Proposition de Stage de Recherche:
Terminaison de programmes : comparaison de méthodes

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Location At the convenience of the candidate, the geographic place for this internship will be either Grenoble or Lyon.

Keywords Static Analysis, Satisfiability Modulo Theory, Termination, Complexity.

Context Proving the termination of a flowchart program can be done by exhibiting a ranking function, i.e., a function from the program states to a well-founded set, which strictly decreases at each program step. In [1] Alias *et al.* proposed a general algorithm for the computation of linear ranking functions, which is adaptation of the Linear-Programming based scheduling method of [2]. However, as the underlying LP instances consider the control flow graph globally, there is a challenging scaling issue.

We recently proposed with Lucas Seguinot (ENS Cachan) a reformulation of the previous algorithm that allows to incrementally solve the LP instances, by using SMT (satisfiability modulo theory)-queries for selecting "pertinent" constraints to be added to the current system-to-solve. We think that combining this new technique with control-graph succint representation [3] will improve the performance of the method. Our preliminary tests show the effectivity of the method on rather small examples, but bigger experiments remain to be done.

Internship subject The candidate, according to his skills and preferences, will be expected to :

- Study the (recent) state of the art of the topic, especially the use of recent advances in SMT-solving ([4, 5])
- Theorically and experimentally compare these approaches with our.
- Implement the extensions of our algorithm, and/or a C-frontend to our current implementation.
- Study the theorical complexity of the underlying problems.

Desired knowledge / skills Background in formal/mathematics approaches (in particular, static analysis, complexity theory and logics), and experience in OCaml Programming are required.

Références

[1] Christophe Alias, Alain Darte, Paul Feautrier, and Laure Gonnord. Multi-dimensional Rankings, Program Termination, and Complexity Bounds of Flowchart Programs. In *Static Analysis Symposium*, Perpignan France, 2010.

[2] Alain Darte and Frédéric Vivien. Optimal fine and medium grain parallelism detection in polyhedral reduced dependence graphs. *International Journal of Parallel Programming*, 25(6) :447–496, December 1997.

[3] Julien Henry, David Monniaux, and Matthieu Moy. Succinct representations for abstract interpretation. In *Static analysis (SAS)*, volume 7460 of *Lecture Notes in Computer Science*, pages 283–299. Springer Verlag, 2012.

[4] Marc Brockschmidt, Byron Cook, and Carsten Fuhs. Better termination proving through cooperation. In *Computer aided verification (CAV)*, volume 8044 of *LNCS*, pages 413–429. Springer, 2013.

[5] Byron Cook, Abigail See, and Florian Zuleger. Ramsey vs. lexicographic termination proving. In *TACAS*, volume 7795 of *LNCS*, pages 47–61. Springer, 2013.