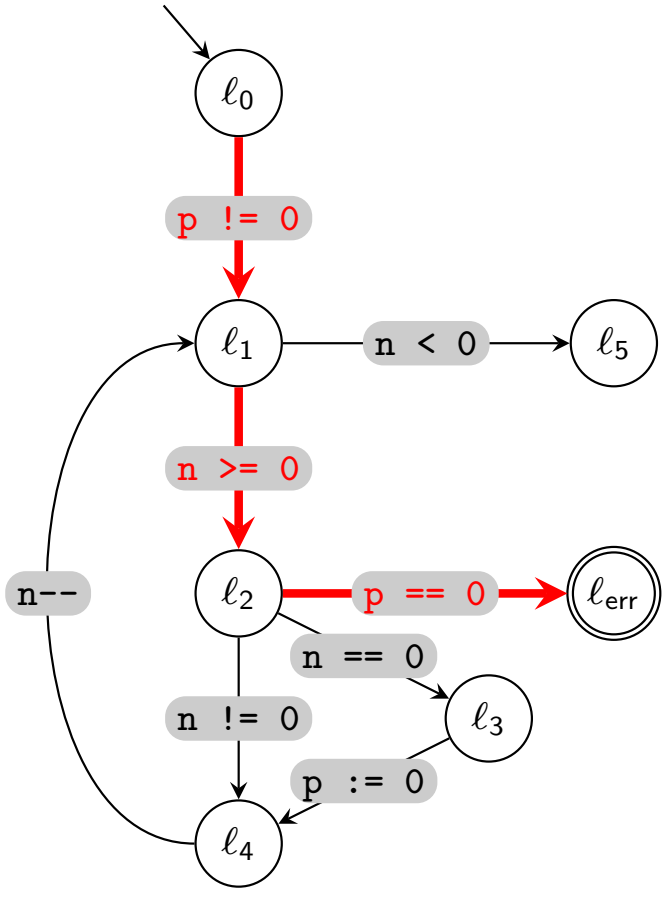
Example



control flow graph of $\mathcal{P}$

Example

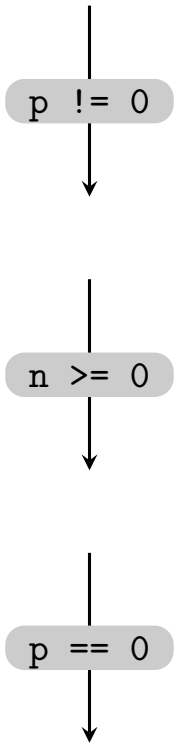
1. pick some error trace



control flow graph of $\mathcal{P}$

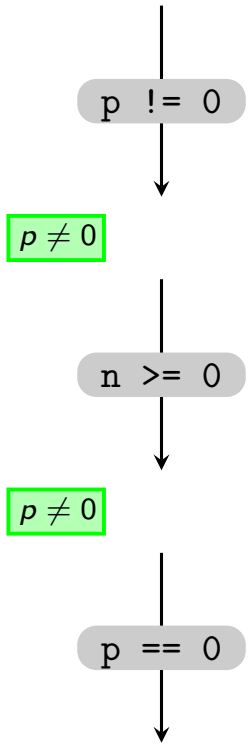
Example

1. pick some error trace
2. is trace feasible?



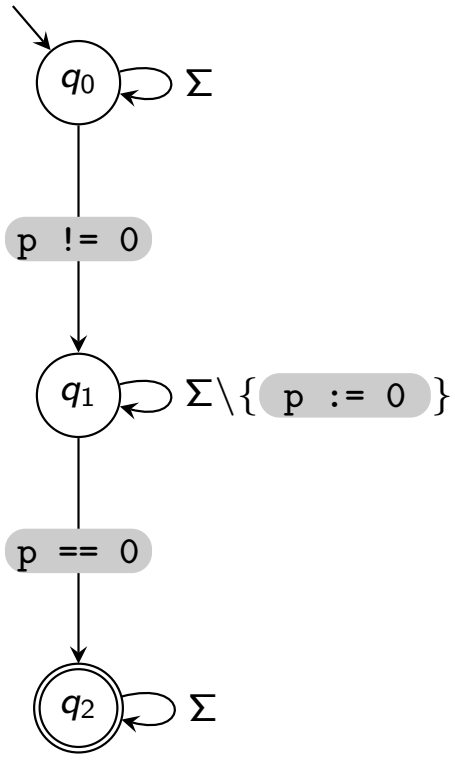
Example

1. pick some error trace
2. is trace feasible?
3. reason for infeasibility?



