

**Lecture Notes in Computer Science**      1139

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

Advisory Board: W. Brauer D. Gries J. Stoer

Michael Hanus  
Mario Rodríguez-Artalejo (Eds.)

# Algebraic and Logic Programming

5th International Conference, ALP'96  
Aachen, Germany, September 25-27, 1996  
Proceedings



Springer

**Series Editors**

Gerhard Goos, Karlsruhe University, Germany

Juris Hartmanis, Cornell University, NY, USA

Jan van Leeuwen, Utrecht University, The Netherlands

**Volume Editors**

Michael Hanus

RWTH Aachen, Lehr- und Forschungsgebiet Informatik II

Ahornstraße 55, D-52074 Aachen, Germany

E-mail: hanus@informatik.rwth-aachen.de

Mario Rodríguez-Artalejo

Universidad Complutense, Dto. de Informatica y Automatica

Av. Complutense s/n, 28040 Madrid, Spain

E-mail: mario@dia.ucm.es

Cataloging-in-Publication data applied for

**Die Deutsche Bibliothek - CIP-Einheitsaufnahme**

**Algebraic and logic programming : 5th international conference ; proceedings / ALP '96, Aachen, Germany, September 25 - 27, 1996.** Michael Hanus ; Mario Rodríguez Artalejo (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Santa Clara ; Singapore ; Tokyo : Springer, 1996

(Lecture notes in computer science ; Vol. 1139)

ISBN 3-540-61735-3

NE: Hanus, Michael [Hrsg.]; ALP <5, 1996, Aachen>; GT

CR Subject Classification (1991): D.3,F.3-4, I.2.3

ISSN 0302-9743

ISBN 3-540-61735-3 Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer -Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1996  
Printed in Germany

Typesetting: Camera-ready by author  
SPIN 10513704 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

## Preface

This volume contains the proceedings of the *Fifth International Conference on Algebraic and Logic Programming* (ALP'96), held in Aachen (Germany) during September 25–27, 1996. The conference was preceded by previous meetings in Gaussig (1988), Nancy (1990), Volterra (1992), and Madrid (1994). The previous proceedings have been published by Springer-Verlag, as in this case, as Lecture Notes in Computer Science, volumes 343, 463, 632, and 850, respectively.

Following the intention of the previous ALP meetings, the conference aims at strengthening the connections between algebraic techniques and logic programming. On the one hand, logic programming has been very successful during the last two decades, and many efforts have been made to enhance its expressive power and efficiency, including in particular the emergence of constraint logic programming. On the other hand, concepts such as functions, types, equational theories, and modularity are particularly well handled in an algebraic framework. As during the previous conferences, ALP promotes the cross-fertilizing exchange of ideas and experiences among researchers from the algebraic and logic programming communities.

On this occasion, ALP was held concurrently with the Eighth International Symposium on Programming Languages, Implementations, Logics, and Programs (PLILP'96) and the Third International Static Analysis Symposium (SAS'96).

The ALP'96 Program Committee met in Aachen on June 22, 1996. Shortly before this meeting, there was an email discussion of those papers for which there was a significant disagreement about the technical quality. Finally, the Program Committee selected 21 papers from 54 submissions. In addition to the selected papers, the scientific program included invited lectures (shared with PLILP'96 and SAS'96) by Claude Kirchner, Lambert Meertens, and Bernhard Steffen. The invited paper by Ilies Alouini and Claude Kirchner is included in this volume.

We would like to thank all the members of the Program Committee and all the referees for their careful work in the reviewing and selection process.

The organization of the conferences was supported by

- The Association of Logic Programming
- Esprit Compulog-Net
- RWTH Aachen
- SUN Microsystems

Finally, we express our gratitude to all members of the local Organizing Committee for their help in organizing a successful event.

Aachen  
Madrid  
July 1996

Michael Hanus  
Mario Rodríguez-Artalejo  
Program Committee Chairmen

## Program Committee Chairmen

Michael Hanus (Germany)  
 Mario Rodríguez-Artalejo (Spain)

## Program Committee

Sergio Antoy (USA)	Luis Monteiro (Portugal)
Egidio Astesiano (Italy)	Fernando Orejas (Spain)
Jürgen Avenhaus (Germany)	Catuscia Palamidessi (Italy)
Pierre Deransart (France)	Frank Pfenning (USA)
Laurent Fribourg (France)	Vijay Saraswat (USA)
Joxan Jaffar (Singapore)	Peter Stuckey (Australia)
Giorgio Levi (Italy)	Andrzej Tarlecki (Poland)
Karl Meinke (UK)	Andrei Voronkov (Sweden)
Aart Middeldorp (Japan)	Martin Wirsing (Germany)

## Local Organization

Michael Hanus, Herbert Kuchen, Markus Mohnen, Ulla Oebel, Frank Zartmann,  
 Olaf Chitil, Arnd Gehrman

