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Preface of STACS 2013 Special Issue

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This special issue contains six articles based on extended abstracts that were presented at the 30th Symposium on Theoretical Aspects of Computer Science (STACS), which was held at the Christian-Albrechts-Universität zu Kiel, Germany, from February 27th to March 2nd, 2013. These extended abstracts were among the top papers of those chosen for presentation at STACS 2013 in a highly competitive peer-review process: the members of the program committee with chairs Thomas Wilke and Natacha Portier selected only 54 papers out of 254 submissions. Compared with the original extended abstracts that appeared in the conference proceedings the articles in this issue have been extended by full proofs and additional results. They underwent a further rigorous reviewing process, following the TOCS standard, completely independent of the selection process of STACS 2013.

The paper *The Arithmetic Complexity of Tensor Contraction* considers the fundamental arithmetic complexity class VP. This class was originally defined by Valiant, in the framework of his theory of arithmetic complexity, as the class of sequences of polynomials with polynomially bounded degree that can be computed by polynomially sized circuits. Although of quite some interest, as the analog of deterministic polynomial time in arithmetic complexity, this class is not too well understood so far. This is partly due to the fact that no really natural characterization of it has been known. In the paper polynomials in VP are characterized as functions obtainable as

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entries in tensors that can be computed by polynomial-size formulas with tensor contraction as the only operation. (This does away with a technical condition necessary in earlier, related characterizations.) Further results emphasize the robustness of the characterization. This new characterization of VP might open the path to a deeper understanding of this interesting complexity class.

The paper *Towards a Realistic Analysis of the QuickSelect Algorithm* is a deep study in the application of methods of the probabilistic analysis of algorithms to a special version of Hoare's QuickSelect algorithm, which finds an item of a given rank in an unsorted array. Here the items in the input are not atomic, but strings over a fixed alphabet of symbols, which are generated by quite general random processes, ranging from fully random over Markov chains to processes with quite strong dependencies. This approach makes it possible to compare performance of comparison-based algorithms (like QuickSort) and digital-based algorithms (like RadixSort) on a common ground. While QuickSort has average complexity $\Theta(n \log^2 n)$ in this model, the authors show that the expected number of symbol comparisons is $\Theta(n)$, with explicitly given leading constants. This paper is dedicated to the memory of Philippe Flajolet, the much-missed pioneer and leading figure of the area of the probabilistic analysis of algorithms.

The paper *Approximate Comparison of Distance Automata* studies distance automata and the problem of approximate comparison of the functions computed by such automata. Distance automata are weighted automata over the tropical semiring, and they play an important role in deciding problems such as the famous starheight problem for regular languages. The main result of the paper is that for any two functions f, g computed by distance automata, it can be decided whether $f \leq g$ up to a range of error of ratio $\varepsilon > 0$: the algorithm answers "yes" if $f \leq (1 - \varepsilon)g$, "no" if $f \not\leq g$, and an arbitrary value otherwise. This result refines the cornerstone result of the theory of regular cost functions, stating that the equivalence of such functions is decidable (in contrast, the equivalence of weighted automata is a well-known undecidable problem).

The paper *Regular Languages of Thin Trees* introduces an algebraic framework for regular languages of infinite, thin trees, in order to obtain effective characterizations for such languages. Regular languages of infinite trees have been thoroughly investigated in logic and automata theory since the founding work by Rabin and Büchi, but a general algebraic formalism is still missing. The novel algebraic tools introduced in this paper for languages of thin trees yield effective characterizations for commutative languages, open sets in the standard topology, languages definable in the temporal logic EF, and languages definable among all trees in weak MSO logic.

The paper *Automaton Semigroups: The Two-State Case* contributes to the study of semigroups generated by finite Mealy automata. The study of "automaton semigroups" has grown out of the study of "automaton groups" and has received much attention recently. The problem of algorithmically determining from a Mealy automaton whether the semigroup it generates is finite is known to be undecidable in general. This paper shows that semigroups generated by two-state invertible-reversible Mealy automata are either finite groups or free semigroups, and that the finiteness problem for such semigroups is decidable, thus exhibiting a new and interesting class with decidable finiteness problem.

The paper *The Simulated Greedy Algorithm for Several Submodular Matroid Secretary Problems* returns to the venerable secretary problem in the matroid version with a submodular monotone weight function. Inspecting the objects from the ground set (the "secretaries") in random order, select a subset that is independent in the matroid and maximizes the total weight of the chosen elements. One seeks good approximation algorithms. This type of problem has been intensively studied in recent years, and the paper included here makes progress in terms of significant improvements of the approximation ratios for special types of matroids (laminar, transversal). A very nice feature of the paper is that it focuses on a known, intriguingly simple algorithm: Observe some fraction of the object without choosing anyone and later include a newly arriving object if it improves the greedy solution for the test set and does not destroy independence. It is the novel, clever ideas employed in the analysis of the behavior of the algorithm that makes the paper special.

We thank the authors for submitting their papers to this issue, and we thank the referees for their thorough reviews of the manuscripts, which were essential in ensuring a high quality of the final versions presented here. Thanks are also due to the program committee of STACS 2013 for the first selection process. We also thank the editor-in-chief of TOCS, Alan L. Selman, for giving us the opportunity to edit this special issue, and the TOCS team for their support. Finally, we hope that the readers will find the articles presented in this volume interesting and enjoyable.

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