LIPIcs – Leibniz International Proceedings in Informatics

LIPIcs is a series of high-quality conference proceedings across all fields in informatics. LIPIcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

Editorial Board
- Susanne Albers (TU München)
- Chris Hankin (Imperial College London)
- Deepak Kapur (University of New Mexico)
- Michael Mitzenmacher (Harvard University)
- Madhavan Mukund (Chennai Mathematical Institute)
- Catuscia Palamidessi (INRIA)
- Wolfgang Thomas (Chair, RWTH Aachen)
- Pascal Weil (CNRS and University Bordeaux)
- Reinhard Wilhelm (Saarland University)

ISSN 1868-8969

http://www.dagstuhl.de/lipics
## Contents

**Preface**  
*Stephan Kreutzer* ................................................................. ix

**The Ackermann Award 2015**  
*Anuj Dawar, Dexter Kozen, and Simona Ronchi Della Rocca* ..................... xv

### Invited Talks

- **The Prophecy of Timely Rollback**  
  *Martín Abadi* ................................................................. 1

- **Temporal Logics with Local Constraints**  
  *Claudia Carapelle and Markus Lohrey* ............................................ 2

- **Thinking Algorithmically About Impossibility**  
  *R. Ryan Williams* ............................................................. 14

### Contributed Talks

- **Simple Parsimonious Types and Logarithmic Space**  
  *Damiano Mazza* ................................................................. 24

- **First-Order Queries on Finite Abelian Groups**  
  *Simone Bova and Barnaby Martin* .............................................. 41

- **A Definability Dichotomy for Finite Valued CSPs**  
  *Anuj Dawar and Pengming Wang* .............................................. 60

- **Evidence for Fixpoint Logic**  
  *Sjoerd Cranen, Bas Luttik, and Tim A. C. Willemse* ......................... 78

- **Elementary Elimination of Prenex Cuts in Disjunction-free Intuitionistic Logic**  
  *Matthias Baaz and Christian G. Fermüller* ..................................... 94

- **Tree Grammars for the Elimination of Non-prenex Cuts**  
  *Stefan Hetzl and Sebastian Zivota* ........................................... 110

- **Automata Theoretic Account of Proof Search**  
  *Aleksy Schubert, Wil Dekkers, and Henk P. Barendregt* .................... 128

- **Maximal Partition Logic: Towards a Logical Characterization of Copyless Cost Register Automata**  
  *Filip Mazowiecki and Cristian Riveros* ...................................... 144

- **Aperiodic Two-way Transducers and FO-Transductions**  
  *Olivier Carton and Luc Dartois* .............................................. 160

- **On Relative and Probabilistic Finite Counterability**  
  *Orna Kupferman and Gal Vardi* .............................................. 175

- **A Model Checking Procedure for Interval Temporal Logics based on Track Representatives**  
  *Alberto Molinar, Angelo  Montanari, and Adriano Peron* .................... 193
Contents

Contextuality, Cohomology and Paradox
Samson Abramsky, Rui Soares Barbosa, Kohei Kishida, Raymond Lal, and Shane Mansfield .......................................................... 211

A Model for Behavioural Properties of Higher-order Programs
Sylvain Salvati and Igor Walukiewicz ............................................ 229

Reachability Analysis of First-order Definable Pushdown Systems
Lorenzo Clemente and Sławomir Lasota ........................................ 244

Relational Semantics of Linear Logic and Higher-order Model Checking
Charles Grellois and Paul-André Melliès ...................................... 260

A Van Benthem Theorem for Modal Team Semantics
Juha Kontinen, Julian-Steffen Müller, Henning Schnoor, and Heribert Vollmer ... 277

Axiomatizing Propositional Dependence Logics
Katsuhiko Sano and Jonni Virtema .............................................. 292

Static Analysis for Logic-based Dynamic Programs
Thomas Schwentick, Nils Vortmeier, and Thomas Zeume .................. 308

Sub-classical Boolean Bunched Logics and the Meaning of Par
James Brotherston and Jules Villard .......................................... 325

Classical and Intuitionistic Arithmetic with Higher Order Comprehension Coincide on Inductive Well-Foundedness
Stefano Berardi ................................................................. 343

Functions out of Higher Truncations
Paolo Capriotti, Nicolai Kraus, and Andrea Vezzosi ......................... 359

Leaving the Nest: Nominal Techniques for Variables with Interleaving Scopes
Murdoch J. Gabbay, Dan R. Ghica, and Daniela Petrișan .................... 374

Rank Logic is Dead, Long Live Rank Logic!
Erich Grädel and Wied Pakusa .................................................. 390

