

On Compositional safety verification with Max-SMT

Fabian Böller with David Korzeniewski

RWTH Aachen

fabian.boeller@rwth-aachen.de

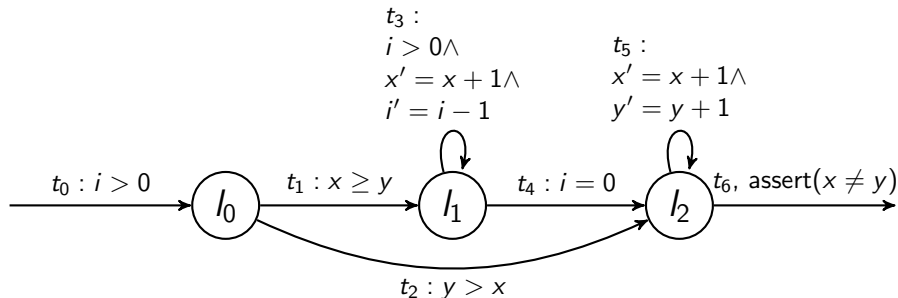
SS 2017

1 Example execution

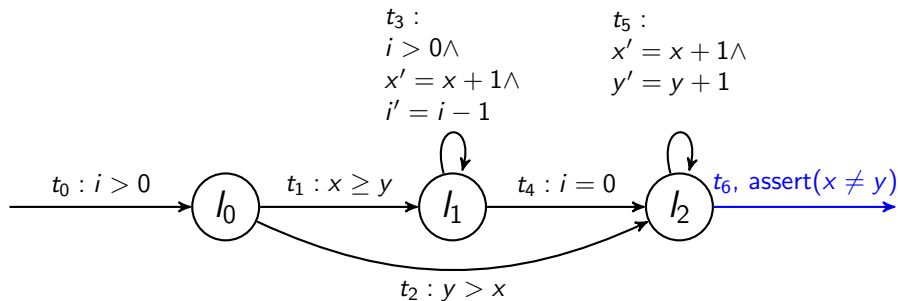
Example program

Program

$\mathcal{V} = \{x, y, i\}$, $\mathcal{L} = \{\ell_0, \ell_1, \ell_2\}$, $\mathcal{T} = \{t_i \mid i \in \{1, \dots, 6\}\}$



