COMPUTING RESEARCH NEWS

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Budget message mixed for computing research

By Fred W. Weingarten
CRA Staff

President Clinton's fiscal 1998 budget request was released February 6. As has been the case in recent years, it contained a mixed message for the computing research community. Of the modest increments in funding proposed, computing research received a higher than average share, which indicates its steady rise in importance within the government's R&D portfolio. Although it may seem ungracious to carp in the face of such endorsement, many observers still ask whether the budget reflects the importance of R&D to the nation's future economic health. Some question whether the budget even reflects the president's political rhetoric.

In terms of political rhetoric, this would seem to be a promising budget year for computer science and engineering. Last October the president announced the Next-Generation Internet (NGI) program, a new initiative of the National Science and Technology Council (NSTC). Clinton repeated his support of the new initiative in his State of the Union Address.

Table 1. CISE Program Funding (in millions of dollars)

	1996 Actual	1997 Planned	1998 Request
Computer & Computation Res.	42.2	42.9	46.4
Info., Robotics & Intelligent Sys.	32.9	35.1	39.8
Microelec. Info. Processing Sys.	26.3	28.1	30.4
Advanced Scientific Computing	80.4	80.0	80.0
Net. & Commun. Res. Infrastruc.	55.0	55.7	62.3
Cross-Disciplinary Activities	27.5	31.6	27.5
Total CISE Funding	**262**	**273**	**294**

Also, education and educational technology have become major themes of the administration. And, at least in Washington, computers and the Internet have loomed large in any discussion of education. The administration has for a long time extolled the benefits to education of access to information technology (IT), particularly the World Wide Web. There was a major push last year to get the Federal Communications Commission to direct deeply discounted or in some case free communication services to schools and libraries.

The administration also argued that technological change, in particular the information revolution, is creating new challenges for education at all levels, including adult job training and literacy. Aside from serving as an educational tool across many disciplines, experience with IT in and of itself is of educational value.

The problem with NGI and educational technology is not simply one of implementing or deploying better existing technology. To build a faster, more reliable and more capable Internet will require substantial research, as will making IT a powerful tool for education.

It seems reasonable to ask whether, in the face of those two priorities, the $100 million increase in High-Performance Computing and Communications (HPCC) funding is appropriate. And regardless of funding levels, does the distribution of these funds makes sense in terms of the goals?

NSF

Until fiscal 1996, NSF funding for computing research tended to increase significantly each year, pushed in part by the HPCC initiative. Over the last two years, the Computer and Information Science and Engineering Directorate as a whole saw much smaller increments. In 1996 the CISE budget increased a mere $4 million, and it increased only $11 million (4%) for 1997. This year, the above-average upward trend has resumed, with a proposed $21 million increase. This 7.6% increase is more than twice the 3.4% overall increase in NSF's research line.

The three research divisions of CISE—Computer and Computation Research (CCR), Microelectronic Information Processing Systems (MIPS), and Information, Robotics and Intelligent Systems (IRIS)—are budgeted for increases.

According to NSF plans, CCR plans increased emphasis in two areas: distributed, multi-agent computing systems capable of adapting to changing conditions of use and configuration; and high-confidence systems capable of reliable and secure operation in an open, networked computing environment.

(In these examples, budget information is sketchy at best. Researchers thinking about submitting proposals should visit the CISE home

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Copyright treaty not discussed by WIPO

By Louise Arnheim

The last time representatives to the United Nation's World Intellectual Property Organization (WIPO) gathered—in 1971—the *Star Wars* trilogy had yet to debut in movie theaters, much less materialize in videocassette form. In fact, videocassettes—as a home entertainment staple—had yet to materialize.

And in 1971, neither John Toland, who won the Pulitzer Prize for nonfiction that year, nor his publisher were losing much sleep over widespread electronic distribution and reproduction of his work, *The Rising Sun*.

Back then the Bell System was still whole, and the ARPAnet was still a long way from evolving into the Internet as we know it today.

So, when delegates to the 1996 WIPO met in Geneva, Switzerland, last December, much of the intellectual property (software, CDs, videocassettes and so on) as well as the actual or potential means of redistributing that intellectual property had never been discussed at a full diplomatic conference of this UN agency.

And given the 25-year interval between WIPO meetings, the stakes were high for many players.

From December 2-20, delegates from 160 countries, including the United States, considered three treaty proposals covering books, electronic databases, sound recordings and other creative works. Of the three proposals, the one generating the most controversy in the United States was the Treaty on Intellectual Property Rights in Respect of Databases.

Approval of the treaty would have given database owners the right to control "utilization and extraction" of their material. (Currently, copyright protection is extended only to databases where the owner has exerted a creative effort either in the selection or compilation of data.) Parties contesting the treaty argued that basic "facts" now in the public domain would no longer be accessible. Concern ranged from mild alarm over the possible unavailability of certain sports statistics to considerable anxiety regarding the future of scientific research.

A few months before WIPO, the US Patent and Trademark Office had circulated a draft proposal for public comment. But Congress did not have the opportunity to consider the proposal, a matter which further incensed many parties—library groups, the scientific research community and legal scholars, among others—that already opposed the treaty.

As it turned out, the controversial treaty, although on the agenda, was never discussed. But member nations did pass a resolution suggesting that "an extraordinary session of the competent WIPO Governing Bodies" be convened in early 1997 to decide on a work schedule for developing such a treaty.

Was there not enough time to discuss the treaty? Was the absence of discussion essentially a defeat?

"The treaty was not defeated. It wasn't even considered," said Dan Duncan, vice president of government relations for the Information Industry Association.

However, Adam Eisgrau, legislative counsel for the American Library Association, viewed the outcome differently. According to Eisgrau, member nations deliberately avoided discussion of the treaty, thus sending a clear message to treaty sponsors. "The world put its foot down" with regard to the electronic database treaty, he said, "and it didn't happen." Eisgrau attended the meeting on behalf of two nongovernment organizations that opposed the treaty.

The fact that WIPO meets so

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Expanding the Pipeline

Fair for minority students at ADMI 97

BY Robert "Corky" Cartwright

The Association of Computer and Information Science and Engineering Departments at Minority Institutions (ADMI) has invited the Computing Research Association to organize a fair on "Opportunities in Computing Research" at the ADMI 97 symposium on May 31 in Washington, DC. The fair will offer programs for minority students at the graduate, undergraduate and high school levels.

• Minority graduate students will have the opportunity to network, explore employment opportunities in academia and industry, and participate in panel discussions on how to become more successful researchers. Particular attention will be paid to the special obstacles minority students must overcome. This program will be organized by a committee of minority graduate students from research institutions under the supervision of Richard Tapia, the Noah Harding Professor of Applied Mathematics at Rice University.

• Minority undergraduates will attend a recruiting fair, where representatives from computer science and engineering departments from across the nation will provide information on opportunities for minority students in their respective programs. Minority undergraduates also will have the opportunity to talk to minority graduate students about their personal experiences in various graduate programs.

• Minority high school students from the Washington, DC, metropolitan area will attend a recruiting fair focusing on opportunities for undergraduate study in CS&E. The Washington area has some outstanding programs in computing for high school students, notably Jesse Bemley's Joint Educational Facilities program. Last year, four students from JEF published the only papers written by high school students in the ADMI 96 symposium.

CRA member institutions are encouraged to send minority graduate students and departmental representatives to participate in the fair. Each participating department will staff a table where prospective undergraduate and graduate students can ask questions and gather information. CRA members from corporate research laboratories are similarly invited to participate. Additional information is available from the CRA home page at http://www.cra.org. Conference registration information is available from the ADMI home page at http://exodo.upr.clu.edu/~admi/home2.html). Departments and corporate laboratories interested in participating should contact Robert Cartwright (cork@rice.edu) before April 1, so sufficient space for the fair can be reserved.

ADMI consists of more than 30 institutions with large minority enrollments, many of which are historically black colleges and universities. The mission of the organization is to strengthen education and research in CS&E at minority institutions, to enhance educational opportunities in CS&E for minority students and to foster the professional development of minority faculty. As part of their mission, ADMI annually sponsors the Symposium on Computing at Minority Institutions. The theme of this year's symposium, ADMI 97, is "Increasing Diversity in Research and Education."

ADMI 97 will be held May 29 to June 1 at the Hyatt Regency near Capitol Hill. The program will include:

• The HUFAST Information Exchange, a forum presenting the research programs and capabilities at minority institutions. The exchange is sponsored by Howard University in cooperation with the Air Force Office of Scientific Research.

• A workshop for minority undergraduate students encouraging them to attend graduate school.

• Sessions consisting of referred faculty papers and open discussions on activities at minority institutions to increase the participation of minorities in computing professions.

• Sessions consisting of original research papers by students from minority institutions.

• The CRA fair on Opportunities in Computing Research for minority students.

The symposium will also include an entertaining program of social activities. Last year's symposium in Mayaguez, Puerto Rico, included a midnight boat ride to see luminescent dinoflagellates (phosphorescent plankton) in the Caribbean.

The symposium is being chaired by Don Coleman, chair of the Department of Systems and Computer Science at Howard University. The technical program is being assembled by a committee chaired by Forbes Lewis from the University of Kentucky. Ramon Vasquez from the University of Puerto Rico-Mayaguez will supervise the publication of the proceedings. Vasquez chaired ADMI 96.

Cartwright, a CRA Board member, is professor and former chair of the Computer Science Department at Rice University. His principal research interests are programming languages, software engineering and computing education.

Intellectual property issues explored

BY Randy Katz

As federal research funding becomes more constrained, increased industrial support for university research can help reduce the funding gap. However, there is widespread belief that university intellectual property rights policies have inhibited some industry-university collaborations. It has also been observed that restrictive intellectual property rights rules of ownership complicate the free exchange of researchers between universities and industrial research laboratories.

To address these issues and to help formulate underlying principles for university-industry agreements, CRA sponsored a one-day workshop in December. Participants included 30 representatives from university computer science and engineering departments, university technology licensing offices, industrial research laboratories and corporate legal staffs. The breakdown was about one-third university faculty and administrators, one-third technology licensing professionals and one-third industry representatives. This was a rare opportunity to discuss the issues among a collection of individuals with such a broad range of experience and expertise.

The workshop participants broke into groups to focus on four broad questions:

1. In what ways is software different from other forms of intellectual property?

2. What are the expectations of the various participants in collaborative arrangements?

3. What are the underlying principles of intellectual property rights?

4. What are the underlying principles of multi-university, multi-industry consortium agreements?

Software does appear to be different from other forms of published works protected by copyright. Multiple authorship is common, with different authors contributing to the work over time, thus complicating rights assignments. Unlike a book, software requires considerable technical support. In general, universities are not well-positioned to be in the software publishing business. There are two views of research software: as an embodiment of intrinsically useful functionality (the "shrink wrap" view) or as the expression of new algorithms (the "research publication" view). In the former, it may be acceptable to distribute software without source code. For the latter, it is most desirable that source code be distributed so that others may learn from and build upon the work. This is in keeping with the traditional view of research publication. A key principle of software as a scholarly artifact is that it can be rapidly disseminated and built upon by others.

The second break-out group examined the expectations for the parties involved in software agreements. Problems have arisen when these expectations are not managed: The sponsor expects exclusive access to commercialize the software along with the delivery of well-supported, high-quality source code. The university may expect a rich stream of licensing income, while the university participants may expect to become wealthy. Experience indicates that these expectations are unrealistic; there are only a few instances where university-developed software is "industrial strength"—it is widely used and yields significant licensing income. In general, faculty and students should be interested in

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Association News

WIPO from Page 1

infrequently, Eisgrau pointed out, underscores the significance of any single treaty's approval or rejection. Although smaller committees may meet during the interim years (and all treaties must eventually be ratified by at least 30 nations), any matter approved at the formal meeting would have been difficult to amend later on.

But debate and possible action on the matter is far from over. *CRN* has learned that WIPO officials are moving ahead with the "extraordinary session," hoping to force a decision on the electronic database issue by September.

Additionally, Congress may consider legislation of a similar nature. Over the past few years, the Clinton administration has been pushing for certain changes in copyright law that would allow authors and publishers greater control over original works and alter legal tenets such as first sale and fair use. Legislation that might have called into question a casual user's ability to browse was introduced but did not make it past the committee stage during the 104th Congress.