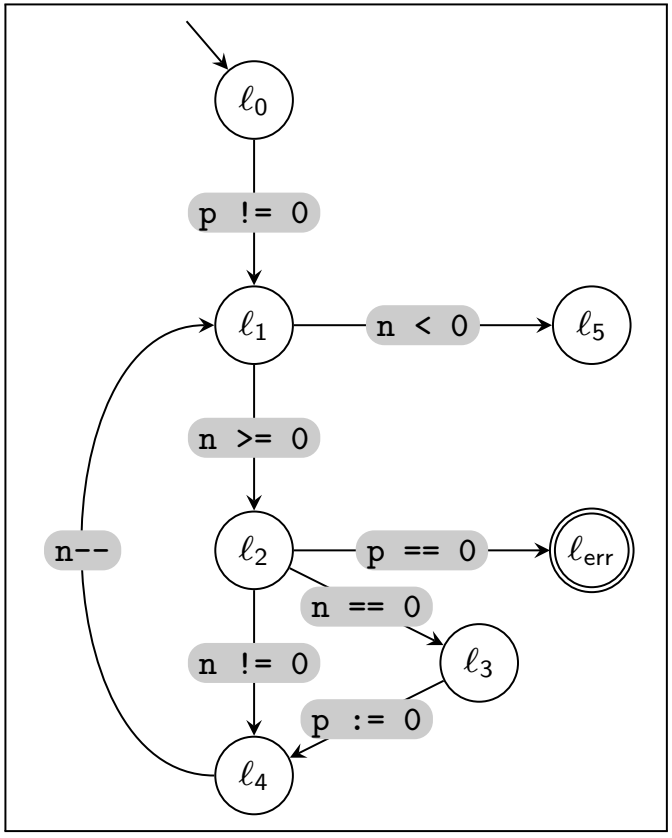
Example

1. pick some error trace
2. is trace feasible?
3. reason for infeasibility?
4. generalize
   from single infeasible trace
   to set of infeasible traces

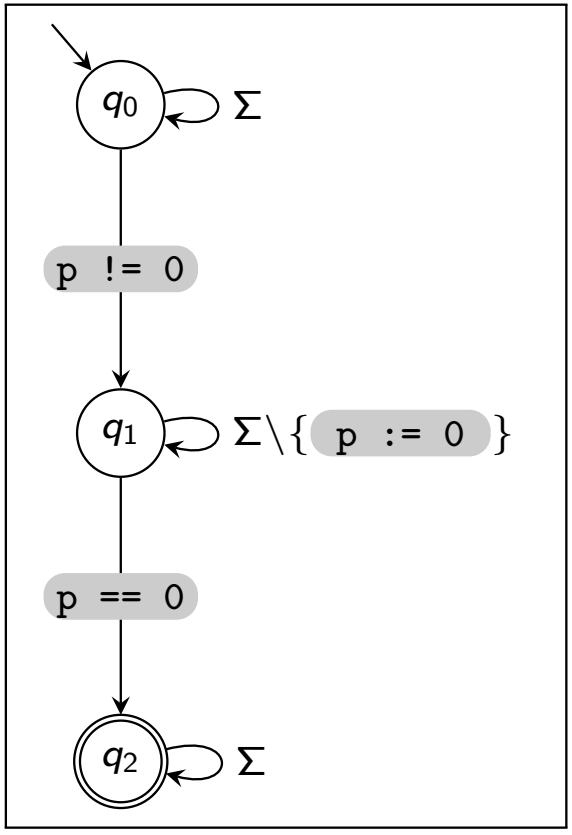


Example - second iteration

restart verification of $\mathcal{P}$
but exclude all error traces whose infeasiblity was proven



