On the Complexity of Confluence for Ground Rewrite Systems

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Abstract

Programming language interpreters, proving equations (e.g. $x^3 = x$ implies the ring is Abelian), abstract data types, program transformation and optimization, and even computation itself (e.g., turing machine) can all be specified by a set of rules, called a rewrite system. A fundamental property of a rewrite system is the confluence or Church-Rosser property. In this paper, we show, using new and direct techniques, that: (i) confluence for ground rewrite systems containing one unary symbol and arbitrary many constants is in the complexity class P, (ii) confluence for ground rewrite systems containing arbitrary many unary symbols and constants is in co-NP, and (iii) confluence for arbitrary ground rewrite systems is in the complexity class deterministic EXPTIME. The best previous decidability results for these problems are indirectly obtained using tree automata techniques and the upper bounds are not precisely specified in these papers.