

## On Modular Termination Proofs of General Logic Programs

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### Abstract

We propose a modular method for proving termination of general logic programs (i.e., logic programs with negation). It is based on the notion of acceptable programs, but it allows us to prove termination in a truly modular way. We consider programs consisting of a hierarchy of modules and supply a general result for proving termination by dealing with each module separately. For programs which are in a certain sense well-behaved, namely well-moded or well-typed programs, we derive both a simple verification technique and an iterative proof method. Some examples show how our system allows for greatly simplified proofs.

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### 1 Introduction

It is standard practice to tackle a large proof by decomposing it into more manageable pieces (lemmata or modules) and proving them separately. By composing appropriately these simpler results, one can then obtain the final proof. This methodology has been recognized an important one also when proving termination of logic programs. Moreover most practical logic programs are engineered by assembling different modules and libraries, some of which might be pre-compiled or written in a different programming language. In such a situation, a compositional methodology for proving termination is of crucial importance.

The first approach to modular termination proofs of logic programs has been proposed by Apt and Pedreschi in (Apt and Pedreschi 1994). It extends the seminal work on acceptable programs (Apt and Pedreschi 1993) which provides an algebraic characterization of programs terminating under Prolog left-to-right selection rule. The class of acceptable programs contains programs which terminate on ground queries. To prove acceptability one needs to determine a measure on literals (*level mapping*) such that, in any clause, the measure of the head is greater than the measure of each body literal. This implies the decreasing of the measure of the

# Termination Proofs For Logic Programs

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## Termination Proofs For Logic Programs:

*Termination Proofs for Logic Programs* Lutz Plümer, 1990 Termination proofs constitute a crucial part of program verification. Much research about termination has been done in the context of term rewriting systems. But until now there was little hope that termination proofs for nontrivial programs could be achieved automatically. This book gives a comprehensive discussion of the termination problem in the context of logic programming. Although logic programs pose special difficulties for termination proofs, it turns out that automation of this task is obtainable to a much larger degree than for programs in imperative languages. A technique for the automatic derivation of termination proofs is presented in detail. The discussion of several nontrivial examples illustrates its range of applicability. The approach is based on the concept of declarative semantics and thus makes use of an important feature of logic programming.

PUBLISHER'S WEBSITE [TERMINATION PROOFS FOR LOGIC PROGRAMS](#) Lutz Plümer, 1990

*Deriving Termination Proofs for Logic Programs, Using Abstract Procedures* K. Verschaetse, D. De Schreye, 1991

*Termination proofs for logic programs based on predicate inequalities* Lutz Plümer, 1990

**Logic Programming** Lee Naish, 1997 Covers the latest research in areas such as theoretical foundations, constraints, concurrency and parallelism, deductive databases, language design and implementation, non-monotonic reasoning and logic programming, and the Internet. 8-12 July 1997, Leuven, Belgium. The International Conference on Logic Programming is the main annual conference sponsored by the Association for Logic Programming. It covers the latest research in areas such as theoretical foundations, constraints, concurrency and parallelism, deductive databases, language design and implementation, non-monotonic reasoning and logic programming, and the Internet.

**Logic Programming** Michael Maher, 1996 Includes tutorials, invited lectures and refereed papers on all aspects of logic programming, including Constraints, Concurrency and Parallelism, Deductive Databases, Implementations, Meta and Higher order Programming, Theory and Semantic Analysis. September 2-6, 1996, Bonn, Germany. Every four years, the two major international scientific conferences on logic programming merge in one joint event. JICSLP 96 is the thirteenth in the two series of annual conferences sponsored by the Association for Logic Programming. It includes tutorials, invited lectures and refereed papers on all aspects of logic programming, including Constraints, Concurrency and Parallelism, Deductive Databases, Implementations, Meta and Higher order Programming, Theory and Semantic Analysis. The contributors are international, with strong contingents from the United States, United Kingdom, France and Japan. Logic Programming series, Research Reports and Notes.

**Meta-Programming in Logic** Alberto Pettorossi, 1992 This volume contains lectures and papers delivered at Meta 92, the Third International Workshop on Metaprogramming in Logic, held in Uppsala, Sweden, June 1992. The topics covered include foundations of metaprogramming in logic, proposals for metaprogramming languages, techniques for knowledge representation and belief systems, and program transformation and analysis in logic. Particular topics include belief revision systems, intensional deduction, belief systems and metaprogramming principles of partial deduction, termination in

logic programs semantics of the vanilla metainterpreter a complete resolution method for metaprogramming semantics of demo hierarchical metalogics the naming relation in metalevel systems modules reflective agents compiler optimizations metalogic and object oriented facilities parallel logic languages the use of metaprogramming for legal reasoning representing objects and inheritance transformation of normal programs negation in automatically generated logic programs reordering of literals in deductive databases abstract interpretations and interarguments in constraint logic programs PUBLISHER S

WEBSITE *Foundations of Software Technology and Theoretical Computer Science* Rudrapatna K.

