# Internship proposal

# Algorithms for Expected-Time Reachability

## Where:

Laboratoire Spécification et Vérification
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**Keywords:** timed automata, graph algorithms, probability theory.

## Description:

Timed automata are a simple natural model of computation for the specification of timed behaviors [1]. They are finite automata extended with clocks, i.e. real-valued variables that increase with the passage of time. Timed automata have been used in a wide range of applications where real-time aspects of computation is important, and they are supported by a variety of efficient tools and model-checkers. The main algorithmic property of timed automata is that the reachability problem (i.e., to decide if a given state of the automaton is accessible from the initial state) is decidable and PSPACE-complete. Some extensions of timed automata with weights and probabilities, as well as robustness questions are also decidable [2, 5]. However, extending timed automata with stopwatch (real-valued clock variables that can pause while counting time) leads to undecidability of the reachability problem [4].

Recently, the time-bounded variant of the reachability problem has been considered for real-time systems, where the final state should be reached within $T$ time units, where $T$ is a given constant. This formulation gives rise to decidability of the reachability problem for timed automata extended with stopwatches [3].

In this internship (with possible continuation as a phd thesis), we consider generalizations of the time-bounded reachability problem where the original question with a fixed horizon $T$ is replaced by an expected time horizon, either given through a fixed stopping-time distribution, or through an adversarial distribution where the stopping-time distribution is unknown and decided by an adversary. We are looking for algorithmic solutions and structural properties in the case of timed automata, including robustness analysis. Several theoretical questions can be investigated and the solutions and heuristics can possibly lead to prototype implementations.

**Expected skills of the student:** Knowledge in analysis, automata theory, and algorithmics. Language: French or English.

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## References

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