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Advances in Graph Algorithms

Special Issue on Selected Papers from the Seventh International Workshop on Algorithms and Data Structures, WADS 2001

Guest Editors' Foreword

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Introduction

This Special Issue brings together papers based on work presented at the Seventh International Workshop on Algorithms and Data Structures (WADS 2001) which was held August 8-10, 2001, at Brown University Providence, USA. Preliminary versions of the results presented at WADS 2001 have appeared in the conference proceedings published by Springer-Verlag, Lecture Notes in Computer Science, volume 2125.

As editors of this JGAA special issue, we chose to invite papers from WADS 2001 that reflect the broad nature of the workshop, which showcase theoretical contributions as well as experimental work in the field of algorithms and data structures. The issue collects six papers. The first three papers present new algorithms that either revisit basic graph algorithms within new realistic models of computation or that deal with fundamental questions about the combinatorial nature of graphs. The remaining three papers are devoted to the growing area of graph drawing and collect results that have a variety of applications from Web searching to Software Engineering.

All contributions in this Special Issue have gone through a rigorous review process. We thank the authors, the referees, and the editorial board of the journal for their careful work and for their patience, generosity, and support. We hope that we have captured a bit of the dynamic quality that the range of research interests presented at the workshop imparts.

Scanning the Issue

External memory graph algorithms have received considerable attention lately because massive graphs arise naturally in many applications. Breadth-first search (BFS) and depth-first search (DFS) are the two most fundamental graph searching strategies. They are extensively used in many graph algorithms. Unfortunately no I/O-efficient BFS or DFS-algorithms are known for arbitrary sparse graphs, while known algorithms perform reasonably well on dense graphs. The paper "On External-Memory Planar Depth-First Search" by L. Arge, U. Meyer, L. Toma, and N. Zeh presents two new results on I/O-efficient depth-first search in an important class of sparse graphs, namely undirected embedded planar graphs.

One of the most studied problems in the area of worst-case analysis of NP-hard problems is graph coloring. An early paper by Lawler, dated 1976, contains two results: an algorithm for finding a 3-coloring of a graph (if the graph is 3-chromatic) and an algorithm for finding the chromatic number of an arbitrary graph. Since then, the area has grown and there has been a sequence of papers improving Lawler's 3-coloring algorithm. However, there has been no improvement to Lawler's chromatic number algorithm. The paper by David Eppstein titled "Faster Exact Graph Coloring" provides the first improvement to Lawler's chromatic number algorithm by showing how to compute the exact chromatic number of a graph in time $O((4/3 + 3^{4/3}/4)^n) \approx 2.4150^n$.

The clique-width of a graph is defined by a composition mechanism for vertex-labeled graphs. Graphs of bounded clique-width are interesting from an algorithmic point of view. A lot of NP-complete graph problems can be solved in polynomial time for graphs of bounded clique-width if the composition of the graph is explicitly given. The paper by W. Espelage, F. Gurski, and E. Wanke titled "Deciding clique-width for graphs of bounded tree-width" shows a linear time algorithm for deciding "clique-width at most k" for graphs of bounded tree-width and for some fixed integer k.

Methods for ranking World Wide Web resources according to their position in the link structure of the Web are receiving considerable attention, because they provide the first effective means for search engines to cope with the explosive growth and diversification of the Web. The paper titled "Visual Ranking of Link Structures" and authored by U. Brandes and S. Cornelsen proposes a visualization method that supports the simultaneous exploration of a link structure and a ranking of its nodes by showing the result of the ranking algorithm in one dimension and using graph drawing techniques in the remaining one or two dimensions to show the underlying structure. These techniques are useful for the analysis of query results, maintenance of search engines, and evaluation of Web graph models.

The paper "An Approach for Mixed Upward Planarization" by M. Eiglsperger, F. Eppinger, and M. Kaufmann considers the problem of finding a mixed upward planarization of a mixed graph, i.e., a graph with directed and undirected edges. Mixed drawings arise in applications where the edges of the graph can be partitioned into a set which denotes structural information and a another set which does not carry structural information. An example is UML class diagrams arising in software engineering. In these diagrams, the vertices of the graph represent classes in an object-oriented software system, and edges represent relations between these classes. In these diagrams hierarchies of subclasses are drawn upward, whereas relations can have arbitrary directions. The authors present a heuristic approach for this problem which provides good quality and reasonable running time in practice, even for large graphs.

Upward planar drawings are the topic of "Upward Embeddings and Orientations of Undirected Planar Graphs" by W. Didimo and M. Pizzonia. The paper characterizes the set of all upward embeddings and orientations of an embedded planar graph by using a simple flow model, which is related to that described by Bousset to characterize bipolar orientations. The authors take advantage of such a flow model to compute upward orientations with the minimum number of sources and sinks of 1-connected embedded planar graphs. A new algorithm that computes visibility representations of 1-connected planar graphs is also presented.