Next generation supercomputers face language problems

Ware Myers, Contributing Editor

"Once we have deviated from pure sequential operation, the programming challenge becomes significantly more complex," Carl Conti, president of IBM's Data Processing Division, told the panel session on supercomputers at the International Conference on Computer Design at Port Chester, New York, October 31. "To exploit the organization of the machines that I think we will see in the future with the parallelism that will be inherent results in a very serious and difficult programming problem yet to be overcome."

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Currently, the computation Department at Lawrence Livermore National Laboratory is investigating two areas, algorithms and languages, for possible solutions to this forthcoming problem, according to John Ranelletti, department head, speaking for supercomputer users. The laboratory currently has seven Cray 1s and expects to get a new Cray X-MP in 1984 "as an interim machine which will take up some of our workload." In introducing Ranelletti, Walter Beam, panel chairman and a former vice president of Sperry Corporation, noted that Livermore is "an operation which, more than any other in this country, has promoted the use of supercomputers." In 1985 Ranelletti expects to solicit bids for a "Class 7" supercomputer, which is to have higher performance than machines now available. "We are willing to look at proposals," he said.

In scientific applications, such as those at Livermore, algorithms and languages fit on a descending scale of "real world, mathematical model, mathematical approximation, numerical model, numerical approximation, programming language, operating system, and finally machine," Ranelletti went on. Traditionally, the laboratory has tried to fit its numerical models into the architecture of the machines it had on hand. With the potential advent of MIMD (multi-instruction multi-data) systems, however, he believes the laboratory will have to push higher up this scale. It will have to rethink what it is doing at the level of the partial differential equations of the mathematical models.

The result may point to a new language. "Much as I hate to say it, Fortran probably isn't going to last forever," Ranelletti conceded. "With multiple processors the early work we have done indicates that Fortran 'ain't gonna cut it.' The reason is basically that it has too many built-in side effects. We need something along the lines of an applicative language. If we could get five to 10 times the speed," he concluded, "we would be willing to do a reasonable amount of conversion."

On the other hand, even if the supercomputer builders retain language compatibility with existing architectures, as several panel members felt they had to, they face difficult problems. "The IBM architecture is such that the programs written for it contain a great many sequential dependencies," Gene Amdahl, chairman of the board of Trilogy Systems, pointed out. "So it is rather difficult to make a very high performance machine."

By sequential dependencies he means operations such as branch- ing, register and memory references, computing address quantities, maintaining the internal state at times of interrupt, and cache misses. Trilogy Systems is designing a fully IBM-compatible computer presently scheduled for delivery in the summer of 1985. Its performance has averaged 32 MIPS over the work Trilogy has studied so far, high for a data-processing system, though below the supercomputer level.

Also accepting the necessity of retaining compatibility with previous systems is L. W. Beers, vice president of Burroughs. He
sees the task essentially as making a concurrent processor out of an inherently sequential one. "The processor must devote significant attention to the task of analyzing the machine code stream in hopes of detecting sequences of instructions and related references that represent independent functions that could be executed concurrently with other such functions," Beers said. "This amounts to performing what we could legitimately call 'decompilation,' in that the sequences of codes and references are catenated into a single operation that represents the recomposition of a higher level function." Thus, to the extent that the decompilation can find independent functions, they can be processed in parallel.

The industry needs to consider the superdisk.

The mechanization of the decompilation process is basically one of minimizing the number of dependent operations—that is, searching for breaks in the dependencies, Beers explained. "To accomplish this, one must have visibility of, access to, and control over a sufficiently broad context within the program to recognize and capture independent functions, which can be a combination of several references and a catenation of several syllables of code. A stack architecture assists this pursuit rather well in that the current environment is conveniently visible, totally controllable by the implementation, and easily replicated. Registers may be dynamically allocated, rather than programmer specific, thus allowing total control by the hardware."

On the other hand, Beers recognizes that there are advantages to lifting the compatibility constraint. "he so-called fifth generation seems bent on a language revolution whose challenge is much the same as we have shared here," he said in closing his remarks, "that is, the definition and development of a functional language system where the preservation of potential concurrency is paramount and fundamental."

Ranelletti sees the supercomputer itself as just one part of the overall supercomputing environment. In addition to appropriate software, he cites two other elements as essential to the full utilization of the machines: I/O structure and storage.

Considering input/output, Ranelletti figures the transfer rate from memory to CPU to be about 240M bytes per second on Livermore's Crays, but the disk transfer rate (assuming four disks) is only 20M bytes per second—about a 12-to-one ratio. With a 10-gigaflop machine in the future (which he believes to be necessary by the end of this decade to meet Livermore's requirements), the memory transfer rate would be about 240 billion bytes per second. Unfortunately, disk speed is likely to increase by only a factor of five over this period, making the ratio of memory transfer to disk transfer even worse than it is today.

Ranelletti estimates that based on these figures it would take well over one and a half minutes to change core contents. Therefore, he concludes, the industry should consider not only the supercomputer, but also the superdisk. Moreover, to do something with the flood of data that would be produced at a 10-gigaflop rate would require a "superintelligent workstation."

Based on Livermore's experience, the need for archival storage scales up with computer capability. In the early 1960's, when the laboratory acquired an IBM photostore, it took seven years of computation to fill its 10^{12} bits. "Today we fill a trillion bits every 54 days," Ranelletti said. "Therefore, I am asking the industry to consider superstorage." By that he means 10^{18} bits, over a 20-year recovery cycle, and, of course, low cost.

