

# Research internship (Master M2)

**Title** Probabilistic specifications

## Description

Current needs in the verification of systems evolve from boolean properties to finer quantitative properties. The overall theory behind automatic verification is actively being extended by the scientific community from the boolean to the quantitative setting. One of the foremost extension concerns the study of probabilistic systems or probabilistic specifications.

In this internship, we mainly focus on probabilistic specification formalisms. In the boolean case, a specification will assign `true` or `false` to each possible behavior. In the probabilistic extension, the specification assigns probabilities to behaviors. Recently, a fragment of weighted regular expressions was proposed and shown to have the same expressive power as probabilistic automata [1] and [3, Chapter 8]. Since the definition of these probabilistic expressions uses rewriting rules, it is not obvious to decide whether a given weighted expression is actually a probabilistic one. Solving this problem is the first aim of this internship. A second objective is to search an equivalent definition of probabilistic expression for which membership would be easier to check.

There are other interesting specification formalisms, and in particular those like PDL (Propositional Dynamic Logic) that mix state formulæ with path regular expressions. A *weighted* extension of PDL has been proposed in the recent PhD thesis of Benjamin Monmege [3]. In this internship, we will also try to define and study a natural fragment of weighted-PDL dedicated to probabilities. As a special case, probabilistic-PDL should subsume the probabilistic extension of LTL defined in [2].

## References

- [1] Benedikt Bollig, Paul Gastin, Benjamin Monmege, and Marc Zeitoun. A probabilistic Kleene theorem. In *Proceedings of ATVA'12*, LNCS 7561, pages 400–415. Springer, 2012.
- [2] Paul Gastin and Benjamin Monmege. Adding pebbles to weighted automata. In *Proceedings of CIAA'12*, LNCS 7381, pages 28–51. Springer-Verlag, 2012.
- [3] Benjamin Monmege. Spécification et Vérification de Propriétés Quantitatives: Expressions, Logique et Automates, *PhD thesis*, 2013.  
<http://www.lsv.ens-cachan.fr/Publis/PAPERS/PDF/monmege-phd13.pdf>

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