Research Internship for Master 2 Students: Logics for Distributed Algorithms

Benedikt Bollig	Arnaud Sangnier
CNRS, LSV, ENS Paris-Saclay	IRIF, Univ Paris Diderot
bollig@lsv.fr	sangnier@irif.fr

The development of correct distributed algorithms is challenging, for different reasons. First, in the presence of failures in asynchronous systems, many problems (e.g., consensus) cannot be solved at all. Furthermore, proving a *given* distributed algorithm to be correct is an extremely difficult task due to the combinatorial explosion of its state space.

In the research project FREDDA (FoRmal methods for the Development of Distributed Algorithms, https://www.irif.fr/~fredda), we develop formal methods to support the design of distributed algorithms. In particular, these methods shall allow us to prove, automatically, that a given algorithm behaves correctly, or to improve its efficiency or robustness. This project lies at the frontier of two research domains with different communities, namely formal verification and distributed algorithms.

The aim of this internship is to lay a formal basis for models and analysis techniques that facilitate the development of distributed algorithms. We will focus on designing logics to specify correctness properties of distributed algorithms with data (like for instance renaming algorithms [3]). We will adapt existing logics working with data [2] to fit the context of distributed algorithms. There will be hence two main directions in this internship:

- Define suitable data logics and study their satisfiability problem.
- Develop corresponding automatic verification methods.

References

- [1] C. Aiswarya, Benedikt Bollig, and Paul Gastin. An automata-theoretic approach to the verification of distributed algorithms, April 2018. http://www.lsv.fr/Publis/PAPERS/PDF/ABG-ic17.pdf.
- [2] Mikołaj Bojańczyk, Claire David, Anca Muscholl, Thomas Schwentick, and Luc Segoufin. Twovariable logic on data words. ACM Trans. Comput. Log., 12(4):27:1–27:26, 2011.
- [3] Armando Castañeda, Sergio Rajsbaum, and Michel Raynal. The renaming problem in shared memory systems: An introduction. *Computer Science Review*, 5(3):229–251, 2011.