On the expressive power of a weighted μ-calculus on words

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In recent years multi-valued and weighted logics attracted more and more interest. A weighted monadic second-order logic over finite words was introduced [3]. Here, weights from an arbitrary commutative semiring are appended. A fragment of this logic turned out as semantically equivalent to the behaviors of weighted finite automata. But for the description of temporal properties the use of modal operators seems more reasonable. Several papers (cf. [5, 2, 4, 6]) deal with such multi-valued temporal logics and attack the model checking problem in a multi-valued setting. The values are taken from certain finite distributive lattices $\mathcal{L}$ (De Morgan algebras). Then multi-valued Kripke structures are considered, i.e., atomic propositions in the states and/or the transitions of the structure take values in $\mathcal{L}$. For several temporal logics and the μ-calculus over these multi-valued Kripke structures the model checking problem was solved (either by a reduction to the classical case or by attacking it directly).

Here, we turn our attention to the expressive power. We define a weighted μ-calculus on finite and infinite words. Generalizing an approach for word languages (cf. [1]), we show the coincidence of a conjunction-free fragment with the class of ω-rational formal power series. Hereby, the weights are taken from semirings with certain completeness properties. These semirings comprise distributive complete lattices but also the tropical $(\min,+)$-semiring. Moreover, we discuss for which other semirings the result may carry over and how conjunction can be handled.

References

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