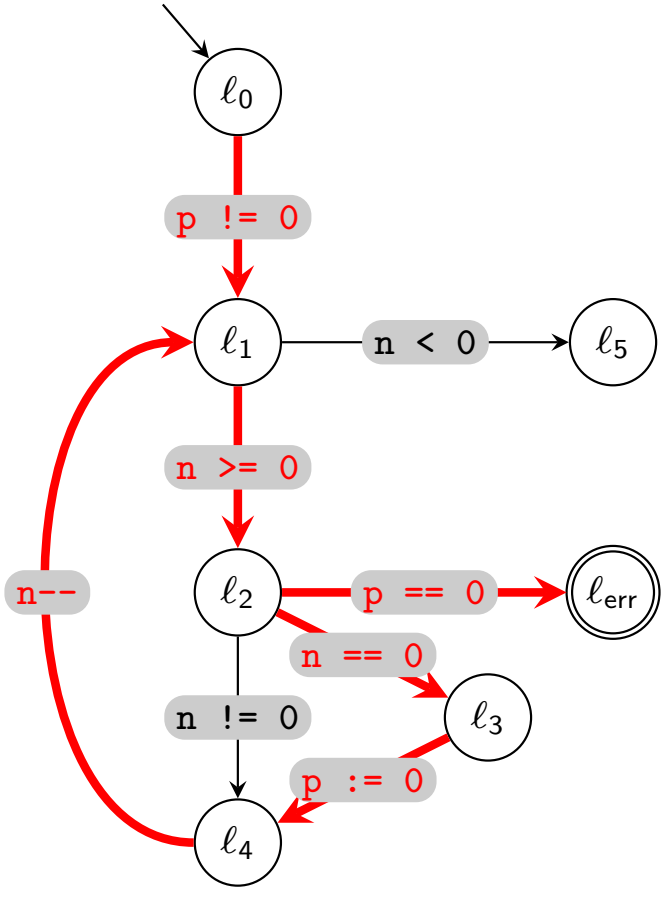
program $\mathcal{P}$
set of error traces



automaton $\mathcal{A}_1$
set of infeasible traces

Example - second iteration

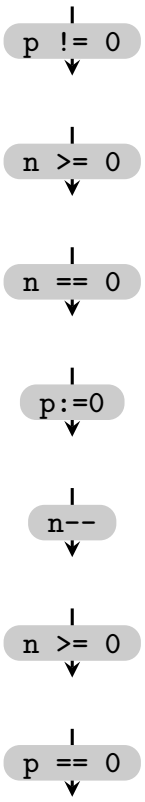
1. pick some error trace



control flow graph of $\mathcal{P}$

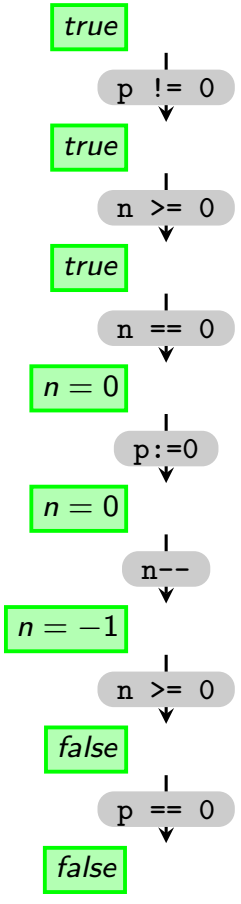
Example - second iteration

1. pick some error trace
2. is trace feasible?



Example - second iteration

1. pick some error trace
2. is trace feasible?
3. reason for infeasibility?



