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Preface of Special Issue on Theoretical Aspects of Computer Science

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This special issue contains nine articles which are based on extended abstracts that were presented at the 28th *Symposium on Theoretical Aspects of Computer Science (STACS)*, which was held at Technische Universität Dortmund, Germany, March 10–12, 2011. These extended abstracts were among the top papers of those that were chosen for presentation at STACS 2011 in a highly competitive peer-review process (after which only 54 papers out of 271 submission were accepted).

Compared with the original extended abstracts the articles have been strongly revised and extended by full proofs and additional results. They underwent a further rigorous reviewing process, following the TOCS standard, completely independent from the selection process of STACS 2011.

Three articles are about formal languages. The first two investigate size issues for automata and (extended) regular expressions, respectively, while the third one investigates the syntactic monoids of regular languages over infinite alphabets.

The article *Series Parallel Digraphs with Loops* by Stefan Gulan studies the question which kinds of finite automata can be translated into regular expressions of linear size. It gives a very comprehensive answer to this question by showing that such linear translations are possible from automata with a certain underlying graph structure, *series parallel loop graphs*, into regular expressions and vice versa. Furthermore it characterizes this graph class (within the class of *hammocks*, i.e., all graphs with dis-

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tinguished source and sink graphs, in which all nodes are on a path from source to sink) in terms of a number of forbidden minors.

In *Extended Regular Expressions: Succinctness and Decidability*, Dominik D. Freydenberger studies an extension of regular expressions by variables (or: back-references) that is widely used in practical contexts, e.g., in PERL and Python. The article shows the surprising fact that the extension has a dramatic effect on the size of regular expressions: there is no computable function that bounds the minimal size of a classical regular expressions in terms of the size of the smallest extended regular expressions. This holds even if only one variable is used and bound only once in the expression. The article further shows that many static analysis tasks, for example, deciding whether an expression denotes the set of all strings, are undecidable.

The article *Nominal Monoids* by Mikołaj Bojańzyk connects two fields of language theory. Regular languages can be represented by their syntactic monoids, and interesting properties of the languages can be read from the properties of the monoids. For example, a central theorem from this area states that a regular language of finite words is definable in first-order logic if and only if its syntactic monoid is aperiodic. However, for many current applications languages of words over *infinite* alphabets provide a more accurate model, XML data being one example. The article provides a version of the above mentioned theorem for regular languages over infinite words.

The article *Stochastic Cellular Automata Solutions to the Density Classification Problem—When randomness helps computing* by Nazim Fatés gives a randomized solution to the Density Classification Problem for cellular automata. In this problem, a ring of cellular automata with states 0 or 1 is required to find out whether its initial configuration contains more 0s or more 1s. As this problem cannot be solved perfectly by deterministic rules, randomized rules were studied in the literature. The article considerably improves the start of the art by introducing a new randomized rule that achieves success with probability arbitrarily close to 1, at the expense of increasing the convergence time.

The article *Spectral Sparsification in the Semi-Streaming Setting* by Jonathan A. Kelner and Alex Levin presents an algorithm that transforms a graph G into a graph G' with the same vertex set but with an almost linear number of edges (in the number of vertices) and such G' approximates G in the sense of spectral sparsification. The algorithm processes G within one pass and uses only nearly linear storage (in the number of vertices), thus considerably improving over previous, random-access based algorithms.

In *Vertex Cover Kernelization Revisited: Upper and Lower Bounds for a Refined Parameter*, Bart M.P. Jansen and Hans L. Bodlaender present a cubic-vertex kernel for the NP-hard Vertex Cover problem with respect to the non-standard parameter *size of a minimum feedback vertex set of the input graph*. This parameter is better than the standard parameter in that it is always smaller and, thus, the presented kernel may be arbitrarily small compared to the standard kernel for Vertex Cover. Also, the presented kernelization may enable to further reduce instances that are considered irreducible with respect to previous kernelizations. In contrast, it is shown that the weighted version of Vertex Cover does not admit a polynomial kernel with respect to the parameter *size of a given vertex cover of the input graph*.

In *Online Scheduling with Interval Conflicts*, Magnus M. Halldorsson, Boaz Patt-Shamir and Dror Rawitz address the following scheduling problem. The goal is to

select as many items as possible from a universe, consisting of several integers. Constraints arrive online, and impose that from a given interval, at most one item is selected. This problem has applications for example in buffer management for routers when dropping a single packet cancels the whole transmission to which this packet belonged. Competitive ratio of this problem is proven to be $\Theta(\lg \rho)$, where ρ is the maximum number of intersecting conflict intervals. In addition several variants are considered in the paper, mainly when the selection is made in a distributed (also called *oblivious*) manner.

The article *Tight Bounds For Distributed Minimum-weight Spanning Tree Verification* by Liah Kor, Amos Korman and David Peleg considers the well studied problem of the minimum spanning tree, but from a distributed computing perspective. As in the centralized setting, verifying if a given tree of a graph on n nodes and m vertices is a minimum spanning tree, seems to be a problem that is easier to handle than the computational problem. This paper provides a distributed algorithm in the CONGEST model, achieving $\tilde{O}(m)$ messages and $\tilde{O}(\sqrt{n} + D)$ time, where D is the diameter of the graph. The algorithm builds a clustering of the graph, and does the verification separately inside clusters and between clusters. Matching lower bounds are given as well, which make clever use of 2-party communication complexity.

In *Towards Duality of Multicommodity Multiroute Cuts and Flows: Multilevel Ball-Growing*, Petr Kolman and Christian Scheideler consider a routing problem where one needs to find h edge-disjoint paths between a source and a sink, and in fact a maximum affine linear combination of these paths is to be found. The dual of this problem concerns cuts with k commodities, and the main result of the paper is a duality theorem, relating for $h \leq 3$ the maximum flow with the minimum cut within factors $1/h$ and $O(\log^4 k)$. To this end an approximation algorithm is presented which introduces a new interesting rounding technique, called *multilevel ball-growing*.

We warmly thank the authors for submitting their papers to this issue, and we are indebted to the referees for many thorough reviews of the manuscripts. Finally we want to acknowledge the support of the organizations, which contributed to the success of STACS 2011.

Guest Editors