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What Can Be Automated?

The Computer Science and Engineering Research Study

(COSERS)

Bruce W. Arden, Editor

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What Can Be Automated?

The *CO*mputer *S*cience and *E*ngineering *R*esearch *S*tudy

(COSERS)

It is truly difficult to capture with a single question the essence of research in a diverse and very active area of science and technology, but the query in the title comes very close. This questions was first posed by the late Professor George Forsythe of Stanford University as the underlying rationale for research in computer science, and this study supports his perception. The many different questions, which are posed explicitly and implicitly in these chapters, can be interpreted as special cases of "What Can Be Automated?" The growing realization that the answers to this question are of increasing importance in a crowded world with many interdependent segments is one of the main motivations for this effort.

The initial planning for the Computer Science and Engineering Research Study (COSERS) commenced in 1974 and the study was subsequently undertaken in 1975 with the goals of completing the work in three years and publishing the report in 1978. The National Science Foundation (Grant GJ-43540 and DCR74-18460) has supported a major part of this effort in the belief that a readily accessible record of past research in computer science and computer engineering, as well as some projections of future research directions, would be useful. These research areas are still relatively new and not well defined in the minds of many technical people not actively involved in such research.

In language often used in the implementation of large computer projects, the schedule "slipped." Self-description is an important aspect of several areas of computing research, and it may be appropriate that the generation of this report should exhibit some of the same problems that the described research addresses.

Needless to say, the subject areas considered are rapidly changing. Research in computing is truly a moving target. New chapters, additions and major revisions appeared well into 1979.

At the outset, the decision was made to heavily edit the submitted manuscripts in an effort to remove jargon, to introduce some uniformity of style, and to avoid "journalese" that would tend to restrict readers to those with some familiarity with the subjects. In short, the goal was to produce prose that would be readily accessible to a layman having a general knowledge of science and technology. Such an excursion into language transformation and semantics is an ambitious and humbling experience, it renews one's apprecia-

tion for the power of succinct notation. The expansion of technical terms into conventional prose inevitably loses precision the author intended even though, up to a point, it improves comprehensibility for a technical layman. There is an elusive, optimal line between lost precision and increased general comprehension which was crossed and recrossed many times - testing the patience of all concerned. It is hoped that the result of this trying process has, to a large extent, achieved the original goals.

Some time after the generation of chapters had started, many of the contributors advocated that the drafts be maintained by computer text-processing and that the published version be phototypeset under computer control. Not only would this facilitate the editing and revision but it would illustrate an important application of computers. In retrospect this was a very good decision but there were difficulties along the way with changing text processing programs and the unfamiliarity of conventional editors and publishers with the media and programs used in computer phototypesetting. It is a powerful, complex tool, but it requires an understanding of computers and programming, if not expertise. Here again, the study illustrated problems shared with many other computer applications.

The Steering Committee, whose names appear on the title page, represent university, industrial, and governmental research activities but, perhaps more relevant, they share a belief in the importance of research in the various aspects of computing. Their support of such research is apparent from their many personal contributions and their willingness to devote some time to COSERS is further evidence of their dedication. The committee suggested study personnel and an organization for the effort; many of the members actively served in liaison roles with specific panels.

There are eighty individual contributors to this report. These authors are grouped into subject area panels which are listed at the beginning of the chapter for which they were responsible. The chairmen of these panels were responsible for the selection of contributors and for the organization of the resultant chapter. Much of the burden of producing this publication has fallen to these chairmen; their commitment to obtaining an accessible exposition of research in their subject areas has sustained the study.

In addition to the contributing authors there have been many readers whose criticisms of specific sections or points have been helpful. On behalf of the panels this assistance is gratefully acknowledged. In a few instances the interaction of readers was such that it was tantamount to participation in the panel and these readers are listed with the panel contributors.

With the exception of the Overview, Applications, and COSERS Statistics, each chapter attempts to cover the significant research results in the area and to identify outstanding problems or, in other words, future directions. There are inevitably major differences in the chapter formats but, in all cases, the references are representative, not comprehensive. For the most part, references to

a chapter-end bibliography are simply indicated by numbers in the text although some results are so closely associated with particular investigators that identification by name is expedient.

As mentioned, the study was made possible by the support of the National Science Foundation. In particular, Dr. Fred Weingarten has been of great assistance. Also Bell Laboratories has assisted in several important ways. The enthusiastic support of Steering Committee member Dr. William O. Baker has been an inspiration to everyone with whom he interacted. The text processing and phototypesetting was done at Princeton and Bell Laboratories on computer systems operated under UNIX™ a widely used operating system developed by the Laboratories. The expertise of Dr. Michael Lesk, one of the designers of the UNIX text processing software, was an invaluable asset in the preparation of camera-ready copy for publication.

Several people at Princeton have been involved in editing, text processing and figure preparation. Mr. Roy Grisham initially edited much of the material and entered it in computer files. Mrs. Betty Steward, the departmental secretary, has handled the correspondence and the many organizational details associated with such a large, protracted effort.

In summary, it has been a lengthy study of rapidly changing subjects. Only the commitment and the enthusiasm of investigators and the promise of increasingly beneficial computer applications seem constant. Computing research and development have made systems of enormous complexity possible, but many questions need to be answered before the exploitation of the full potential is commonplace.

B. Arden
Princeton University
July, 1979

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