COMPUTING RESEARCH NEWS

The News Journal of the Computing Research Association

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News Analysis

Deciding the future of NSF

By Fred W. Weingarten
CRA Staff

This political year will see fierce debates over several key R&D issues, many with serious implications—both domestically and internationally—for the future of science and engineering. Many of those debates will concern the National Science Foundation (NSF), and the outcome may determine the future of that agency. It is an issue the entire scientific community must pay attention to.

Last year, there were broad, strategic discussions about the future of science and technology (S&T) policy and the changing relationship between government and the research community. This year, those general discussions will continue, but they will be accentuated by battles over specific issues.

The political process ultimately collapses large issues into a series of smaller, concrete decisions that ultimately rest on binary votes. A member of Congress votes "yea" or "nay" on a bill; a judge decides for the plaintiff or defendant; and an agency head decides whether or not to issue a regulation.

In early January, NSF lost its long battle over relocation. (See Page 11). NSF could not muster support from the new administration to stave off a sudden burst of pressure from the outgoing Bush administration. NSF will move to suburban Virginia, a few miles away from its cozy location virtually next door to the White House.

Though the effects of the move can be exaggerated, access to agency heads will be more difficult and the officials may feel more isolated, just when S&T policy is undergoing great change. Worse, with the departure of Director Walter Massey (See Page 10), NSF may, in essence, be leaderless at a time when its own future is being decided.

In a city in which nearly anything can have political meaning, the move also seems to have symbolic meaning. In this case, it seems to reflect the threat, at least perceived, that basic research, as represented by NSF, may become isolated from the broader thrust of federal S&T policy—"marginalized," to use a current buzzword. There is some basis for worry. NSF was barely mentioned in the confirmation hearings for the new science adviser, John Gibbons. NSF's recent budget woes have been cataloged in *CRN,* and there

Continued on page 10

"Gore II" bill introduced on first day of new session

By Juan Antonio Osuna
CRA Staff

Less than 24 hours after President Clinton was inaugurated, Senate Democrats introduced a bill to strengthen national competitiveness in critical areas of technology such as high-performance computing and networking, advanced manufacturing and wind engineering.

The National Competitiveness Act of 1993 (S 4), introduced in late January by Sen. Ernest Hollings (D-SC), includes legislation struck down last year by the Bush administration.

The three bills reincarnated in the current one are the Manufacturing Strategy Act, the Wind Engineering Act and the Information Infrastructure and Technology Act. The first two were introduced by Hollings and the third by then-Sen. Al Gore (D-TN).

The current legislation reflects a long history of debate and refinement and is consistent with Clinton/Gore campaign statements.

The Information Infrastructure and Technology Act, labeled "Gore II," seeks to:

- increase funding for high-performance computing R&D,
- improve education at all levels,
- build digital libraries accessible over networks,
- improve electronic communication among health care providers,
- increase productivity of workers, especially in manufacturing, and
- coordinate the building of a national information infrastructure to serve all citizens.

The legislation specifically mentions the creation of several testbed projects—one to link hospitals, clinics, doctors and medical libraries together, the other to connect primary and secondary schools to the Internet.

The legislation would authorize $60 million for fiscal 1993, $120 million

Continued on page 11

Inside CRN

CRA board members meet in Chicago

By John R. Rice
CRA Chair

At the CRA board of directors meeting in Chicago Dec. 10-11, we welcomed two new board members. Patrick Hayes of Stanford University is the American Association for Artificial Intelligence representative, and John Werth of the University of Texas is the second Association for Computing Machinery representative.

The first substantial item of discussion was finances, and the report was satisfactory: (1) The 1992 year ended with $18,807 more income than expenses. (2) Payment of dues by academic and industrial members is about as expected in spite of hard times in academia and the computer industry. (3) The 1993 estimate projects an income of $584,700—of which $385,800 already has been collected—and expenses of $553,000. (4) The projected year-end funds balance is just over $100,000, which is much better than a year or two ago, but still low for an organization of this size and type.

Fred W. Weingarten reported on the collaborative agreement between CRA and ACM in the area of government relations. Through the arrangement, ACM will provide support for additional government relations efforts and a new junior staff person. Weingarten has assumed the additional title and duties of ACM director of US public policy.

Weingarten also reported on the progress in installing a workstation and network connection in the CRA offices. It is anticipated that CRA can use this equipment to provide several useful information services to its members.

