PREFACE

Computer Science, or Informatics as it is often called in Europe, is viewed by many as being both a science and a technology. Clearly, its technological aspects are very much upon us on a day to day basis. Yet all other exact sciences such as physics, biology or chemistry are also very present in our daily lives through the technologies they generate, and yet we do not doubt that they have scientific foundations.

In some ways, Informatics is akin to a mathematical science, since formalisation, definition and deduction play an important role in the development of its concepts and in the embodiment of the concepts into artifacts. Informatics is also very similar to physics and engineering science, where models have to be linked to observation and measurement. Current research on computer networks and computer systems is an illustration of this second approach.

Some of the confusion about Informatics as a Science and as a Technology may arise from the fact that most of its pioneering contributors, many of whom are fortunately still alive, have actively contributed (and still do) to both the scientific principles, often based on mathematics, and to its technological and practical developments.

The links between computer arithmetic, which is based on algebra and algorithms, and digital circuit design are one example. The connection between mathematical models of queueing networks, which were originally inspired by telecommunications, computer systems and computer networks, and the commercial software tools that are used to analyse the performance of computer systems, and which incorporate these mathematical models, are another example. Yet another instance of this connection lies in the use of formal methods for the verification and testing of programs and software systems, which have enjoyed a long standing interaction with mathematical logic.

Much of the history of Informatics still remains to be written, and this effort can be undertaken after scholarly historians of science will have a better understanding of the field. However, aside from the original papers where seminal ideas were first presented, and surveys or discussions that appear at conferences and in a few specialised journals, the origins of the concepts in Informatics are not always well documented.

Furthermore, although basic concepts in Informatics are disseminated through educational programmes, the increasingly practical orientation of many undergraduate courses, and the increasing specialisation of many post-graduate courses, imply that pointers to the broad initial scientific concepts of Informatics are often not adequately transmitted to future generations. On the other hand, developments in computer technology, which are naturally far more "visible" both to the public and to students of the subject, are well documented both in every day life, in industry and commerce, in exhibits, and in specialised museums.

As we have already stated, we do believe that the writing of a history of Computer Science is best left to professional historians of science. However this book responds to an urgent need to grasp a unique opportunity, and to capitalise on the fact that contrary to the other sciences, many of the founders of Informatics are still professionally active.

This collection of essays is an attempt to reach out to Computer Scientists who wish to write about their own or others' seminal contributions, and we have been able to collect contributions representing a *broad* range of areas within Informatics. This volume has attracted a nice balance of papers, some with a theoretical outlook and others that concern significant practical developments. Most of the chapters are authored by the originators of the ideas and technologies themselves, while some are authored by computer scientists who have had a first-hand knowledge of the developments and of the pioneers whom they discuss.

The first chapter, devoted to a fundamental contribution by Corrado Bohm, one of the European pioneers of Computer Science, on Bohm's Theorem, relates to a fundamental and early result on program schemata, i.e. formalised flowcharts, and it is written by some of Bohm's distinguished students, Stefano Guerrini, Adolfo Piperno, and Mariangiola Dezani-Ciancaglini, with guidance from Prof. Bohm himself. The next chapter, on Membrane Computing is contributed by Prof. Gheorghe Păun, the person who actually launched the concepts in that area. The following chapter is authored by Giuseppe Longo, who discusses the distinction between simulation of nature based on highly causal computation, and nature itself in which non-determinism and randomness can play a dominant

role. The fourth chapter is authored by the originator of a class of mathematical models called G-networks, together with colleagues who have made significant contributions to the subject; these are models of service systems (such as computer networks) as well as of neuronal networks, and it is shown these probabilistic models are also deterministic models of approximate computation. The next contribution by Tony Hoare, a pioneer of several areas of Informatics, including algorithms, programming methodology and parallel processing, discusses one of his important contributions to programming methods and to the verification of computer programmes. The fifth chapter is written by Steve Furber, a leading researcher and entrepreneur in computer processor technology, where he describes a processor technology based on a very successful design that has resulted in widespread use in commercial computing devices. The chapter on Carl Adam Petri is biographical nature, and also discusses the contributions and perspectives brought by Petri Nets. It is written by his eminent colleagues and friends Wilfried Brauer and Wolfgang Reisig, who have first hand knowledge of the contributions of this major pioneer. Jeff Buzen's chapter concerning some of the origins and successes of stochastic models of computer performance modelling is written by the person whose work gave rise to most of the basic algorithms used in this area. Jeff was also involved in bringing these techniques "to market" via a successful industrial venture. Finally, the last chapter by Olivier Pironneau on high performance computing, discusses the transformation that this field has effected on the design of aircraft and other modern transportation systems.

Most of the authors of this volume are members of their relevant National Academies, or of Academia Europaea, or both. Their articles in this volume express not only the fact that they have made imortant contributions to the field of Informatics, but that they also feel strongly about presenting the ideas and techniques that Informatics has generated and which need to be understood and appreciated by the scientific community and by future historians of the field.

We hope that this first volume will be followed by others that continue the presentation of Fundamental Concepts in Computer Science, through the eyes of the pioneers of this exciting field.

Erol Gelenbe
Member,
Turkish Academy
of Sciences, and French National
"Académie des Technologies"

Jean-Pierre Kahane
Member,
French Academy of Sciences