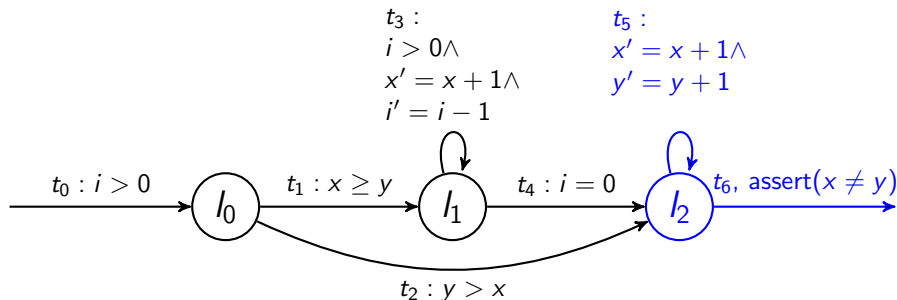
Example execution



Task

Prove that the program is safe for $x \neq y$ at t_6

Example execution



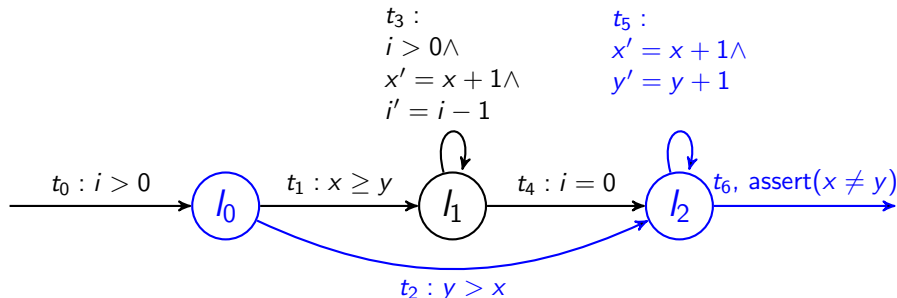
CheckSafe on $\{l_2\}$ for $x \neq y$

t_6 does not already imply $x \neq y$

t_6 is not an initial transition

Call CondSafe, get $x > y$ as precondition

Example execution



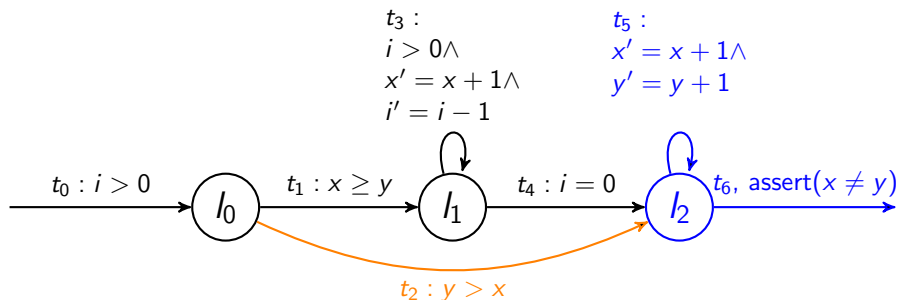
CheckSafe on $\{l_0\}$ for $x > y$

t_2 does not already imply $x > y$

t_2 is not an initial transition

Call CondSafe

Example execution

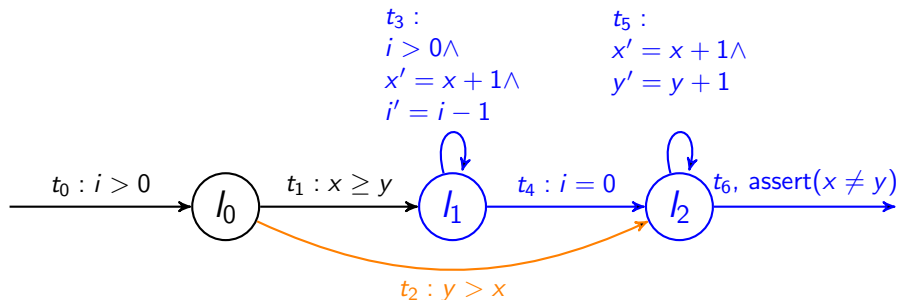


CheckSafe on $\{l_0\}$ for $x > y$

No precondition, since $y > x$ contradicts $x > y$