Shyamasundar, 1993-11-23 For more than a decade Foundations of Software Technology and Theoretical Computer Science Conferences have been providing an annual forum for the presentation of new research results in India and abroad This year 119 papers from 20 countries were submitted Each paper was reviewed by at least three reviewers and 33 papers were selected for presentation and included in this volume grouped into parts on type theory parallel algorithms term rewriting logic and constraint logic programming computational geometry and complexity software technology concurrency distributed algorithms and algorithms and learning theory Also included in the volume are the five invited papers presented at the conference

**ESOP '92** Bernd Krieg-Brückner, 1992-02-19 This volume contains selected papers presented at the

European Symposium on Programming ESOP held jointly with the seventeenth Colloquium on Trees in Algebra and Programming CAAP in Rennes France February 26 28 1992 the proceedings of CAAP appear in LNCS 581 The previous symposia were held in France Germany and Denmark Every even year as in 1992 CAAP is held jointly with ESOP ESOP addresses fundamental issues and important developments in the specification and implementation of programming languages and systems It continues lines begun in France and Germany under the names Colloque sur la Programmation and the GI workshop on Programmiersprachen und Programmierung The programme committee received 71 submissions from which 28 have been selected for inclusion in this volume

*Generative Programming and Component Engineering* Don Batory, Charles Consel, Walid Taha, 2003-06-30 This volume constitutes the proceedings of the first ACM SIGPLAN SIGSOFT International Conference on Generative Programming and Component Engineering GPCE 2002 held October 6 8 2002 in Pittsburgh PA USA as part of the PLI 2002 event which also included ICFP PPDP and a related workshops The future of Software Engineering lies in the automation of tasks that are performed manually today Generative Programming developing programs that synthesize other programs Component Engineering raising the level of modularization and analysis in application design and Domain Specific Languages elevating program specifications to compact domain specific notations that are easier to write and maintain are key technologies for automating program development In a time of conference and workshop proliferation GPCE represents a counter trend in the merging of two distinct communities with strongly overlapping interests the Generative and Component Based Software Engineering Conference GCSE and the International Workshop on the Semantics Applications and Implementation of Program Generation SAIG Researchers in the GCSE community address

the topic of program automation from a contemporary software engineering viewpoint SAIG correspondingly represents a community attacking automation from a more formal programming languages viewpoint Together their combination provides the depth of theory and practice that one would expect in a premier research conference Three prominent PLI invited speakers lectured at GPCE 2002 Neil Jones University of Copenhagen Catuscia Palamidessi Penn State University and Janos Sztipanovits Vanderbilt University GPCE 2002 received 39 submissions of which 18 were accepted

**Principles and Practice of Declarative Programming** Gopalan Nadathur, 2006-12-29 This book constitutes the refereed proceedings of the International Conference on Principles and Practice of Declarative Programming PPDP 99 held in Paris France in September October 1999 The 22 revised full papers presented together with three invited contributions were carefully reviewed and selected from a total of 52 full length papers submitted Among the topics covered are type theory logics and logical methods in understanding defining integrating and extending programming paradigms such as functional logic object oriented constraint and concurrent programming support for modularity the use of logics in the design of program development tools and development and implementation methods

**Logic Programming** Christoph Beierle, Lutz Plümer, 1995 This text aims at promoting a convergence between the technical challenges of developing advanced software systems and the formal techniques tools and features evolving from the logic programming paradigm It provides

contributions towards different aspects of logic programming **Automated Termination Analysis for Logic Programs** Kirack Sohn, 1993 *Logic Program Synthesis and Transformation*, 1996 ACM Transactions on Programming Languages and Systems Association for Computing Machinery, 2000

**Constructing Logic Programs** Jean-Marie Jacquet, 1993-09-21 This is an in depth analysis of the complexities and practical advantages of several approaches to logic program development The authors highlight state of the art research illustrating and clarifying each concept by example Exercises and a general tutorial style give the book its practical perspective It addresses the problems which may be encountered in the complicated process of writing a logic program A structured discussion of each facet of this task covers broadly the synthesis derivation and analysis of a logic program as well as the necessary underlying theoretical foundations Page 4 de la couverture

Functional and Logic Programming, 1999 Principles and Practice of Declarative Programming, 2006 Foundations of Software Technology and Theoretical Computer Science, 2005 **Programming Languages Implementation and Logic Programming**, 1992

## Whispering the Techniques of Language: An Mental Journey through **Termination Proofs For Logic Programs**

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