Created in 1967, WIPO is a special agency of the United Nations. Its mission, according to the UN home page, is to "promote the protection of intellectual property throughout the world, through cooperation among States, and to ensure administrative cooperation among the Unions." WIPO also helps developing nations by "promoting creative intellectual activity" and "facilitating the transfer of technology related to industrial property" to such countries.

The other two treaties discussed (and adopted) in Geneva were the WIPO Copyright Treaty, which pertains to books and other works, and the WIPO Performances and Phonograms Treaty, which covers sound recordings. Further information regarding all three treaties may be found at http://www.wipo.org.

Transitions

Tomasz Imielinski became chair of the Department of Computer Science at Rutgers University in July 1996.

John A. Stankovic has been appointed the BP America Professor and chair of the Department of Computer Science at the University of Virginia, effective January 1.

Daniel A. Reed became head of the Department of Computer Science at the University of Illinois at Urbana-Champaign last May.

James H. Cross II was appointed chair of the Department of Computer Science and Engineering at Auburn University in July 1996.

Prith Banerjee joined Northwestern University in September 1996 as Walter P. Murphy Chaired Professor of Electrical and Computer Engineering and director of the Center for Parallel and Distributed Computing.

Stephen B. Seidman became chair of the Department of Computer Science at Colorado State University in July 1996.

Thomas J. LeBlanc became acting dean of the University of Rochester's Faculty of Arts, Sciences and Engineering (one-year appointment) in July 1996. **Michael L. Scott** became chair of the Department of Computer Science.

Michael C. Loui has been appointed associate dean of the Graduate College at the University of Illinois at Urbana-Champaign, where he is a professor of electrical and computer engineering.

Have you changed jobs, been promoted or appointed to a key committee or task force? For example, we are interested in listing the new chairs of CS, CE or related departments or colleges; new heads of research laboratories; or key changes in granting agency personnel. Send announcements to crn@cra.org.

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Upcoming CRA workshops

CRA ACADEMIC CAREERS WORKSHOP

The Computing Research Association's Academic Careers Workshop is oriented for both men and women. Its target audience is faculty in the beginning years of their careers and senior graduate students contemplating an academic career. This workshop is inspired by the very successful Workshops on Academic Careers for Women in Computer Science staged by the CRA Committee on the Status of Women in Computing Research (CRA-W). It will be held June 4-5 in Denver.

Some of the sessions include:
- The Tenure Process
- Networking, Selecting and Managing a Research Program
- Getting Funding
- Time Management/Family Issues

Workshop presenters include:
- Janice Cuny (CRA-W co-chair, University of Oregon)
- Susan Eggers (NSF Presidential Young Investigator, University of Washington)
- John Hennessy (Dean of the College of Engineering, Stanford University)
- Mary Jane Irwin (Vice chair of CRA and ACM, Pennsylvania State University)
- David Patterson (CRA Board chair and past Computer Science Department chair, University of California at Berkeley)
- Bobby Schnabel (Associate dean of academic affairs for engineering, University of Colorado at Boulder)

The careers workshop will begin June 4 at 1 P.M. and conclude June 5 at noon. This workshop will be followed by a one-day workshop on effective teaching. Space is limited.

At press time, CRA was negotiating with a hotel to hold the workshop. If you are interested in receiving information when it becomes available, send your request, name and e-mail address to info@cra.org. Or call Kimberly Peaks at 202-234-2111. Special discounts will be given to CRA members; special rates will be given to attendees who register for both workshops.

CRA EFFECTIVE TEACHING IN CS&E WORKSHOP

The purpose of the Computing Research Association's Effective Teaching in Computer Science and Engineering Workshop is to help new faculty members teach more effectively. This highly interactive workshop includes theoretical material on learning styles and instructional objectives, and practical tips on effective lecturing, creative problem-solving and collaborative learning.

The workshop will be held in Denver and begin June 5 at 6 P.M. and end June 6 at noon. The CRA Academic Careers Workshop will be held in the same location on June 4-5.

Attendees will actively participate individually, in pairs and in small groups.

This workshop is intended for new faculty members teaching college and university courses in computer science and engineering. If space is available, more experienced faculty are welcome to attend.

The workshop leader is Michael R. Williams, a professor of computer science at the University of Calgary. Williams graduated with a B.Sc. in chemistry from the University of Alberta and earned a Ph.D. in computer science from the University of Glasgow. He joined the University of Calgary, first in the Department of Mathematics, then as a professor of computer science. Besides his work as editor-in-chief of the journal *The Annals of the History of Computing*, he has worked closely with the IEEE History Committee (serving as its chair in 1994 and 1995) and the IEEE History Center, and he is a member of editorial boards concerned with publishing material in the area of the history of computing.

During his career he has received several awards, the most notable including:

• The C.C. Gotlieb Award, presented in May 1990 by the Canadian prime minister "in recognition of outstanding contributions to the Canadian Information Processing Society and to the profession on CIPS' behalf."

• University of Calgary, Faculty of Science, Award of Excellence for Consistently Outstanding Contributions in Teaching, April 1993.

At press time, CRA was negotiating with a hotel to hold the workshop. If you are interested in receiving information when it becomes available, send your request, name and e-mail address to info@cra.org. Or call Kimberly Peaks at 202-234-2111. Special discounts will be given to CRA members; special rates will be given to attendees who register for both workshops.

CRA welcomes its new members

The Computing Research Association continues to grow. CRA is pleased to welcome USENIX as a new affiliated professional society member. Two academic departments recently joined as new members: the University of Puerto Rico-Mayaguez, Department of Electrical and Computer; and Western Michigan University, Department of Computer Science. CRA also appreciates the numerous professional society, academic and industrial members that support CRA and have renewed their memberships.

Washington Update

Telecommunications law: one year later

BY Louise Arnheim

When it was signed into law last year, the Telecommunications Reform Act of 1996 was hailed as the most comprehensive set of changes to the nation's telecommunications laws in over half a century.

The simplicity of the act's brief introduction, however, belied the number, volume and complexity of the regulatory proceedings it set into motion. Public Law 104-104 (110 Stat. 56) states that its purpose is to "promote competition and reduce regulation in order to secure lower prices and higher-quality services for American telecommunications consumers and encourage the rapid deployment of new telecommunications technologies." Consumers would benefit from lower rates, more choices and the availability of advanced services.

But a year's time may be insufficient to gauge the impact of the new law, particularly because many of the rules have only been in place a short while and because the Federal Communications Commission (FCC) is still working its way through a challenging implementation schedule.

Here is a snapshot of what has happened since President Clinton signed the act in February 1996:

• According to the United States Telephone Association (USTA), more than 300 interconnection agreements have been signed between local exchange carriers (LECs) and new entrants.

• TV sets are now required to include V-chips to help parents better select viewing for children, and a new ratings system is in effect.

• Four out of seven Baby Bells have announced plans to merge (Pacific Telesis with SBS Communications and Bell Atlantic with Nynex).

The act directed the FCC to undertake more than 80 regulatory proceedings. Those proceedings covered matters such as alarm monitoring services, manufacturing protocols of Bell Operating Companies, cable reform, interconnection, pole attachments, radio and TV broadcast station ownership, spectrum matters and telemessaging.

Noting the commission's success in meeting all its deadlines to date, National Cable Television Association (NCTA) President Decker Anstrom recently gave the FCC "high marks." However, some parties think the FCC may have overstepped its authority in setting certain pricing rules for local interconnection, and successfully sought a stay of those rules.

The pricing rules were part of the larger matter of interconnection: that is the direct or indirect connection of a requesting entrant's facilities and equipment with the incumbent LEC's network. The telecommunications act required LECs and new entrants to voluntarily negotiate interconnection arrangements in "good faith." The incentive driving LECs to reach agreement was the hope of offering in-region long-distance services. In fact, LECs had to satisfy a 14-point competitive checklist of conditions set by Congress in order to qualify to offer such services.

To prevent breakdowns in negotiations, the act allowed any party to the negotiation—135 days to 160 days after a request had been filed—to seek arbitration from the state public utility commission. By statute, state utility commissions had to resolve matters no later than nine months to the day the entrant filed its request. The FCC was charged with crafting the guidelines for these and related matters.

Shortly after the FCC released its order last August, the LECs, several states and even some members of Congress argued that the FCC had overstepped its authority in setting certain pricing rules. A US Court of Appeals agreed and stayed the pricing rules last October. Oral arguments on the matter were presented January 16, and parties are now awaiting the court's decision.

Although the stay casts some doubt over the future of the rules, interconnection negotiations and arbitrations are continuing nationwide. "For one year out, we think that things are going well," said Mary McDermott, vice president at USTA. But long-distance companies disagree. According to Carol Ann Bischoff, vice president of legislative and regulatory affairs for CompTel, "Just because agreements have been signed doesn't mean there's competition out there." CompTel is the trade association representing competitive long-distance providers.

In January, CompTel sponsored a Congressional briefing on local competition to date. Along with member companies as well as several competitive LECs, CompTel argued that local competition was not a reality. "The primary goal of the act was to promote local competition," Bischoff said, "and that has not happened."

If the emergence of competition in the local exchange has been slower than anticipated, NCTA's Anstrom said at a recent press conference, it can be attributed to three factors. One factor was local telephone company efforts to thwart competition.

The other two factors, Anstrom said, were cities' attempts to extend their jurisdiction into telecommuni-

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Clinton creates new committee to advise on HPCC technologies

President Clinton recently announced that Ken Kennedy, director of the Center for Research on Parallel Computation at Rice University, will co-chair a new committee to advise the government on computing and communications research. The Advisory Committee on High-Performance Computing and Communications, Information Technology and the Next-Generation Internet will provide advice to the National Science and Technology Council on "all areas of high-performance computing, communications and information technologies," Clinton said.

At press time the other co-chair had not been named, and some members had not been selected. Members that were announced are:

Eric A. Benhamou, 3Com Corp.
Vinton Cerf, MCI Communications
Ching-Chih Chen, Simmons College
David Cooper, Lawrence Livermore National Laboratory
Steven D. Dorfman, Hughes Electronics Corp.
Robert Ewald, Cray Research Inc. and Silicon Graphics Inc.
David J. Farber, University of Pennsylvania
Sherrilynne S. Fuller, University of Washington
Hector Garcia-Molina, Stanford University
Susan Graham, University of California at Berkeley
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David C. Nagel, AT&T Labs
Raj Reddy, Carnegie Mellon University
Edward H. Shortliffe, Stanford University
Larry Smarr, University of Illinois at Urbana-Champaign
Leslie Vadasz, Intel Corp.
Andrew J. Viterbi, QUALCOMM Inc.
Steven J. Wallach, Hewlett-Packard Co. and Convex Computer Corp.

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traditional metrics of academic success—fame and reputation—although financial support for the research group is also a consideration. Staff programmers actually have fewer rights than students; because they work "for hire," their rights are passed to the institution. It seems unfair that students lose their authorship rights when they become staff.

The third break-out group focused on the fundamental principles underlying intellectual property rights. They recommended that all intellectual property be treated in a consistent manner by university policies, whether protected by patents, copyrights or other forms of

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1996 CRA Taulbee Survey

Grad, undergrad student enrollments up

BY Gregory R. Andrews
Chair, CRA Surveys Committee

The accompanying tables present the results of the 26th annual CRA Taulbee Survey[1] of Ph.D.-granting departments of computer science (CS) and computer engineering (CE) in the United States and Canada. Information was gathered during the fall and early winter. The tables include all responses received by the first week of February.

An innovation this year is that the survey could be submitted online or on paper. About half of the respondents used the online form for at least part of their input.

Information on degree production and enrollment applies to the previous academic year (1995-96). Information on faculty applies to the current academic year (1996-97). Faculty salaries reflect those in effect as of Jan. 1, 1997. Readers should keep in mind that survey results are from Ph.D.-granting departments only; there are hundreds more departments that only award bachelor's and master's degrees.

This article draws attention to the most significant results of the survey, especially results that are substantially different from last year.

