Master subject

Model Checking Petri Nets

Supervisor

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Key words :

Infinite-state systems, verification, decidability, logic, well structured transition systems.

General Context

The theory of *Well Structured Transition Systems*, (WSTS) allows the automatical verification of safety properties of infinite-state systems, such that parts of reachability sets can be finitely represented [7, 11, 10]. Termination, boundedness and coverability are decidable for WSTS [4, 5, 9].

As Petri nets are WSTS, the previous properties are decidable.

For complete WSTS [10], the Karp and Miller procedure [13, 10] computes the finite set of maximal elements of the downward closure of the reachability set. This procedure logs a state space exploration of the reachability set with a finite tree allowing to decide some other reachability problems like the reccurent control-state reachability problem.The class of very-WSTS in which this procedure terminates has been determined very recently in [2] and, still, Petri nets are very-WSTS. When the Ideal Karp Miller algorithm terminates, LTL is decidable on very-WSTS under natural but new effective conditions that are also verified on Petri nets [2].

Objective :

The main objective is to construct an efficient coverability graph algorithm and to construct an efficient LTL model checker for Petri nets.

1. Analyse the three following minimal coverability algorithms of Gilles Geeraerts and Jean-François Raskin and Laurent Van Begin in [12], of Pierre-Alain Reynier and Frédéric Servais in [18], and of Artturi Piipponen and Antti Valmari in [17].

2. Compare these three different coverability algorithms.
3. Compare the three differents tools.
4. From the previous survey on existing algorithms, construct an efficient implementation of the minimal coverability graph algorithm based on the original minimal coverability set procedure [8].
5. Extend the decidability of LTL to temporal logics beyond LTL (see, for instance, bounded Model Checking on WSTS [6]).

Location

This internship will be supervised at the Ecole Normale Supérieure Paris-Saclay.

Qualifications and Connections

This internship is opened to strongly motivated and excellent Bachelor or Master students who like discrete mathematics, theoretical computer science and algorithmics.

Ideally, the candidate holds a Master degree in Computer Science (with courses in formal verification, theoretical computer science and mathematical structures for CS) or equivalently is graduated from a Computer Science Engineering School with a strong background in theoretical computer science.

This research program is directly connected to MPRI C2-9 course, on *Mathematical foundations of the theory of infinite transition systems*. It should suit a theoretically-minded student with some taste for theoretical and algorithmic constructions. The internship is an ideal opportunity for starting a PhD thesis (possible collaborations with Bordeaux and Montréal).

Références

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