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ALGORITHM DESIGN FOR COMPUTER SYSTEM DESIGN

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PREFACE

For a long time the design of data processing systems has been mainly based on experience and practical considerations more than on formal quantitative approaches. This was true both in the design of computer architecture and in the design of software systems such as operating systems and database systems. Two relevant exceptions were the early studies in switching theory, concerned with such problems as minimization and reliability, on the one hand, and on the other hand, the general mathematical approach to computer system modeling and performance evaluation. More recently, the evaluation of distributed computing related to technological advances in microelectronics, has increased the need for quantitative studies for optimizing the design of computer systems.

As the complexity of computer systems grows, the need for formalization and theoretical analysis is becoming more and more important. The development of formal semantics has provided tools for dealing with correctness and other desirable properties of distributed computing, the development of formal models in different areas (such as distributed system layout, data base design, computer network topology, scheduling and routing) has provided tools for dealing with efficiency and performance optimization; advances in theory of algorithms design and technological increases in computing power have led to the feasibility of the exact or well approximated solution of large scale optimization problems; finally advances in the theory of computing and analysis of algorithms and data structures have led to a new approach to the design of algorithms for the efficient solution of hard problems related to distributed processing systems. Such problems as optimal memory management, optimal design of computer networks and multiprocessor systems, optimal layout of VLSI systems, efficient exploitation of parallel computing systems, optimal management of database schemes, concurrency control, have been thoroughly investigated recently with relevant practical results.

Starting from previous experience in the area of analysis and design of algorithms and their application in combinatorial optimization (a School held in September 1979[1] and a Workshop held in September 1982 [2] both organized by the Department of Computer and System Science of the University of Rome and CISM in Udine) it appeared to be of great relevance in computer science to devote a School to the interactions between formal approaches to computer system design and the theory of algorithms.

Therefore in July 1983, a School on "Algorithm design for computer system design" was then held in Udine under the sponsorship of the International Centre for Mechanical Sciences and the Department of Computer and System Science of the University of Rome, and with the financial support of UNESCO and the Italian Research Council, CNR, through its Committee for Mathematics.

The aim of the School was to provide young postgraduates and junior professionals in Computer Science with an uptodate algorithmic approach to the design and optimization of computer systems. Some of the leading scientists in the field were invited to deliver lectures on the state of the art in the following areas: storage allocation and packing problems (E.G. Coffman), design and implementation of VLSI systems (F. Preparata, C.K. Wong), multiprocessor system design (G. Cioffi), network design (F. Maffioli), concurrency control (D.P. Bovet). Other topics related to basic algorithmic and combinatorial problems in computer system modeling and design were presented by the organizers (C. Papadimitriou, G. Ausiello, M. Lucertini).

This volume presents a collection of unpublished papers referring to some of the issues discussed during the School.

The first part of the volume, devoted to combinatorial problems in computer system design, includes an introduction to the complexity of the exact and approximate solution of combinatorial problems (G. Ausiello), a survey on graph optimization and integer programming models of task assignment problems in distributed systems (M. Lucertini), an extended state of the art paper on approximation algorithms for bin packing (E.G. Coffman, M.R. Garey, D.S. Johnson), a paper on topological network design under multiple non simultaneous demands (M. Lucertini, G. Paletta) and a paper on minimal representation of directed hypergraphs and their applications to data base design (G. Ausiello, A.D'Atri, D. Saccà).

The second part presents papers devoted to specific issues in the optimal design of parallel computer systems and includes an introduction on parallel computer models (G. Ausiello, P. Bertolazzi), a state of the art paper on structural organization of MIMD machines (G. Cioffi), a paper on a new proposal for a VLSI sorter (C.K. Wong) and a selected and annotated bibliography on the theory of VLSI layout (F. Preparata).

G. Ausiello, M. Lucertini, P. Serafini

(1) G. Ausiello, M. Lucertini Eds. "Analysis and design of algorithms in combinatorial optimization", CISM Courses and Lectures N. 266, Springer-Verlag, New York, 1981.

(2) G. Ausiello, M. Lucertini Eds. "Analysis and design of algorithms for combinatorial problems", to appear in Annals of Discrete Mathematics, North Holland, 1984.

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