The board discussed at some length the policy of paying travel expenses for CRA activities. Currently, CRA pays expenses for the staff and for some board members to attend a few specialized activities, such as travel to Washington to testify before Congress. All board members pay for at least two trips a year to attend board meetings, and many pay to attend committee meetings.

This is a substantial financial burden that larger, more affluent organizations pay for their volunteers. It was reaffirmed that board members are responsible for the travel expenses to board meetings. CRA may help pay for the expenses of extra activities, especially for CRA officers, and the chair may use his contingency fund of $5,000 to help board members with acute problems.

Brief reports were given on past and proposed workshops. The evaluations of the CRA Snowbird Conference '92 were extremely positive, although many attendees wanted more free time. Plans for FCRC '93 in May are on track. CRA organized the Computing Research Policy Summit last October. In November, CRA held a small planning workshop on human resources data in Washington, DC. CRA participation in ACM's Computer Science Conference was discussed. Next year, ACM is reorganizing CSC, and CRA plans to collaborate with the ACM planning committee so CRA retains a significant role in this conference. The first CRA Industrial Research Workshop at Snowbird is July 11-13.

Government affairs issues consumed a large part of the agenda due to the many changes in federal and industrial research funding. This was the topic of the board's dinner meeting, and these discussions are summarized at the end of this article.

CRA submitted a statement to the Commission on the Future of the National Science Foundation. The future directions of change for NSF still are uncertain, especially with the recent resignation of Walter Massey as NSF director. Ed Lazowska, chair of the CRA Government Committee, has an ambitious plan to develop CRA positions and initiatives in this area. A meeting of this committee is scheduled for March 17 to help crystallize ideas

Continued on page 3

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Expanding the Pipeline

Reducing the drop-out rate

BY Claire Toynbee

Why do so few women study computer science? While there are no easy answers, my research at Victoria University of Wellington in New Zealand suggests computer culture alienates young women in their initial contact with the field. Three years of research, including two surveys and 40 in-depth interviews with drop-outs, shows that women taking introductory courses find themselves "on the outer," facing adversities unfamiliar to many white, middle-class men. Given these adversities, it is surprising so many women succeed.

The research

In 1990, our computer science department asked me to find out why women were disappearing from an entry-level course for computer science majors. The intent of the research was to alleviate the situation. I worked regularly with Judy Brown, the women's adviser and one of only two women in the department. She was to act on our recommendations.

Our department offers three courses at the first-year level—COMP 102, an introductory class for computer science majors; COMP 103, a continuation of 102; and COMP 130, an introduction for non-majors.

In the course for non-majors, about half the students are women, and the drop-out rate is low for both sexes. In COMP 102, the major course, women make up just less than a quarter of the class and drop out at double the rate of men. Women also are more likely to fail than men, as 52% of women pass compared with 78% of men. Finally, only 11% of women compared with 28% of men get As, providing they complete the course by taking the final exam.

University statistics show that (1) women generally surpass men in their first year at Victoria University, and (2) overall they are no more prone than men to drop out. Women do not disproportionately drop out of other courses. Even in physics, where women are poorly represented, the drop-out rates are the same for both sexes.

We surveyed the class because little was known about the students, apart from their academic records. After designing and conducting the survey, too few women remained to do a statistical analysis. Survey results from the next two years do indicate some gender-related differences. About 370 students were surveyed in 1991 and 1992. This represents a 70% response rate, as some students had skipped class on the survey days.

Overall, COMP 102 students were young (about 18 years old), still lived at home and spoke English as their native language. However, women were on average older, less likely to be first-year students and less likely to speak English as their native language. They were less likely to own a computer and to have had prior computing courses. Also, more women were employed than men. Generally, the students were quite confident. Almost half of the men—and only a third of the women—expected to get an A in the course.

Many men had enrolled in the course because they enjoyed hacking and had owned computers before entering college. They were much more likely than the women to have ventured into programming before college. Many men had been members of computing clubs and users of electronic bulletin boards.

Some women also had owned computers at home, were confident, and eagerly looked forward to becoming computer scientists. But, overall, women were less likely to have owned computers, and those who did had to compete for access to "the family" machine.

Although the course prospectus welcomed inexperienced students, most of them had to struggle with the Macintosh and conceptual problems associated with their assignments. Overall, 40% said they would have liked an introductory course. The corresponding statistic for women was 60%.

The time that students spent with computers varied widely according to whether students worked at home or in the labs, doing their assignments or just hacking. A relatively high proportion of young men could complete weekly assignments in less than five hours, and some could even do them in less than two hours. Young women, and students whose mother tongue was not English, took much longer. Several students confessed to spending more than 20 hours a week on assignments. And they all had other course work to complete.