## List of Referees

J. Alferes, Z. Ariola, P. Barahona, M. Bednarczyk, M. Bidoit, S. Blom, N. Boland, A. Borzyszkowski, L. Caires, M. Carlsson, M. Cerioli, P. Chambre, W.N. Chin, O. Chitil, M. Comini, H. Comon, M.-M. Corsini, J.N. Crossley, A. Degtyarev, G. Delzanno, J. Denzinger, W. Drabent, A. Ed-Dbali, S. Etalle, M. Falaschi, C. Fecht, C. Fermüller, M. Fernandez, J.A. Fernández, R. Fettig, T. Fruehwirth, M. Gabbirelli, M. García de la Banda, M. Gaspari, A. Gavilanes-Franco, A. Geser, R. Giacobazzi, J.C. González-Moreno, B. Gramlich, M. Hamana, W. Harvey, T. Hortalá-Gonzalez, A. Hui-Bon-Hoa, S. Kahrs, S. Kekkonen, R. Kennaway, S.C. Khoo, C. Kirchner, J.W. Klop, T. Knäpik, P. Kosiuczenko, F. Laburthe, A. Lallouet, T. Lindgren, F. López-Fraguas, B. Malfon, P. Mancarella, N. Martí-Oliet, P.-A. Melliès, P. Mello, M.-C. Meo, D. Miller, H. Millroth, E. Moggi, M. Mohnen, L. Monteiro, T. Mora, A. Mycroft, G. Nadathur, C.W. Ngan, R. Nieuwenhuis, S. Nieva-Soto, E. Ohlebusch, H. Olsén, V. van Oostrom, P. Pączkowski, E. Palmgren, W. Pawłowski, L. M. Pereira, E. Pimentel-Sánchez, A. Porto, F. van Raamsdonk, G. Reggio, S. Renault, B. Reus, J.-H. Rety, J. Richardson, S. Ronchi della Rocca, A. Rubio, S. Ruggieri, M. Rusinowitch, F. Sáenz-Pérez, A. Sattler-Klein, M. Schmidt-Schauff, D. Seipel, R. Sekar, H. Søndergaard, M. Thielscher, A. Tolmach, R. Treinen, M. Veines, P. Volpe, F.-J. de Vries, M. Wallace, T. Yamada, R. Yap, H. Zantema, F. Zartmann

## Table of Contents

### Invited Talk

- Toward the Concurrent Implementation of Computational Systems ..... 1  
*Ilies Alouini and Claude Kirchner*

### Logic Programming

- On Negation as Instantiation ..... 32  
*Alessandra Di Pierro and Włodzimierz Drabent*
- Independence in Dynamically Scheduled Logic Languages ..... 47  
*Maria García de la Banda, Manuel Hermenegildo, and Kim Marriott*
- Heterogeneous Constraint Solving ..... 62  
*Frédéric Benhamou*
- A Hierarchy of Semantics for Normal Constraint Logic Programs ..... 77  
*François Fages and Roberta Gori*

### Term Rewriting

- Order-Sorted Termination: The Unsorted Way ..... 92  
*Peter Csaba Ölveczky and Olav Lysne*
- Unravelings and Ultra-properties ..... 107  
*Massimo Marchiori*
- Standardization Theorem Revisited ..... 122  
*Taro Suzuki*
- Discrete Normalization and Standardization in Deterministic Residual Structures ..... 135  
*Zurab Khasidashvili and John Glauert*

### Integration of Paradigms

- A Language for the Logical Specification of Processes and Relations ..... 150  
*Luís Caires*
- A Process Algebra for Synchronous Concurrent Constraint Programming . 165  
*Luboš Brim, David Gilbert, Jean-Marie Jacquet, and Mojmír Křetínský*
- An Algebraic Approach to Mixins and Modularity ..... 179  
*Davide Ancona and Elena Zucca*
- A Strict Border for the Decidability of E-Unification for Recursive Functions 194  
*Heinz Faßbender and Sebastian Maneth*

**Abstract Interpretation**

- Prime Factorizations of Abstract Domains Using First Order Logic ..... 209  
*Elena Marchiori*

- Abstractions of Uniform Proofs ..... 224  
*Paolo Volpe*

- Complementing Logic Program Semantics ..... 238  
*Roberto Giacobazzi and Francesco Ranzato*

**Lambda-Calculus and Rewriting**

- Meaningless Terms in Rewriting ..... 254  
*Richard Kennaway, Vincent van Oostrom, and Fer-Jan de Vries*

- Unique Normal Form Property of Higher-Order Rewriting Systems ..... 269  
*Ken Mano and Mizuhito Ogawa*

- $\lambda$ -Calculi with Explicit Substitutions and Composition which Preserve  
 $\beta$ -strong Normalization (Extended Abstract) ..... 284  
*Maria C.F. Ferreira, Delia Kesner, and Laurence Puel*

**Types**

- Algebraic Semantics for Functional Logic Programming with  
Polymorphic Order-Sorted Types ..... 299  
*Jesús M. Almendros-Jiménez, Antonio Gavilanes-Franco, and Ana Gil-Luezas*

- Specifying Type Systems ..... 314  
*Dieter Nazareth*

- The Semantic Treatment of Polymorphic Specification Languages ..... 330  
*Dieter Nazareth*

- Author Index** ..... 345