USL seeks contributions for microprogramming repository

The University of Southwestern Louisiana Computer Science Department is seeking contributions for a repository of materials related to microprogramming and firmware engineering. According to Bruce D. Shriver of USL, the repository has received an extensive private collection of reports and memorabilia as an initial endowment. With additional contributions from both corporations and individuals, it will serve as a centralized holding place for material that is now difficult to access, thereby facilitating work in microprogramming and providing a basis for historical investigations.

"It has been over 30 years since Maurice V. Wilkes published his now-famous paper, 'The Best Way to Design an Automatic Calculating Machine,' that introduced the concept of microprogramming," Shriver noted. "Since that time, microprogramming has played an increasingly important role in the implementation of almost all commercially successful computer systems.

"However, as in other sub-disciplines of computer science, many people worked in the area for a few years, made important contributions, and then moved on," Shriver continued. "A number of these contributions were then lost to other researchers and practitioners."

"USL will publish an annual index of the repository holdings," Shriver said. Access to the material will be possible throughout the year in Lafayette, Louisiana, and where no copyright infringements are involved, copies of specific materials will be sent upon request.

Correspondence regarding the repository may be addressed to Bruce D. Shriver, Microprogramming Repository, Computer Science Dept., University of Southwestern Louisiana, PO Box 44330, Lafayette, LA 70504.
Progress made in software numbering

The subcommittee of the American National Standards Committee Z39 (standards developing organizaton for library and information sciences and related publishing practices) investigating software numbering has announced agreement on the format of the number to be assigned to software for micro- and minicomputers. The structure agreed upon is based on the concept that the number will identify a “shippable” unit—that is, a unique item that can be purchased, shipped, and inventoried distinctly from any other. The number, the committee said, must facilitate inventory control, ordering, royalty accounting, and sales tracking by manufacturers, distributors, and retailers.

Each distinct software item available for sale will be identified by a number composed of the following sections:

(1) Registrant. This part of the number will reflect the organization or individual who makes the item available for sale.
(2) Product. The name of the software program.
(3) Delivery medium. This element will reflect a combination of the physical media on which the program appears, the operating system(s) required for its operation, and any other distinctive information that uniquely identifies one offering of the same program from others available from the same registrant.
(4) Check digit. This will be a mathematical check digit to verify the preceding numbers. The subcommittee is currently reviewing the pros and cons on Modulus 10 versus Modulus 11 verification.

In addition to the number, the standard will recommend and define certain elements of bibliographic data, which would include such variables as the minimum memory/hardware configurations, version numbers, and operating systems.

The subcommittee hopes to have a draft standard ready for review by the members of ANSC Z39 by early 1984.

Orlando welcomes seventh international SE conference

It has been 15 years since the term “software engineering” was first coined. Exploring what has happened to the field during this decade and a half will be the focus of the Seventh International Conference on Software Engineering, which runs in Orlando from March 26-29.

Jointly sponsored by the IEEE Computer Society, ACM Sigsoft, and the National Bureau of Standards, the conference features tutorials, technical sessions, and a tools fair.

For further information, see the advanced program on pp. 89-94 in this issue.

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First-ever Softcon anticipates large turnout

Organizers of Softcon are expecting attendance figures for the first international conference and trade fair for the software industry to top 18,000. Panel discussions, conferences, seminars, and exhibits from over 500 software companies will highlight the February 21-23 show at the Louisiana Superdome in New Orleans.

The conferences, which will be held in the nearby Hyatt Regency hotel, have been divided into three tracks: (1) software publishers and developers, (2) software merchandisers (dealers, retailers, distributors, OEMs, etc.), and (3) software industry standards and technical issues.

The technical third track is set to explore three major areas where standards are critical problems for the software industry—"Network Protocols," "Standards for Data Exchange," and "Standards for User Interfaces." Also included in this track will be discussions on "Political Lobbying," "The Micro to Mainframe Bonanza," and "Copy Protection and Piracy." A roundtable session will follow each of these panel discussions, allowing attendees to ask questions of the panelists and moderators.

Of the 500 different software companies participating in Softcon, nearly 100 are start-ups seeking financial and/or management assistance, according to Softcon officials. Several well-known high-tech venture capitalists, such as Benjamin Rosen of Sevin Rosen Partners Ltd. (funded Lotus Development and Compaq) and Jacqueline Morby of TA Associates (funded Digital Research), will be participating in the panel discussions.

Admission to the complete Softcon show, including all of the panel discussions, roundtable sessions, seminars, workshops, keynote addresses, and the exhibit floor, is $195. Entrance to the exhibits only costs $30. For further information contact Softcon, Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167; (617) 739-2000 or (800) 841-7000.

Survey shows software base for IBM PCs doubles

Sofsearch International's October 1983 Sofsearch Software Database Survey shows that there are a minimum of 32,241 packaged software programs, offered in 90,000 operating versions, on today's market. The two-part survey summarizes software product counts by system range (micro/mini/mainframe), functional category, and industries served.

One of the survey's findings is that the number of software packages available for the IBM PC and PC-compatible microcomputers has more than doubled in the past eight months—going from less than 2000 to more than 4000 products as of October 1983 (based on changes in Sofsearch listings). Much of this growth is not reflected in the micro software totals on the current survey as compared to previous surveys, because many of the new packages are actually new versions of existing products (e.g., Apple software), and not totally new products.

Sofsearch also provides a locator service provided on a subscription or single-search basis, with fees ranging from $30 to $75 per search request. Subscribers receive reduced rates on searches, plus pass-through discounts on product purchases.

Subscription information and search requests can be made by calling toll-free (800) 531-5955 (in Texas (512) 340-8735).