Path is maybe safe, but not for $x > y$

Example execution



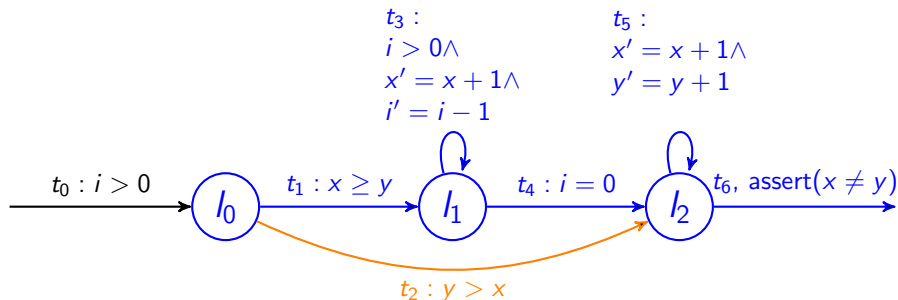
CheckSafe on $\{l_1\}$ for $x > y$

t_4 does not already imply $x > y$

t_4 is not an initial transition

Call CondSafe, get $i > 0 \wedge x \geq y$ as precondition

Example execution



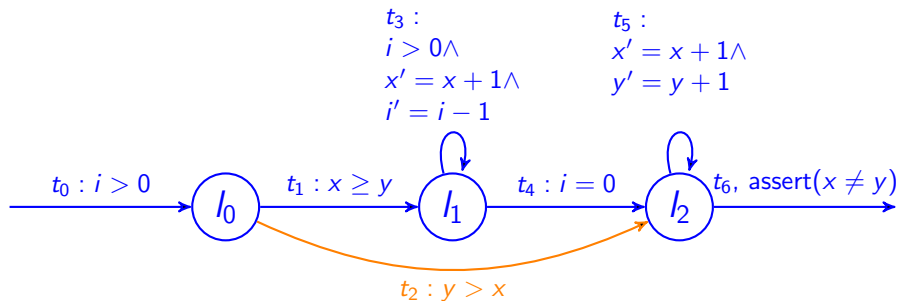
CheckSafe on $\{l_0\}$ for $i > 0$

t_1 does not already imply $i > 0$

t_1 is not an initial transition

Call CondSafe, get $i > 0$ as precondition

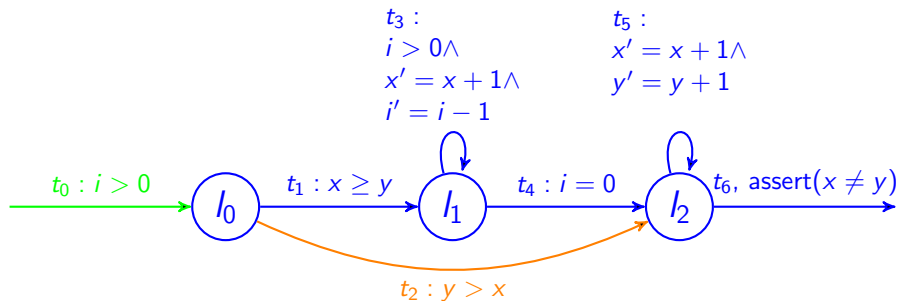
Example execution



CheckSafe on initial SCC for $i > 0$

t_0 does already imply $i > 0$

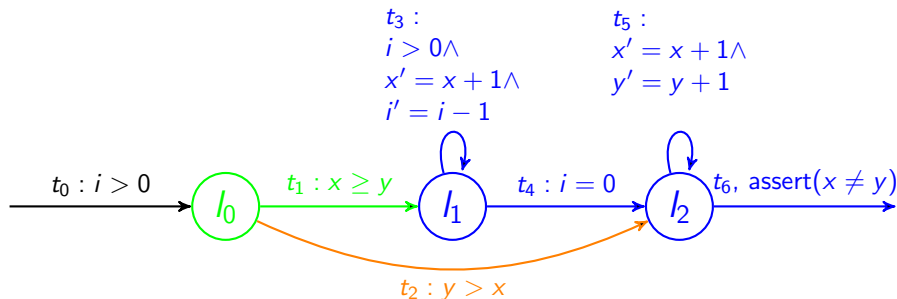
Example execution



CheckSafe on initial SCC for $i > 0$

