Preface

This volume contains the proceedings of the 13th International Conference on Relational and Algebraic Methods in Computer Science (RAMiCS 13). The conference took place in Cambridge, UK, September 17–20, 2012, and was the second conference using the RAMiCS title, but the 13th in a series that started out using the name “Relational Methods in Computer Science” with the acronym RelMiCS. From 2003 to 2008, RelMiCS conferences were held as joint events with “Applications of Kleene Algebras” (AKA) conferences, motivated by the substantial common interests and overlap of the two communities. The purpose of the RAMiCS conferences continues to be bringing together researchers from various subdisciplines of computer science, mathematics, and related fields who use the calculus of relations and/or Kleene algebra as methodological and conceptual tools in their work.

The call for papers invited submissions in the general area of relational and algebraic methods in computer science, adding special focus on formal methods for software engineering, logics of programs, and links with neighboring disciplines. This focus was also realized in the choice of the following three invited talks:

*Formalized Regular Expression Equivalence and Relation Algebra in Isabelle*, by Alexander Krauss (Munich, Germany) on joint work with Tobias Nipkow:

We present the Isabelle formalization of an elegant equivalence checker for regular expressions. It works by constructing a bisimulation relation between (derivatives of) regular expressions. By mapping expressions to binary relations, an automatic and complete proof method for (in)equalities of binary relations over union, composition and (reflexive) transitive closure is obtained, which adds a practically useful decision procedure to the automation toolbox of Isabelle/HOL.

Ongoing extensions of this work to partial derivatives and extended regular expressions will be covered in the end of the talk.

*Algebraic Laws of Concurrency and Separation*, by Peter O’Hearn (London, UK):

This talk reports on ongoing work — with Tony Hoare, Akbar Hussain, Bernhard Möller, Rasmus Petersen, Georg Struth, Ian Wehrman, and others — drawing on ideas from Kleene algebra and concurrent separation logic. The approach we are taking abstracts from syntax or particular models. Message passing and shared memory process interaction, and strong (interleaving) and weak (partial order) approaches to sequencing, are accommodated as different models of the same core algebraic axioms. The central structure is that of an ordered bimonoid,
two monotone monoids over the same poset representing parallel and sequential composition, linked by an algebraic version of the exchange law from 2-categories. Rules of program logic, related to Hoare and Separation logics, flow at once from this structure: one gets a generic program logic from the algebra, which holds for a range of concrete models.

*Using Relation Algebraic Methods in the Coq Proof Assistant*, by Damien Pous (Grenoble, France):

If reasoning in a point-free algebraic setting can help on the paper, it also greatly helps in a proof assistant. We present a Coq library for working with binary relations at the algebraic, point-free, level. By combining several automatic decision procedures (e.g., for Kleene algebra and residuated semirings) and the higher-order features of Coq, this library allows us to formalize various theorems in a very simple way: we benefit from the expressiveness of an interactive theorem prover and from the comfort of automation for decidable fragments of relation algebra.

The body of this volume is made up of 23 contributions by researchers from all over the world, selected by the Program Committee from 39 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.

The conference included, for the fifth time now, a PhD program; this gave PhD students the opportunity to present their work in progress (not included in this volume) interleaved with the general conference program. Motivated by the presence of the PhD program, but also integrated with the remainder of the conference, were two invited tutorials, each delivered in two installments:

*Kleene Algebra with Tests*, by Dexter Kozen (Cornell, USA):

Kleene algebra with tests (KAT) is a versatile algebraic system for reasoning about the equivalence of low-level imperative programs. It has been shown to be useful in verifying compiler optimizations and performing static analysis. This three-hour tutorial introduces the basic definitions, results, applications, and extensions of KAT. Possible topics include: basic examples of equational reasoning; history and relation to classical systems such as Hoare logic; common models, including language, relational, trace, and matrix models; axiomatizations and their completeness and complexity; and applications.

*The Isabelle/HOL Theorem Prover*, by Lawrence C. Paulson (Cambridge, UK):

Isabelle/HOL is an interactive theorem prover for higher-order logic, with powerful automation both to prove theorems and to find counterexamples. There are two sophisticated user interfaces, and a flexible language (Isar) in which to express proofs. In two separate one-hour sessions, the tutorial introduces two aspects of Isabelle usage.
1. The verification of functional programs using induction and simplification. Isabelle’s specification language includes recursive datatypes and functions. This executable fragment of HOL, although lacking in syntactic niceties, is sufficient for writing and verifying substantial functional programs.

2. Inductively defined sets and relations. In computer science, this fundamental concept is frequently used to define the operational semantics of programming languages. Isabelle has expressive mechanisms for defining sets inductively and for reasoning about them.

The tutorial is designed to give participants a glimpse at the main features of Isabelle, equipping them to learn more through self-study. In two hours, nothing can be covered in depth, but many things can be mentioned: the various kinds of automation; axiomatic type classes and locales, both of which allow abstract theory development followed by instantiation; the extensive built-in modeling mechanisms and libraries.

We are very grateful to the members of the Program Committee and the external referees 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, and Peter Höfner for doing an excellent job in publicity. We are grateful to the University of Cambridge for hosting RAMiCS 2012 and to the Computer Laboratory for providing administrative support. We gratefully appreciate the excellent facilities offered by the EasyChair conference administration system. Last but not least, we would like to thank the British Logic Colloquium and Winton Capital Management for their generous financial support.

July 2012

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