

Preface

The concept of adaptive memory programming (AMP) is proposed for grouping a number of generic optimization techniques for combinatorial problems. The same common features that are the use of memory and a local search procedure drive these *Emerging Optimization Techniques* which include artificial neural networks, genetic algorithms, tabu search, and ant systems. The primary motivation for adaptive memory programming, therefore, is to group and unify all these emerging optimization techniques for enhancement of the computational capabilities that they offer to combinatorial problems which are encountered in real life in the area of production planning and control.

One memoryless technique, simulated annealing, is also included in the book manuscript for completeness.

The text, *Emerging Optimization Techniques in Production Planning and Control* describes the theoretical aspects of the adaptive memory programming together with relevant production planning and control applications. These production planning and control applications are taken from journal articles that the author has already published or submitted for publication in international journals, as well as from lecture-notes that he has prepared for teaching undergraduate and post-graduate courses in operations/production planning and control. Algorithms for the computer programs written for each application are also given. This way, the text covers the techniques, applications and algorithms. It is therefore possible for readers to adapt the algorithms presented for other areas of application.

The main objectives of the text are to serve as an instructional material for upper division undergraduates, entry-level graduate student, and a resource material for production planners and controllers, research scientists, practicing engineers, operations researchers, management scientists, applied mathematicians, and computer scientists. To achieve the first objective, the eight chapters have been written in such a way that it can serve as an instructional

text to students and those who are taking tuition on their own. The numerical examples given are first solved manually to enhance the readers understanding of the material, followed by the description of the algorithms and computer results. This way, the students can fully follow the materials presented. In addition, problems are given at the end of each chapter for students to practice with. Because all production planning and control applications in the text have been computerized, solutions for all problems are given in a separate Reference Manual. This way, the Lecturers can use the text as both instructional text and a Reference Manual for setting examinations and tutorials. To achieve the second objective, the algorithms described for each application are useful to both interested students and practitioners in grasping how to implement similar applications in computer code using the Emerging Optimization Techniques.

Those to purchase the book include upper division undergraduates or entry-level graduate students, professionals and academics of disciplines listed above, and libraries.

Our approach throughout the text is to present in a systematic manner the superiority of implementing the Emerging Optimization Techniques over other known heuristics available in the literature. To this end, additional intractable (complex) real life problems encountered in practice in the area of production planning and control are presented and solved using Emerging Optimization Techniques in each chapter.

The book has three parts: one, two and three. The text commences with part one, which contains an introductory chapter (Chapter 1) that gives an overview of Adaptive Memory Programming and Production Planning and Control. The second part of the book contains Chapters 2 and 3, respectively. The basic components of Production Planning System are presented in Chapter 2, while the basic components of Production Control System are presented in Chapter 3. These two chapters are quite adequate for a two-semester course on Production Planning and Control at the final year undergraduate level or first year of a graduate program. Part three of the book contains Chapters 4 to 8, dealing with Emerging Optimization Techniques and their applications to Production Planning and Control. Chapter 9 deals with programming techniques. Beginning with neural networks in Chapter 4, four basic types which include back propagation networks (BPN), self-organizing map (SOM), adaptive resonance theory (ART 1 and ART 2), and Hopfield networks are presented. Practical examples treated in this chapter are the

application of Hopfield networks to machine tooling and production sequencing in manufacturing cell planning, as well as flow shop and job shop scheduling. Chapter 5 presents the basic theory of genetic algorithms (GAs) and we then apply GAs to the aggregate production planning-problem. In Chapter 6, tabu search (TS) theory is presented. In this chapter, TS is applied to resource planning and allocation based on constraint management principles. This is altogether, a new application. Then follows Chapter 7 on Ant Systems and its underlying theory. The chapter presents the application of Ants Systems (AS) to scheduling bi-criteria flow shop problems. Again, this is altogether a new application. Recent advances in Emerging Optimization Techniques include hybrid systems. As has been mentioned, one approach that does not have memory structures is included in the text for completeness. This is Simulated Annealing (SA) in Chapter 8, applied to cell formation problem. Chapter 9 discusses programming techniques, and presents source code of one of the memory-based optimization techniques presented in this book.

Godfrey C. Onwubolu