

Theoretical Aspects of Computing

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The International Colloquium on Theoretical Aspects of Computing was founded in 2004. In 2014, the 11th International Colloquium on Theoretical Aspects of Computing was for the first time organized in Europe, namely in Bucharest, Romania. Since its early days, the study of computer science in Romania has had a strong theoretical component, owing in part to the mathematical orientation of some of its most notable pioneers, such as Grigore Moisil. In modern times, this legacy is carried on by some strong research institutions, such as Romanian Academy and main universities in Iași, Bucharest and Timișoara.

The 11th International Colloquium on Theoretical Aspects of Computing (ICTAC) aimed to bring together practitioners and researchers from academia, industry and government, with the purpose of encouraging the presentation of novel research directions, through the exchange of both ideas and experience, related to current theoretical challenges in computing, as well as practical applications of existing theoretical results. ICTAC 2014 welcomed submissions from the following areas: automata theory and formal languages; principles and semantics of programming languages; theories of concurrency, mobility and reconfiguration; logics and their applications; software architectures and their models, refinement and verification; relationship between software requirements, models and code; static and dynamic program analysis and verification; software specification, refinement, verification and testing; model checking and theorem proving; models of object and component systems; coordination and feature interaction; integration of theories, formal methods and tools for engineering computing systems; service-oriented architectures: models and development methods; models of

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concurrency, security, and mobility; theories of distributed, grid and cloud computing; real-time, embedded, hybrid and cyber-physical systems; type and category theory in computer science; case studies, theories, tools and experiments of verified systems; domain-specific modeling and technology; challenges and foundations in environmental modeling and monitoring.

The event has attracted several submissions from 36 countries around the world. Program Committee was chaired by Gabriel Ciobanu and Dominique Méry. The selection process was rigorous, each paper receiving at least four reviews. After careful discussions on the submitted papers, the Program Committee decided to accept 25 papers corresponding to an acceptance rate of around 30%. The accepted papers cover several aspects of theoretical aspects of computing, providing a scientifically exciting program for the ICTAC meeting with interesting discussions and exchanges of ideas among the participants. Together with three stimulating invited talks, all these papers were published by Springer as volume 8687 of Lecture Notes in Computer Science [1].

We devote this issue of the Scientific Annals of Computer Science to the 11th International Colloquium on Theoretical Aspects of Computing; it contains the extended versions of five selected ICTAC papers. These extended versions were additionally reviewed by the members of the journal editorial board and some external reviewers (including members of the ICTAC program committee). Many thanks to all of them for their high-quality reviews and discussions.

In *Probabilistic Recursion Theory and Implicit Complexity*, Ugo Dal Lago, Sara Zuppiroli and Maurizio Gabbrielli give a characterization of computable probabilistic functions by a natural generalization of Kleene's partial recursive functions. In their non-trivial proof of completeness for the obtained algebra, Kleene's minimization operator is used in an unusual way. The authors show how probabilistic recursion theory provides characterizations of concepts like "computable distribution" and "computable real number". This recursion-theoretical framework is then applied to polynomial-time computation by following the Leivant's ramified recurrence with a random base function. It is provided a characterization of polynomial-time computable distributions, a key notion in average-case complexity.

In *Rely-Guarantee Based Reasoning for Message-Passing Programs*, Jinjiang Lei and Zongyan Qiu propose a compositional reasoning system for verifying distributed programs with asynchronous message passing. Their

approach integrates some ideas from Separation Logic and Rely-Guarantee reasoning. In order to separate environmental and local assertions, the authors use certain Hoare style triples to specify and verify distributed programs in a modular way.

In *Learning Cover Context-free Grammars from Structural Data*, Mircea Marin and Gabriel Istrate propose an algorithm that efficiently learns a cover context-free grammar by using two types of queries: structural equivalence and structural membership. This algorithm synthesizes a minimal deterministic cover automaton consistent with an observation table maintained via a learning protocol called “minimally adequate teacher”. The algorithm runs in time polynomial in the number of states of the minimal deterministic finite cover tree automaton.

In *Arithmetic and Boolean Operations on Recursively Run-Length Compressed Natural Numbers*, Paul Tarau describes a tree-based number system where trees are built by recursively applying run-length encoding on the usual binary representation until the empty leaves corresponding to 0 are reached. This numbering system is canonical, namely each natural number is represented as a unique object. The author investigates various properties of the new tree-based canonical number representation, and show that arithmetic operations on very large numbers are performed in constant time (or time proportional to their representation). Arithmetic operations on recursively run-length compressed numbers are specified as pattern-directed recursive equations made executable by using a purely declarative subset of the functional language Haskell.

In *Modeling Simply-Typed Lambda Calculi in the Category of Finite Vector Spaces*, Benoît Valiron and Steve Zdancewic use finite vector spaces as a non-standard computational model of linear logic. They present the interpretation of two PCF-like languages in finite vector spaces. They consider two languages based on PCF. For a finite PCF-like lambda-calculus with booleans, they study two finite models: one based on finite sets, and other based on finite vector spaces. The first model is shown to be fully complete with respect to the operational semantics of the language, while the second model is not. This finite lambda-calculus is then extended with an additional algebraic structure. For this language the authors provide two canonical rewrite systems: one call-by-name, and another call-by-value. These two operational semantics are related to their corresponding denotational semantics based on finite vector spaces.

We warmly thank the authors for submitting their papers to ICTAC 2014, and then the extended versions for this issue. Their papers present interesting theoretical aspects of computing, harmonizing nicely with the features of Scientific Annals of Computer Science.

- [1] Gabriel Ciobanu and Dominique Méry (Editors). *Proceedings of the 11th International Colloquium on Theoretical Aspects of Computing (ICTAC 2014)*, volume 8687 of Lecture Notes in Computer Science, Springer, 2014. [doi:10.1007/978-3-319-10882-7](https://doi.org/10.1007/978-3-319-10882-7).