Preface

Recent research trends have shown that industry is inundated with grouping problems that require efficient computational algorithms for grouping system entities based on specific guiding criteria. Grouping problems commonplace in industry include vehicle routing, container loading, equal piles problem, machine-part cell formation, cutting stock problem, job shop scheduling, assembly line balancing, and task assignment. These problems have a group structure with identifiable characteristic features, that is, the need to form efficient groups of entities according to guiding criteria, and the need to allocate those groups to specific assignees in order to satisfy the desired objectives. It is interesting to note that, across all the spectrum of these problems, grouping and allocation criteria are inherently very similar in nature.

The wide spectrum of real-world grouping problems, the striking similarities between their features, and the multi-criteria decisions involved are three major motivating factors behind the research momentum in this area. However, more challenging issues in this field have appeared in recent researches. First, there is an ever-growing need to address uncertainties in various grouping problem situations. Second, decision analysts in the field often call for multi-criteria decision approaches by which multiple criteria can be handled simultaneously. Third, researchers and decision analysts have realized the need for interactive, population-based algorithms that can provide alternative solutions rather than prescribe a single solution to the decision maker. Examples of such approaches are tabu search, particle swarm optimization, ant colony optimization, simulated evolution algorithm, simulated metamorphosis algorithm, genetic algorithms, and grouping genetic algorithms. Thus, in sum, recent research has emphasized the need for development of interactive multi-criteria computational algorithms that can address grouping problems, even in uncertain or fuzzy environments.

Evidently, notable research has focused on advances in genetic algorithms and related hybrid approaches, with application in various problem areas. Current research trends tend to show that there is a high potential for remarkable advances in genetic algorithms and its variants, specifically in grouping genetic algorithms. Genetic algorithm-based approaches offer a more user-friendly, flexible, and

adaptable population-based approach than related algorithms. Given these advantages, further developments and advances in grouping genetic algorithms are quite promising.

The purpose of this book is to provide an account of recent research advances and, above all, applications of grouping genetic algorithm and its variants. The prospective audience of the book "Grouping Genetic Algorithms: Advances and Applications" includes research students, academicians, researchers, decision analysts, software developers, and scientists. It is hoped that, by going through this book, readers will obtain an in-depth understanding of the novel unique features of the algorithm and apply it to specific areas of concern.

The book comprises three parts. Part I presents an in-depth reader-friendly exposition of a wide range of practical grouping problems, and the emerging challenges often experienced in the decision process. Part II presents recent novel developments in grouping genetic algorithms, demonstrating new techniques and unique grouping genetic operators that can handle complex multi-criteria decision problems. Part III focuses on computational applications of grouping genetic algorithms across a wide range of real-world grouping problems, including fleet size and mix vehicle routing, heterogeneous vehicle routing, container loading, machine-part cell formation, cutting stock problem, job shop scheduling, assembly line balancing, task assignment, and other group technology applications. Finally, Part IV provides concluding remarks and suggests further research extensions.

Johannesburg, South Africa

Michael Mutingi
Charles Mbohwa

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Mutingi, M.; Mbohwa, C.
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