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Guest Editor's Foreword: Algorithms, Combinatorics, & Geometry

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Knowledge of mathematics and combinatorics is central to the design of combinatorial algorithms. In addition, applications-related concepts may also give rise to interesting mathematical problems, or may even be used to solve mathematical problems. The workshop on Algorithms, Combinatorics, and Geometry (ACG) was held during November 29–December 1, 2007, at the University of North Texas (UNT), Denton, Texas. The ACG workshop was intended to provide a deeper understanding of some important concepts which are fundamental to different disciplines, and to bring together researchers in different areas of discrete mathematics and computer science and provide an opportunity for them to interact. The ACG workshop did not have a proceedings, but an abstract for each talk was posted online. See acg.unt.edu for details.

This special issue of Algorithmica presents a collection of 10 invited papers which are related to the main theme of the workshop. Preliminary versions of some of these papers may have been published in conferences. Nonetheless, all papers appearing in this issue have been thoroughly refereed and are revised so that they are in a suitable form for publication in Algorithmica. We have included papers that cover a broad range of important concepts which are of interest to researchers in graph theory and graph algorithms, combinatorial and computational geometry, computer security, graph drawing, and randomized algorithms. While the main results in some papers may appear purely structural, all results have computational consequences.

Cabello and Mohar study the crossing number problem for those graphs that become planar after removal of one edge. They develop min-max formulas, and hence, efficiently computable lower and upper bounds that give rise to approximation algorithms that improve the best known previous results.

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Goodrich, Tamassia and Triandopoulos study variations of important problems that arise in the authentication of network management systems and geographic information systems. They present new and efficient techniques for authenticating data structures that represent graphs and collections of geometric objects. They introduce a new primitive, the path hash accumulator, that employs cryptographic hashing for efficiently authenticating various properties of structured data represented as paths.

Cranton, Kim and Yu study the injective coloring of graphs, which is an assignment of colors to the vertices of a graph so that any two vertices with a common neighbor receive distinct colors. They derive a new upper bound for the injective chromatic number in terms of the maximum degree, when the maximum average degree (over all subgraphs) is small.

Brandes et al. study visualization problems that arise in software engineering and bioinformatics. They focus on a relaxed variation for the problem of finding a simultaneous straight line planar embedding of a finite set of planar graphs on the same vertex set, and derive some interesting results when one of these graphs is outer planar, and the remaining are acyclic.

Zhang, Jiang and Chen study efficient planarization of wireless sensor networks, and present a novel planarization method for a network model, where sensors can have non-uniform transmission ranges and no location information is needed. As a part of their work they also derive an efficient approximation algorithm that improves the best known performance ratio for the one-sided two layer planarization problem of bipartite graphs.

Schaefer, Sedgwick and Štefankovič show that for every n there are two simple curves on the torus intersecting at least n times without the two curves folding or spiraling with respect to each other. Their construction is particularly interesting, since it suggests that the existing methods for verifying NP-hardness of certain problems associated with planar curves may not be generalized to surfaces.

Dumitrescu and Tóth study the problem of minimizing the length (sum of edge lengths) of a planar graph that connects a set of given points in the plane and has convex faces. They present new tight bounds and efficient algorithms. Specifically, the length of their constructed planar graph is within a small and tight (but non-constant) multiple factor of the lower bound of the sum of edge lengths of a Euclidean minimum spanning tree of the given points.

Bein, Larmore, Noga and Reischuk study competitive randomized online algorithms.They propose the novel concept of knowledge states that can be used to design competitive online algorithms and to explore the trade-off between memory and competitiveness. Their general model settles an open problem, when applied to randomized k-paging.

Pelsmajer, Schaefer and Štefankovič study the crossing number of graphs associated with drawings that are equipped with a rotation system. The authors prove that computing the crossing number of these graphs is NP-hard, and use this to prove that other interesting versions of crossing number problems are also NP-hard. An interesting aspect of the work is a connection to edit-distance problems in cyclic strings.

Dumitrescu and Jiang consider a new and natural problem. Given a set of points in the plane, what is the best way to move the points to a target point using a sequence of sweeps, given a sweep-line as a tool? They present a 1.27 times optimal approximation algorithm (for the sweep length measure) which only uses four sweeps.

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