The first notable difference is that the response rate was much lower (81% versus 91% a year ago). This is surprising, because we simplified the survey form and provided both hard copy and online versions. Part of the reason may be that we held to a firm deadline for responding. The major reason is probably that we made fewer follow-up calls than last year. However, the response rate is certainly high enough for the results to be meaningful.

Degree production (Figures 1 and 2; Tables 1-7)

The tables and graphs show that a total of 915 Ph.D. degrees were awarded in 1996 by the 130 responding departments. We believe that about 100 degrees were awarded by the other 30 Ph.D.-granting departments. This estimated total of 1,015 degrees is down somewhat from last year. But as Figure 2 shows, Ph.D. production has been essentially flat for six years.

Production should hold steady next year as well, based on the predicted number of new Ph.D.s (Table 1) less the usual correction of about 150 for overly optimistic predictions by departments. Longer-range predictions are harder to make however: Enrollment of new Ph.D. students was down about 300 students last year, and about 100 fewer students passed their Ph.D. qualifying exam this year than last. On the other hand, enrollment of new Ph.D. students rose back to the level of two years ago (see next section).

Table 5 shows the areas of specialization and types of first appointments for last year's Ph.D. recipients. The table has been changed in two ways relative to last year. First, there are 10 columns for specializations rather than six, and the columns have more descriptive headings. Second, there are now several rows rather than just one for the positions taken by new Ph.D.s who were hired by

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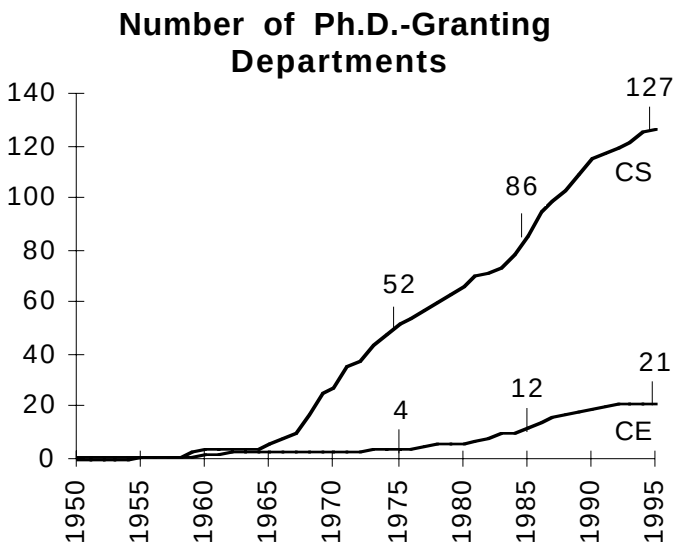
[1] *The title of the survey honors the late Orrin E. Taulbee of the University of Pittsburgh, who conducted these surveys for the Computer Science Board from 1970 until 1984.*

[2] *Although the University of Pennsylvania and the University of Chicago were tied in the National Research Council rankings, CRA made the arbitrary decision to place Pennsylvania in the second tier of schools.*

DEGREE PRODUCTION IN ACADEMIC YEAR 1995-96



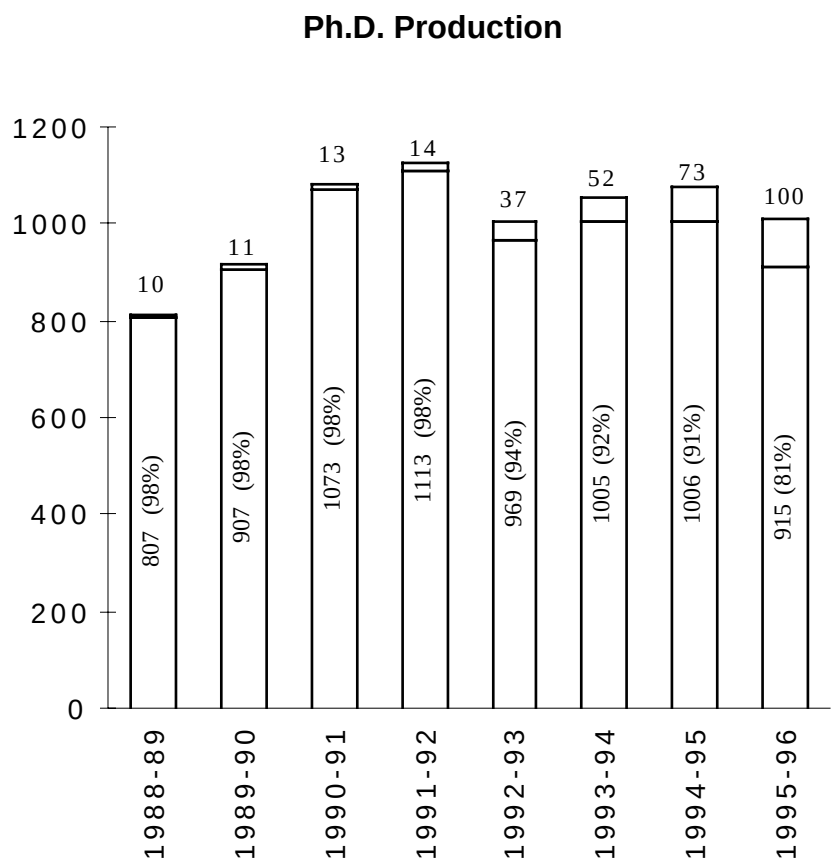


Figure 1 (above) shows a steady growth over time in the number of US and Canadian departments awarding CS and CE degrees. Actual numbers may be slightly higher because not all Forsythe schools completed their survey every year. **Figure 2** (right) shows a plateau in recent years in the total production of CS and CE doctoral degrees. To correct for the recent trend downward in the percentage of schools returning their surveys, the bottom bars show actual numbers reported, while the top bars project the numbers, assuming all schools had returned their surveys. Twelve schools did not return the survey in 1995; 30 did not respond in 1996. In the past three years there has been a more strenuous effort to include only CS and CE degrees in our data.

Table 1. Ph.D. Production by Ranking

	Ph.D.s Produced	Average per Dept.	Ph.D.s Next Year	Average per Dept.	Passed Qualifier	Average per Dept.
US CS Ranked 1-12	205	17.1	210	17.5	185	15.4
US CS Ranked 13-24	142	12.9	166	15.1	91	8.3
US CS Ranked 25-36	99	9.0	128	11.6	79	7.2
US CS Other	347	4.7	447	6.0	343	4.6
Canadian CS	83	6.9	93	7.8	57	4.8
US CE	39	3.9	66	6.6	123	12.3
Total	**915**	**7.0**	**1,110**	**8.5**	**878**	**6.8**

Table 2. Gender and Ethnicity of Ph.D. Recipients

	CS			CE			CS & CE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Nonresident Alien	253	30	283	32	4	37*	285	34	320*
African American, Non-Hispanic	10	0	10	1	0	1	11	0	11
Native American or Alaskan Native	4	1	5	0	0	0	4	1	5
Asian or Pacific Islander	113	17	130	12	1	13	125	18	143
Hispanic	19	5	24	2	1	3	21	6	27
White, Non-Hispanic	293	43	336	14	0	14	307	43	350
Other/Not Listed	22	2	24	0	0	0	22	2	24
Subtotal	**714**	**98**	**812**	**61**	**6**	**68***	**775**	**104**	**880***
Did Not Indicate	22	3	31*	2	0	4*	24	3	35*
Total	**736**	**101**	**843**	**63**	**6**	**72**	**799**	**107**	**915***

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Table 3. Gender of Ph.D. Recipients

	CS		CE		CS & CE	
Male	736	(87%)	63	(88%)	799	(87%)
Female	101	(12%)	6	(8%)	107	(12%)
Total	**843***		**72***		**915***	

Table 4. Gender of Bachelor's and Master's Recipients

	Bachelor's		Master's	
Male	6,692	(80%)	3,318	(78%)
Female	1,336	(16%)	852	(20%)
Total	**8,411***		**4,260***	

Table 5. Employment of New Ph.D. Recipients by Specialty

New Ph.D.s in Ph.D.-Granting Depts.	Artificial Intelligence/ Robotics	Hardware Systems/ Architecture	Numerical Analysis/ Scientific Computing	Programming Languages/Compilers	Operating Systems/ Networks	Software Engineering	Theory/Algorithms	Graphics/ Human Interfaces	Databases/ Information Systems	Other/Unknown	Total
Tenure-Track	23	5	3	11	15	9	11	1	5	12	95
Researchers	21	8	3	2	3	3	2	3	9	1	55
Postdocs	32	3	4	4	4	2	10	1	4	5	69
Instructors	4	1	0	1	4	2	2	2	2	5	23
New Ph.D.s, Other Categories											
Other CS/CE Dept.	8	2	1	3	3	1	3	0	1	3	25
Non-CS/CE Dept.	2	1	0	0	1	0	2	9	2	1	18
Industry	57	52	18	28	74	32	21	23	22	48	375
Government	3	1	5	0	1	0	1	3	4	6	24
Self-Employed	5	1	0	0	1	2	1	1	3	2	16
Employed Abroad	12	7	1	6	7	4	10	6	9	7	69
Unemployed	1	0	2	0	0	1	0	1	2	0	7
Other/Unknown	4	6	2	4	4	1	3	3	7	105	139
Total	**172**	**87**	**39**	**59**	**117**	**57**	**66**	**53**	**70**	**195**	**915**

Table 6. Ethnicity of Ph.D. Recipients

	CS		CE		CS & CE	
Nonresident Alien	283	(34%)	37	(51%)	320	(35%)
African American, Non-Hispanic	10	(1%)	1	(1%)	11	(1%)
Native American or Alaskan Native	5	(1%)	0	(0%)	5	(1%)
Asian or Pacific Islander	130	(15%)	13	(18%)	143	(16%)
Hispanic	24	(3%)	3	(4%)	27	(3%)
White, Non-Hispanic	336	(40%)	14	(19%)	350	(38%)
Other/Not Listed	24	(3%)	0	(0%)	24	(3%)
Subtotal	**812**	**(96%)**	**68**	**(94%)**	**880**	**(96%)**
Did Not Indicate	31	(4%)	4	(6%)	35	(4%)
Total	**843**	**(100%)**	**72**	**(100%)**	**915**	**(100%)**

Table 7. Ethnicity of Bachelor's and Master's Recipients

	Bachelor's		Master's	
Nonresident Alien	626	(7%)	1,499	(35%)
African American, Non-Hispanic	207	(2%)	51	(1%)
Native American or Alaskan Native	12	(0%)	45	(1%)
Asian or Pacific Islander	1,029	(12%)	730	(17%)
Hispanic	182	(2%)	39	(1%)
White, Non-Hispanic	4,086	(49%)	1,387	(33%)
Other/Not Listed	110	(1%)	98	(2%)
Subtotal	**6,252**	**(74%)**	**3,849**	**(90%)**
Did Not Indicate	2,159	(26%)	411	(10%)
Total	**8,411**	**(100%)**	**4,260**	**(100%)**

STUDENT ENROLLMENT IN ACADEMIC YEAR 1995-96

Table 8. New Students in Fall 1996

	Bachelor's Full Time	Dept. Avg.	Master's Full Time	Dept. Avg.	Ph.D. Full Time	Dept. Avg.
US CS Ranked 1-12	2,037	185.2	596	49.7	280	23.3
US CS Ranked 13-24	1,014	92.2	325	29.5	217	19.7
US CS Ranked 25-36	1,051	95.5	177	16.1	147	13.4
US CS Other	7,275	97.0	1,679	22.4	560	7.6
Canadian CS	2,267	226.7	253	21.1	63	5.25
US CE	595	59.5	324	32.4	78	7.8
Total	**14,239**	**111.2**	**3,354**	**25.8**	**1,345**	**10.3**

Footnotes

All ethnicity tables: "Asian or Pacific Islander" includes people originating from the Pacific Islands, China, Japan, Korea, the Philippine Islands, Samoa, India and Vietnam; "White, Non-Hispanic" includes people originating from Europe, North Africa and the Middle East.