Example - second iteration

1. pick some error trace
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4. generalize
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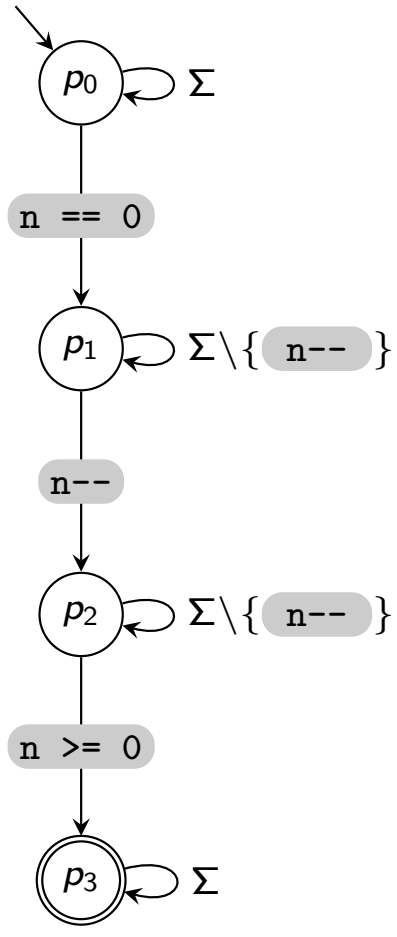
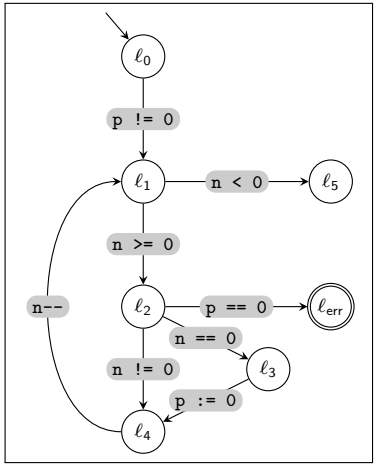
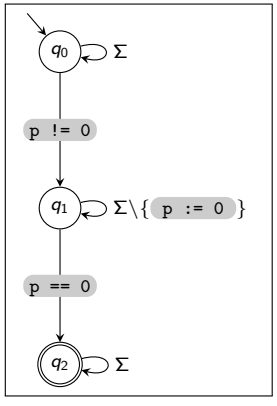


Example - each error trace is infeasible



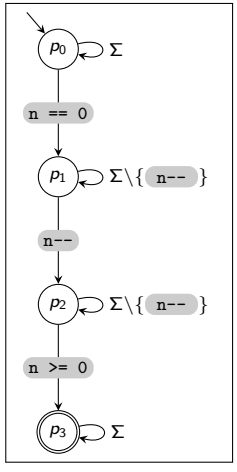
program $\mathcal{P}$
set of error traces

$\subseteq$



automaton $\mathcal{A}_1$
set of infeasible traces

$\cup$



automaton $\mathcal{A}_2$
set of infeasible traces

interprocedural analysis and recursive programs

- nested word automata

H., Hoenicke, Podelski: **Nested Interpolants** (POPL 2010)

interprocedural analysis and recursive programs

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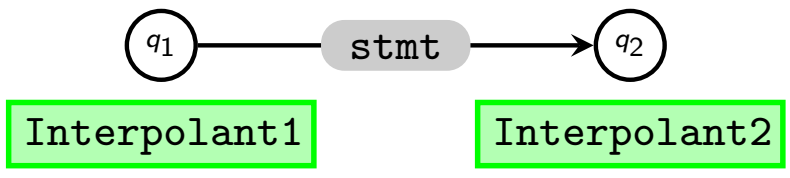
generalization from single infeasible trace to set of infeasible traces

Hoare triple

{ `Interpolant1` } `stmt` { `Interpolant2` }

automaton transition



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interprocedural analysis and recursive programs

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generalization from single infeasible trace to set of infeasible traces

Hoare triple

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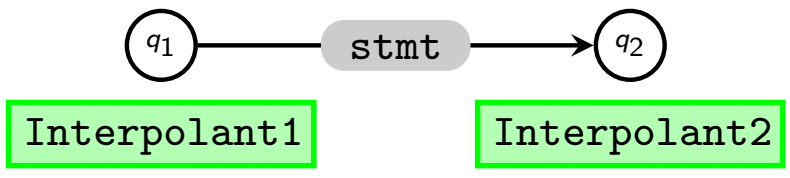
automaton transition



H., Hoenicke, Podelski: **Software Model Checking for People who Love Automata** (CAV 2013)

termination analysis

- Büchi automata


Ultimate Adventure
Center

ULTIMATE WEB-INTERFACE

Task:
Verify C

Sample:

Tool: NullpointerAfterLastIterati...

Trace Abstraction

Trace abstraction toolchain

SETTINGS

```
1  int main() {
2      int p, n;
3      p = 1;
4      while ( n>=0 ) {
5          //@ assert p != 0;
6          if (n == 0) {
7              p = 0;
8          }
9          n--;
10     }
11     return 0;
12 }
13
```

EXECUTE

Show editor fullscreen

Browse...

	Line	Ultimate Result
	5	**assertion always holds**
	0	**Ultimate Automizer runtime statistics** Ultimate Automizer took 121ms
	1 - 12	**Procedure Contract for main** \true
	4 - 10	**Loop Invariant** ((n<=(-1))||(0<=(p+(-1))))

http://ultimate.informatik.uni-freiburg.de/automizer