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Author(s)	松野，吉宏
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Description	Supervisor:酒井 正彦，情報科学研究科，修士

On Efficient Implementation of Narrowing

Yoshihiro Matsuno

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Abstract

E-unification is a problem to find a substitution θ that makes $s\theta$ and $t\theta$ equal on a modulo of equational theory E foe terms s and t. To solve an equation efficiently, narrowing was introduced.

In the field of declarative programming, E-unification has recieved special attention recently, since it has become clear that E-unification is the key computation mechanism in integrating functional and logic programming. Programming method that integrates functional and logic programming is called functional-logic programming. Namely, one of the most promising approach to the integration is equation solving as a computational model of functional-logic programming .

Narrowing was first studied in the context of an efficient way to find E-unifier. At first, Fay proposed it and Hullot refined it. They showed that narrowing is a complete method for solving equations in the confluent and terminating term rewriting system. Completeness means that narrowing can find general solution for any solution to concerning equations. It is known that narrowing with respect to normalized substitution is complete. we can drop the condition of termination. In other words, narrowing is complete for confluent term rewriting systems.

In general,narrowing takes large search space. In order to reduce search space, Hullot proposed to basic narrowing. He showed that basic narrowing is complete for confluent and terminating term rewriting systems. Basic narrowing is not complete for confluent term rewriting systems with respect to normalized substitution. This narrowing has particular forms of narrowing sequence. Certain subterms of s and term obtained from s by narrowing, are never narrowed themselves. Aart showed that basic narrowing is complete for right linear term rewriting system with respect to normalized substitution.

Narrowing works on equational theory and logic programming on horn logic, but both narrowing and logic programming use unification to calculate. Because of this, these days there are much interest in incorporating the functional programming paradigms and logic programming paradigms.

For example, programming language ALF uses inner most narrowing instead of logic programming's derivation. To use narrowing instead of derivation, we can amalgame both functional programming paradigm and logic programming paradigm. Recently, this area is studied by using lazy narrowing instead of narrowing. Examples include an abstract machine LNAM.

But narrowing is nondeterminstic as regards to choices of rewrite rule and redexies, and in general narrowing is inefficient. so various strategies for reducing search space are proposed .

This study's aim is to find redex in term speedy. So ,by using tree patern matching 's idea , the way to create an automaton for unification

On one hand, many speedy methods to Tree pattern matching have been proposed. For several patterns, effectively patterns are matched by using these methods. So, subterms that

match to patterns are easy to find . Narrowing is necessary to find easily subterms that are unifiable to patterns. So, this method werw able to use in narrowing process, it is expected that it makes narrowing effective .

So in this study ,we make improvements on the speedy method for tree pattern matching and make possible to apply uniification. We made narrowing effective by using tree automaton.

In actually, we made experiments with new method by using workstation, and it was realized that in the case that many pattern are used,this study's unification method is more effective than other methods.

According to this fact, we presupose that patterns and object terms are linear. And by using this study's algorithm, we pick up patterns and sub object terms that have an ability of unification, and those patterns and terms are regarded as unifiable candidates, it make genaral unificaiton algorithm apply those candidates . This method decides problems with nonlinear patterns.

In fact, experiences on workstation make us realize that this method is effective.

This paper discuss following two items:

- Construction of automaton to find out unifable occurrence. by using tree automaton speed up the way to find unifiable occurrence.
- to establish a way to combine basicnarrowing and tree automaton to find out unifiable occurrence.

Tree automaton's inputed data are object terms and patterns are linear.An evaluation was made to this study's algorithm and Alberto Martell and Ugo Montanari's algorithm . Results are shown next.

- The run time of this study algorithm is faster than Alberto's algorithm.
- A precomputing time for making trasitional rules is under the influence of pattern set's character.
- In the case of that object term is big and table is repeatedly used, the overhead is small than running time's merit.