All tables with rankings: Statistics sometimes are given according to departmental rank. Schools are ranked only if they offer a CS degree and according to the quality of its CS program as determined by reputation. Those that only offer CE degrees are not ranked, and statistics are given on a separate line, apart from the rankings. In Table 1, the "Ph.D.s Produced" column shows the number of CS and CE degrees produced throughout the rankings. While CE degrees are mixed into all rank categories, there are no CS degrees in the CE category.

**Totals do not match:* The reader may find that totals from certain tables do not equal each other, even though theoretically they should. These discrepancies stem from inconsistencies in the way departments answered different questions. We tried to minimize this by calling departments that provided inconsistent answers.

Nonresident faculty: A small percentage of faculty were nonresident aliens when they were hired to work in fiscal 1996-97. In many cases, these new employees were gaining residency based on their new employment prospects.

All faculty tables: The survey makes no distinction between faculty specializing in CS versus CE programs. We tried to minimize inclusion of any faculty in electrical engineering.

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Ph.D.-granting CS or CE departments. Despite these improvements, the number of unknown degree specializations and unknown types of first positions are much too large (10% to 20%). We plan to investigate why in hopes of having more accurate data next year.

The number of bachelor's degrees that were awarded is up about 850 (more than 10%), which reflects a recent and continuing increase in the number of undergraduates majoring in CS/CE. However, the number of master's degrees awarded is about the same as last year.

The gender and ethnicity percentages remain relatively stable. The notable exception is that the number of master's and Ph.D. degrees earned by Native Americans or Alaskan Natives is way up—from three to 45 for master's degrees and from one to five for Ph.D. degrees.

Student enrollment (Tables 8-12)

To put it succinctly: Enrollments are *up*.

The number of new Ph.D. students rose from 1,072 to 1,345, which puts it back to the level of two years ago. The number of new master's students rose from 2,173 to 3,354, which is also about the level it was two years ago. Most dramatically, the number of new bachelor's students is up from 10,099 to

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Table 9. Gender and Ethnicity of Enrolled Ph.D. Students

Enrollment by Gender	CS	CE	CS & CE
Male	5,407	381	5,788
Female	1,063	60	1,123
Total	**6,470**	**455***	**6,925***
Enrollment by Ethnicity			
Nonresident Alien	2,133	189	2,322
African American, Non-Hispanic	88	5	93
Native American or Alaskan Native	3	0	3
Asian or Pacific Islander	796	109	905
Hispanic	108	14	122
White, Non-Hispanic	2,726	120	2,846
Other/Not Listed	229	2	231
Subtotal	**6,083**	**439**	**6,522**
Did Not Indicate	387	16	403
Total	**6,470**	**455**	**6,925**

Table 10. Prior Education of New Ph.D. Students

	Bachelor's in CS or CE			% of Total
US CS Ranked 1-12	223	of	280	(80%)
US CS Ranked 13-24	89	of	217	(41%)
US CS Ranked 25-36	115	of	147	(78%)
US CS Other	325	of	560	(58%)
Canadian CS	55	of	63	(87%)
US CE	10	of	78	(13%)
Total	**817**	**of**	**1,345**	**(61%)**

Table 11. Master's Degree Candidates for 1996-97

	CS		CE		CS & CE	
US CS Ranked 1-12	625	(17%)	16	(3%)	641	(16%)
US CS Ranked 13-24	455	(13%)	3	(1%)	458	(11%)
US CS Ranked 25-36	279	(8%)	0	(0%)	279	(7%)
US CS Other	1,938	(54%)	142	(29%)	2,080	(51%)
Canadian CS	236	(7%)	0	(0%)	236	(6%)
US CE	85	(2%)	327	(67%)	412	(10%)
Total	**3,618**	**(100%)**	**488**	**(100%)**	**4,106**	**(100%)**

Table 12. Bachelor's Degree Candidates for 1996-97

	CS		CE		CS & CE	
US CS Ranked 1-12	1,169	(16%)	143	(11%)	1,312	(15%)
US CS Ranked 13-24	729	(10%)	226	(18%)	955	(11%)
US CS Ranked 25-36	617	(9%)	0	(0%)	617	(7%)
US CS Other	3,406	(47%)	592	(47%)	3,998	(47%)
Canadian CS	1,194	(17%)	0	(0%)	1,194	(14%)
US CE	113	(2%)	298	(24%)	411	(5%)
Total	**7,228**	**(100%)**	**1,259**	**(100%)**	**8,487**	**(100%)**

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14,239, a 40% increase on top of last year's 5% rise!

The marketplace and the Web are clearly having effects. In fact, the increases are actually quite a bit greater than shown in Table 8, because 10% fewer departments completed the survey this year than last.

Faculty demographics (Tables 13-18)

Table 13 illustrates current and predicted numbers of full-time equivalent faculty members, with rows this year for different faculty ranks, including researchers and postdoctorates. We also include a table that presents faculty data by different groups of departments.

For some reason, departments are pessimistic about next year but then predict a slow growth back to this year's total number of faculty. By contrast, past surveys have always predicted growth and have been overly optimistic.

As expected, the gender and ethnicity percentages for faculty remain almost the same as last year. Of note, however, are the differences between percentages in Table 6 (ethnicity of new Ph.D.s) and Table 19 (ethnicity of newly hired faculty); a much smaller percentage of nonresident aliens are hired into tenure-track positions than are awarded Ph.D.s. And a much larger percentage of white, non-Hispanics are hired into tenure-track positions than are awarded Ph.D.s.

Faculty salaries (Tables 20-28)

Faculty salaries again rose about 3% in all ranks relative to a year ago. (The overall averages in Table 20 are slightly higher than those reported in January.)

This year, salaries for newly reported faculty are listed by type of position (tenure-track, researcher, postdoctorate and other) rather than by groups of departments.

Rankings

For tables that group computer science departments by the rank of 1-12, 13-24 and 25-36, we based our ranking on information released in the 1995 assessment of research-doctorate programs in the United States done under the auspices of the National Research Council.

Our top 12 schools are Stanford University, the Massachusetts Institute of Technology, the University of California at Berkeley, Carnegie Mellon University, Cornell University, Princeton University, the University of Texas at Austin, the University of Illinois at Urbana-Champaign, the University of Washington, the University of Wisconsin at Madison, Harvard University and the California Institute of Technology.

The departments ranked 13-24 are Brown University, Yale University, the University of California at Los Angeles, the University of Maryland at College Park, New York University, the University of Massachusetts at Amherst, Rice University, the University of Southern California, the University of Michigan, the University of California at San Diego, Columbia University and the University of Pennsylvania.[2]

The departments ranked 25-36 are the University of Chicago, Purdue

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FACULTY GROWTH IN FISCAL 1996-97

Table 13. Anticipated Faculty Growth by Position

	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	Five-Year Increase	
Tenure-Track	2,371	2,226	2,243	2,312	2,320	2,398	27	(1%)
Researcher	257	253	268	280	292	297	40	16%)
Postdoc	226	210	219	227	235	243	17	(8%)
Instructor	256	200	201	203	204	200	-56	(-22%)
Other/Not Listed	100	62	65	64	66	66	-34	(-34%)
Total	**3,210**	**2,951**	**2,996**	**3,086**	**3,117**	**3,204**	**-6**	**(0%)**

Table 14. Anticipated Faculty Growth by Ranking

	1996-97	1997-98	1998-99	1999-00	2000-01	2002-02	Five-Year Increase	
US CS Ranked 1-12	456	455	448	480	464	495	39	(9%)
US CS Ranked 13-24	385	374	394	408	422	432	47	(12%)
US CS Ranked 25-36	301	259	278	291	311	319	18	(6%)
US CS Other	1,512	1,319	1,321	1,345	1,378	1,412	-100	(-7%)
Canadian CS	391	376	398	403	406	409	18	(5%)
US CE	165	148	157	159	136	137	-28	(-17%)
Total	**3,210**	**2,951**	**2,996**	**3,086**	**3,117**	**3,204**	**-6**	**(0%)**

Table 15. Ethnicity of Newly Hired Faculty

	Tenure-Track		Researcher		Postdoc		Other	
Nonresident Alien	12	(11%)	10	(29%)	15	(23%)	2	(3%)
African American, Non-Hispanic	0	(0%)	0	(0%)	0	(0%)	1	(2%)
Native American or Alaskan Native	1	(1%)	0	(0%)	0	(0%)	0	(0%)
Asian or Pacific Islander	21	(18%)	2	(6%)	9	(14%)	4	(6%)
Hispanic	3	(3%)	1	(3%)	3	(5%)	3	(5%)
White, Non-Hispanic	70	(61%)	21	(60%)	35	(54%)	43	(65%)
Other/Not Listed	5	(4%)	0	(0%)	2	(3%)	1	(2%)
Subtotal	**112**	**(98%)**	**34**	**(97%)**	**64**	**(98%)**	**54**	**(82%)**
Did Not Indicate	2	(2%)	1	(3%)	1	(2%)	12	(18%)
Total	**114**		**35**		**65**		**66**	

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Table 16. Gender of Newly Hired Faculty

	Tenure-Track	Researcher	Postdoc	Other
Male	95 (83%)	28 (80%)	56 (86%)	42 (64%)
Female	17 (15%)	7 (20%)	9 (14%)	13 (20%)
Total	**114***	**35**	**65**	**66***

Table 17. Ethnicity of Professors

	Assistant		Associate		Full	
Nonresident Alien	27	(5%)	4	(0%)	5	(0%)
African American, Non-Hispanic	7	(1%)	9	(1%)	6	(1%)
Native American or Alaskan Native	1	(0%)	0	(0%)	0	(0%)
Asian or Pacific Islander	117	(22%)	173	(21%)	124	(12%)
Hispanic	12	(2%)	19	(2%)	25	(2%)
White, Non-Hispanic	315	(59%)	547	(66%)	772	(75%)
Other/Not Listed	15	(3%)	6	(1%)	10	(1%)
Subtotal	**494**	**(92%)**	**758**	**(91%)**	**942**	**(91%)**
Did Not Indicate	42	(8%)	76	(9%)	90	(9%)
Total	**536**	**(100%)**	**834**	**(100%)**	**1,032**	**(100%)**

Table 18. Gender of Professors

	Assistant		Associate		Full	
Male	434	(81%)	750	(90%)	975	(94%)
Female	102	(19%)	84	(10%)	57	(6%)
Total	**536**		**834**		**1,032**	

Table 19. Faculty Losses

	Total
Died	4
Retired	33
Took Academic Position Elsewhere	62
Took Nonacademic Position	44
Remained, Changed to Part Time	6
Other	16
Unknown	0
Total	**165**

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University, Rutgers—the State University of New Jersey, Duke University, the University of North Carolina at Chapel Hill, the University of Rochester, the State University of New York at Stony Brook, the Georgia Institute of Technology, the University of Arizona, the University of California at Irvine, the University of Virginia and Indiana University.

Acknowledgments

Juan Osuna drafted the survey and prepared the online version. Phillip Louis collected data and handled follow-up e-mail and telephone calls. Andy Goldstein prepared the accompanying tables. Joan Bass coordinated production and layout.

Telecom from Page 4

cations via "new, costly regulatory regimes" and the "fickleness" of financial markets.

And yet, the interconnection rules have only been in place since August, and two related FCC proceedings are still unfolding: universal service and access charge reform.

Universal service. Today, nearly 94% of Americans have access to basic affordable telephone service.

Given the advent of competition in the local exchange, Congress wanted to ensure the perpetuation of universal service, particularly in high-cost and rural areas, and guarantee access to certain advanced telecommunications services by schools, some health care providers and libraries. To assist with policy making related to these and other issues, Congress directed the FCC to establish a Federal/State Joint Board on Universal Service.

