TU/e technische universiteit eindhoven

TPA

Termination Proved Automatically

http://www.win.tue.nl/tpa

Adam Koprowski A.Koprowski@tue.nl

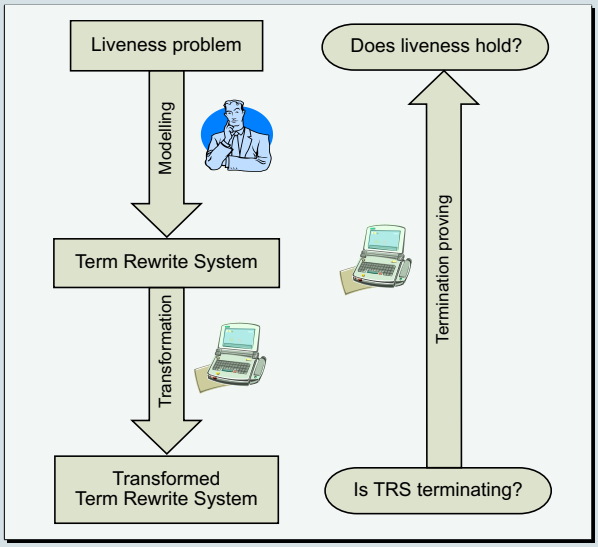
Introduction

TPA is a tool designed to prove termination of term rewrite systems (TRSs) fully automatically. Moreover it is capable of proving liveness properties by transforming them to termination problems. It uses following termination techniques:

- polynomial interpretations,
- semantic labelling both with booleans and with natural numbers,
- recursive path ordering,
- dependency pairs transformation.

Verification

Liveness properties can be verified by transformation to problems of termination of term rewrite systems.



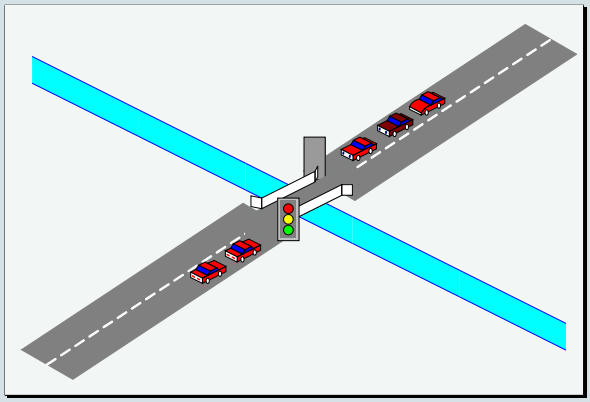
The only human activity is to model the system.

TPA overview

- Proving termination of TRSs fully automatically.
- Proving liveness properties automatically.
- 3rd place in the international termination competition '2005 (Nara, Japan).

Example

There is a road with a bridge permitting only one single lane of traffic, controlled by traffic lights.
Liveness property: every car will eventually be able to cross the bridge.



Model

We model fairness by distinguishing progress steps ($\rightarrow$) and non-progress steps ($\xrightarrow{=}$).

$$
\begin{array}{lrcl}
(1) & \mathrm{top}(\mathrm{left}(\mathrm{car}(x,y),z)) & \rightarrow & \mathrm{top}(\mathrm{right}(y,z)) \\
(2) & \mathrm{top}(\mathrm{right}(x,\mathrm{car}(y,z))) & \rightarrow & \mathrm{top}(\mathrm{left}(x,z)) \\
(3) & \mathrm{top}(\mathrm{left}(\mathrm{bot},x)) & \rightarrow & \mathrm{top}(\mathrm{right}(\mathrm{bot},x)) \\
(4) & \mathrm{top}(\mathrm{right}(x,\mathrm{bot})) & \rightarrow & \mathrm{top}(\mathrm{left}(x,\mathrm{bot})) \\
(5) & \mathrm{top}(\mathrm{left}(\mathrm{car}(x,y),z)) & \xrightarrow{=} & \mathrm{top}(\mathrm{left}(y,z)) \\
(6) & \mathrm{top}(\mathrm{right}(x,\mathrm{car}(y,z))) & \xrightarrow{=} & \mathrm{top}(\mathrm{right}(x,z)) \\
(7) & \mathrm{bot} & \xrightarrow{=} & \mathrm{car}(\mathrm{new},\mathrm{bot})
\end{array}
$$

(1), (2)	Car crosses the bridge, light changes.
(3), (4)	Nobody is waiting - light changes.
(5), (6)	Car crosses the bridge, light remains the same.
(7)	New car arrives and is waiting to cross the bridge.

TPA can automatically prove the liveness property stating that every car will eventually cross the bridge.