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Experimental Algorithms

15th International Symposium, SEA 2016
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Proceedings

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Preface

This volume contains the 25 papers presented at SEA 2016, the 15th International Symposium on Experimental Algorithms, held during June 5–8, 2016, in St. Petersburg, Russia. The symposium was organized by the Steklov Mathematical Institute at St. Petersburg of the Russian Academy of Sciences (PDMI). SEA covers a wide range of topics in experimental algorithmics, bringing together researchers from algorithm engineering, mathematical programming, and combinatorial optimization communities. In addition to the papers, three invited lectures were given by Juliana Freire (New York University, USA), Haim Kaplan (Tel Aviv University, Israel), and Yurii Nesterov (Ecole Polytechnique de Louvain, Belgium).

The Program Committee selected the 25 papers presented at SEA 2016 and published in these proceedings from the 54 submitted papers. Each submission was reviewed by at least three Program Committee members, some with the help of qualified subreferees. We expect the full versions of most of the papers contained in these proceedings to be submitted for publication in refereed journals.

Many people and organizations contributed to the smooth running and the success of SEA 2016. In particular our thanks go to:

– All authors who submitted their current research to SEA
– Our reviewers and subreferees who gave input into the decision process
– The members of the Program Committee, who graciously gave their time and expertise
– The members of the local Organizing Committee, who made the conference possible
– The EasyChair conference management system for hosting the evaluation process
– Yandex
– The Government of the Russian Federation (Grant 14.Z50.31.0030)
– Steklov Mathematical Institute at St. Petersburg of the Russian Academy of Sciences
– Monomax Congresses & Incentives

June 2016

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Abstracts of Invited Talks

Provenance for Computational Reproducibility and Beyond

Juliana Freire

New York University, New York, USA

The need to reproduce and verify experiments is not new in science. While result verification is crucial for science to be self-correcting, improving these results helps science to move forward. Revisiting and reusing past results — or as Newton once said, “standing on the shoulders of giants” — is a common practice that leads to practical progress. The ability to reproduce computational experiments brings a range of benefits to science, notably it: enables reviewers to test the outcomes presented in papers; allows new methods to be objectively compared against methods presented in reproducible publications; researchers are able to build on top of previous work directly; and last but not least, recent studies indicate that reproducibility increases impact, visibility, and research quality and helps defeat self-deception.

Although a standard in natural science and in Math, where results are accompanied by formal proofs, reproducibility has not been widely applied for results backed by computational experiments. Scientific papers published in conferences and journals often include tables, plots and beautiful pictures that summarize the obtained results, but that only loosely describe the steps taken to derive them. Not only can the methods and implementation be complex, but their configuration may require setting many parameters. Consequently, reproducing the results from scratch is both time-consuming and error-prone, and sometimes impossible. This has led to a credibility crisis in many scientific domains. In this talk, we discuss the importance of maintaining detailed provenance (also referred to as lineage and pedigree) for both data and computations, and present methods and systems for capturing, managing and using provenance for reproducibility. We also explore benefits of provenance that go beyond reproducibility and present emerging applications that leverage provenance to support reflective reasoning, collaborative data exploration and visualization, and teaching.

This work was supported in part by the National Science Foundation, a Google Faculty Research award, the Moore-Sloan Data Science Environment at NYU, IBM Faculty Awards, NYU School of Engineering and Center for Urban Science and Progress.

Minimum Cost Flows in Graphs with Unit Capacities

Haim Kaplan

Tel Aviv University, Tel Aviv, Israel

We consider the minimum cost flow problem on graphs with unit capacities and its special cases. In previous studies, special purpose algorithms exploiting the fact that capacities are one have been developed. In contrast, for maximum flow with unit capacities, the best bounds are proven for slight modifications of classical blocking flow and push-relabel algorithms.

We show that the classical cost scaling algorithms of Goldberg and Tarjan (for general integer capacities) applied to a problem with unit capacities achieve or improve the best known bounds. For weighted bipartite matching we establish a bound of $O(\sqrt{r}m \log C)$ on a slight variation of this algorithm. Here r is the size of the smaller side of the bipartite graph, m is the number of edges, and C is the largest absolute value of an arc-cost. This simplifies a result of Duan et al. and improves the bound, answering an open question of Tarjan and Ramshaw. For graphs with unit vertex capacities we establish a novel $O(\sqrt{n}m \log (nC))$ bound.

This better theoretical understanding of minimum cost flow on one hand, and recent extensive experimental work on algorithms for maximum flow on the other hand, calls for further engineering and experimental work on algorithms for minimum cost flow. I will discuss possible future research along these lines.

Complexity Bounds for Primal-Dual Methods Minimizing the Model of Objective Function

Yurii Nesterov

CORE/INMA, UCL, Louvain-la-Neuve, Belgium

We provide Frank–Wolfe (Conditional Gradients) method with a convergence analysis allowing to approach a primal-dual solution of convex optimization problem with composite objective function. Additional properties of complementary part of the objective (strong convexity) significantly accelerate the scheme. We also justify a new variant of this method, which can be seen as a trust-region scheme applying the linear model of objective function. Our analysis works also for a quadratic model, allowing to justify the global rate of convergence for a new second-order method. To the best of our knowledge, this is the first trust-region scheme supported by the worst-case complexity bound.

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