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Mathematical Theory and Computational Practice

5th Conference on Computability in Europe, CiE 2009
Heidelberg, Germany, July 19-24, 2009
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Preface

CiE 2009: Mathematical Theory and Computational Practice
Heidelberg, Germany, July 19–24, 2009

After several years of research activity, the informal cooperation "Computability in Europe" decided to take a more formal status at their meeting in Athens in June 2008: the *Association for Computability in Europe* was founded to promote the development, particularly in Europe, of computability-related science, ranging over mathematics, computer science, and applications in various natural and engineering sciences such as physics and biology, including the promotion of the study of philosophy and history of computing as it relates to questions of computability. As mentioned, this association builds on the informal network of European scientists working on computability theory that had been supporting the conference series CiE-CS over the years, and now became its new home.

The aims of the conference series remain unchanged: to advance our theoretical understanding of what can and cannot be computed, by *any* means of computation. Its scientific vision is broad: computations may be performed with discrete or continuous data by all kinds of algorithms, programs, and machines. Computations may be made by experimenting with any sort of physical system obeying the laws of a physical theory such as Newtonian mechanics, quantum theory or relativity. Computations may be very general, depending on the foundations of set theory; or very specific, using the combinatorics of finite structures. CiE also works on subjects intimately related to computation, especially theories of data and information, and methods for formal reasoning about computations. The sources of new ideas and methods include practical developments in areas such as neural networks, quantum computation, natural computation, molecular computation, and computational learning. Applications are everywhere, especially, in algebra, analysis and geometry, or data types and programming. Within CiE there is general recognition of the underlying relevance of computability to physics and a broad range of other sciences, providing as it does a basic analysis of the causal structure of dynamical systems.

This volume, *Mathematical Theory and Computational Practice*, comprises the proceedings of the fifth in a series of conferences of CiE, that was held at the Ruprecht-Karls-Universität Heidelberg, Germany.

The first four meetings of CiE were at the University of Amsterdam in 2005, at the University of Wales Swansea in 2006, at the University of Siena in 2007, and at the University of Athens in 2008. Their proceedings, edited in 2005 by S. Barry Cooper, Benedikt Löwe and Leen Torenvliet, in 2006 by Arnold Beckmann, Ulrich Berger, Benedikt Löwe and John V. Tucker, in 2007 by S. Barry Cooper, Benedikt Löwe and Andrea Sorbi, and in 2008 by Arnold Beckmann, Costas Dimitracopoulos, and Benedikt Löwe were published as *Springer Lecture Notes in Computer Science*, volumes 3526, 3988, 4497 and 5028, respectively.

CiE and its conferences have changed our perceptions of computability and its interface with other areas of knowledge. The large number of mathematicians and computer scientists attending those conferences had their view of computability theory enlarged and transformed: they discovered that its foundations were deeper and more mysterious, its technical development more vigorous, its applications wider and more challenging than they had known. The annual CiE conference has become a major event, and is the largest international meeting focused on computability theoretic issues. Future meetings in Ponta Delgada, Açores (2010, Portugal), Sofia (2011, Bulgaria), and Cambridge (2012, UK) are in planning. The series is coordinated by the CiE Conference Series Steering Committee consisting of Arnold Beckmann (Swansea), Paola Bonizzoni (Milan), S. Barry Cooper (Leeds), Benedikt Löwe (Amsterdam, Chair), Elvira Mayordomo (Zaragoza), Dag Normann (Oslo), and Peter van Emde Boas (Amsterdam).

The conference was based on invited tutorials and lectures, and a set of special sessions on a range of subjects; there were also many contributed papers and informal presentations. This volume contains 17 of the invited lectures and 34% of the submitted contributed papers, all of which have been refereed. There will be a number of post-conference publications, including special issues of *Annals of Pure and Applied Logic*, *Journal of Logic and Computation*, and *Theory of Computing Systems*.

The tutorial speakers were Pavel Pudlák (Prague) and Luca Trevisan (Berkeley).

The following invited speakers gave talks: Manindra Agrawal (Kanpur), Jeremy Avigad (Pittsburgh), Mike Edmunds (Cardiff, Opening Lecture), Peter Koepke (Bonn), Phokion Kolaitis (San Jose), Andrea Sorbi (Siena), Rafael D. Sorkin (Syracuse), Vijay Vazirani (Atlanta).

Six special Sessions were held:

Algorithmic Randomness. *Organizers:* Elvira Mayordomo (Zaragoza) and Wolfgang Merkle (Heidelberg).
Speakers: Laurent Bienvenu, Bjørn Kjos-Hanssen, Jack Lutz, Nikolay Vereshchagin.

Computational Model Theory. *Organizers:* Julia F. Knight (Notre Dame) and Andrei Morozov (Novosibirsk).

Speakers: Ekaterina Fokina, Sergey Goncharov, Russell Miller, Antonio Montalbán.

Computation in Biological Systems — Theory and Practice.
Organizers: Alessandra Carbone (Paris) and Erzsébet Csuhaj-Varjú (Budapest).
Speakers: Ion Petre, Alberto Policriti, Francisco J. Romero-Campero, David Westhead.

Optimization and Approximation. *Organizers:* Magnús M. Halldórsson (Reykjavik) and Gerhard Reinelt (Heidelberg).
Speakers: Jean Cardinal, Friedrich Eisenbrand, Harald Räcke, Marc Uetz.

Philosophical and Mathematical Aspects of Hypercomputation.
Organizers: James Ladyman (Bristol) and Philip Welch (Bristol).
Speakers: Tim Button, Samuel Coskey, Mark Hogarth, Oron Shagrir.

Relative Computability. *Organizers:* Rod Downey (Wellington) and Alexandra A. Soskova (Sofia)
Speakers: George Barmpalias, Hristo Ganchev, Keng Meng Ng, Richard Shore.

The conference CiE 2009 was organized by Klaus Ambos-Spies (Heidelberg), Timur Bakibayev (Heidelberg), Arnold Beckmann (Swansea), Laurent Bienvenu (Heidelberg), Barry Cooper (Leeds), Felicitas Hirsch (Heidelberg), Rupert Hölzl (Heidelberg), Thorsten Kräling (Heidelberg), Benedikt Löwe (Amsterdam), Gunther Mainhardt (Heidelberg), and Wolfgang Merkle (Heidelberg).

The Program Committee was chaired by Klaus Ambos-Spies and Wolfgang Merkle:

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We were proud to offer the program "Women in Computability" funded by the Elsevier Foundation as part of CiE 2009. The Steering Committee of the conference series CiE-CS is concerned with the representation of female researchers in the field of computability. The series CiE-CS has actively tried to increase female participation at all levels in the past years. Starting in 2008, our efforts are being funded by a grant of the Elsevier Foundation under the title "*Increasing representation of female researchers in the computability community.*" As part of this program, we had another workshop, a grant scheme for female researchers, a mentorship program, and free childcare.

The high scientific quality of the conference was possible through the conscientious work of the Program Committee, the special session organizers, and the referees. We are grateful to all members of the Program Committee for their efficient evaluations and extensive debates, which established the final program. We also thank the following referees:

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Klaus Ambos-Spies
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Wolfgang Merkle

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