In November the joint board issued its recommendations (a hefty 457 pages). The FCC is now considering those recommendations as well as the many

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FACULTY SALARIES IN FISCAL 1996-97

Table 20. Nine-Month Salaries, 98 Responses of 131 US CS Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	413	$33,155	$53,353	$68,000	$55,360	$46,957	$57,847	$76,400
Associate	653	$37,871	$58,477	$82,500	$64,307	$52,404	$71,075	$100,750
Full	815	$39,300	$70,755	$95,000	$87,604	$61,721	$113,259	$200,000

Table 21. Nine-Month Salaries, 12 Responses of 12 US CS Departments Ranked 1-12

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	63	$50,500	$56,653	$64,700	$59,459	$58,000	$63,446	$76,400
Associate	75	$55,690	$62,052	$66,400	$68,474	$71,250	$77,244	$90,000
Full	165	$39,300	$70,431	$80,000	$95,957	$100,000	$134,507	$163,300

Table 22. Nine-Month Salaries, 11 Responses of 12 US CS Departments Ranked 13-24

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	44	$54,000	$56,553	$63,650	$58,348	$55,821	$60,862	$66,100
Associate	75	$54,247	$63,376	$72,450	$68,647	$67,000	$75,135	$91,150
Full	139	$61,911	$74,018	$89,600	$98,070	$111,600	$132,992	$200,000

Table 23. Nine-Month Salaries, 11 Responses of 12 US CS Departments Ranked 25-36

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	47	$53,000	$55,234	$57,770	$57,521	$55,825	$60,393	$65,500
Associate	63	$57,948	$61,989	$69,000	$67,158	$64,654	$72,902	$81,400
Full	89	$65,574	$73,625	$90,300	$91,233	$86,752	$121,499	$170,400

Table 24. Nine-Month Salaries, 69 Responses of 95 US CS Departments Ranked Higher than 36 or Unranked

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	259	$33,155	$52,131	$68,000	$54,029	$46,957	$56,259	$76,000
Associate	440	$37,871	$56,870	$82,500	$62,804	$52,404	$69,519	$100,750
Full	422	$47,871	$69,920	$95,000	$84,299	$61,721	$106,064	$176,300

Table 25. Nine-Month Salaries, 8 Responses of 13 US CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	24	$49,396	$53,225	$58,976	$55,787	$54,461	$58,737	$65,000
Associate	56	$55,659	$59,357	$66,273	$64,928	$63,500	$70,861	$77,650
Full	55	$57,000	$72,124	$80,900	$85,460	$75,298	$106,945	$146,145

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Table 26. 12-Month Salaries, 9 Responses of 16 Canadian CS Departments (Canadian Dollars)

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	48	$42,000	$50,392	$60,000	$55,059	$49,189	$60,032	$69,370
Associate	100	$49,432	$59,476	$76,086	$69,720	$60,330	$80,266	$125,233
Full	118	$62,664	$75,451	$92,607	$89,951	$78,449	$111,564	$159,802

Table 27. Nine-Month Salaries, 106 Responses of 144 US CS and CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	437	$33,155	$53,344	$68,000	$55,389	$46,957	$57,908	$76,400
Associate	709	$37,871	$58,543	$82,500	$64,353	$52,404	$71,059	$100,750
Full	870	$39,300	$70,868	$95,000	$87,427	$61,721	$112,738	$200,000

Table 28. Salaries for Newly Appointed Faculty, 17 RespondIng US CS and CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximums		
		Min.	Mean	Max.		Min.	Mean	Max.
Tenure-Track	46	$45,000	$54,739	$82,500	$55,060	$45,000	$55,540	$82,500
Researcher	12	$35,000	$55,541	$71,412	$56,158	$35,000	$56,900	$78,288
Postdoc	24	$29,997	$37,921	$54,756	$39,607	$33,000	$41,482	$55,000
Other/Not Listed	25	$35,000	$42,871	$51,000	$45,152	$35,000	$47,430	$60,330

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legal protection. Incentives for those involved in the development, protection and transfer of intellectual property should be formulated to achieve the institution's desired goals. For example, university licensing offices are all too often measured by the licensing fees they earn rather than the successful university-industry liaisons they have facilitated. The result is a narrow focus on finding the next home run piece of intellectual property, such as the NCSA Mosaic browser. Benefits should be shared fairly among all individuals and organizations who have contributed to development of the intellectual property. Because time can be of the essence in disseminating the ideas embodied in software, licensing decisions must be expedited. Also, the university should not forget to reserve educational and research rights to its licensed intellectual property. Faculty and students must be better educated about the changing nature of intellectual property laws.

The final break-out group focused on the issues of multi-university, multi-industry consortium agreements. The group examined the different kinds of consortia: affiliates programs and sponsored research agreements involving different numbers of universities and industry sponsors. Affiliates are the simplest, with modest expectations in terms of research funding and access to intellectual property. Arrangements that involve many participants, especially when they span multiple institutions, are especially difficult because of the complexities of reaching a uniform licensing agreement. For example, the concepts of ownership and control vary at different universities. At some, ownership and control vest with the faculty creator, while at others the institution owns the intellectual property, but the creator controls it. The key challenge is to set up consistent rules within consortium agreements.

In summary, the workshop participants thought it very important to take the broad view of the university's mission with respect to industrial interaction and intellectual property. They encouraged the formulation of uniform policies that maximize the value received for university intellectual property, including patents, copyrights and trade secrets. Such policies should recognize the many facets of the university mission: disseminating knowledge, fostering industry relationships and enhancing the fame and reputation of the institution. Recurring royalties are but one measure of successful technology transfer. The workshop participants committed themselves to work toward making a difference in the intellectual property rights policies at their institutions.

With the help of Rick Adrion, Peter Freeman, Bill Gear and Ed Lazowska, we are in the process of drafting a comprehensive workshop report and set of recommendations. A raw form of the workshop notes can be found at http://www.cs.Berkeley.edu/~randy/CRA.WS.html.

Katz is a CRA Board member and professor of computer science at the University of California at Berkeley.

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comments filed in response. It is required to issue a report in May.

Interstate access charges. The FCC has just started work on what it calls the "third in a trilogy of actions" (the first two being interconnection and universal service) related to the competitive future: the system of interstate access charges. In December it released a *Notice of Proposed Rulemaking (NPRM)* requesting comment.

Access charges are the fees paid by long-distance carriers to local exchange providers for the costs of using the local network in originating and terminating calls. Part 69 of the FCC's rules ensure that these rates are kept "just, reasonable and nondiscriminatory."

Those rules, as the *NPRM* notes, were developed about the same time as divestiture and with the emerging competitive long-distance (interexchange) market in mind. "While our Part 69 rules expressly contemplated competition in the interexchange market, they were not designed to address the potential effects of competition in the local exchange and exchange access markets."

To address this disparity and related matters, the FCC is requesting comment on 1) a market-based approach that would let actual and potential competition drive prices toward economic cost; 2) a "prescriptive" approach that would allow the FCC to set the "nature and timing of the changes to existing rate levels" (both approaches are detailed in the *NPRM*); or 3) a combination of the two approaches.

The *NPRM* also raises the new issue of whether access charges should be paid by another group of parties that make use of the local network to provide interstate services: i.e., information service providers and Internet access providers (what the FCC refers to collectively as "enhanced service providers").

Local telephone companies contend that the flat monthly business line rate Internet access providers pay does not cover the costs they incur meeting burgeoning demand. Internet service providers argue that the revenue telephone companies are now getting from customers ordering second phone lines as well as current rates more than cover such demand.

In raising the specter of possible rules regarding Internet services, the FCC appears almost apologetic, writing that "…we have long sought to avoid unnecessary regulation of information services. As usage continues to grow, such services may have an increasingly significant effect on the public switched network. Therefore, as part of this comprehensive proceeding, we must consider how our rules can provide incentives for investment and innovation in the underlying networks that support the Internet and other information services."

While the FCC tentatively concluded that information service and Internet access providers should not have to pay access charges (as currently constituted), it issued a related *Notice of Inquiry (NOI)* along with the *NPRM* to address related issues.

In its *NOI*, the FCC explained why growing residential usage of Internet services may require attention: "Virtually all residential users today connect to the Internet—a packet-switched data network—through incumbent LEC switching facilities designed for circuit-switched voice calls. The end-to-end dedicated channels created by circuit switches are unnecessary and even inefficient when used to connect an end user to an ISP [Internet service provider]."

For more information on both the *NPRM* and *NOI,* see http://www.fcc.gov/isp.html. Although the comment and reply dates for the NPRM have passed, the commission is now accepting comments on the *NOI*. Informal comments may be sent to isp@fcc.gov until March 24 (specify CC Docket No. 96-263). Reply comments are due April 23.

What's ahead?

• On Capitol Hill, there are stirrings about oversight hearings regarding the act's impact to date. There's also new leadership on the major congressional committees with oversight of telecommunications. Sen. John McCain (R-AZ) took over as chair of the Commerce Committee. Rep. Billy Tauzin (R-LA) replaced retiring Congressman Jack Fields (R-TX) as chair of the House Commerce Telecommunications and Finance Subcommittee.

• At the FCC, it is possible an entirely new set of players will be implementing future policy. Currently there are four commissioners, with one Republican seat vacant. Recently, the name of Michael Powell, son of Gen. Colin Powell, has been circulating as a possible nominee. Powell is a chief of staff at the Justice Department. There is also speculation that Chairman Reed Hundt might step down, and that Commissioner Susan Ness is interested in filling that seat. Democratic Commissioner James Quello (who has served since 1974) is leaving in June, and it is uncertain whether Republican Commissioner Rachelle Chong will be reappointed.

Professional Opportunities

CRN Advertising Policy

Send copy and payment for Professional Opportunities advertisements to Advertising Coordinator, *Computing Research News*, 1875 Connecticut Ave. NW, Suite 718, Washington, DC 20009-5728. Tel. 202-234-2111; fax: 202-667-1066; e-mail: crn@cra.org. E-mail submissions are preferred.

The format of an ad must conform to the following: 1) the first line must contain the name of the university or organization, 2) the second line must contain the name of the department or unit, and 3) the body of the ad should be in paragraph form. The words in the first two lines are included in the total word count for the ad. You may request in writing that some text be set in bold; a bold word in the body of the ad counts as two words.

The rate is $2.25 (US) per word. Purchase orders, money orders and checks are acceptable *(please do not send cash)*. All CRA members receive at least 200 free words per dues year. CRA's standard advertising package consists of printing an ad in *CRN* and distributing it electronically to CRA's jobs listserv and Web page (where it remains for two months). As an alternative to this package, advertisers may request that their Professional Opportunities ads just be published in *CRN* or just distributed electronically. The cost of the ad is the same whether the standard or the alternative package is selected.

Professional Opportunities display ads cost $60 (US) per column inch, with a two-inch minimum. Ads must be submitted in camera-ready, offset (positives or negatives) or mechanical form. If your ad is larger than three inches, please request our Advertising Rate Card.

Computing Research News is published five times per year: in January, March, May, September and November. Professional Opportunities ads with application deadlines falling within the month of publication of *CRN* will not be accepted for publication in *CRN* unless the ad says applications will be accepted until the position is filled. If the closing date of a Professional Opportunities ad does not correspond with the publication of an issue of *CRN*, advertisers can choose the alternative advertising package and only have the ad distributed electronically. Advertising copy that is to appear in *CRN* must be received at least one month before publication. The deadline for the May issue is April 1. Ads for electronic distribution only may be submitted at any time.

Purdue University
School of Electrical and Computer Engineering

The Purdue University School of Electrical and Computer Engineering seeks outstanding candidates in all areas of computer engineering. Candidates are expected to have demonstrated exceptionally strong research and superior teaching potential. Several openings are anticipated for tenure-track faculty at all levels.

Applicants will be required to have a doctoral degree. Send a resume, including a statement of research and teaching interests and a list of at least three references, to Head, School of Electrical and Computer Engineering, Purdue University, 1285 EE Building, West Lafayette, IN 47907-1285. Applications will be considered as they are received.

Purdue University is an equal opportunity, affirmative action employer.

University of Michigan
Division of Computer Science and Engineering

Applications are solicited for several faculty positions in the Computer Science and Engineering (CSE) Division at all ranks. Qualifications include an outstanding academic record, a doctorate or equivalent in computer engineering or computer science, and a strong commitment to teaching and research. Particular areas of interest include multimedia, computer networks, software for distributed computing (including OS), databases, object-oriented programming, graphics and programming languages.

Please send resume and names of five references to Professor Toby J. Teorey, Chair of the Faculty Search Committee, CSE Division, Department of Electrical Engineering and Computer Science, The University of Michigan, 1301 Beal Ave., Room 3401, Ann Arbor, MI 48109-2122.

