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Research on Frontiers in Computing

Ci Yungui

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Edited by

Ci Yungui and Zhang Chenxi

Dept. of Computer Science

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Contents

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Preface

With the rapid progress in VLSI, computer science technology has developed dramatically during the last decade. Many new ideas and techniques have emerged. "Frontiers in Computing" is very suitable for expressing the constantly changing and newly emerging areas in computing. Although it includes many many areas, this book only covers six areas of recent research work of several Chinese computer scientists. The six areas are: logic-based inference machines from sequential to parallel, knowledge-based systems, functional programming, heuristic search in AI, dataflow computer architecture, and optimization techniques for supercomputing.

The bases of the text are forty-nine selected papers written within recent three years. Most of these papers have been published in proceedings of over 15 very recent international conferences and in about 8 different journals in various countries. During compiling the text, many of them have been carefully revised by adding some new materials or new ideas.

The material in the text is structured in a modular fashion, with each chapters considerably independent of every other chapter. In each chapter the papers are arranged in a systematical and reasonable series, with each paper as a section, so that the readers would be able to obtain a complete concept or idea.

The text of this book reflects a major part of the very recent research work on new generation computing and supercomputing in China. It is designed for graduate students, educators, engineers, programmers and those who are engaged in the research and development of computation models, algorithms, languages, computer architectures and programming for supercomputing and AI applications. We hope that after reading this book readers would be able to get a better understanding of research work in China and to understand the related design issues, realize the limitations and promote more research in some areas.

The text is organized into eight chapters. An introduction or a survey is provided at the beginning of each chapter (with the exception of Chapter 1) to

explain the underlying concepts.

Chapter 1 provides a general and preliminary introduction to the six research areas covered in the book.

Chapter 2 and Chapter 3 focus on some topics in logic programming, mainly sequential and parallel execution of logic programs.

Chapter 2 investigates implementation techniques and extensions of Prolog. Execution models for non-logical components of Prolog in the framework of the WAM are described in detail. An effective type system and a powerful builtin, `listof`, are described.

Chapter 3 concentrates on computation model and computer architecture for parallel execution of logic programs. A new method for describing the AND-OR-parallel execution of logic programs and a model based on the method are presented in detail.

Chapter 4 discusses knowledge-based systems. Research results on knowledge base systems, relational knowledge base prototype machines, developing tools for expert systems, and knowledge acquisition are presented.

Chapter 5 gives a quantitative analysis of static dataflow computers, investigates dataflow computation models and architectures which can effectively reduce overhead, and describes an implemented prototype machine.

Chapter 6 presents some expansion theorems for solving systems of linear and nonlinear functional equations in FP algebra, and describes the FP-s, a functional programming language, and the KLND, a language combining logic programming and functional programming.

Chapter 7 is on statistical heuristic search algorithm (SA). The principle of SA, the computation complexity of SA, and the extraction of global information are discussed. Hierarchical view of heuristic search is presented.

Chapter 8 discusses optimized parallel execution of loops, processor self-scheduling and job scheduling in parallel computer systems.

We would like to take this opportunity to thank all the authors who have contributed to the text of this book. We apologize to our colleagues in this country whose valuable papers could not be included owing to time and page limitations. It is hoped that in future republications there would be included more valuable papers of many other Chinese computer scientists.

We would like to acknowledge the supports of China National Natural Science Foundation and of the Computer Science Department, Changsha Institute of Technology in preparing the text of this book. Finally we would like to thank sincerely Ms. Gao Wanyu and Mr. Wang Zhaoqi for their patient secretarial helps.

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