Two-Restricted One Context Unification is in Polynomial Time
Adrià Gascón, Manfred Schmidt-Schauss, and Ashish Tiwari ............ 405

Confluence of Layered Rewrite Systems
Jiaxiang Liu, Jean-Pierre Jouannaud, and Mizuhito Ogawa ................. 423

A Unified Approach to Boundedness Properties in MSO
Lukasz Kaiser, Martin Lang, Simon Leßenich, and Christof Löding ........ 441

Deciding the First Levels of the Modal $\mu$ Alternation Hierarchy by Formula Construction
Karoliina Lehtinen and Sandra Quickert ..................................... 457

Infinite and Bi-infinite Words with Decidable Monadic Theories
Dietrich Kuske, Jiamou Liu, and Anastasia Moskvinj ....................... 472

A Coalgebraic Decision Procedure for WS1S
Dmitriy Traytel ................................................................. 487

Weak Subgame Perfect Equilibria and their Application to Quantitative Reachability
Thomas Brihaye, Véronique Bruyère, Noémie Meunier, and Jean-François Raskin 504
What are Strategies in Delay Games? Borel Determinacy for Games with Lookahead
Felix Klein and Martin Zimmermann ............................................ 519

On Unambiguous Regular Tree Languages of Index (0,2)
Jacques Duparc, Kevin Fournier, and Szczepan Hummel ......................... 534

Least and Greatest Fixed Points in Ludics
David Baelde, Amina Doumane, and Alexis Saurin ............................................ 549

Modelling Coeffects in the Relational Semantics of Linear Logic
Flavien Breuvart and Michele Pagani ........................................... 567

On Classical PCF, Linear Logic and the MIX Rule
Shahin Amini and Thomas Ehrhard .............................................. 582

Uniform One-Dimensional Fragments with One Equivalence Relation
Emanuel Kieroński and Antti Kuusisto ............................................ 597

Finite-Degree Predicates and Two-Variable First-Order Logic
Charles Paperman ............................................................... 616

Two-variable Logic with Counting and a Linear Order
Witold Charatonik and Piotr Witkowski .......................................... 631
The annual conference Computer Science Logic (CSL 2015) of the European Association for Computer Science Logic (EACSL) was held in Berlin, Germany, from 7 to 10 September 2015. CSL started as a series of international workshops on Computer Science Logic, and became at its sixth meeting the Annual Conference of the EACSL. This conference was the 29th workshop and 24th EACSL conference. The conference was organised by the Logic and Semantics Research Group of the Technical University Berlin.

A total of 99 abstracts were registered for the conference. After a two week electronic meeting, the programme committee selected 39 papers for presentation at the conference and publication in the proceedings. Each paper was assigned to at least three programme committee members. The overall quality of the submissions was very high with essentially no bad papers submitted. This made the work of the programme committee a difficult task. Due to lack of space, the programme committee had to reject several very good papers in the end.

In 2015, CSL followed a selective rebuttal strategy. There was no general rebuttal phase but whenever questions arose during the discussion or in a review that could meaningfully be posed to the authors, the authors were notified and asked for clarification. The average response time by the authors was less than a day, even for difficult questions, making this a valuable tool for the programme committee discussion. As a result of this selective rebuttal system, two papers were withdrawn by the authors due to flaws in their arguments that could not be fixed. For several other papers, the referees’ concerns could be clarified by the authors or the authors were able to present simple fixes for factual mistakes in their papers which were verified and accepted by the programme committee.

The programme committee was assisted by a number of external reviewers providing additional expertise. The list of external reviewers is included in these proceedings. On behalf of the programme committee I wish to express my sincere gratitude to the external referees for the time and energy they spent on assessing submissions to CSL 2015.

In addition to the contributed talks, CSL 2015 had four invited speakers:

- Martín Abadi (Google),
- Elham Kashefi (Edinburgh),
- Markus Lohrey (Siegen), and
- Ryan Williams (Stanford).

Some invited speakers have contributed an abstract which is included in the proceedings.

The Ackermann Award is the EACSL Outstanding Dissertation Award for Logic in Computer Science. This year, the eleventh Ackermann Award was presented at CSL 2015. The jury decided to give the Ackermann Award for 2015 to Hugo Férée and Mickael Randour. The awards were officially presented at the conference on 9 September 2015. The citation of the awards, an abstract of the theses and a biographical sketch of the recipients written by Anuj Dawar is included in the proceedings.

I wish to warmly thank all members of the programme committee and all external reviewers for the time and energy spent on reviewing and discussing the papers.

