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Varmo Vene (Eds.)

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Algebraic Methodology and Software Technology

11th International Conference, AMAST 2006
Kuressaare, Estonia, July 2006
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Preface

This is the proceedings of the 11th edition of the Algebraic Methodology and Software Technology (AMAST) conference series. The first conference was held in the USA in 1989, and since then AMAST conferences have been held on (or near) five different continents and have been hosted by many of the most prominent people and organizations in the field.

The AMAST initiative has always sought to have practical effects by developing the science of software and basing it on a firm mathematical foundation. AMAST has interpreted software technology broadly, and has, for example, held AMAST workshops in areas as diverse as real-time systems and (natural) language processing. Similarly, algebraic methodology is interpreted broadly and includes abstract algebra, category theory, logic, and a range of other mathematical subdisciplines. The truly distinguishing feature of AMAST is that it seeks rigorous mathematical developments, but always strives to link them to real technological applications. Our meetings frequently include industry-based participants and are a rare opportunity for mathematicians and mathematically minded academics to interact technically with industry-based technologists. Over the years AMAST has included industrial participants from organizations specializing in safety-critical (including medical) systems, transport (including aerospace), and security-critical systems, amongst others.

AMAST has continued to grow and change. Much of the work that was the subject of early meetings is now established and used. A good deal of it has been presented in the eight monographs that have so far appeared as part of Springer's LNCS series. Many of the issues that the AMAST community was concerned with academically have now become part of major industrial organizations' research and development as security, correctness, and safety-critical performance become more and more important in the systems we use daily. Other issues remain unresolved, and new questions continually arise. What is certain is that in the future the fundamental character of AMAST—serious mathematics developed for real technology—will remain important.

The 11th edition of the conference was held in Kuressaare in Estonia, hosted by the Institute of Cybernetics at Tallinn University of Technology. Among the 55 full submissions, the Programme Committee selected 24 regular papers and 3 system demonstrations. All submissions were reviewed by three PC members with the help of external reviewers. In addition to the accepted papers, the conference also featured invited talks by three distinguished speakers: Ralph Back (Åbo Akademi University, Finland), Larry Moss (Indiana University, USA) and Till Mossakowski (Universität Bremen, Germany).

After the successful dual meeting in Stirling in 2004, the conference was co-located with Mathematics of Program Construction (MPC) for the second time. We thank the MPC organizers for suggesting this co-location. It is also worth noting that AMAST enjoys the cooperation and overlapping organizational participation with other like-minded conferences including CALCO, CMCS and WADT.

AMAST 2006 was the result of a considerable effort by a number of people. It is our pleasure to express our gratitude to the AMAST Programme Committee and additional referees for their expertise and diligence in reviewing the submitted papers, and to the AMAST Steering Committee for its general guidance. Our special thanks go to Tarmo Uustalu and his colleagues from the Institute of Cybernetics for taking care of practical matters in the local organization. We are also grateful to Andrei Voronkov for providing the EasyChair system, which was used to manage the electronic submissions, the review process, the electronic PC meeting, and to assemble the proceedings. Finally, we would like to express our thanks to Springer for its continued support in the publication of the proceedings in the *Lecture Notes in Computer Science* series.

April 2006

Michael Johnson
Varmo Vene

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System Descriptions

Incremental Software Construction with Refinement Diagrams

Ralph-Johan Back

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Abstract. We propose here a mathematical framework for *incremental software construction* and *controlled software evolution*. The framework allows incremental changes of a software system to be described on a high architecture level, but still with mathematical precision so that we can reason about the correctness of the changes. The framework introduces *refinement diagrams* as a visual way of presenting the architecture of large software systems. Refinement diagrams are based on lattice theory and allow reasoning about lattice elements to be carried out directly in terms of diagrams. A refinement diagram proof will be equivalent to a Hilbert like proof in lattice theory. We show how to apply refinement diagrams and refinement calculus to the incremental construction of large software system. We concentrate on three topics: (i) *modularization* of software systems with component specifications and the role of information hiding in this approach, (ii) *layered extension* of software by adding new features one-by-one and the role of inheritance and dynamic binding in this approach, and (iii) *evolution of software* over time and the control of successive versions of software.

M. Johnson and V. Vene (Eds.): AMAST 2006, LNCS 4019, p. 1, 2006.

Recursive Program Schemes: Past, Present, and Future

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Abstract. This talk describes work on one of the first applications of algebra to theoretical computer science, the study of recursive program schemes. I would like to put a lot of the past work in perspective and then to describe recent work by Stefan Milius and myself which reworks the classical theory of uninterpreted and interpreted recursive program schemes using tools from coalgebraic recursion theory. Finally, I hope to speculate on whether the new work could be of interest to those pursuing AMAST's goal of "setting of software technology on a firm, mathematical basis."

M. Johnson and V. Vene (Eds.): AMAST 2006, LNCS 4019, p. 2, 2006.

Monad-Based Logics for Computational Effects

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Abstract. The presence of computational effects, such as state, store, exceptions, input, output, non-determinism, backtracking etc., complicates the reasoning about programs. In particular, usually for each effect (or each combination of these), an own logic needs to be designed.

Monads are a well-known tool from category theory that originally has been invented for studying algebraic structures. Monads have been used very successfully by Moggi [1] to model computational effects (in particular, all of those mentioned above) in an elegent way. This has been applied both to the semantics of programming languages (e.g. [2, 3, 4, 5]) and to the encapsulation of effects in pure functional languages such as Haskell [6].

Several logics for reasoning about monadic programs have been introduced, such as evaluation logic [7, 8], Hoare logic [9] and dynamic logic [10, 11]. Some of these logics have a semantics and proof calculus given in a completely monad independent (and hence, effect independent) way. We give an overview of these logics, discuss completeness of their calculi, as well as some application of these logics to the reasoning about Haskell and Java programs, and a coding in the theorem prover Isabelle [12].

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