

# Preface

Relations and formal languages are omnipresent in computer science and in software design. While quantifier-oriented (first- or higher-)order logics can be used to specify and reason about relations, this “element-level style” often obfuscates the structure of specifications and makes reasoning harder. A useful analogy is to consider how element-level reasoning gives way to matrix-level calculations in linear algebra. Similarly, *relation algebra* allows for calculational, largely quantifier-free reasoning about relations, and shares a large subtheory with *Kleene algebra*, the mathematical theory of the regular expressions used for the specification of certain formal languages.

An international collaboration to establish a conference series as a forum for the use of relational methods in computer science, RelMiCS, was initiated during the “38th Banach Semester on Algebraic Methods in Logic and their Computer Science Application” in Warsaw, Poland, September and October 1991. Adapting essentially a one-and-a-half year rhythm, the first 11 RelMiCS conferences were held from 1994 to 2009 on all inhabited continents except Australia. Starting with RelMiCS 7, these were held as joint events with “Applications of Kleene Algebras” (AKA) conferences. At RelMiCS 11 / AKA 6 in Doha, Qatar, it was decided to continue the series under the unifying name “Relational and Algebraic Methods in Computer Science (RAMiCS).” The next events, RAMiCS 12–14, were then held in Rotterdam, The Netherlands, in 2011, Cambridge, UK, in 2012 and Marienstatt, Germany, in 2014.

This volume contains the proceedings of the 15th International Conference on Relational and Algebraic Methods in Computer Science (RAMiCS 2015), held in Braga, Portugal, from September 28 to October 1, 2015, exactly 24 years after the Banach Semester that resulted in founding this conference series.

The call for papers invited submissions about the theory of relation algebras and Kleene algebras, process algebras, fixed point calculi, idempotent semirings, quantales, allegories, and dynamic algebras, and cylindric algebras, and about their applications in areas such as verification, analysis and development of programs and algorithms, algebraic approaches to logics of programs, modal and dynamic logics, interval and temporal logics, etc.

We were fortunate to be able to invite Gheorghe Stefanescu and Ian Hodkinson who, with their presentations on “A Quest for Kleene Algebra in 2 Dimensions” and “Connections Between Relation Algebras and Cylindric Algebras”, nicely emphasized the two traditional theoretical pillars of the RAMiCS conferences, and Ernst-Erich Doberkat, whose presentation “Towards a Probabilistic Interpretation of Game Logic,” opened up new opportunities related to modal logic.

The body of this volume is made up of invited papers accompanying these three invited talks, and of 20 contributions by researchers from around the world

The papers have been arranged into three groups:

**Theoretical Foundations**

Including studies of relation-algebraic theories ranging from nominal Kleene algebra to allegories and covering a range of relation concepts, including multirelations,  $n$ -ary relations, and relational resource semantics

**Reasoning About Computations and Programs**

With contributions addressing refinement, type checking, and verified relation- and Kleene-algebraic programming

**Applications of Relational and Algebraic Methods**

Including to fuzzy databases, rough set theory, preferences, optimization, and text categorization

The contributed papers were selected by the Program Committee from 25 relevant submissions. Each submission was reviewed by at least three Program Committee members; the Program Committee did not meet in person, but had over one week of intense electronic discussions.

We are very grateful to the members of the Program Committee and the subreviewers for their care and diligence in reviewing the submitted papers. We would like to thank the members of the RAMiCS Steering Committee for their support and advice especially in the early phases of the conference organization. We are grateful to INESC TEC and the University of Minho for generously providing administrative support, and we gratefully appreciate the excellent facilities offered by the EasyChair conference administration system. Last but not least, we thank FCT (Fundação para a Ciência e a Tecnologia, Portugal) for their financial support.

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