A nondiscriminatory, affirmative action employer.

Clemson University
Department of Computer Science

The Department of Computer Science seeks applicants for two assistant professor level tenure-track faculty positions and one non-tenure-track lecturer position for fall 1997. For the tenure-track positions, strong preference will be given to applicants in the areas of graphics, software engineering and networking/distributed systems. Applicants should hold or expect to receive the Ph.D. degree in computer science or a related field by the appointment date. Evidence of accomplishment or strong potential for accomplishment in both teaching and research are expected. For the lecturer position, applicants should hold the M.S. degree in computer science and provide evidence of a strong commitment to high-quality undergraduate instruction.

The department has more than 300 undergraduate majors and more than 100 graduate students, and offers B.A., B.S., M.S. and Ph.D. degrees. Clemson University is the land-grant university of South Carolina and has an enrollment of more than 17,000. Clemson, SC, is a small college town located on Lake Hartwell at the edge of the Blue Ridge Mountains.

Applicants should send a curriculum vitae and names of three references to the Faculty Search Committee, Department of Computer Science, Clemson University, Clemson, SC 29634-1906. Screening began Jan. 31, 1997, and will continue until the positions are filled.

Clemson University is an equal opportunity, affirmative action employer.

University of Houston
Department of Electrical and Computer Engineering

The University of Houston Department of Electrical and Computer Engineering invites applications for tenure-track/tenure junior/senior positions in telecommunications and/or computer engineering. Selected candidates will have an outstanding opportunity to assume leadership roles in the development of new initiatives in both these areas.

The University of Houston is an equal opportunity, affirmative action employer. Minorities, women, veterans and persons with disabilities are encouraged to apply.

Applicants should send a comprehensive resume with three references and cover letter discussing professional career objectives to W.L. Anderson, Chair, Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4793.

University of Saskatchewan
Department of Computer Science

Applications are invited for a tenure-track faculty position at the assistant professor level. The department is interested in outstanding candidates from all areas of computer science. However, preference will be given to candidates interested in collaborative, applied research that cuts across traditional boundaries. Applicants must have a Ph.D. in computer science or equivalent. The successful applicant will be expected to build and sustain a strong research program and to make a commitment to excellence in teaching at both the undergraduate and graduate levels.

The University of Saskatchewan is a major Western Canadian university with a wide range of academic programs and approximately 15,000 full-time students. The Department of Computer Science offers graduate programs at the M.Sc. and Ph.D. levels, with approximately 65 students enrolled, as well as professionally accredited undergraduate programs. The department is home to a diverse collection of vigorous research programs, and was recently ranked No. 1 among Canadian computer science departments in terms of average research impact per publication, by the Institute for Scientific Information (ISI) in Philadelphia. For further information about the department, see http://www.cs.usask.ca.

Please direct applications or inquiries to the Chair: Professor Derek Eager, Department of Computer Science, University of Saskatchewan, Saskatoon, SK S7N 5A9 Canada. E-mail: eager@cs.usask.ca. Applications should include a curriculum vitae and the names and addresses of three references, and will be accepted until the position is filled.

This position has been cleared for advertising at the two-tier level. Applications are invited from qualified individuals regardless of their immigration status in Canada. The university is committed to employment equity. Members of designated groups (women, aboriginal people, people with disabilities and visible minorities) are encouraged to self-identify on their applications.

University of North Carolina, Chapel Hill
Department of Computer Science

Applications are invited for one or more tenure-track positions at any rank to begin in fall 1997 or spring 1998.

We particularly invite applications from candidates with expertise in building novel experimental hardware systems; image analysis, especially for biomedical applications; high-speed computer communications; and logic and functional programming. Outstanding candidates who would strengthen other existing research groups in the department will be welcomed.

Candidates must hold or expect to hold a Ph.D. before starting employment, or must present an equivalent level of professional accomplishment.

Further information about the department and this search may be obtained by e-mail to search@cs.unc.edu; via our Web site at http://www.cs.unc.edu under Joining Our Department/Faculty Recruiting; or by post to Faculty Search Committee, Department of Computer Science, Campus Box 3175, Sitterson Hall, Chapel Hill, NC 27599-3175.

Minorities and women are encouraged to apply. The University of North Carolina is an equal opportunity, affirmative action employer.

Bowdoin College
Department of Computer Science

The Department of Computer Science at Bowdoin College invites applications for a two-year full-time visiting assistant professor for the 1997-98 and 1998-99 academic years. Ph.D. preferred. Teaching experience highly desirable. Duties include teaching two undergraduate computer science courses each semester and directing independent studies. The successful candidate will be expected to teach introductory courses, algorithms, at least one other core course (computer organization, programming languages and theory of computation), as well as offering advanced undergraduate electives. The field of specialty is open.

Bowdoin is a highly selective, coeducational, liberal arts college of 1,550 students located two hours north of Boston along the coast of Maine in a community of 24,000. The college has a computer science major program with small classes and excellent students. Departmental lab facilities include Macintoshes for the introductory courses, and DEC Alphas for use by students in advanced courses. Further information about Bowdoin and the department is available on the World Wide Web at http://www.bowdoin.edu.

Applicants should send a letter of application, a vita and a statement of teaching philosophy, and arrange for three reference letters to be sent to David Garnick, Chair, Department of Computer Science, Bowdoin College, Brunswick, ME 04011.

Questions can be directed by e-mail to garnick@polar.bowdoin.edu.

Consideration of applications began Feb. 10, 1997, and will continue until the position is filled. Bowdoin is committed to equal opportunity through affirmative action. Women and minority candidates are encouraged to apply.

NEC Research Institute
Postdoctoral Researcher

Applications are invited for a two-year postdoctoral researcher position in the area of image databases at the NEC Research Institute. The successful candidate will have a Ph.D. and experience in image processing with knowledge of wavelet and Fourier transforms, image compression, and a strong background in mathematics and statistics to support research in image searching techniques.

The Institute, located in Princeton, NJ, has close ties with many outstanding research universities located in the area. The institute's laboratories are state of the art and include several high-end parallel computer servers. For more details about the NEC Research Institute, please see http://www.neci.nj.nec.com.

Applicants must show documentation of eligibility for employment. NEC is an equal opportunity employer. Interested applicants should send their resumes, along with copies of selected publications and names of at least three references, to Harold S. Stone, NEC Research Institute, 4 Independence Way, Princeton, NJ, 08540. E-mail: hstone@research.nj.nec.com.

Wright State University
Information Technology Research Institute

WSU seeks applicants and nominees for the position of director of the Wright State University Information Technology Research Institute, an R&D organization within the College of Engineering and Computer Science at the university, associated with the Department of Computer Science and Engineering. The Information Technology Research Institute was formally established in January 1997.

The chosen candidate will hold a Distinguished Professor tenure-track position in the Department of Computer Science and Engineering and must have an earned doctorate and a notable academic and industrial record in computer science, computer engineering or closely related field of information technology appropriate for the rank. The role of the institute director is to initiate, stimulate, support and actively pursue research and development initiatives and projects involving both the faculty and graduate students at Wright State University and industrial and government organizations involved in the information technology field.

A major role for the director of the institute is to provide active leadership and mentoring in R&D associated with the doctoral program in Computer Science and Engineering, as part of the enhancement of this program by the Ohio Board of Regents. Areas of R&D activities are computer networking and distributed computing, software engineering, computer graphics and simulation, human-computer interaction, multimedia and distributed databases, and information systems in general. The director reports to the dean of the College of Engineering and Computer Science and is advised by internal and external boards of industrial and academic leaders.

The College of Engineering and Computer Science has 1,800 students and 80 teaching and research staff. The Computer Science and Engineering Department, one of four departments in the college, has 20 faculty members, 500 undergraduate majors and 140 graduate students, including 35 doctoral students. It is housed in a new, attractive engineering building with a fully networked Unix environment and excellent laboratories. WSU, an institution of 17,000 students, is located on a spacious campus with a significant area of protected green space, in a rapidly growing high-technology suburban community. It is surrounded by commercial and government research and development facilities, including Wright-Patterson Air Force Base, Wright Laboratory and Armstrong Laboratory. The university is committed to industrial and government partnerships for research and development ventures to stimulate the economic growth of Ohio's Miami Valley region. Affordable, pleasant living environments, attractive to professionals and their families, are conveniently located in the proximity of campus.

Candidates should include an up-to-date vita, a brief statement of previous R&D and administrative background and goals, a record of activities representing the candidate's strongest contributions, documentation of administrative ability, names of five references who may be contacted by the committee and any additional important supporting information. The salary is competitive. Send applications to WSU-ITRI Director Search Committee, College of Engineering and Computer Science, Wright State University, Dayton, OH 45435.

Consideration begins immediately and continues on the first of each month until July 1, 1997, or until the position is filled. Direct inquiries to tel. 937-775-5134; fax: 937-775-5133; e-mail: cse_dept@cs.wright.edu.

Wright State University is an EEO/AA employer.

Eastern Connecticut State University
Department of Mathematics and Computer Science

Tenure-track assistant professor position in computer science starting fall 1997. The candidate must have a Ph.D. in computer science and be able to teach a broad range of undergraduate computer science courses. Research background in artificial intelligence or databases is preferred.

Submit application, vita, transcripts and three letters of recommendation to Dr. Jianhua Lin, Search Chair, Computer Science, Eastern Connecticut State University, Willimantic, CT 06226. AA/EOE. Visit http://www.ecsu.ctstateu.edu for information about Eastern and the department.

Princeton University
Department of Computer Science

The Department of Computer Science at Princeton University seeks applications from outstanding teachers to assist the faculty in teaching our introductory course sequence. There is no deadline for applications, but candidates are encouraged to apply early. We expect to make a lecturer appointment for the 1997-98 academic year.

Candidates should have an exceptional record of classroom instruction and curricular innovation. Princeton University prides itself on the quality of its undergraduate teaching, and the Computer Science Department is committed to being a leader in developing new courses and teaching methods.

The job involves teaching recitation sections (two per semester) in the beginning courses as well as certain responsibilities for overall management of the introductory sequence. There is also work supervising assistants in instruction (i.e., TAs) and developing curricular material, classroom demonstrations and laboratory exercises.

Lecturers are appointed to one-year terms, renewable for up to six years. Promotion to the rank of senior lecturer, with unlimited renewable terms, is a possibility. We are seeking candidates who are interested in establishing a long-term professional relationship at Princeton.

Qualified applicants should send a letter of application, a resume and the names of four references to Lecturer Recruiting Committee, Department of Computer Science, Princeton University, Princeton, NJ 08544.

Princeton University is an equal opportunity, affirmative action employer.

Professional Opportunities

University of Southern California
Department of Electrical Engineering-Systems

The Department of Electrical Engineering-Systems of the University of Southern California invites applications from outstanding candidates for tenure-track positions at all faculty levels in the following three areas:

1) Computer/communication networks.

2) Computer architecture with emphasis on processor/compiler design. Candidates with knowledge of configurable architectures, parallel algorithm design and analysis, and applied parallel computation are sought.

3) VLSI systems development and chip design with expertise in a broad spectrum of the design hierarchy including mapping algorithms and applications to multimedia.

Senior applicants should have demonstrated leadership ability and a distinguished teaching and research record. All applications must include a comprehensive resume, a list of three to five professional references and a letter of interest. The applicant is responsible for asking the references to submit letters directly to the address given below. These letters will not be solicited by the department. Please send material to the Chair, EE-Systems Search Committee, University of Southern California, Los Angeles, CA 90089-2560.

Mississippi State University
Department of Computer Science

The Department of Computer Science expects to have openings for tenure-track faculty at the assistant or associate professor level, beginning as early as August 1997. Areas of particular interest are a) software engineering, with additional expertise in distributed computing, databases or high-performance computing considered desirable; b) data communications, networking and high-performance computing; and c) computer graphics, scientific visualization and geometric modeling. However, other areas or combinations may also be considered. A Ph.D. in computer science or a closely related field is required by the date of hire. Applications will be reviewed beginning March 1, 1997, and will continue until the positions are filled.

