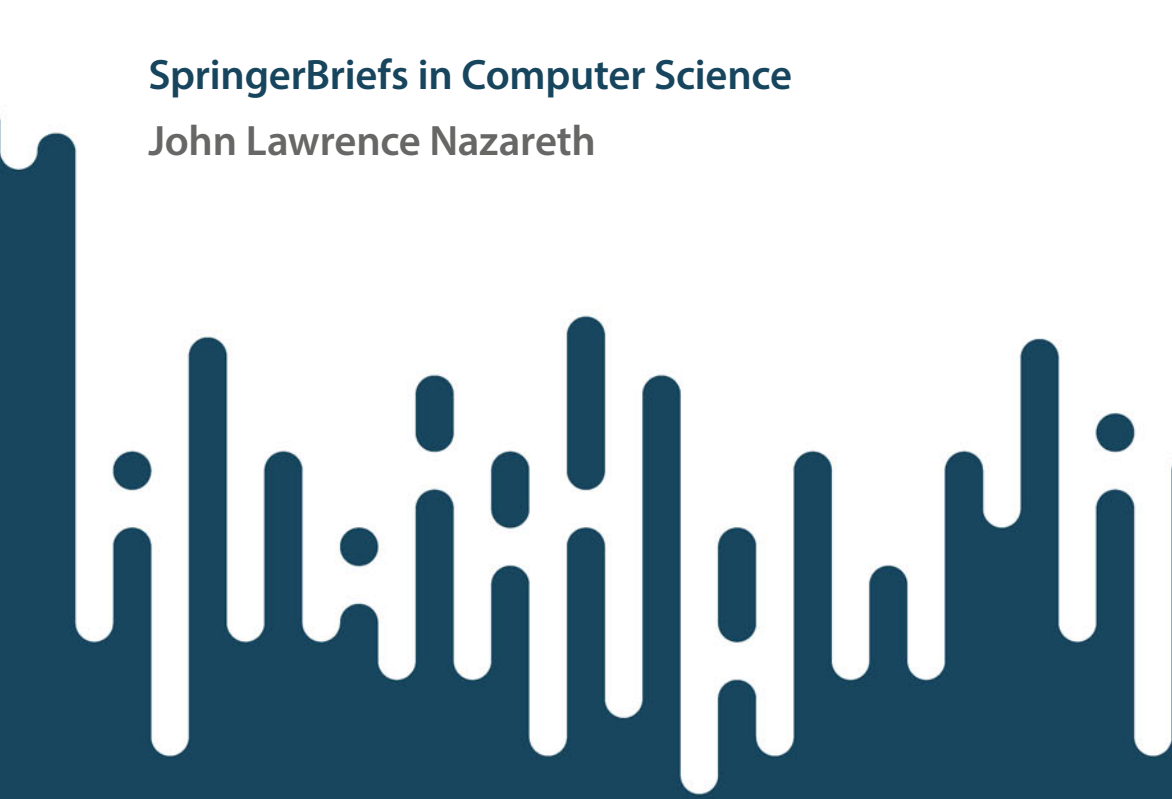


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John Lawrence Nazareth



Concise Guide to Numerical Algorithmics

The Foundations and Spirit
of Scientific Computing

SpringerBriefs in Computer Science

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*Dedicated, with grateful thanks, to my
mentors,
George Dantzig, William Davidon,
Stuart Dreyfus, and Beresford Parlett,
who, as time went by, also became friends*

Preface

Mathematics in full-flower as we know it today, both pure and applied, has evolved from the root concept of number. Likewise, the foundation of modern computer science is the concept of the symbol-based algorithm. The central theme of this book is that these two foundational concepts—number and algorithm—can be brought together in two fundamentally different ways.

The first approach, speaking metaphorically, is to bring “algorithm under the rubric of number.” This leads to the well-established discipline of *numerical analysis*, which today is fully embraced by pure and applied mathematics and has widespread applications in science and engineering. (It might have been preferable to call this discipline “algorithmic numerics,” but traditional nomenclature must now prevail.)

The second approach, again speaking metaphorically, is the converse, namely, to bring “number under the rubric of algorithm.” This leads to a re-emerging discipline within computer science to which the name *numerical algorithmic science and engineering* (NAS&E), or more compactly, *numerical algorithmics*, will be attached. A discussion of the underlying rationale for numerical algorithmics, its foundational models of computation, its organizational details, and its role, in conjunction with numerical analysis, in support of the modern *modus operandi* of scientific computing, or computational science and engineering, is the primary focus of this short monograph.

Our book comprises six chapters, each with its own bibliography. Chapters 2, 3 and 6 present its primary content. Chapters 1, 4, and 5 are briefer, and they provide contextual material for the three primary chapters and smooth the transition between them. An outline of each chapter now follows.

Chapter 1 is titled “The Big Picture: Mathematics, Science and Engineering” and it sets the stage for subsequent chapters of the book. The primary content of this book—the concepts of number and algorithm and their integration to recreate the discipline of numerical algorithmics within computer science—is placed into its broader context of mathematics, science and engineering. A “visual icon” is presented which captures the relationships between these three broad, embracing arenas and their *modi operandi*. It serves to frame the discussion in this chapter and, in particular, it enables us to clarify the nomenclature, or terminology, used throughout our book.