Because of a resource shortage in 1990 and 1991, some students became frustrated by the lack of Macintoshes, working printers and an efficient booking system. The lack of campus resources gave an advantage to students with computers at home. Inexperienced students without computers at home spent more time doing their weekly assignments. Also, many students had heavy academic work loads, involving long laboratory hours each week in addition to lectures and tutorials.

Some women were overwhelmed by the first assignments and had little idea how to approach the exercises. Some remarked that everyone else seemed so confident and that they themselves felt stupid. They said they were afraid to seek help and reveal their ignorance.

Perhaps, the problem also has to do with low self-esteem. Several women said they dropped out because they felt intellectually intimidated in seeing others finish their work early and in hearing others persistently ask questions in an unfamiliar jargon. Students who finished lab work quickly often were reported as "showing off" by going on to do other creative tasks such as drawing background screens. One mature woman student referred to this as "strutting behavior."

Changes from 1990 to 1992

From 1990 to 1992, following our research, the course was changed to remedy the high drop-out rate. The first immediate change was to upgrade the labs and the booking system. Later, a new lab was formed with more Macintoshes and better printing facilities.

Based on our research, we recommended splitting COMP 102 into two courses so inexperienced students wishing to major in computer science could proceed more slowly through the

Continued on page 9

Letters to the Editor

Children at conferences

Dear Editor:

Thank you for publishing Elaine Weyuker's column about the lack of childcare at conferences [January *CRN*, Page 2]. I would like to add my two cents to the debate. My motives are only partially selfish: One of the most memorable moments of my "home conferences" (the ACM Symposium on the Theory of Computing and the IEEE Foundations of Computer Science) was watching Maria Klawe's and Nick Pippenger's infant daughter Sasha enjoy the penguins at the Boston Aquarium, years ago. At the time, I thought Sasha was too young to see anything that far away. Now that I have had a second, more observant, child of my own, it is not at all hard to believe.

I do like seeing kids at conferences. My suggestion to the (often overworked) local arrangements chair is to recruit a volunteer to organize a childcare cooperative. Ideally, this volunteer would find a local childcare provider willing to work evenings and perhaps some daytime hours at a hotel suite. The rest of the labor and toys and other necessities would be provided by parents (conference attendees) participating in the co-op. The hotel should be able to set up a few cribs. Pre-conference organization (to decide on a schedule and operating policies) could be carried out by E-mail and moderated by the volunteer coordinator. I would expect the registration fee to cover the cost of the hotel suite for the child-care—although an ambitious fund-raising committee probably would consider a corporate donation an attractive option. One reason to set up a co-op is to sidestep some of the liability exposure of a more formalized childcare operation. I would not be surprised to hear that the fear of litigation is one of the reasons hotels are so recalcitrant about delivering anything in the way of childcare services. Another reason to set up a co-op is that it can be a lot of fun, once you get past the organizational hassles.

Clark Thomborson
ACM visiting professor of electrical engineering and computer science at the Massachusetts Institute of Technology and a computer science professor at the University of Minnesota at Duluth.

Association News

CRA sponsoring workshop for industry at Snowbird

The Computing Research Association is sponsoring the CRA Industrial Research Workshop at Snowbird for technical managers of industrial computing research. The goal of the workshop is to increase the effectiveness of industrial computing research by promoting the communication of common concerns and solutions.

The workshop is at the Snowbird resort near Salt Lake City. It begins the evening of Sunday, July 11, and ends at noon on Tuesday, July 13. The registration fee, which includes meals, is $350. Hotel costs are extra. Attendance is limited.

The workshop is modeled after the extremely successful biannual CRA Snowbird Conference for academic department chairs, government officials and industrial computing research managers. The workshop will feature panel discussions, invited speakers and plenty of time to get to know one another.

Attendance is limited to managers of industrial computing research organizations in North America who are at a level roughly equivalent to academic department chairs. The focus will be on managing strategically oriented, pre-competitive research, a substantial fraction of which is published in the open scientific literature. If a large number of people want to attend the workshop, CRA and the workshop organizers will select the attendees.

The keynote speaker will be John Seely Brown, who is vice president of advanced research for Xerox, head of Xerox's Palo Alto Research Center and the Xerox chief scientist. Brown is the author of the controversial article, "How Research Reshapes the Corporation," published recently in the *Harvard Business Review.*

Topics planned for the panel discussions include managing the relationship with the company; the social contract for industrial fundamental research; joint research with universities and with other companies; handling successes and disasters; research metrics and quality management; managing intellectual property; and the balance between research freedom and research management.

