Master's Internship

Location

Laboratoire Spécification et Vérification
École Normale Supérieure de Cachan
Cachan, France

Title: VASS Simulations

Context

Vector addition systems with states (VASS) are simple counter systems commonly employed to model concurrent, distributed systems. They are also a highly useful formalism of restricted computing capabilities, and are often employed as an intermediate step in complexity proofs.

The two problems of testing whether a VASS *simulates* a finite-state system, or is simulated by one, are both decidable [2]. These algorithms have been extended to operate in a generic way on *well-structured transition systems* [1], and we can provide Ackermannian upper bounds on their complexities.

On the other hand, the best known lower bounds to date are due to Lasota [3], who proved both problems to be ExpSpace-hard, already for a very restricted class of VASS of *communication-free systems*.

Objectives

- Find the exact complexity (lower and upper bounds) of the VASS simulation problems.

This is a problem that has remained open for a while, thus progress towards matching lower and upper bounds would already be a significant contribution. This internship can be undertaken on its own or as a prelude to a PhD thesis.

Prerequisites

Basics in complexity; having followed MPRI course 2-9-1 is a plus but the necessary material can also be learned during the internship.

Contact

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References

[1] Abdulla, P.A., Čerāns, K., Jonsson, B., and Tsay, Y.K., 2000. Algorithmic analysis of programs with well quasi-ordered domains. *Information and Computation*, 160(1–2):109–127. doi:10.1006/inco.1999.2843.

[2] Jancar, P. and Moller, F., 1995. Checking Regular Properties of Petri Nets. In *CONCUR '95*, *Lecture Notes in Computer Science* 348–362. doi:10.1007/3-540-60218-6_26.

[3] Lasota, S., ExpSpace lower bounds for the simulation preorder between a communication-free Petri net and a finite-state system. *Information Processing Letters*, 109(15):850–855. doi:10.1016/j.ipl.2009.04.003.