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# Solving Combinatorial Optimization Problems in Parallel

## Methods and Techniques

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# Preface

*I know nothing except the fact of my ignorance*
*Socrates*

The search for solutions in a combinatorially large problem space is a major problem in computer science, engineering, and operations research. A general class of difficult and very important combinatorial problems include integer programming with linear or nonlinear objective functions. Although in the worst case such problems require solution times that grow exponentially as a function of their input size, in practice many instances can be solved in polynomial time by such traditional techniques as divide-and-conquer and branch-and-bound methods. Consequently, parallel systems, possibly with hundreds or thousands of processors, give us the perspective of efficiently solving relatively large instances of hard problems, which is a motivation for using parallel processing.

On the other hand, in several industrial, research, or other real-world environments, mathematical programmers must face up to moderate instances of hard problems for which an *exact optimal solution* is highly desirable (e.g. VLSI floor-plan optimization). In such circumstances, parallel processing can bring the time of solution from some days or months, which is typical when one workstation is used, to a few minutes or seconds. This is crucial in some applications that require real time solutions (e.g. robot motion planning and speech understanding).

These facts were the main motivations of Dr. Ferreira for the constitution of the Human Capital and Mobility project *SCOOP - Solving Combinatorial Optimization Problems in Parallel*, of the European Union. This project aims at proposing application methods for parallel optimization that are built upon a solid theoretical background. The chapters composing this book have been written, upon invitation, by the partners of SCOOP, our objective being to present recent results on parallelism in terms of how it affects combinatorial algorithm design and implementation. The primary audience for this book is intended to be graduate students and scientists interested in the design and implementation of parallel algorithms for solving combinatorial optimization problems.

November 1995 A. Ferreira, P.M. Pardalos

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