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Intelligent Computer Mathematics

9th International Conference, CICM 2016
Bialystok, Poland, July 25–29, 2016
Proceedings

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ISSN 0302-9743

ISSN 1611-3349 (electronic)

Lecture Notes in Artificial Intelligence

ISBN 978-3-319-42546-7

ISBN 978-3-319-42547-4 (eBook)

DOI 10.1007/978-3-319-42547-4

Library of Congress Control Number: 2016944413

LNCS Sublibrary: SL7 – Artificial Intelligence

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Printed on acid-free paper

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Preface

Mathematics is “the queen of the sciences” (Friedrich Gauss), and “the language with which God has written the universe” (Galileo Galilei). This language is at the same time flexible enough to describe a wide variety of complex phenomena and rigorous enough to be verified in detail based on a small set of assumptions. But the collection of mathematical knowledge is exploding, and it can no longer be handled by the paradigmatic “pencil and paper” approach: Each year there are 120,000 new articles, and this week there was an announcement of a 200-terabyte “proof” of the Boolean Pythagorean triples conjecture.

The Conference on Intelligent Computer Mathematics (CICM) offers a venue for discussing and developing ways of involving computers in the process of “doing mathematics” in the broadest sense. The conference is the result of merging three independent meetings with considerable overlap: CALCULEMUS (integration of deduction and symbolic calculation), Mathematical Knowledge Management (MKM), and Digital Mathematical Libraries (DML). CICM has been held annually since 2008, with previous meetings in Birmingham (UK 2008), Grand Bend (Canada 2009), Paris (France 2010), Bertinoro (Italy 2011), Bremen (Germany 2012), Bath (UK 2013), Coimbra (Portugal 2014), and Washington, DC (USA 2015).

CICM 2016 was held in Białystok, Poland. As in previous years, we had several tracks: CALCULEMUS, Digital Mathematics Libraries (DML), and Mathematical Knowledge Management (MKM), which mirror the three main communities that form CICM, and a track each on “Systems and Data” and “Projects and Surveys.” The papers accepted to these five tracks form the content of these proceedings. CICM 2016 had invited talks by John Harrison (Intel), Claudio Sacerdoti-Coen (University of Bologna), and Nicolas M. Thiéry (LRI University of Paris Sud). Additionally, the conference had seven workshops, two tutorials, a doctoral mentoring program, and an informal track for presenting work in progress; the proceedings of these events are published with CEUR-WS. The program of the meeting, as well as additional materials, is available at <http://cicm-conference.org/2016/>.

The track structure of CICM provides a framework for organizing the conference. The CALCULEMUS track examines the integration of symbolic computation and mechanized reasoning. The Digital Mathematics Libraries track deals with math-aware technologies, standards, algorithms, and processes. The Mathematical Knowledge Management track is concerned with all aspects of managing mathematical knowledge in informal, semi-formal, and formal settings. The Systems and Data track contains descriptions of systems and data collections, both of which are key to a research topic where theory and practice interact on explicitly represented knowledge. The Projects and Surveys track keeps the community informed of relevant projects and consolidates knowledge where the subject matter fits into one of the other four tracks.

This year, CICM had 41 submissions. Each submission received at least four reviews. The reviewing included a response period, in which authors could clarify points raised by the reviewers. This made for a highly productive round of deliberations before the final decisions were taken. In the end, the track Program Committees decided to accept 12 papers for these proceedings.

The Program Committee work for the tracks was managed using the EasyChair system. This year we modeled the multi-track Program Committee as a single committee and the track assignments as “keywords.” This made track assignments and cross-track reviewing more flexible than in previous years. The fact that we had five chairs—the general chair and four track chairs—together with excellent conflict management made transparent and “safe” handling of submissions authored or co-authored by any of the chairs almost painless.

As in previous years, several workshops and informal programs were organized in conjunction with CICM 2015. This year these were:

- The CICM Doctoral Program, providing a dedicated forum for PhD students to present their on-going or planned research and receive feedback, advice, and suggestions from a dedicated research advisory board.
- The CICM Work-in-Progress Session, a forum for the presentation of original work not yet in a suitable form for communication as a formal paper.
- ThEdu 2016: Theorem Provers Components for Educational Software, with the goal of combining and focusing on systems from theorem proving, computer algebra, and dynamic geometry to enhance existing educational software and the design of the next generation of mechanized mathematics assistants. ThEdu was organized by Walther Neuper, Graz University of Technology, Austria, and Pedro Quaresma, University of Coimbra, Portugal.
- MathUI 2016: 11th Workshop on Mathematical User Interfaces, an international workshop to discuss how users can be best supported when doing/learning/searching for/interacting with mathematics using a computer. MathUI was organized by Andrea Kohlhasse, University of Applied Sciences Neu-Ulm, and Paul Libbrecht, University of Education of Weingarten, Germany.
- Formal Mathematics for Mathematicians, a workshop dealing with developing large repositories of advanced mathematics. It was organized by Adam Naumowicz, University of Białystok, Poland.
- The 27th OpenMath Workshop. OpenMath is a language for exchanging mathematical formulae across applications (such as computer algebra systems and theorem provers). The workshop was organized by James Davenport, the University of Bath, Jan-Willem Knopper, Eindhoven University, and Michael Kohlhasse, Jacobs University Bremen.
- The Proof Engineering Workshop, which brings together researchers interested in the new field of proof engineering, defined as the construction, maintenance, documentation, and presentation of large formal proof developments. This workshop was organized by David Aspinall (School of Informatics, University of Edinburgh, UK) and Christoph Lüth (DFKI Bremen and University of Bremen, Germany)

- The Tetrapod Workshop, which studies the deep interactions of (a) mathematical knowledge (formal and informal), (b) specification-based computation, (c) logic, and (d) algorithms and data structures. The workshop was organized by Jacques Carette, Bill Farmer (both McMaster University, Canada), Michael Kohlhase, and Florian Rabe (both Jacobs University Bremen, Germany)
- The Mizar Hands-On Tutorial by Adam Naumowicz et al.
- The MMT Tutorial by Florian Rabe et al.

We thank all those who contributed to this meeting. In particular we would like to thank the EasyChair team (Andrei Voronkov et al.) for the EasyChair system, which we found indispensable. We would like also to thank the invited speakers, the contributing authors, the reviewers, the members of the Program Committee, and the local organizers, all of whose efforts contributed to the practical and scientific success of the meeting.

June 2016

Michael Kohlhase
Moa Johansson
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Leonardo de Moura
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