The Department of Computer Science has 18 faculty positions and offers academic programs leading to the bachelor's, master's and doctoral degrees. The undergraduate program is accredited by CSAB. The department cooperates with the Department of Electrical and Computer Engineering in offering bachelor's, master's and doctoral degrees in computer engineering, and participates in the interdisciplinary program in computational engineering leading to master's and doctoral degrees. Faculty and graduate students in the department work with the NSF Engineering Research Center for Field Simulation (which specializes in high-performance scientific computing) and with the Diagnostic Instrumentation and Analysis Laboratory (specializing in complex instrumentation problems, often in severe environmental situations).

The successful applicant will be involved in maintaining the quality of the undergraduate program, and will contribute to the strength of the graduate programs. Applicants are expected to have strong commitments to both research and teaching, with experience and productivity in both areas strongly encouraged. Interested individuals should forward a vita and names of at least three references to D.W. Dearholt, Head, Department of Computer Science, Box 9637, Mississippi State University, MS 39762.

MSU is an affirmative action, equal opportunity employer.

Ohio State University
Department of Computer and Information Science

A position for assistant or associate professor is available in the Department of Computer and Information Science at The Ohio State University. Expertise in one or more of the following areas is desirable: human-computer interaction, human-centered intelligent systems, computer-supported cooperative work and distributed cognitive systems.

This is a tenure-track position funded by the CIS Department and the Institute for Ergonomics at Ohio State. (The Institute for Ergonomics is an interdisciplinary center focusing on cognitive and physical ergonomics.)

Applicants should send a curriculum vitae, along with copies of the most important publications, to Chair, Faculty Search Committee, Department of Computer and Information Science, The Ohio State University, Columbus, OH 43210-1277. E-mail: fsearch@cis.ohio-state.edu.

The Ohio State University is an equal opportunity, affirmative action employer. Qualified women, minorities and individuals with disabilities are encouraged to apply.

Northeastern University
College of Computer Science

The College of Computer Science invites applications for a tenure-track faculty position at the assistant professor level. Preference will be given to candidates in the broad area of software engineering. The successful candidate will complement Northeastern's well-established research programs in programming languages and software design methodology. Candidates with specialties in information science/systems, databases, networks or operating systems will also be considered. Ph.D. in computer science or related field is required.

The college has a diverse full-time faculty of 19 and 350 undergraduate, 120 master's and 30 Ph.D. students. The faculty has significant external support and is engaged in a broad range of successful research programs. Research seminars draw upon computer science talent from the greater Boston area. The college maintains a state-of-the-art computing environment including a large network of Sparc and Alpha workstations, specialized laboratories for research in networking and distributed computing, and Macintosh and Windows NT teaching laboratories. In addition, the college recently acquired major research facilities in a new $30 million Engineering Science Research Center.

Please send resume, statement of research interests and three letters of recommendation to Faculty Hiring Committee, College of Computer Science, 161 Cullinane Hall, Northeastern University, Boston, MA 02115. Applications deadline is March 15, 1997. For further information, send e-mail to hiring@ccs.neu.edu or see the college's home page at http://www.ccs.neu.edu.

Northeastern University is an equal opportunity, affirmative action employer. We strongly encourage applications from women and minorities.

Case Western Reserve University
Department of Computer Engineering and Science

The Case School of Engineering invites applications at all ranks for tenure-track or tenured positions in the Department of Computer Engineering and Science, starting in the 1997-98 academic year. Applicants should have a Ph.D. in computer engineering, computer science or a closely related field. Demonstrated excellence in both research and teaching is required. Candidates in all areas are encouraged to apply. However, the areas of computer architecture, graphical interface design, concurrent programming, distributed computer systems and networks, virtual reality, software development environments, algorithms, design automation and parallel computing are of most interest.

Salary will be commensurate with appointment rank and qualifications of the applicant. Case Western Reserve University is a private, research university located in the University Circle area of Cleveland. The University Circle area is a unique region of Cleveland containing numerous schools, museums and other cultural organizations. For instance, Severance Hall, the home of the Cleveland Orchestra, is within 100 yards of the university's main administration building.

Applications should be directed to Faculty Search Committee, 406 Olin, Case Western Reserve University, 10900 Euclid Ave., Cleveland, OH 44106-7071.

A complete application shall contain a CV, the names and addresses of at least three references, and a statement of research and teaching objectives. The search committee will make its decisions based on its estimation of the candidate's ability to perform excellent research and effective teaching.

Case Western Reserve University is an equal opportunity, affirmative action employer.

New York University
Department of Computer Science

The department expects to have several regular faculty positions beginning in September 1997 and invites candidates at all levels. The department is strengthening and broadening its existing systems research and to this end is particularly interested in the areas of distributed computing, networking, multimedia, operating systems and security. Faculty members are expected to develop an independent first-rate research program. In addition, they are expected to participate in the departmental teaching activities at all levels, from the undergraduate to the doctoral.

There may also be openings for regular joint positions with science departments. Candidates for such positions are expected to combine expertise and research interests from both computer science and another subject such as chemistry, biology or medicine. The department may also have one or more visiting positions in computer science. Appointments for visiting positions can be for a period of either one or two semesters.

The new appointees for regular positions will be offered competitive salaries, competitive start-up packages and low-cost university housing within short walking distance of the department. New York University, the largest private university in the world, is located in Greenwich Village, one of the most attractive residential areas of Manhattan.

The department has 23 regular faculty members and a number of visiting, adjunct and research faculty members. Current strengths of the department lie in algorithms, artificial intelligence, compilers, computer graphics, computer vision, databases, distributed and parallel computing, multimedia, natural language processing, programming languages and scientific computing. The department provides a general-purpose, state-of-the-art computing environment. In addition, there are specialized laboratories and research facilities for compiler optimization and instruction level scheduling, computer graphics and multimedia, computer vision, and parallel and distributed computing.

The department faculty obtain external funding at the level of $6 million per year. Among the funding sources are federal agencies such as AFOSR, DARPA, DOE, NSF and ONR; and industrial organizations such as BellCore, IBM Research, Intel, Microsoft, HP and SGI. Collaborative research with industry is facilitated by the geographic proximity to the main research centers of AT&T, BellCore, IBM, Lucent, Matsushita, NEC and Siemens.

Applications should include a resume, statement of career objectives, names of references (at least three for junior positions and at least five for senior positions) and key publications. Applicants are encouraged to provide a URL for a page describing their activities. The evaluation of candidates for the positions is in progress. Interested persons are encouraged to apply as all applicants will be considered as long as the positions remain unfilled.

Please send applications to Professor Zvi Kedem, Faculty Search Committee, Department of Computer Science, New York University, 251 Mercer St., New York, NY 10012-1185.

New York University is an equal opportunity, affirmative action employer.

New York University
Department of Computer Science

The Computer Science Department seeks candidates for a clinical faculty position starting September 1997 (pending funding approval). Junior and senior candidates will be considered (the possible appointments are as a clinical assistant professor, clinical associate professor or clinical professor). This is a nontenured position, with a renewable three-year term; it is primarily a teaching and not a research position. The main duties are:

• Teaching in the professional M.S. programs (the department graduates 90 M.S. students annually).

• Managing the projects course for the M.S. in Information Systems program, a joint program of the Computer Science Department and the Information Systems Department in the Stern School of Business. (The projects are performed in collaboration with major local corporations.) The clinical faculty member would be expected to help obtain funding from these corporations in support of these joint projects.

Candidates must be experienced practitioners. Experience in an industrial setting especially involving one or more of the following topics is preferred: Internet and intranet services, groupware, computer security, networks, intelligent agents. Prior teaching experience is desired. A Ph.D. is preferred.

The Computer Science and Mathematics departments together form the Courant Institute of Mathematical Sciences, a division of New York University. The Computer Science Department has 23 regular faculty and a number of associated, visiting, adjunct and research faculty members. The department provides a general-purpose, state-of-the-art computing environment. In addition, there are specialized laboratories and research facilities for compiler optimization and instruction-level scheduling, computer graphics and multimedia, computer vision, and parallel and distributed computing. Additional information can be found on the department's home page (http://cs.nyu.edu).

New York University, the largest private university in the country, is located in Greenwich Village, one of the most attractive residential areas of Manhattan. Applications should be sent to Professor Richard Cole, Chair, Department of Computer Science, New York University, 251 Mercer St., New York, NY 10012-1185.

To ensure full consideration, please submit your application by March 1, 1997; the search will continue until all positions are filled. Early application is encouraged. Applications should include a resume and the names of at least three references.

An equal opportunity, affirmative action employer.

Columbia University
Department of Computer Science

The Department of Computer Science anticipates at least one tenure-track opening and at least one instructional appointment for a stated term. We invite applications from exceptional candidates at all ranks and in all areas.

Our department of 19 tenure-track faculty and two lecturers emphasizes excellence in research and teaching and attracts excellent Ph.D. students, virtually all of whom are fully supported. Departmental facilities include numerous Sun 4 servers; Sun, HP, Digital, IBM and SGI workstations; Macs; PCs; an HP parallel cluster; and state-of-the-art experimental equipment. The department is in the first year of a new NSF CISE research infrastructure grant. We are within an hour's drive of the research laboratories of AT&T, BellCore, IBM, Lucent, Matsushita, NEC, Nynex, Philips, Siemens and other leading industrial companies.

Columbia University is one of the leading research universities in the United States, and New York City is one of the cultural, financial and communications capitals of the world. Columbia's enclosed campus of tree-lined walks is located in Morningside Heights on the Upper West Side. The department has its own building plus additional space and facilities in the new interdisciplinary Schapiro Center for Engineering and Physical Science Research. University subsidized housing and parking are available.

Candidates for assistant professor should exhibit exceptional research promise, while those seeking a more senior position should have an outstanding record of research achievement. Candidates for the instructional post should possess a doctorate and have experience in bringing innovation and excellence to computer science teaching. Interest and ability in teaching undergraduates and graduates is necessary. Please submit a summary of research interests, CV, e-mail address and the names of at least three references to Faculty Search Chairperson, Department of Computer Science, 450 Computer Science Building, Columbia University, New York, NY 10027. E-mail: recruiting@cs.columbia.edu.

Columbia University is an equal opportunity, affirmative action employer. We encourage applications from women and minorities.

Virginia Polytechnic Institute and State University, Northern Virginia Graduate Center
Department of Computer Science

The Virginia Tech Department of Computer Science seeks to fill two tenure-track positions at the assistant or associate professor level. The primary research area is software engineering. Background in human-computer interaction is also desirable. The ability to teach a variety of courses and to support the administrative needs of the program are required. Interaction with other faculty in the interdisciplinary Information Systems Technology program is expected.

The department has special strengths in software engineering, information retrieval and HCI. Virginia Tech NVGC is located in Fairfax County, near Washington, DC, one of the premier industrial centers for computing, software and networks. This location offers excellent opportunities for industrial collaboration.

Please send resume and the names of three references to Faculty Search, Computer Science Department, Virginia Tech NVGC, 7054 Haycock Rd., Falls Church, VA 22043. All materials must arrive by March 31, 1997.

Virginia Tech has a strong commitment to the principle of diversity and, in that spirit, seeks a broad spectrum of candidates including women, minorities and people with disabilities.

Individuals with disabilities desiring accommodations in the application process should notify Faculty Search, Department of Computer Science by the application deadline.

For more information, see http://frakes.cs.vt.edu/csaprog.html.

University of Memphis
Department of Mathematical Sciences

Elaborating on the advertisement in *CACM* (December 1996), applications are invited for a tenure-track faculty position in computer science at the assistant professor rank. Desired research areas in computer science include software development and related areas, object-oriented languages and systems, distributed information systems, multimedia and user interfaces. Applications for possible visiting positions in any areas of computer science are also invited.

Applicants must have a Ph.D. by Sept. 1, 1997, and a strong potential for excellence in research and teaching. Women and minorities are strongly urged to apply. Successful candidates must meet guidelines of the Immigration and Reform Control Act of 1986. For more information, see our Web pages at http://www.msci.memphis.edu.

An EO/AA university.

