

Springer

Berlin

Heidelberg

New York

Barcelona

Hong Kong

London

Milan

Paris

Singapore

Tokyo

Thorsten Altenkirch Wolfgang Naraschewski
Bernhard Reus (Eds.)

Types for Proofs and Programs

International Workshop, TYPES '98
Kloster Irsee, Germany, March 27-31, 1998
Selected Papers



Springer

Series Editors

Gerhard Goos, Karlsruhe University, Germany
Juris Hartmanis, Cornell University, NY, USA
Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editors

Thorsten Altenkirch
Bernhard Reus
Ludwig-Maximilians-Universität, Institut für Informatik
Oettingenstr. 67, D-80538 München, Germany
E-mail: {alti,reus}@informatik.uni-muenchen.de

Wolfgang Naraschewski
Technische Universität München, Institut für Informatik
Arcisstr. 21-1528, D-80290 München, Germany
E-mail: narasche@informatik.tu-muenchen.de

Cataloging-in-Publication data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Types for proofs and programs : international workshop, types '98, Kloster Irsee, Germany, March 27 - 31, 1998 ; selected papers / Thorsten Altenkirch ... (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer, 1999
(Lecture notes in computer science ; Vol. 1657)
ISBN 3-540-66537-4

CR Subject Classification (1998): F.4.1, F.3.1, D.3.3, I.2.3

ISSN 0302-9743

ISBN 3-540-66537-4 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 1999
Printed in Germany

Typesetting: Camera-ready by author
SPIN 10704119 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

Preface

This book contains a selection of papers presented at the second annual workshop held under the auspices of the Esprit Working Group 21900 Types. The workshop took place in Irsee, Germany, from 27 to 31 of March 1998 and was attended by 89 researchers.

Of the 25 submissions, 14 were selected for publication after a regular refereeing process. The final choice was made by the editors.

This volume is a sequel to the proceedings from the first workshop of the working group, which took place in Aussois, France, in December 1996. The proceedings appeared in vol. 1512 of the LNCS series, edited by Christine Paulin-Mohring and Eduardo Giménez.

These workshops are, in turn, a continuation of the meetings organized in 1993, 1994, and 1995 under the auspices of the Esprit Basic Research Action 6453 *Types for Proofs and Programs*. Those proceedings were also published in the LNCS series, edited by Henk Barendregt and Tobias Nipkow (vol. 806, 1993), by Peter Dybjer, Bengt Nordström and Jan Smith (vol. 996, 1994) and by Stefano Berardi and Mario Coppo (vol. 1158, 1995). The Esprit BRA 6453 was a continuation of the former Esprit Action 3245 *Logical Frameworks: Design, Implementation and Experiments*. The articles from the annual workshops organized under that Action were edited by Gerard Huet and Gordon Plotkin in the books *Logical Frameworks* and *Logical Environments*, both published by Cambridge University Press.

Acknowledgments

We would like to thank Irmgard Mignani and Agnes Szabo-Lackinger for helping us with processing the registrations, and Ralph Matthes and Markus Wenzel for organizational support during the meeting. We are indebted to the organizers of the Working Group Types and also to Peter Clote, Tobias Nipkow and Martin Wirsing for giving us the opportunity to organize this workshop and for their support. We would also like to acknowledge funding by the European Union. This volume would not have been possible without the work of the referees. They are listed on the next page and we thank them for their invaluable help.

June 1999

Thorsten Altenkirch
Wolfgang Naraschewski
Bernhard Reus

List of Referees

Peter Aczel
Thorsten Altenkirch
Gilles Barthe
Henk Barendregt
Uli Berger
Marc Bezem
Venanzio Capretta
Mario Coppo
Catarina Coquand
Roberto Di Cosmo
Gilles Dowek
Marc Dymetman
Jean-Christophe Filliâtre
Neil Ghani
Martin Hofmann
Furio Honsell
Paul Jackson
Felix Joachimski
Florian Kammüller
James McKinna
Simão Melo de Sousa
Thomas Kleymann
Hans Leiss

Petri Mäenpää
Ralph Matthes
Michael Mendler
Wolfgang Naraschewski
Tobias Nipkow
Sara Negri
Christine Paulin-Mohring
Henrik Persson
Randy Pollack
David Pym
Christophe Raffalli
Aarne Ranta
Bernhard Reus
Eike Ritter
Giovanni Sambin
Monika Seisenberger
Anton Setzer
Jan Smith
Sergei Soloview
Makoto Takeyama
Silvio Valentini
Markus Wenzel
Benjamin Werner

Table of Contents

On Relating Type Theories and Set Theories	1
<i>Peter Aczel</i>	
Communication Modelling and Context-Dependent Interpretation: An Integrated Approach	19
<i>René Ahn, Tijn Borghuis</i>	
Gröbner Bases in Type Theory	33
<i>Thierry Coquand, Henrik Persson</i>	
A Modal Lambda Calculus with Iteration and Case Constructs	47
<i>Joëlle Despeyroux, Pierre Leleu</i>	
Proof Normalization Modulo	62
<i>Gilles Dowek, Benjamin Werner</i>	
Proof of Imperative Programs in Type Theory	78
<i>Jean-Christophe Filliâtre</i>	
An Interpretation of the Fan Theorem in Type Theory	93
<i>Daniel Fridlender</i>	
Conjunctive Types and SKInT	106
<i>Jean Goubault-Larrecq</i>	
Modular Structures as Dependent Types in Isabelle	121
<i>Florian Kammüller</i>	
Metatheory of Verification Calculi in LEGO	133
<i>Thomas Kleymann</i>	
Bounded Polymorphism for Extensible Objects	149
<i>Luigi Liquori</i>	
About Effective Quotients in Constructive Type Theory	164
<i>Maria Emilia Maietti</i>	

Algorithms for Equality and Unification in the Presence of
Notational Definitions 179
Frank Pfenning, Carsten Schürmann

A Preview of the Basic Picture: A New Perspective on Formal Topology .. 194
Giovanni Sambin, Silvia Gebellato