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PREFACE

Computer performance is a central issue both in computer science and in the applications of computer science especially to the physical sciences. Indeed, it is the evolution of available computing power which has progressively widened the possibility to use computers to handle more realistic and complex models.

There is a wide gap however between the gross estimate of computer performance, given in MIPS (millions of instructions per second) or in LIPS (logical inferences per second) which may be provided by examining processor structures, and the real computer processing power which needs to integrate in a complex manner a large number of factors including:

- the nature of the algorithms chosen,
- the structure and content of application programs,
- the degree of logical and semantic interaction between portions of the application program,
- the effect of consistency of data,
- the interaction of user programs with the operating system, and the operating system overhead,
- the computer and processor architecture,
- the structure of the memory hierarchy,
- the structure of the network which interconnects the processors with the memory hierarchy,
- the organization of input-outputs, and the access to fast secondary memory,
- the multiprogramming level, and the management of virtual memory.

All these factors may seem to be too complex to be included in any given performance measure. Yet, for a given class of applications, and a given computer architecture, much can be said using appropriate tools based on mathematical modelling. In fact this is the approach currently taken in a routine manner by major industrial research and development laboratories.

Mathematical modelling tools for computer performance evaluation such as QNAP II—Queueing network analysis package—(used by companies such as SIMULOG and BULL, by many European universities, and by the French Telecommunications Research Institute CNET, and by INRIA), or RESQ developed by the IBM Research Center at Yorktown Heights, and several modelling packages developed at Bell Laboratories, allow someone with a good knowledge of computer performance evaluation methodology and of computer architecture to proceed with detailed evaluation studies. These existing tools are fully adequate to handle multiprogramming systems with little or no parallelism *within* application programs.

Many aspects are still in the domain of research. The existing tools we mention above have been constructed using the research results of the seventies. The major challenge today is to obtain mathematical results which may be adequately applied to the coupled parallel and distributed architectures which are being examined in advanced research and development environments today.

The purpose of this Special Issue is to point out certain research directions in performance evaluation of parallel algorithms, programs and systems.

Four out of the five papers contained in this Special Issue were selected from the Proceedings of the Workshop on High Performance Computer Systems organized by the Ecole des Hautes Etudes en Informatique in Paris in December 1987.

Two of these papers (by Kruskal et al. and by Robert et al.) concern the design of efficient numerical algorithms for parallel processing. The paper by Lyon concerns the important issues of practical measurement instrumentation and benchmarking for multiprocessors; indeed it seemed most appropriate to me that the issue of measurement and benchmarking be included in a journal issue concerning high performance computer systems.

The issues of memory contention and of interconnection network contention are of major importance to multiprocessing and to parallel processing in general. Related performance studies are presented in the paper by Bermond et al. Finally, the paper by Akyildiz et al. presents some recent mathematical results concerning networks of queues which are the basic tool for handling performance evaluation issues in a precise theoretical framework.

It is hoped that this Special Issue will contribute to the better understanding of the issues in performance evaluation of computer systems on the part of the community of theoretical computer scientists.

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Guest-Editor