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Evolving Computability

11th Conference on Computability in Europe, CiE 2015
Bucharest, Romania, June 29 – July 3, 2015
Proceedings

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Preface

CiE 2015: Evolving Computability Bucharest, Romania, June 29 – July 3, 2015

The evolution of the universe, and us within it, invites a parallel evolution in understanding. The CiE agenda – fundamental and engaged – targets the extraction and development of computational models basic to current challenges. From the origins of life, to the understanding of human mentality, to the characterizing of quantum randomness – computability theoretic questions arise in many guises. The CiE community this year met for the first time in Bucharest, to carry forward the search for coherence, depth, and new thinking across this rich and vital field of research. In line with other conferences in this series, CiE 2015 had a broad scope and provided a forum for the discussion of theoretical and practical issues in computability with an emphasis on new paradigms of computation and the development of their mathematical theory.

The conference series Computability in Europe is organized by the Association CiE. The association promotes the development of computability-related science, ranging from mathematics, computer science, and applications in various natural and engineering sciences, such as physics and biology, as well as the promotion of related fields, such as philosophy and history of computing. In particular, the conference series successfully brings together the mathematical, logical, and computer sciences communities that are interested in developing computability-related topics.

The host of CiE 2015 was the Faculty of Mathematics and Computer Science of the University of Bucharest.

The ten previous CiE conferences were held in Amsterdam (The Netherlands) in 2005, Swansea (Wales) in 2006, Siena (Italy) in 2007, Athens (Greece) in 2008, Heidelberg (Germany) in 2009, Ponta Delgada (Portugal) in 2010, Sofia (Bulgaria) in 2011, Cambridge (UK) in 2012, Milan (Italy) in 2013, and Budapest (Hungary) in 2014. The proceedings of all these meetings were published in the Springer series *Lecture Notes in Computer Science*. The annual CiE conference has become a major event and is the largest international meeting focused on computability theoretic issues. CiE 2016 will be held in Paris, France.

The series is coordinated by the CiE Conference Series Steering Committee consisting of Arnold Beckmann (Swansea, chair), Laurent Bienvenu (Paris), Alessandra Carbone (Paris), Barry Cooper (Leeds), Natasha Jonoska (Tampa FL), Benedikt Löwe (Amsterdam and Hamburg), Florin Manea (Kiel), Dag Normann (Oslo), Mariya Soskova (Sofia), and Susan Stepney (York).

The Program Committee of CiE 2015 was chaired by Victor Mitrana (Bucharest) and Mariya Soskova (Sofia). It was responsible for the selection of the invited speakers and the special session organizers and for running the reviewing process of all submitted regular contributions.

The conference had two tutorials by John Reif (Duke University) and by Stephen Simpson (Pennsylvania State University), and one public lecture by Mircea Dumitru (University of Bucharest and Romanian Academy).

In addition, the Program Committee invited seven speakers to give plenary lectures: Ann Copestake (University of Cambridge), Pawel Gawrychowski (University of Warsaw), Julia Knight (University of Notre Dame), Anca Muscholl (Université Bordeaux), Gheorghe Paun (Romanian Academy), Alexander Razborov (University of Chicago and Steklov Mathematical Institute), and Vlatko Vedral (University of Oxford).

Springer generously funded a Best Student Paper Award. For the second year in a row the winner was Ludovic Patey. His contribution to this year's volume is entitled "Iterative Forcing and Hyperimmunity in Reverse Mathematics."

The conference CiE 2015 has six special sessions: two sessions, Representing Streams and Reverse Mathematics, were introduced for the first time in the conference series. In addition to this, new developments in areas frequently covered in the CiE conference series were addressed in the further special sessions on Automata, Logic and Infinite Games, Bio-inspired Computation, Classical Computability Theory, and History and Philosophy of Computing. Speakers in these special sessions were selected by the special session organizers, and were invited to contribute a paper to this volume:

Automata, Logic, and Infinite Games

Organizers. Dietmar Berwanger and Ioana Leustean

Speakers. Christian Georg Fermüller (Wien), Slawomir Lasota (Warsaw), Paulo Oliva (London), Michael Vanden Boom (Oxford)

Bio-inspired Computation

Organizers. Andrei Paun, Petr Sosik

Speakers. Erzsébet Csuhaj-Varjú (Budapest), Ion Petre (Turku), Alexandru Tomescu (Helsinki), Sergey Verlan (Paris)