For more information about the workshop, contact Mark Weiser, the workshop organizer, at Xerox PARC, 3333 Coyote Hill Road, Palo Alto, CA 94304. E-mail to weiser@xerox.com is preferred. For more information about registering, contact Kimberly Peaks at tel. 202-234-2111 or E-mail: kimberly@cs.umd.edu.

Snowbird is renowned as a winter resort, but also is great fun in the summer. On a mountain incline 30 miles northeast of Salt Lake City, the resort features mountain hikes, a tram ride to the top of the mountain, clean air, rushing mountain streams and a full-service health spa.

Attention CRA Members:

One of the benefits of being a member of the Computing Research Association is access to free mailing labels of our membership and the CRA Forsythe List. The labels are available in electronic form or on Cheshire or laser labels. The labels are available to non-members for $25 per set. For more information, contact Phil Louis at tel. 202-234-2111; fax: 202-667-1066; or E-mail: plouis@cs.umd.edu.

COMPUTING RESEARCH NEWS

Vol. 5/No. 2/March 1993

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Two appointed to CRA board

The Computing Research Association welcomes two new members to its board of directors. John Werth, a senior lecturer and research scientist in the Department of Computer Sciences at the University of Texas, Austin, was appointed as a second Association for Computing Machinery representative. (Dorothy Denning is the other ACM representative.)

The other new board member is Patrick Hayes, a consulting professor in computer science at Stanford University and a visiting scholar at the Beckman Institute at Urbana in Illinois. Hayes, who is the president of the American Association for Artificial Intelligence, is the AAAI representative on the CRA board.

Werth earned a bachelor's and master's degree in mathematics from Emory University and a doctorate in mathematics from the University of Washington.

Werth was assistant professor, then assistant department head of mathematics at New Mexico State University from 1968-1975. He then was an associate professor and later chair of computer science and electrical engineering at the University of Nevada, Las Vegas, from 1975-1985. He has been an ACM member since 1975 and is program chair for the Computer Science Conference '94.

His research interests are in parallel programming, software engineering and computer science education. He is participating in the specification and construction of a graphical software development environment for writing parallel programs. He is active in the continuing education of computing professionals.

Hayes read mathematics at Cambridge, graduating in 1965 to join the new Machine Intelligence Program at Edinburgh, and earned a Ph.D. in automatic theorem-proving. In 1972 he became a professor at Essex University, establishing a new AI group there. He spent 1979 as a fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford, and in 1981 emigrated to the United States, taking a Luce Chair at the University of Rochester. In 1985 he began pursuing industrially sponsored research in California.

Hayes has been involved with many of the major AI academic societies. He was secretary of Artificial Intelligence and Simulation of Behavior (AISB) for several years, wrote its constitution and edited its newsletter from 1968 to 1971. He was chair of the International Joint Conference on Artificial Intelligence from 1980 to 1982 and an IJCAI trustee until 1987. He organized the fifth Cognitive Science conference in 1983 and was a member of that society's governing board for several years.

Rice from page 1

and to plan for involvement of the entire computing research community. "Town meetings" on this topic are scheduled at both CSC and FCRC.

Other committee reports received and discussed by the board were: (1) *Publications:* A small pilot effort will be started to increase advertising revenue in *Computing Research News.* (2) *Status of Women:* Maria Klawe and Nancy Leveson reported that the committee has organized a workshop at FCRC '93 and is making good progress in developing its database resource. (3) *Elections:* Juris Hartmanis and David Wise reported that the procedures and schedule now have been codified. (4) *CRA Taulbee Survey:* Earl Schweppe reported that the data has been collected and analysis programs implemented. (5) *Teaching:* David Patterson described his program to provide videos and course notes from top teachers to help new faculty get started in teaching. The board endorsed the program.

The dinner discussion was long and vigorous. It almost entirely revolved about the "Case for Computing Research," (a document being planned by the Government Committee) though this was not explicitly stated. John Rice started the discussion with remarks about the Computing Research Policy Summit:

- The goals of the 20 or so attendees were remarkably compatible, including those from industry and the social responsibility group.
- It is felt that Congress is the decision-making body for any substantial changes in research funding and policies. Congress is pushing for changes and is likely to make it happen. Legislators are looking for research clearly related to national goals.