Path is safe for $i > 0$

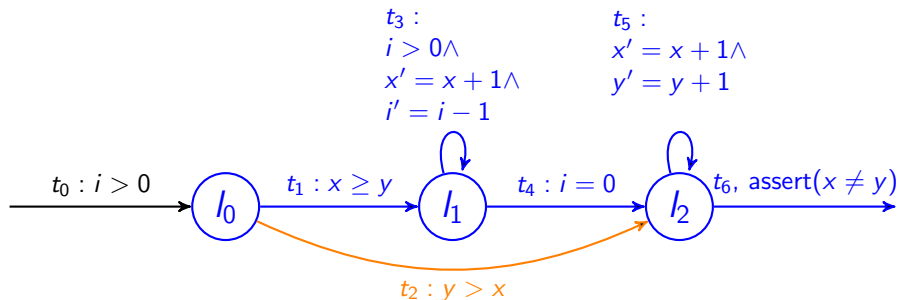
Example execution



CheckSafe on $\{l_0\}$ for $i > 0$

Path is safe for $i > 0$

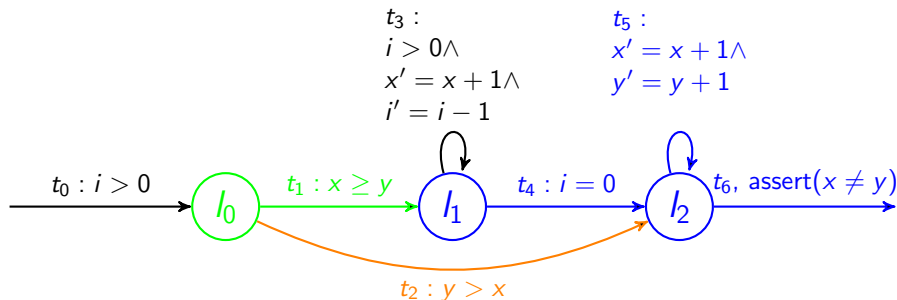
Example execution



CheckSafe on $\{l_0\}$ for $x \geq y$

t_1 does already imply $x \geq y$

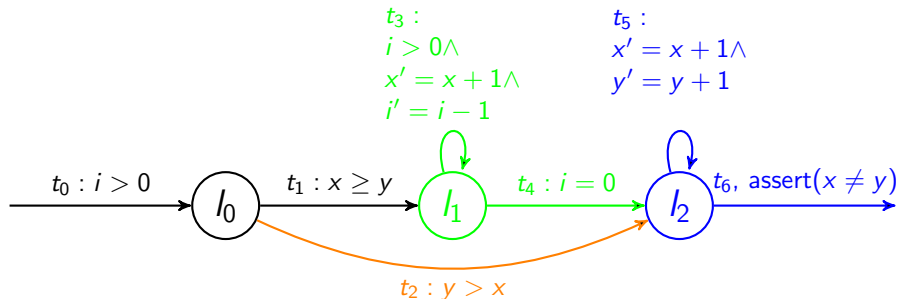
Example execution



CheckSafe on $\{l_0\}$ for $x \geq y$

Path is safe for $x \geq y$

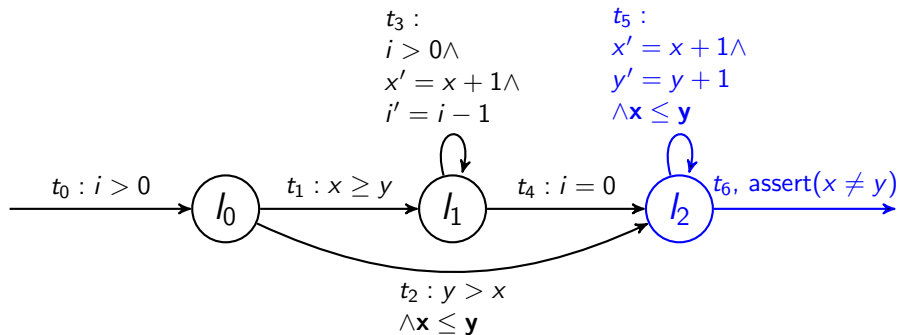
Example execution



CheckSafe on $\{l_1\}$ for $x > y$

Path is safe for $x > y$

Example execution

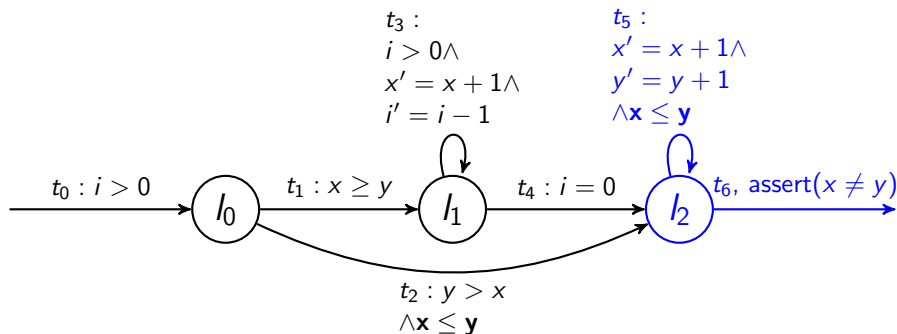


Narrow on $\{l_2\}$

Add $x \leq y$ to t_2

Add $x \leq y$ to t_5

