Lecture Notes in Computer Science 13270

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Cristina Bazgan · Henning Fernau (Eds.)

Combinatorial Algorithms

33rd International Workshop, IWOCA 2022
Trier, Germany, June 7–9, 2022
Proceedings

Springer

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ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-031-06677-1 ISBN 978-3-031-06678-8 (eBook)
https://doi.org/10.1007/978-3-031-06678-8

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The 33rd International Workshop on Combinatorial Algorithms (IWOCA 2022) was planned as a hybrid event, with the on-site activities taking place at the University of Trier, Germany. Due to the COVID-19 pandemic and also in order to lower the carbon footprint of the conference, it was decided that the conference could be also attended online. The conference was scheduled during June 7–9, 2022, followed by the Graphmaster and Stringmaster Workshops.

IWOCA is an annual conference series that started in 1989 as AWOCA (Australasian Workshop on Combinatorial Algorithms), and became an international conference in 2007, having been held in Australia, Canada, the Czech Republic, Finland, France, Indonesia, India, Italy, Japan, Singapore, South Korea, the UK, and the USA. Now, Germany can be added to this list of IWOCA countries. The conference brings together researchers on diverse topics related to combinatorial algorithms, such as algorithms and data structures; algorithmic and combinatorial aspects of cryptography and information security; algorithmic game theory and complexity of games; approximation algorithms; complexity theory; combinatorics and graph theory; combinatorial generation, enumeration, and counting; combinatorial optimization; combinatorics of words; computational biology; computational geometry; decompositions and combinatorial designs; distributed and network algorithms; experimental combinatorics; fine-grained complexity; graph algorithms and modeling with graphs; graph drawing and graph labeling; network theory and temporal graphs; quantum computing and algorithms for quantum computers; online algorithms; parameterized and exact algorithms; probabilistic and randomized algorithms; and streaming algorithms.

The Program Committee (PC) of IWOCA 2022 received 96 abstract submissions; finally, 86 full papers were submitted. Each submission was reviewed by at least three PC members and some trusted external referees, and evaluated on its quality, originality, and relevance to the conference. The PC selected 35 papers for presentation at the conference and inclusion in the proceedings. Three invited talks were scheduled for IWOCA 2022, given by Akanksha Agrawal (Indian Institute of Technology Madras, India) Erik Demaine (MIT, USA), and Bhaskar Ray Chaudhury (University of Illinois Urbana-Champaign, USA), as also testified by these proceedings.

The Program Committee also selected two papers to receive the Best Paper Award and the Best Student Paper Award, respectively. These awards were sponsored by Springer. The awardees are

- Best Paper Award: Hideo Bannai, Tomohiro I, Tomasz Kociumaka, Dominik Köppl, Simon Puglisi. Computing Longest (Common) Lyndon Subsequence.
- Best Student Paper Award: Kanae Yoshiwatari, Hironori Kiya, Tesshu Hanaka, Hirotaka Ono. Winner Determination Algorithms for Graph Games with Matching Structures.

We would like to thank all invited speakers for accepting to give a talk at the conference, the Program Committee members who graciously gave their time and energy, and the 122 external reviewers for their expertise.

The organization of IWOCA 2022 started in the middle of the pandemic crisis. To cope with the related uncertainties, we decided to run IWOCA as a hybrid event. We still hope that, in particular, a number of younger participants were able to enjoy IWOCA as an on-site event, possibly as their first-ever conference.

We also thank Springer for publishing the proceedings of IWOCA 2022 in their ARCoSS/LNCS series and for their financial support towards the best paper awards. Also, we were one of the last conferences collecting experiences with OCS, a Springer system we used for managing the collection and editing of the papers.

Finally, we thank the Steering Committee for giving us the opportunity to serve as program chairs of IWOCA 2022 and for their continuous support.

April 2022

Cristina Bazgan
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Graphs as Algorithms: Characterizing Motion-Planning Gadgets through Simulation and Complexity (Abstract of Invited Talk)

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Abstract. Most motion planning problems—designing the route for one or more agents (robots, humans, cars, drones, etc.) through a changeable environment—are computationally difficult: NP-hard, PSPACE-hard, or worse. Such hardness proofs usually consist of several *gadgets*—local pieces of environment with limited agent interactions/traversals, some of which change local state, which in turn change available interactions/traversals—that can be pasted together into the overall reduction. Such gadgets essentially act like finite automata, where the transitions are controlled by one or more agents traversing the environment.

In this talk, I'll describe our quest to characterize exactly which such gadgets suffice to prove different kinds of hardness, in our *motion-planning-through-gadgets framework* that has developed over the past few years [1–9]. This framework enables many hardness proofs, old and new, to be distilled down to a single diagram of a single gadget.

Even stronger, we aim to characterize which motion-planning gadgets can *simulate* which others. Gadget simulations are given by a graph describing how to connect together the simulating gadgets (along with their initial states) in a way that acts like the simulated gadget, essentially representing a reduction algorithm as a graph. See Fig. 1.

Keywords: Gadgets · Motion planning · Computational complexity

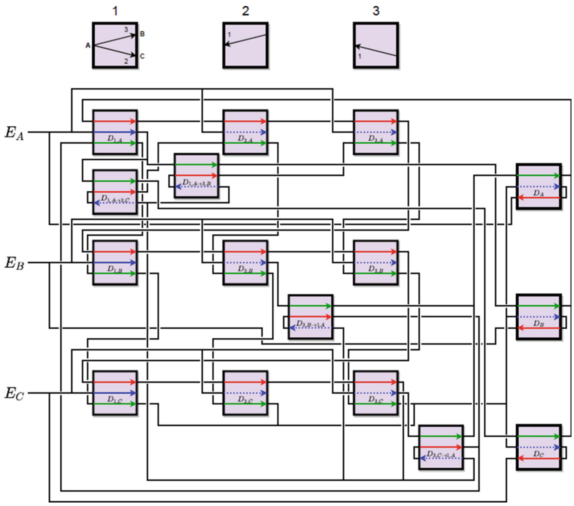

Fig. 1. Illustrative example of a proof that a "door" gadget is *universal*, meaning that it can simulate all other gadgets, from [2]. This graph of connections between door gadgets (drawn as shaded squares) describes an algorithmic reduction from motion planning on doors to motion planning on the desired gadget (with state diagram at top).

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