Very special thanks go to Christoph Dittmann who collected the papers from the authors and compiled them into these proceedings, solving numerous LATEX-issues and checking the papers for layout consistency. Many thanks also to Marc Herbstritt from the Dagstuhl/LIPIcs team for assisting us in the publication process and the final production of the proceedings.

Finally, I also want to thank the members of the organising committee, especially...
Preface

Christoph Dittmann, Jana Pilz, Roman Rabinovich and Sebastian Siebertz, for their pro-
active, thoughtful, reliable and energetic help in organising CSL 2015.

The conference received support from the Technical University Berlin, from the European
Association for Computer Science Logic (EACSL) and from the Deutsche Forschungsge-
meinschaft (DFG). I thank these organisations for their generous support.

Stephan Kreutzer
Conference Organisation

Programme Committee
- Albert Atserias (Universitat Politècnica de Catalunya, Barcelona)
- Achim Blumensath (Technical University Darmstadt)
- Mikolaj Bojanczyk (Warsaw University)
- Maria Paola Bonacina (Università degli Studi di Verona)
- Patricia Bouyer-Decitre (LSV, CNRS & ENS de Cachan)
- Ugo Dal Lago (Università di Bologna)
- Maribel Fernández (King’s College London)
- Richard Garner (Macquarie University, Sydney)
- Rajeev Goré (Australian National University, Canberra)
- Stéphane Graham-Lengrand (CNRS & École Polytechnique, Paris-Saclay)
- Martin Grohe (RWTH Aachen University)
- Lauri Hella (University of Tampere)
- Martin Hofmann (Ludwig-Maximilians-University Munich)
- Stephan Kreutzer (Technical University Berlin, PC chair)
- Martin Lange (University of Kassel)
- Luigi Santocanale (LIF, Aix-Marseille Université & CNRS)
- Alexandra Silva (Radboud University Nijmegen)
- Alex Simpson (University of Edinburgh)
- Sonja Smets (University of Amsterdam)
- Makoto Tatsuta (National Institute of Informatics, Tokyo)
- Kazushige Terui (Kyoto University)
- James Benjamin Worrell (University of Oxford)
- Nobuko Yoshida (Imperial College London)

Organising Committee
- Saeed Amiri (Technical University Berlin)
- Christoph Dittmann (Technical University Berlin)
- Viktor Engelmann (Technical University Berlin)
- Stephan Kreutzer (Technical University Berlin, chair)
- Jana Pilz (Technical University Berlin)
- Roman Rabinovich (Technical University Berlin)
- Sebastian Siebertz (Technical University Berlin)
External Reviewers

Alexis Bernadet
Andreas Herzig
Antoine Miné
Arnaud Carayol
Arnaud Sangnier
Ben Moszkowski
Benedikt Bollig
Bernhard Reus
Charles Paperman
Daisuke Kimura
Dan Ghica
Daniele Varacca
Diego Figueira
Dominic Orchard
Erich Grädel
Florian Bruse
Georg Zetzsche
Ilya Shapirovsky
Jakob Rehof
Jelena Ivetic
Joanna Ochremiak
Johannes Waldmann
Jordi Levy
Juha Kontinen
Julian Bitterlich
Julian Gutierrez
Koji Nakazawa
Louwe B. Kuijer
Marcus Kracht
Martin Avanzini
Matthew Collinson
Milka Hutagalung
Mnacho Echenim
Nicole Schweikardt
Philipp Ruemmer
Roy Dyckhoff
Standa Zivny
Stefan Haar
Stephan Merz
Takeshi Tsukada
Uwe Waldmann
Vincent Rahli
Zhe Hou

Amaldev Manuel
Andrew M. Marshall
Antti Kuusisto
Arnaud Durand
Ashutosh Trivedi
Benedetto Intrigila
Beniamino Accattoli
Charles Grellois
Christof Löding
Damiano Mazza
Daniel Kernberger
Detlef Plump
Dimitrios Vytiniotis
Dominique Larchey-Wendling
Felix Canavoi
Gabriele Pulcini
Igor Walukiewicz
Iosif Petrakis
James Brotherston
Jérôme Fortier
Joel Ouaknine
Jonathan Hayman
Joshua Moerman
Jules Hedges
Julian Bradfield
Kerkko Luosto
Kord Eickmeyer
Manuel Bodirsky
Marino Miculan
Martin Otto
Michael Vanden Boom
Minghui Ma
Nicolas Markey
Nikos Tzevelekos
Ramyaa Ramyaa
Sebastian Siebertz
Stefan Göller
Stefan Kiefer
Stéphane Demri
Thomas Colcombet
Vincent Aravantinos
Wouter M. Kooiwen