York University
Department of Computer Science

Applications are invited for tenure-track and/or contractually limited term positions at the assistant professor level. The department plans to increase its overall strengths and has particular interest in applied areas such as computer and software systems, parallel processing and architecture, programming languages, and database and software engineering; but excellent candidates from other areas are also encouraged to apply. A recent doctoral degree in computer science is required. Applicants must demonstrate strong potential for excellence in research and teaching at both the graduate and undergraduate levels.

The Department of Computer Science at York includes over 25 faculty members, and has recently moved to expanded facilities in the new Chemistry and Computer Science Building. For further information, see http://www.cs.yorku.ca. York University is the third largest university in Canada.

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Professional Opportunities ads available on Web

Not all departments and organizations choose to run their Professional Opportunities ads in *CRN*—their ads are only distributed electronically to the Computing Research Association's Web site and jobs listserv. If you are interested in seeing more Professional Opportunities ads, access the Jobs Web page at http://www.cra.org/Jobs. If you would like to subscribe to jobs@cra.org so you can read the announcements before they are published in *CRN* (or see the ones that don't appear in *CRN*), send the following mail message to listproc@cra.org: subscribe jobs firstname lastname.

Professional Opportunities

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It is located in metropolitan Toronto, and is within easy reach of downtown Toronto.

Applications, with curriculum vitae and the names of four references, should be sent to Michael Jenkin, Search Committee Chair, Department of Computer Science, 126 CCB, Faculty of Pure and Applied Science, York University, North York, ON M3J 1P3 Canada. Applications should be received by March 15, 1997, although later applications received before April 15, 1997, may also be considered if positions are still available.

York University is implementing a policy of employment equity, including affirmative action for women faculty members. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents.

University of Southwestern Louisiana and Southern University, Baton Rouge

Center for Advanced Computer Studies and Department of Computer Science

The Center for Advanced Computer Studies (CACS) at the University of Southwestern Louisiana (USL) and the Department of Computer Science at Southern University-Baton Rouge (Southern) invite applications for two tenure-track positions at the level of assistant or associate professor in computer science. These positions are made available through support from the Louisiana Board of Regents' Joint Faculty Appointments Program (JFAP); the new faculty members will be designated Louisiana Board of Regents' EPSCoR assistant/associate professors. Louisiana's JFAP has received strong support from the National Science Foundation, and has been hailed as having the potential to become a model program for the nation. The administrative plan ensures that both faculty members will enjoy full association with both partnering institutions. The start-up packages will include laboratory equipment, two years' support for summer salaries, research assistants and travel costs to professional meetings. USL and Southern are linked to each other, as well as to other research universities in the state, by the new Louisiana Audio-Visual Research Network, facilitating distance learning and remote collaboration.

USL is the largest campus in the University of Louisiana system, and is a Doctoral-II university. According to the 1995 National Research Council study, CACS ranks seventh in program effectiveness and faculty quality among all Ph.D.-granting computer science departments in all Doctoral-II universities. In a report published in the December 1996 issue of the *Communications of the ACM*, USL is ranked 35th among all Ph.D.-granting computer science departments. USL is located in Lafayette, the hub of French Louisiana, which is known for its Cajun culture. Lafayette is located about 52 miles west of Baton Rouge, and about 129 miles west of New Orleans. Southern University is the largest historical black university in Louisiana, and is located in Baton Rouge, the state capitol. South Louisiana is renowned for its joie de vivre, which has given it an international reputation.

We are recruiting two candidates who have Ph.D. degrees in computer science or in a closely related area by the date of appointment, and who have a demonstrated commitment to research and teaching. The teaching load is one course per semester, plus a continuing research seminar. The new faculty members will primarily be associated with the Media Technology Laboratory at USL and with the Multimedia Laboratory at Southern. General computing facilities at CACS include a network of Sun workstations, with Unix as the primary operating system. Additional facilities are available in the research laboratories in automated reasoning, computer vision and pattern recognition, intelligent robotic systems, software research and VLSI systems.

The broad areas of specialization are in multimedia information retrieval; multimedia signal processing and data communications; or graphics and data visualization. Preference will be given to candidates who have experience in some aspects of complex, distributed software systems research and development (such as in object-oriented programming, network protocols, intelligent agents, multimedia indexing, softbot development, networked database interoperability, communication security or data compression). The successful candidates are expected to contribute to the lab's goal of developing into a highly competitive research team that can engage in comprehensive studies of issues arising in the context of heterogeneous, networked information sources and can provide practical solutions to large-scale, real-life applications.

Additional information about these positions can be found at http://extreme.cacs.usl.edu/~cice/jfap.html. Interested individuals can direct their inquiries to Professor Vijay Raghavan, Center for Advanced Computer Studies, The University of Southwestern Louisiana, P.O. Box 44330, Lafayette, LA 70504-4330. Tel. 318-482-6603; fax: 318-482-5791; e-mail: raghavan@cacs.usl.edu. Or to Professor Erold Hinds, Computer Science Department, Southern University-Baton Rouge, Baton Rouge, LA 70813-0400. Tel. 504-771-2060; fax: 504-771-4223; e-mail: ewhinds@aol.com.

Applicants should send a complete vita, samples of publications, three names and addresses of references and a brief description of research interests to Professor Raghavan at USL. For full consideration, applications should be submitted by the closing date of April 15, 1997. USL and Southern University are both EEO/AA employers.

University of California, Davis

Department of Computer Science

The Department of Computer Science announces lecturer positions for the 1997-98 academic year. Several full- and part-time lecturer positions are available for the 1997-98 academic year. Additional information regarding these positions can be found at http://www.cs.ucdavis.edu.

Qualifications: Candidates should have a Ph.D. in computer science (or equivalent background) or an M.S. in computer science with at least two years teaching or work experience.

Salary range: (depending on level of education and experience) ranges from a full-time, nine-month rate of about $43,572 to $57,408.

To apply: Interested candidates should send a curriculum vitae and the names and addresses of at least three references by May 1, 1997, to Professor Charles Martel, Chair, Department of Computer Science, University of California at Davis, Davis, CA 95616-8562. Or e-mail above information (in ASCII or Postscript format) to lecturer@cs.ucdavis.edu, attention Professor Martel.

These positions are covered by a collective bargaining agreement. The University of California is an affirmative action, equal opportunity employer.

Southwest Texas State University

Department of Computer Science

Applications are invited for a tenure-track assistant professorship in software engineering to begin fall 1997. Applicants must have an earned doctorate in computer science, software engineering or a closely related field, and potential for excellence in teaching, research and service.

The Computer Science Department, with 15 faculty members, 400 undergraduate majors and 130 master's students, is part of SWT, a comprehensive university with 21,000 students located in San Marcos, TX. For more information, see http://www.cs.swt.edu.

Application review will begin March 15, 1997, and will continue until the position is filled. To apply, mail a letter of application, resume and a list of at least three references with addresses to Chair, Recruitment Committee, Department of Computer Science, Southwest Texas State University, 601 University Drive, San Marcos, TX 78666-4616.

Southwest Texas State University is an equal opportunity, affirmative action employer. SWT is committed to increasing the number of women and minorities in faculty and administrative positions.

James Madison University

Department of Computer Science

The Department of Computer Science invites applications at the assistant/associate professor level for teaching positions. Requirements include a Ph.D. in computer science or a related discipline, a commitment to quality in teaching, and an interest in two or more of the following: networks, data communications, information security, software engineering and interactive instructional materials. Preference will be given to documented excellence in teaching, established research specialty in an area indicated above or substantial industrial experience in CS.

While the faculty member will participate in all usual faculty activities, primary duties are to teach and to develop curriculum and research programs in the areas above. Salary will be commensurate with qualifications and experience in the range of $50,000 to $60,000.

The Department of Computer Science offers both the B.S. and M.S. degrees in computer science. There are presently nine full-time faculty positions in the department, with 200 undergraduate and 50 graduate students. James Madison University is a comprehensive state university enrolling about 12,000 undergraduate and 500 graduate students. JMU is located in Harrisonburg, a progressive and growing city of 30,000 in the heart of the famous Shenandoah Valley of Virginia. The 472-acre campus straddles Interstate 81 and is two hours from Washington, DC.

Please send a letter of application with a resume and the names, addresses and telephone numbers of three references to Search Committee, Department of Computer Science, James Madison University, Harrisonburg, VA 22807. These materials may also be sent in ASCII format to reynolds@cs.jmu.edu.

Review of candidates will begin March 1, 1997, and will continue until the positions are filled.

James Madison University is an equal opportunity, affirmative action, equal access employer and especially encourages applications from minorities, women and persons with disabilities.

Computists International

Computists' Communique

AI students/faculty: weekly e-mail digests of M.S./Ph.D. research jobs, grant competitions, resource announcements, industry news, etc. Computists International is a professional association of AI/IS/CS research scientists. Details from http://www.computists.com or laws@computists.com. Free departmental trials.

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page at http://www.cise.nsf.gov for more information and for program announcements.)

MIPS will emphasize advanced memory hierarchies and rapid design for prototyping electromechanical systems.

IRIS will have three new initiatives:

1. A new Digital Libraries Initiative.

2. Knowledge networking research in such areas as collaboration technology and virtual environments.

3. A new program to support information infrastructure to facilitate data-centered experimental research.

Advanced Scientific Computing, the division that funds the National Supercomputer Centers program, will stay level, continuing a three-year trend. Over the next year the centers face a major restructuring of support. The outcome of the recompetition will be presented to the National Science Board in late March. It is expected that the number of centers supported will decrease by one or two, but that the pattern of support will be more complex, with funding going not only to the national centers, but also to other research centers associated with a national center.

The Networking and Communication Research Infrastructure Division will receive an 11% boost after three years of flat funding. The NCRI increase is linked to its role supporting NGI activities.

Table 2. HPCCI Funding (in millions of dollars)

Agency	1996 Actual[1]	1997 Planned	1998 Request[2]
Commerce (NIST & NOAA)	31	32	35
Defense (DARPA & NSA)	315	334	357
Education	12	12	12
Energy	111	117	152
EPA	12	6	6
HHS (NIH)	81	90	97
NASA	116	114	128
NSF	291	278	294
Transportation	23	20	25
Veterans Affairs	21	22	22
Total HPCCI Funding	**1,023**	**1,025**	**1,128**

[1]Estimated; [2]Includes $100 million for Next-Generation Internet initiative

The Cross-Disciplinary Activities Office continues to grow rapidly, in terms of percentage and increment. The increase will go toward a new Learning Technologies initiative and infrastructure support for the Knowledge Networking initiative.

HPCCI

The HPC Act has expired. Although the House Science Committee held hearings, the administration was ambivalent and the act was not renewed. The administration argued that the president would continue the program as a NSTC initiative although possibly in a significantly expanded form.

The initiative is still in the budget under the HPCC label. It has been level for the past few years at about $1 billion, but the 1998 request is up by 10%. The $103 million increase corresponds to the $100 million NGI program that has been put into the HPCC budget.

In terms of absolute increase in funding, the departments of Energy and Defense are the big winners, with NSF coming in third. This has raised some questions, because NSF has played a major role in past Internet developments. NSF participation in HPCC had dropped over the last three years, and even the increase for 1998 does not bring NSF up to the 1995 level.

Some NSF officials explain these numbers as reprogramming, and no doubt to some extent, that is still going on. Yet the symbolism to the outside world, particularly Congress, may be more negative. Some congressional staff have questioned whether NSF's move to the Virginia suburbs represents an administrative as well as physical move to the margins of science and technology policy.

Similarly, in the face of the great administrative emphasis on educational technology, the Education Department's participation in HPCC is flat. Somehow, the fact that today's high-performance computer is the everyday classroom desktop computer of the 21st century has not percolated into the budget process.

Half full or half empty?

So, does the budget contain good news or bad news? The good news is that computing research clearly is still an R&D priority, in the public and political minds. Despite threats and continuing concerns about the effects of budget balancing, research seems to be holding its own, at least for now.

But, as Rep. George Brown, the ranking Democrat on the House Science Committee and a longtime observer of science policy, said when the budget was released: "The president's strong State of the Union comments in support of science, technology and education were extremely encouraging. Overall, however, his budget falls far short of what needs to be done."

If R&D, particularly computing research, is as important to the nation's future well-being as we believe and say, then it is time to get serious about improving the funding picture in a dramatic way. And NSF has to help lead the way.