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PREFACE

Preface

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This special volume of the *Annals of Operations Research* contains a collection of papers arising from a Dagstuhl Seminar on *Cutting, Packing, Layout and Space Allocation* held in March 2007 (http://www.dagstuhl.de/07112). The seminar attracted seventeen participants from a nine different countries. At the same time another seminar, focusing on Computational Geometry, was being hosted at Dagstuhl (http://www.dagstuhl.de/07111). This provided the opportunity for the two groups of scientists to explore common issues, which was beneficial to both seminars.

The nineteen papers in this special volume were accepted after being subjected to a full review process, in keeping with the expectations of an internationally recognized journal. The papers are presented in four sections, these being:

1) Real world applications
2) n-dimensional packing
3) Theoretical issues
4) Evolutionary approaches

Section 1: Real world applications

This section contains eight papers. Muritiba, Iori, Martello, and Gomes consider placing the maximum number of rectangles (exhibition stands) onto an irregular area which may contain holes (the exhibition area). The linear programming model is applied to a real world example from Brazil. Glass and van Oostrum investigate a real world two dimensional guillotine cutting stock problem which cuts out buns in a cake production environment. The presented

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case study demonstrates the effectiveness of the approach. Janiak, Kozik, and Lichtenstein present a Block Packing Problem, which is a key issue in VLSI chip design. Their proposed approach, based on Complementary Mirror Constraint Graphs, shows that a constructive heuristic is able to produce high quality solutions. Bay, Crama, Langer, and Rigo consider an assembly problem that arises in shipyards by modelling it as a three dimensional bin packing problem and utilizing Guided Local Search. Good quality results are produced in a few minutes. The paper by Hahn, Smith, and Zhu presents a formulation for a multistory facility assignment problem, which can be found in many industrial sectors including hotels, hospitals, factories, warehouses, etc. The innovative formulation, along with a branch and bound algorithm, is shown to produce good quality results on a number of test problems. Burke, Mareček, Parkes, and Rudová survey seven formulations for vertex covering and present a clique-based integer programming for graph coloring. The formulation enables a previously unknown optimal solution to be found for a course timetabling problem.

The last two papers in this section both consider shelf space allocation within supermarkets. Russell and Urban model the shelf-management problem such that individual products are categorized as being part of a product family, so that they are located together on the shelves. The paper presents two models. The first can produce optimal solutions for small problems. The second model is able to tackle larger problems. Results are provided for test problems as well as one taken from the real world. Gajjar and Adil consider space elasticity in the context of shelf space allocation. They develop a heuristic solution that is able to produce near optimal solutions for randomly generated instances with a varying number of products and shelf sizes.

Section 2: *n*-Dimensional packing

This section contains seven papers. The first paper, by Alem, Junior, Arenales, and Ferreira, considers a one-dimensional cutting stock problem. A simplex method is proposed to solve a linear relaxation of the problem which is formulated as a two-stage stochastic nonlinear program with recourse. The methodology is shown to be effective when compared to other approaches. Jarboui, Ibrahim, and Rebai also consider a one-dimensional problem, in this case a bin packing problem. They present a new lower bounding scheme which is shown to be effective when compared to other lower bounds that are available. Parreño, Alvarez-Valdes, Oliveira, and Tamarit present a hybridized GRASP/VND algorithm to pack a given set of boxes into a minimum number of bins. The methodology is not only fast but equal to, or better than, the best heuristic methods. Bettinelli, Ceselli, and Righini investigate a variation of the classical bin packing problem in which bins have different costs and capacities, and each bin has a minimum capacity that has to be utilized. It is shown that this constraint makes the problem much more difficult to solve. The proposed methodology is shown to be superior to general purpose solvers such as CPLEX. Maag, Berger, Winterfield, and Kűfer introduce a novel approach to the minimal area rectangular packing problem. Their approach, based on non-linear optimization, is shown to be competitive when compared with simulated annealing and constraint programming. Korf, Moffitt, and Pollack consider the same problem and present two constraint-satisfaction formulations. Both approaches outperform previous approaches for optimal rectangle packing. They also solve a problem that has been open since 1996. Morabito and Pureza present a heuristic approach for the constrained two-dimensional guillotine cutting problem. The hybridization of a dynamic programming formulation with an and/or graph search shows that the method is competitive with other approaches from the literature.

Section 3: Theoretical issues

This section contains two papers. Clatiaux, Alves, and de Carvalho present a survey of dual-feasible functions, which are useful when computing lower bounds. In addition, they perform a computational comparison of the different functions when used to compute lower bounds for bin-packing problems. In some cases current lower bounds are improved. Bennell, Scheithauer, Stoyan, and Romanova review phi-functions, drawing out the relationship with Minkowski Sums and the No Fit Polygon. A step-by-step procedure is presented for generating phi-functions and describing how rotations can be handled.

Section 4: Evolutionary approaches

This section contains two papers. Terashima-Marín, Ross, Farías-Zárate, López-Camacho, and Valenzuela-Rendón present a GA based hyper-heuristic for regular and irregular two-dimensional bin-packing problems. The GA evolves combinations of condition-action rules. The proposed methodology is tested on a large set of benchmark instances, with very good results being reported. The final paper, by Rohlfshagen and Bullinaria, proposes two genetic algorithms which are inspired by molecular genetics. The algorithms are tested on two packing problems (bin-packing and the multiple knapsack problem). The results are competitive with other approaches reported in the literature.

Finally, we would like to thank all those who attended the Dagstuhl seminar and all those who submitted their papers to this special volume. In particular, we would like to thank all the reviewers. Without their help, support, expertise, and patience this volume would not have been possible.