Classical Computability Theory

Organizers. Marat Arslanov, Steffen Lempp

Speakers. Sergey Goncharov (Novosibirsk), Wei Li (Vienna), Frank Stephan (Singapore), Dan Turetsky (Vienna)

History and Philosophy of Computing

Organizers. Christine Proust, Marco Benini

Speakers. Felice Cardone (Turin), Laura Crosilla (Leeds), Baptiste Mèlès (Nancy), Eric Vandendriessche (Paris)

Representing Streams

Organizers. Jörg Endrullis, Dimitri Hendriks

Speakers. Juhani Karhumäki (Turku), Jean-Eric Pin (Paris), Narad Rampersad (Winnipeg), Luke Schaeffer (Waterloo)

Reverse Mathematics

Organizers. Damir Dzhafarov, Alberto Marcone

Speakers. David Belanger (Ithaca, NY), Takako Nemoto (Ishikawa), Ludovic Patey (Paris), Paul Shafer (Ghent)

We received 64 non-invited contributed paper submissions, which were reviewed by the Program Committee and many expert reviewers. In the end, 42 % of the submitted papers were accepted for publication in this volume. In addition, this volume contains ten invited papers. Without the help of our expert reviewers, the production of the volume would have been impossible. We would like to thank all of them for their excellent work; their names are listed at the end of this Preface.

All authors who contributed to this conference were encouraged to submit significantly extended versions of their papers with unpublished research content to *Computability: The Journal of the Association CiE*.

The Steering Committee of the conference series CiE is concerned about the representation of female researchers in the field of computability. In order to increase female participation, the series started the Women in Computability (WiC) program in 2007, first funded by the Elsevier Foundation, then taken over by the publisher Elsevier. We are proud to continue this program with its annual WiC workshop and mentorship program for junior female researchers in 2015. Both initiatives are coordinated by Liesbeth De Mol. The workshop speakers are Johanna Franklin (University of Connecticut) Anca Muscholl (Labri, Université Bordeaux I) and Cezara Dragoi (CNRS/Inria/Equipe Antique, Ecole Normale Supérieure, Paris).

The organizers of CiE 2015 would like to acknowledge and thank the following entities for their financial support (in alphabetic order): the Association for Symbolic Logic (ASL), the European Association for Theoretical Computer Science (EATCS), Springer, the University of Bucharest, and the Asociatia Alumni Universitatii din Bucuresti. We would also like to acknowledge the support of our nonfinancial sponsor, the Association Computability in Europe (CiE).

We thank Andrej Voronkov for his EasyChair system that facilitated the work of the Program Committee and the editors considerably.

April 2015

Arnold Beckmann
Victor Mitrană
Mariya Soskova

Organization

CiE 2015 was organized by the Faculty of Mathematics and Computer Science of the University of Bucharest. The members of the Organizing Committee were Radu Gramatovici (Bucharest) and Liviu Marin (Bucharest).

Program Committee

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Franco Montagna
1948 – 2015



Prof. Franco Montagna died on February 18, 2015, at 66. He was Professor of Mathematical Logic at the University of Siena, which he entered in 1973 working with Roberto Magari of whom he had been a student. Internationally well-known logician, Franco Montagna has authored and coauthored more than 120 papers (with an amazingly long list of national and international coauthors), which appeared in international journals of logic, algebra and computer science. Since 1973 until 1994, his main scientific interest was Provability Logic, a modal logic in which it is possible to express a counterpart of self-reference and incompleteness in arithmetic. His recent interest was the logic of uncertainty, especially manyvalued logics. In this field, his results are related to Łukasiewicz Logic with additional operators, like product and product residuation; the generalizations of Łukasiewicz logic, like Hájek's logic BL, and its further generalizations like the logic of GBL-algebras, or the monoidal t-norm logic, as well as the connections between many-valued logic and substructural logics. He had a special interest in the relationships between many-valued logics and probability, in particular the problem of coherence for probabilistic assessments. Although not a specialistic computability theorist, he cultivated and used computability theory throughout his work, with the rigour and elegance which characterized his mathematical style. He served in the Program Committee of CiE 2007. He will be remembered as a fine researcher, and as a precious teacher, beloved by his students. Colleagues and friends will remember him for his goodness, his generosity, and his gentleness.

