

Proposition de stage de Master (M2)

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Title: Quantitative versus Probabilistic Logics

Description:

Formal methods for specifying and verifying qualitative as well as probabilistic properties of critical systems are already well-developed. But other quantitative properties of systems are of interest, e.g., energy consumption, waiting time, various kinds of costs or rewards, their probabilistic versions such as expected rewards, ...

Weighted automata provide a very general framework for the modelization of quantitative systems but a strong theory for specifying and verifying quantitative properties still needs to be developed. In 2005, a quantitative (weighted) extension of MSO logic was introduced and its relationship with weighted automata was studied [4]. This result has been generalized to numerous settings such as trees, pictures, concurrent systems, ..., but weighted extensions of temporal logics (linear time or branching time) were lacking. Moreover, weighted MSO was incomparable with the well-established probabilistic versions of CTL or CTL*.

Very recently [2], a generalization of weighted MSO (wMSO) was introduced as well as weighted extensions of CTL and CTL* which subsume the probabilistic versions of CTL and CTL*. The authors reconciled weighted and probabilistic logics by proving that probabilistic or weighted CTL are fragments of wMSO. Several problems were left open and we propose to study *some* of them during the internship:

1. Satisfiability is undecidable for wMSO in general. Try to identify decidable fragments.
2. Model checking algorithms are known for probabilistic CTL or CTL* (see [1, 3]). Try to extend these methods to wCTL or wCTL* in order to verify other quantitative properties of systems.
3. Extend the result in [2] with a translation of wCTL* in wMSO which is valid for probabilistic systems.
4. Generalize the above results to the *expectation semiring* defined in [5] which allows to compute expected rewards.

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References

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