

Review

An overview of term rewriting systems

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It is well-known that termination of finite term of rewriting systems is generally undecidable. Notwithstanding, a remarkable result is that, rewriting systems are *Turing complete*. A number of methods have been developed to establish termination for certain term of rewriting systems, particularly occurring in practical situations. In this paper, we present an overview of the existing methods used for termination proofs. We also outline areas of applications of term rewriting systems along with recent developments in regard to automated termination proofs.

Key words: Confluence, rewriting, term, termination, turing complete.

INTRODUCTION

Rewriting is a very powerful method for dealing computationally with equations. However, applying effectively this approach is in general not straightforward. Alternatively, oriented equations, called rewrite rules, are used to replace equals by equals, but only in one direction. A rewrite system is a set of rules used to compute, by repeatedly replacing parts of a given formula with equal ones until the simplest possible form, called normal form, is obtained. For instance, an equation $2+3=5$ can be interpreted as “5 is the result of computing $2+3$ ”, but not vice versa. This directional replacement is expressed by $2+3 \rightarrow 5$ which reads “ $2+3$ reduces to 5”.

This computational aspect of equations naturally leads to term rewriting systems (TRSs, for short). Depending on the kinds of objects that are rewritten, there are different kinds of rewrite systems such as string rewrite (Thue or semi-Thue) systems, TRSs and graph rewriting to mention a few (Baader and Nipkow, 1998; Terese, 2003; Dershowitz, 2005).

The formal study of rewriting and its properties began in 1910 with a paper by Axel Thue (Book, 1987). Significantly, most early models of computation were

based on notions of rewriting strings or terms. The emergence of Thue systems; Alonzo Church's lambda Calculus; Andrei Markov's normal algorithms, just to mention a few, led to sustained study of rewriting in the context of programming language semantics (Book, 1987). To be more specific, the study of TRSs originated in combinatory logic (CL) and lambda calculus (Curry and Feys, 1958) developed and deeply analyzed half a century ago to investigate the foundation of functions. CL is actually a TRS. One could say that the paradigmatic example of a TRS is the system of CL. As a matter of fact, the roots of the very notion of term rewriting and much of its theory can be found in the system of CL.

In the recent years, a strong impulse for the study of TRSs (including extensions of the usual rewriting format) is given by the design of functional languages such as Miranda (Terese, 2003). Another strong impulse is given by efforts of many researchers to combine logic programming with functional programming (Toyama, 1990; Marché and Zanema, 2007). In this direction, Toyama (1990) proposed and applied Knuth-Bendix completion algorithm for a better performance. The compiling technique proposed in this algorithm is dynamic in the sense that, rewriting rules are repeatedly compiled in the completion process. The execution time of the completion with dynamic compiling is ten or more times faster than the one obtained with a traditional TRS interpreter.

Two of the most central properties of TRSs are

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Term Rewriting And Applications

JL Elias



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