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Foreword

Foreword: Selected papers from the 22nd International Symposium on Fundamentals of Computation Theory (FCT 2019)

This special issue contains the full versions of papers selected from the 22nd International Symposium on Fundamentals of Computation Theory (FCT 2019) held on August 12–14, 2019, in Copenhagen, Denmark. FCT is a biennial conference that circulates between various European countries on a regular basis. It was established in 1977 for researchers interested in all aspects of theoretical computer science, and in particular in algorithms, computational complexity, and formal and logical methods.

The editors of the special issue invited the best FCT 2019 papers based on the program committee's discussions, the reviewers' reports, and the authors' conference presentations. All submitted articles underwent a rigorous reviewing process endorsed by the *Journal of Computer and System Sciences*. This process resulted in the selection of nine articles for publication in this special issue, which together provide a representative sample of the wide range of interesting topics and research methods presented at FCT 2019. All nine articles are the complete and extended versions of the original conference papers. We would now like to take this opportunity to briefly introduce each of them.

In the article "On Weisfeiler-Leman invariance: Subgraph counts and related graph properties", V. Arvind, Frank Fuhlbrück, Johannes Köbler, and Oleg Verbitsky study to what extent the k-dimensional Weisfeiler-Leman algorithm can identify certain graph properties. Focusing on subgraph counts, they establish precisely for which pattern graphs F it holds that if two graphs G and H are indistinguishable by the algorithm with $k = 1$, then G and H must contain equally many copies of F. They also make significant progress on the case $k = 2$.

The objective of the article "Space efficient representations of finite groups" by Bireswar Das, Shivdutt Sharma, and P.R. Vaidyanathan is to design data structures that can store a group (in the abstract algebra sense) compactly and still be able to answer multiplication queries on pairs of the group's elements quickly. For general groups, they present a data structure that occupies $O(n^{1+\delta}/\delta)$ words of size $O(\log n)$ bits that can answer any multiplication query in $O(1/\delta)$ time, where n is the number of elements in the group and δ is a trade-off parameter satisfying $1/\log n \leq \delta \leq 1$. They also describe how to store various special classes of groups using only a linear number of words while supporting multiplication queries in logarithmic time.

In the article "Circular pattern matching with k mismatches" the authors Panagiotis Charalampopoulos, Tomasz Kociumaka, Solon P. Pissis, Jakub Radoszewski, Wojciech Rytter, Juliusz Straszyński, Tomasz Waleń, and Wiktor Zuba consider the circular pattern matching with k mismatches (k-CPM) problem. In this problem the task is to compute for every length-m substring of the text T, where $|T| = n$, the minimal Hamming distance between this substring and any cyclic rotation of the pattern P, where $|P| = m$, but only if this distance is no larger than the threshold value k. This is a variant of the well-known k-mismatch problem. The past research focuses solely on the average-case upper bounds for this variant. In this paper, the authors provide non-trivial worst-case upper bounds by proposing two alternative algorithms operating in time $O(nk)$ and $O(n + \frac{n}{m}k^4)$.

In the article "Largest common prefix of a regular tree language" the authors Markus Lohrey and Sebastian Maneth propose a family of tree automata of size n such that the size of the largest common prefix (lcp) tree of all accepted trees is exponential in n. They show that this prefix tree is neither compressible via DAGs (directed acyclic graphs) nor via tree straight-line programs. They also show that determining whether or not the lcp trees of two given tree automata are equal is coNP-complete; the result holds even for deterministic bottom-up tree automata accepting finite tree languages. These results are in sharp contrast to the case of context-free string grammars.

The article "On the fast delivery problem with one or two packages" by Iago Carvalho, Thomas Erlebach, and Kleitos Papadopoulos is inspired by practical applications such as delivering packages using swarms of autonomous drones. It

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studies two problems where autonomous mobile agents are initially located on distinct nodes of a weighted graph. Each agent has a predefined velocity and can only move along the edges of the graph. The first problem is to deliver one package from a source node to a destination node. The second is to simultaneously deliver two packages, each from its source node to its destination node. These deliveries are achieved by the collective effort of the agents, which can carry and exchange a package among them. For one package, an efficient algorithm is given for computing a delivery schedule that minimizes the delivery time. For two packages, the authors show that the problem of minimizing the maximum or the sum of the delivery times is NP-hard for arbitrary agent velocities, but polynomial-time solvable for agents with equal velocity.

The article "Automatic Kolmogorov complexity, normality, and finite state dimension revisited" by Alexander Kozachinskiy and Alexander Shen provides a characterization of normal sequences and finite-state dimension in terms of the automatic Kolmogorov complexity and finite-state a priori probability. It shows that many known results about normal sequences and finite-state dimension become easy corollaries of this characterization. The paper also gives a machine-independent characterization of normality and finite-state dimension in terms of superadditive calibrated functions. Furthermore, it provides a comparison with previous results and notions relating finite automata and complexity.

In the article "Optimal channel utilization with limited feedback" the authors Gianluca De Marco, Tomasz Jurdziński, and Dariusz R. Kowalski consider channels with multiplicity feedback returning the exact number of stations transmitting simultaneously when a collision occurs. It is known that in this model $\Theta((d\log(\frac{n}{d}))/\log d)$ time rounds are sufficient and necessary to identify d out of n transmitting stations. In contrast, in the ternary feedback model the required time is $\Theta(d\log(\frac{n}{d}))$. In this paper the authors consider a new model with the feedback interval $[x, y]$, where $0 \le x \le y \le d$, allowing the communication channel to return the exact number of transmitting stations only if this number belongs to this interval. The authors show that for any feedback interval of size $\Omega(\sqrt{d\log d})$ centered in $\frac{d}{2}$ one can identify d out of n stations as efficiently as in the model with the unbounded multiplicity feedback. On the other hand, further reduction of this size to $O(\frac{\sqrt{d}}{\log d})$ implies that a protocol with time complexity $O((d\log(\frac{n}{d}))/\log d)$ is no longer feasible.

In "Nominal syntax with atom substitutions", Jesús Domínguez and Maribel Fernández study algorithmic problems related to unification and matching in a nominal syntax extended with non-capturing atom substitutions. The authors prove that although unification becomes undecidable with their extension, matching remains decidable. They also develop an algorithm for matching that computes complete sets of solutions, introduce a class of matching constraints for which matching is guaranteed to always have at most one solution, and describe some applications to term rewriting systems that demonstrate how their extension makes it easier to model certain formal systems.

The article "Bivariate B-splines from convex configurations" by Dominique Schmitt makes a significant contribution to a topic which is important in the area of curve modeling. It defines a family of configurations that gives rise to bivariate B-splines that retain the fundamental properties of univariate B-splines. It also gives an algorithm to construct these configurations. One of the major contributions of the paper is a proof that configurations constructed by an algorithm of Liu and Snoeyink in 2007 have the desired properties which guarantee that the algorithm always works.

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Guest Editors:
Leszek Gąsieniec *
Jesper Jansson *
Christos Levcopoulos *
E-mail addresses: l.a.gasieniec@liverpool.ac.uk (L. Gąsieniec), jesper.jansson@polyu.edu.hk (J. Jansson), christos.levcopoulos@cs.lth.se (C. Levcopoulos)

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* Corresponding authors.