Lecture Notes in Computer Science 12227

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Reversible Computation

12th International Conference, RC 2020
Oslo, Norway, July 9–10, 2020
Proceedings

Springer

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ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-030-52481-4 ISBN 978-3-030-52482-1 (eBook)
https://doi.org/10.1007/978-3-030-52482-1

LNCS Sublibrary: SL2 – Programming and Software Engineering

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

Preface

This volume contains the papers presented at the 12th Conference on Reversible Computation (RC 2020), held during July 9–10, 2020, online due to the COVID-19 pandemic, while initially expected to take place virtually in Oslo, Norway, hosted by the Institute for Informatics, University of Oslo.

The RC conference brings together researchers from computer science, mathematics, engineering, and physics to discuss new developments and directions for future research in the emerging area of Reversible Computation. This includes, for example, reversible formal models, reversible programming languages, reversible circuits, and quantum computing.

The conference received 23 submissions with authors from 16 countries. All papers were reviewed by at least three members of the Program Committee. After careful deliberations, the Program Committee selected 17 papers for presentation. In addition to these papers, this volume contains the abstracts of the two invited talks: "Problems and Prospects for Bidirectional Transformations" by Perdita Stevens (University of Edinburgh, UK) and "Inverse Problems, Constraint Satisfaction, Reversible Logic, Invertible Logic and Grover Quantum Oracles for Practical Problems" by Marek Perkowski (Portland State University, USA).

Of course the COVID-19 pandemic had a strong impact on the conference, as well as on research and the society in general. This was the first edition of RC to be held online, similar to other conference scheduled for this time. This is of course a difficulty, since in-person presence makes interaction much easier, but also a challenge and an occasion. Indeed, an online conference stimulates larger participation, in particular from persons whose budget or constraints may not allow in-person participation, not even under normal circumstances.

The conference would not be possible without the enthusiasm of the members of the Program Committee; their professionalism and their helpfulness was exemplary. For the work of the Program Committee and the compilation of the proceedings, the extremely useful EasyChair conference managment system was employed. Finally, we would like to thank all the authors for their submissions, their willingness to continue improving their papers, and their wonderful presentations during RC 2020.

April 2020

Ivan Lanese
Mariusz Rawski

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Abstracts of Invited Talks

Problems and Prospects For Bidirectional Transformations

Perdita Stevens

School of Informatics, University of Edinburgh

Abstract. Bidirectional transformations maintain consistency between two, or more, sources of information. These information sources can be code, documents, database views, etc.: the general term "model" covers them all. I will explain why I think bidirectional transformations have the potential to transform software development and help solve the "capacity crisis", in which the demand for software engineering outstrips the supply of people able to do it. In order to bring this to fruition we need to solve many problems; for example I have recently been working on how to manage networks of many models, not just two. It turns out that reversibility – whose relationship with bidirectionality is, in general, not as obvious as we might think at first sight – is relevant to some outstanding problems. I will describe progress and indicate some possible directions for future work.

Inverse Problems, Constraint Satisfaction, Reversible Logic, Invertible Logic and Grover Quantum Oracles for Practical Problems

Marek Perkowski

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Abstract. It is well-known that the "Unsorted Database" quantum algorithm by Grover gives quadratic speedup to several important combinatorial and enumerative problems, such as: SAT, Graph Coloring, Maximum Cliques, Travelling Salesman and many others. Recently, quantum programming languages such as Quipper start to be used to design, verify and simulate practical quantum algorithms for important problems in Quantum Machine Learning. So far, however, no methodologies have been created to program Grover Oracles for particular classes of problems. In contrast, such methodologies have been already created for classical Constraint Satisfaction Problems. The goal of this invited talk is to show results of some initial research towards creating systematic methodologies to program quantum computers that solve search problems in Artificial Intelligence, Logic Design and Machine Learning. Our methods are based on unified oracle blocks for such problem representations as set partition algebra, cube calculus and optimal mappings. For instance, several important problems in CAD and Machine Learning can be solved using only two basic operations on set partitions; $\Pi_1 \leq \Pi_2$ and $\Pi_1 \Pi_2$. Moreover, building oracles is the fundamental concept in the new approach to solve CSP proposed here and based on Invertible Logic introduced recently by Supriyo Datta and his team.

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