Contents

Invited Papers

Computers and the Mechanics of Communication: Outline of a Vision from the Work of Petri and Holt.	3
<i>Felice Cardone</i>	
Error and Predicativity.	13
<i>Laura Crosilla</i>	
Is Human Mind Fully Algorithmic? Remarks on Kurt Gödel's Incompleteness Theorems.	23
<i>Mircea Dumitru</i>	
A New Approach to the Paperfolding Sequences.	34
<i>Daniel Goč, Hamoon Mousavi, Luke Schaeffer, and Jeffrey Shallit</i>	
Covering the Recursive Sets.	44
<i>Bjørn Kjos-Hanssen, Frank Stephan, and Sebastiaan A. Terwijn</i>	
On Distributed Monitoring and Synthesis.	54
<i>Anca Muscholl</i>	
Unconventional Computing: Do We Dream Too Much?	63
<i>Gheorghe Păun</i>	
Newton's Forward Difference Equation for Functions from Words to Words	71
<i>Jean-Éric Pin</i>	
Degrees of Unsolvability: A Tutorial.	83
<i>Stephen G. Simpson</i>	
Universality in Molecular and Cellular Computing	95
<i>Sergey Verlan</i>	

Contributed Papers

Some Results on Interactive Proofs for Real Computations.	107
<i>Martijn Baartse and Klaus Meer</i>	
Prime Model with No Degree of Autostability Relative to Strong Constructivizations	117
<i>Nikolay Bazhenov</i>	

Immune Systems in Computer Virology.	127
<i>Guillaume Bonfante, Mohamed El-Aqqad, Benjamin Greenbaum, and Mathieu Hoyrup</i>	
ITRM-Recognizability from Random Oracles	137
<i>Merlin Carl</i>	
P Systems with Parallel Rewriting for Chain Code Picture Languages	145
<i>Rodica Ceterchi, K.G. Subramanian, and Ibrahim Venkat</i>	
Base-Complexity Classifications of QCB_0 -Spaces	156
<i>Matthew de Brecht, Matthias Schröder, and Victor Selivanov</i>	
New Bounds on Optimal Sorting Networks	167
<i>Thorsten Ehlers and Mike Müller</i>	
Nonexistence of Minimal Pairs in $L[d]$	177
<i>Chengling Fang, Jiang Liu, Guohua Wu, and Mars M. Yamaleev</i>	
Intuitionistic Provability versus Uniform Provability in RCA	186
<i>Makoto Fujiwara</i>	
Randomness and Differentiability of Convex Functions	196
<i>Alex Galicki</i>	
Weighted Automata on Infinite Words in the Context of Attacker-Defender Games.	206
<i>Vesa Halava, Tero Harju, Reino Niskanen, and Igor Potapov</i>	
Turing Jumps Through Provability	216
<i>Joost J. Joosten</i>	
Rice's Theorem in Effectively Enumerable Topological Spaces.	226
<i>Margarita Korovina and Oleg Kudinov</i>	
Decidability of Termination Problems for Sequential P Systems with Active Membranes.	236
<i>Michal Kováč</i>	
Weihrauch Degrees of Finding Equilibria in Sequential Games	246
<i>Stéphane Le Roux and Arno Pauly</i>	
Prefix and Right-Partial Derivative Automata	258
<i>Eva Maia, Nelma Moreira, and Rogério Reis</i>	
A Note on the Computable Categoricity of ℓ^p Spaces	268
<i>Timothy H. McNicholl</i>	

On the Computational Content of Termination Proofs	276
<i>Georg Moser and Thomas Powell</i>	
Local Compactness for Computable Polish Metric Spaces is Π_1^1 -complete . . .	286
<i>André Nies and Slawomir Solecki</i>	
Iterative Forcing and Hyperimmunity in Reverse Mathematics	291
<i>Ludovic Patey</i>	
Completely Regular Bishop Spaces	302
<i>Iosif Petrakis</i>	
Computing Equality-Free String Factorisations	313
<i>Markus L. Schmid</i>	
Towards the Effective Descriptive Set Theory.	324
<i>Victor Selivanov</i>	
On Computability of Navier-Stokes' Equation	334
<i>Shu Ming Sun, Ning Zhong, and Martin Ziegler</i>	
Kalmár and Péter: Undecidability as a Consequence of Incompleteness	343
<i>Máté Szabó</i>	
How to Compare Buchholz-Style Ordinal Notation Systems with Gordeev-Style Notation Systems	353
<i>Jeroen Van der Meeren and Andreas Weiermann</i>	
Author Index	363