Guest Editors’ Introduction

Computer Workstations

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Computer workstations have become the key tool for increasing the productivity of many professionals. This is particularly evident in engineering design, software design and development, technical publishing, and advanced office applications. Integrated circuits, mechanical assemblies, computer programs, complex technical documents, and business reports and presentations are today being more efficiently and effectively designed and developed by professionals using dedicated computer workstations. Graphics is so integral to these workstations and applications that the term graphics workstation is redundant.

Last November in San Jose, California, IEEE held the First International Conference on Computer Workstations. This conference recognized that workstations are rapidly becoming a sizable segment of the computer business, and that systems of workstations (ideally linked to mainframes) are becoming a major computer resource of many organizations.

The idea of a computer workstation—a combination of computational power and display capability, used to perform a professional task—is not a recent notion. Over the past decade a number of tasks have been done on a small computer and attached display dedicated to a single user. In computer-aided design in the automotive industry, for example, designers have used a large computer with attached powerful display terminals on a time-share basis. The resulting performance has often demonstrated the effects of this economic compromise: When systems become heavily loaded, users adjust their schedules to avoid the interference caused by sharing with colleagues.

Rapid advances in the semiconductor industry are the primary cause for the increased emphasis on computer workstations. With microprocessors having the power of recent mainframe CPUs, the compromises of time-sharing are no longer necessary. In most interactive applications the power of the micro that can affordably be dedicated to a single user in a workstation will more than satisfy the requirements of the user’s tasks. This economical and powerful computational capability is creating an ever-increasing number of workstation customers, as it continues to be less of an economic burden to provide a dedicated and powerful machine to each user.

The other major advance provided by the semiconductor industry (which has had a significant impact on computer workstations), is the rapid decline in the price of memory. Until very recently memory was the major cost component for the display system required for many interactive design applications. In the last five years the cost of memory has dropped by an order of magnitude. A megabyte of memory, for providing a bit-map buffer for a raster display, is now priced at less than $1000 while in 1980 the price was at least 10 times that amount. As memory prices continue to decline and performance capability continues to improve function and speed, many more users will be able to afford dedicated and powerful workstations.

Chip Hatfield, editor-in-chief of IEEE CG&A, and the guest editors (program cochairmen of the Workstation Conference) selected a set of papers from the conference for development into articles for inclusion in this special issue. They were all reviewed in accordance with CG&A guidelines, and the six included here were selected for their quality and relevance to readers.

Workstations for professional users is the subject of the first article, by R.H. Campbell and W.J. Kubitz and their colleagues at the University of Illinois. The aim of their professional workstation—a network of single-user Unix stations for such intensive graphics applications as CAD—is both user productivity and ease of application devel-
opment. The authors describe the system implemented at Illinois, which employs a heterogeneous collection of workstations plus shared minicomputers connected by Ethernet.

Workstation performance has a significant impact on the productivity of professional workers. James Brady, in the next article, describes the observations of various authors on these productivity effects. Brady interprets them with respect to some models of cognitive science and then develops an intriguing "roll" theory to explain an apparent amplification of productivity achieved with improved response time.

Windows and window management are one of the major new developments in user interfaces for computer workstations. This manifestation of multitasking is still under development, and the next two articles present differing views for managing the windows.

Ellis Cohen, Edward Smith, and Lee Iverson describe a system for managing windows by the "tiling" philosophy. With tiling, when many windows are displayed on a small screen, the specific size and screen location of each window is provided by an internal system algorithm. The authors describe a new window management algorithm featuring a "constraint-based" layout mechanism, which allows the user to specify the appearance of individual windows and constrain relationships between windows.

The other article on this subject approaches windows with the "messy-desk" philosophy. Michael Goodfellow describes WHIM—Window Manager and Handler—which has been developed on the premise that the user should control the display, and that no algorithm will satisfy all the user's requirements. Fundamental to the support offered is the notion that overlapping windows can still provide high performance. The user controls which window is visible and which windows are (totally or partially) obscured.

R.L. Phillips and his colleagues at the University of Michigan next describe a network of workstations with even more diverse capabilities. At the center of their system is an Apollo Domain network, and the authors have developed software to allow an Apple Macintosh to access programs running in the Apollo environment. This arrangement allows the College of Engineering at Michigan to provide a large number of workstations and lets users at the least expensive ones—the Macintoshes—access all the computational power provided by the Apollos.

In the last article R.G. Spiers discusses a topic central to graphics workstations: the GKS Standard and the implementation and application of workstations based on this graphics standard. As GKS is now the standard for 2D graphics, it is important to test and verify this standard with workstation implementations. Spiers gives a thorough description of the implementation of the GKS standard on the SIBMEX 6100 workstation, and he discusses in detail both the implications and the limitations.

These articles provide a sampling of the range of exciting papers presented at the Workstation Conference last November. The Proceedings of this conference is available from IEEE Computer Society (Order No. 649). The increased power and performance of the hardware affordable in workstations has led to significant developments in the function that can be provided to workstation users. Examples, covered by other papers presented at this conference, are found in system architecture and design, in user interfaces, in workstation operating systems and user language support, and in a variety of applications.

Workstations and workstation users do not often exist in isolation. The support for networking of workstations is an important dimension of this new direction in computing, and it was the topic of several papers presented at the conference. Communication between users, via their workstations, is essential to professional productivity. Many resources will continue to be shared, even when processing for interactive applications is not. Shared resources include database/file management, printers, and batch computations or special-purpose computing support.

New application areas for workstations are beginning to emerge, and one new dimension is the support for other types of data in the workstation environment. Two papers presented at this conference described applications supporting audio data in conjunction with text, and one dealt with the support of image data in the workstation environment.

The editors wish to express their thanks to all who made possible the First International Conference on Computer Workstations, and especially those whose contributions led to this special issue of CG&A. We wish in particular to thank the authors for their work in developing these papers into the articles for this issue, the members of the program committee for providing the reviewing, and Chip Hatfield for helping us put it all together.

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Mantey received his BS and MS in electrical engineering from the University of Notre Dame and the University of Wisconsin respectively. He earned his PhD in electrical engineering from Stanford University in 1965, where he was a research associate and lecturer until joining IBM in 1967.

Robin Williams is department manager of the Office Systems Lab at IBM, and his current interests are focused on distributed computing systems and applications for the office environment, and all aspects of document systems. This includes distributed operating systems and workstation software, document-creation editing, formatting, storage, and query; and printing and scanning systems. Before that he was at IBM, where he joined the Research Division in 1972, after being an assistant professor at New York University. At IBM he developed an interactive bit-mapped color graphics workstation in the mid 70s, together with graphics systems software for providing database support for graphical applications. He then became manager of the database and distributed systems department, working on distributive database systems, high availability, and multiprocessor data management.

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