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Niranjan Balachandran · R. Inkulu (Eds.)

Algorithms and Discrete Applied Mathematics

8th International Conference, CALDAM 2022 Puducherry, India, February 10–12, 2022 Proceedings

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Preface

This volume contains the papers presented at CALDAM 2022 (the 8th International Conference on Algorithms and Discrete Applied Mathematics) held during February 10–12, 2022, at Pondicherry University, Puducherry, India. CALDAM 2022 was organized by the Department of Mathematics, Pondicherry University, and the Association for Computer Science and Discrete Mathematics (ACSDM), India. The program committee consisted of 34 highly experienced and active researchers from various countries.

The conference topics included algorithms, graph theory, computational geometry, and optimization. We received 80 submissions from authors from all over the world. Each paper was extensively reviewed by program committee members and other expert reviewers. The committee decided to accept 24 papers for presentation. The program included three Google invited talks by Timothy M. Chan (University of Illinois at Urbana-Champaign), Daya R. Gaur (University of Lethbridge), and Joseph S. B. Mitchell (Stony Brook University).

As volume editors, we would like to thank the authors of all submissions for considering CALDAM 2022 for the potential presentation of their works. We are very much indebted to the program committee members and the external reviewers for providing serious reviews within a very short period. We thank Springer for publishing the proceedings in the Lecture Notes in Computer Science series. Our sincerest thanks to the invited speakers, Timothy M. Chan, Daya R. Gaur, and Joseph S. B. Mitchell, for accepting our invitation to give a talk. We thank the organizing committee, chaired by S. Francis Raj of Pondicherry University, for conducting CALDAM 2022 smoothly, and Pondicherry University for providing the necessary facilities. We are very grateful to the chair of the steering committee, Subir Ghosh, for his active help, support, and guidance. And, we thank the Program Committee co-chairs of CALDAM 2021, Apurva Mudgal and C R Subrahmanyam, for their timely input throughout. We thank our sponsors, Google Inc. for their financial support and Springer for the best paper presentation awards. We also thank Springer OCS staff for their support.

February 2022

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Abstracts of Invited Talks

All-Pairs Shortest Paths and Fine-Grained Complexity

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Abstract. The all-pairs shortest paths (APSP) problem is one of the most fundamental problems in algorithm design and fine-grained complexity. The problem for general weighted dense graphs is conjectured to require close to n^3 time. On the other hand, substantially subcubic algorithms are known in some important special cases via fast matrix multiplication; for example, for directed graphs that are unweighted (or have small integer weights), the current best algorithm due to Zwick (FOCS 1998) had running time near $n^{2.5}$ if the matrix multiplication exponent ω is equal to 2.

In this talk, I will survey the current landscape surrounding the complexity of APSP and its variants, and how the conjectured hardness of APSP in the general and unweighted cases have been used as the basis for establishing conditional lower bounds for other problems. In particular, I will describe recent joint work with Virginia Vassilevska Williams and Yinzhan Xu (ICALP 2021), showing that Zwick's algorithm is in some sense optimal for directed unweighted graphs.

Linear Programming and its Uses in Algorithm Design

Daya R. Gaur

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Abstract. Linear programming has a rich history. In this talk, we focus on its use in algorithm design. We will look at its use in three areas. The first is the design of exact algorithms, and the second is the design of approximate algorithms. Thirdly, its use in the creation of practical algorithms for computationally challenging problems. I will give several examples of how researchers in my group use linear programming to develop exact and approximate algorithms. These illustrative examples will also highlight the computational challenges still remaining. Most of the theory that will be covered is explained nicely in these books [Dantzig and Thapa, 2006; Vazirani, 2003; Lau et al., 2011; Cook et al., 1998]. This talk will be a little tour of the strengths of linear programming and how to use them. This introductory talk will be a mix of theory and practice and no background is assumed.

Approximation Algorithms for Some Geometric Optimization Problems

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Abstract. We discuss approximation algorithms for some instances of geometric optimization problems, including maximum independent set, dominating set, vehicle routing, and set cover. In all cases the problems are specified by geometric data, such as points, rectangles, polygons, and disks, and the results strongly exploit geometry to yield better results than can be achieved (or at least better than results known so far) in non-geometric settings. We are motivated by applications of computational geometry in sensor networks and mobile robotics, including classic problems on "art galleries" that need to be guarded by static or mobile guards within a polygonal domain. Almost all of these optimization problems are NP-hard even in simple two-dimensional settings. The problems get even harder when we take into account uncertain data, time constraints for scheduled coverage, and routing/connectivity problems in combination with coverage constraints. We discuss selected versions of these geometric optimization problems from the perspective of approximation algorithms and we describe some techniques that have led to new or improved approximation bounds for certain maximum independent set and routing/coverage problems.

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