

**SOLUTIONS TO  
PARALLEL AND  
DISTRIBUTED  
COMPUTING PROBLEMS**



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# **SOLUTIONS TO PARALLEL AND DISTRIBUTED COMPUTING PROBLEMS**

**LESSONS FROM BIOLOGICAL  
SCIENCES**

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Edited by

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## PREFACE

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For some years now, techniques inspired by natural phenomena that are normally studied in biological sciences have gained great acceptance as efficient vehicles for solving a range of problems in a wide variety of disciplines. More recently, biologically inspired (bio-inspired, for short) techniques such as fuzzy logic, neural networks, simulated annealing, genetic algorithms, evolutionary computing models, and other bio-inspired techniques have been used to solve problems in a number of key areas in parallel and distributed computing.

Most if not all bio-inspired techniques have an inherently parallel structure. Thus, solutions based on such methods can be conveniently implemented on parallel computers. Furthermore, bio-inspired methods are considered to be “intelligent” because of their capability in adapting *in situ* in response to changes in the environment (e.g., solution space) that were not predicted in advance.

This compendium is composed of ten chapters that deal with the different issues and application possibilities that bio-inspired paradigms can offer in solving problems in parallel and distributed computing. The chapters present a range of subjects and applications. For example, Chapters 1 and 2 deal with the parallel and distributed computing of cellular automata and evolutionary algorithms, which are two very popular classes of bio-inspired methods. Speeding up bio-inspired algorithms will have a great impact on the applicability of such techniques to a wider range of problems. Chapter 3 reviews a number of bio-inspired techniques and provides a comprehensive framework to classify and study them. Chapter 4 investigates the use of a number of bio-inspired techniques, such as the simulated annealing algorithm and genetic algorithms, to solve problems that arise in parallel simulations. Chapters 5–9 propose techniques to solve different instances of the scheduling and load-balancing problems that are critical for the performance of parallel and distributed computers. Scheduling problems in parallel and distributed computing systems dealing with the mapping of tasks (e.g., parts of a program) onto an autonomous target machine consisting of several processing elements (or computers), so as to meet some performance objective such as minimum execution time and acceptable load balancing. Finally, Chapter 10 applies neural networks to solve problems in wireless communication systems. Mobile computing and communications are areas that are growing at a very fast pace. A great deal of overlap exists between the underlying principles of mobile computing and communication and parallel and distributed computing.

Overall, encouraging results have been obtained by the contributors of the chapters that appear in this book. This means that bio-inspired methods can become viable alternatives to classic solutions to a wide variety of problems in parallel and distributed computing research.

In putting together this book, we are hoping to increase awareness in the parallel and distributed computing community of the potential of such new paradigms. We also want to generate more interest and concerted effort in studying these paradigms and applying them to a wider range of problems in high-performance computing (i.e., parallel, distributed, and mobile).

Ideally, the reader of the book should be someone who is familiar with parallel and distributed computing and would like to learn more about how bio-inspired paradigms can be used to solve problems in their areas. In general, the book could be used by a wider audience such as graduate students, senior undergraduate students, researchers, instructors, and practitioners in Computer Science and Engineering.

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