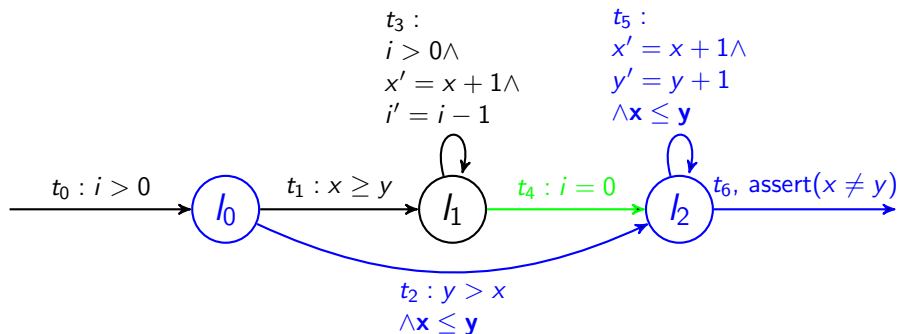
Example execution



CheckSafe on $\{l_2\}$ for $x \neq y$

Call CondSafe, get $y > x$ instead of $x > y$ as precondition

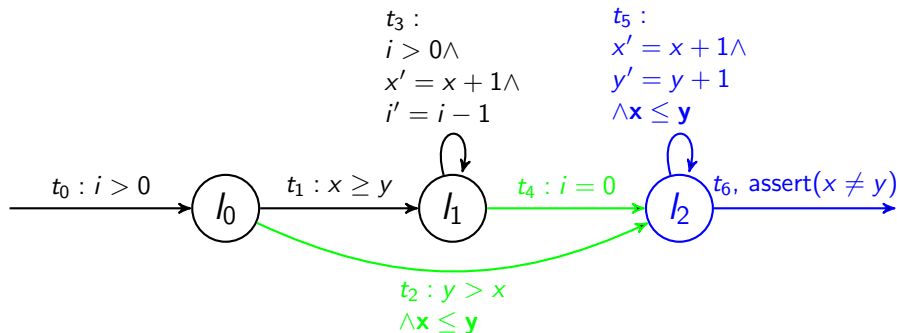
Example execution



CheckSafe on $\{l_0\}$ for $y > x$

t_2 does already imply $y > x$

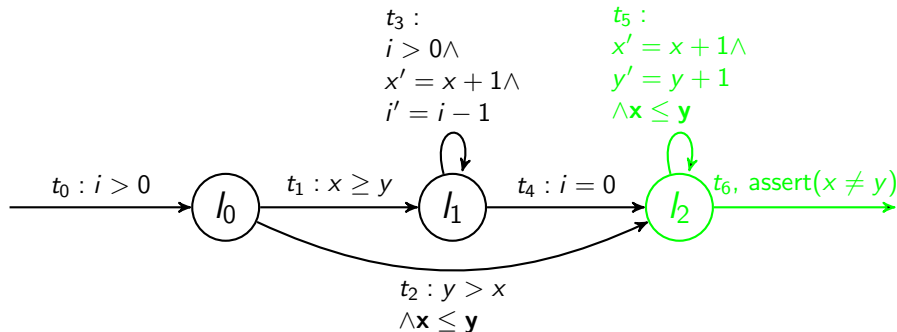
Example execution



CheckSafe on $\{l_0\}$ for $y > x$

Path is safe for $y > x$

Example execution



CheckSafe on $\{l_0\}$ for $y > x$

Program is safe for $x \neq y$



Brockschmidt, Marc and Larraz, Daniel and Oliveras, Albert and Rodriguez-Carbonell, Enric and Rubio, Albert (2015)

Compositional Safety Verification with Max-SMT

Proceedings of FMCAD'15

The End