Considerable heat was generated in discussions of competition between the sciences, but it finally was agreed that CRA's efforts should focus on the benefits of computing research.

The discussion then shifted to what CRA should do to influence this process. Weingarten described how congressional decisions involve many parties and combinations of interests. Our objective should be to educate non-technical decisionmakers about computing research. Steps to do this include:

(1) Prepare short case statements of about three pages in length on topics such as science, engineering and medical applications, communication and networks, information infrastructure, education, economic impact, and control of processes.

(2) Prepare a long case statement that combines the aforementioned topics with specific recommendations.

(3) Schedule at least three congressional policy seminars in 1993 on key topics.

(4) Congressional testimony, either oral or written, should be presented by the heads of CRA, ACM and IEEE, probably at NSF's reauthorization hearings.

Finally, there was a discussion of Klawe's innovative proposal to "invite your local politician to the computing lab." This is a longer-term proposal, but such steps are important for our profession.

John Rice is chair of the CRA board of directors and chair of computer science at Purdue University.

1991-92 CRA Taulbee Survey

CS departments produced 909 Ph.D.s; rate of growth increased, but not by much

The 1991-92 CRA Taulbee Survey is the Computing Research Association's survey on the production and employment of Ph.D.s and faculty in computer science and computer engineering.

BY Earl Schweppe

This report describes the results of a survey, completed in December 1992, of the CRA Forsythe List of computing departments.[1] The survey concerns the production and employment of Ph.D. recipients who graduated in 1991-1992[2] and the faculty of Ph.D.-granting computing departments during the academic year 1992-1993.

All 140 computer science (CS) departments offering a Ph.D. degree (128 in the United States and 12 in Canada) and 31 of 33 departments offering a Ph.D. degree in computer engineering (CE) participated in the survey. CE statistics are reported separately so comparisons with previous years can be made for computer science. However, the statistics for computer science and computer engineering slowly are being merged. Some survey highlights:

• The 140 computer science departments produced 909 Ph.D.s, an increase of 47 (5.5%) over the previous year. This compares with an increase of 17% last year. Of the 909, 410 were known to be US citizens, 44 were Canadians and 425 were foreigners. Of the 807 whose job placement was known, 311 (39%) stayed in academia, 313 (39%) went to industry, 32 (4%) went to government, 121 (15%) left North America, 14 (1.7%) were self-employed and 16 (2%) were unemployed.

• Only 1,221 students passed their Ph.D. qualifying examination in the computer science departments, a 6% decrease from the 1,301 in 1990-91.

• Only 11 blacks, 15 Hispanics and 108 women (12%) received Ph.D.s in computer science.

• The 140 CS departments have 2,699 faculty members (in last year's survey, 137 departments had 2,725): 861 assistant, 813 associate and 1,025 full professors. The total decreased by about 1%, but seniority increased this year.

• The 140 CS departments reported hiring 138 new Ph.D.s and losing 173 faculty to retirement, death, graduate school or non-academic positions.

• Only 14 assistant professors in the 140 departments are black, 17 Hispanic and 118 (13.7%) female, but this is a gain of almost 4% for women. There were 76 (9%) female associate professors—a loss of nine—and 47 (4.5%) female full professors—a loss of three.

Growth of faculty in the Ph.D.-granting departments was steady for 20 years. Last year that number remained about the same, and this year the number of faculty declined by about 1%. Several factors contributed to this trend. The current economic climate has restricted hiring in many schools, but more importantly, departments appear to be approaching a steady state in size relative to other university departments. The newer and smaller departments still are projecting a five-year growth of 10% to 25%, but the larger, more mature departments indicated a slower rate. These projections have proven to be fairly optimistic in the past and may be now as well.

The number of losses from death and retirements decreased from 35 to 27 this year. But in 1989-90 and before, that number was much lower. The field is maturing, so we can expect even more losses in the future.

As another sign of maturity, the computer science Ph.D.-granting departments now have more full professors (1,025) than assistant professors (861). As departments become more tenured, there will be fewer openings for new Ph.D.s.

This decrease in faculty positions in Ph.D.-granting departments is reflected in a decrease in the percentage of the new Ph.D.s staying in academia. Three years ago, 49% of the new Ph.D.s stayed in academia. Last year that dropped to 42%, and this year it was only 39%. The reduced number of openings in the larger, more well-established departments means that more Ph.D.s are available to staff smaller Ph.D.-granting departments, master's-degree departments and teaching-only departments. This makes a better-educated staff available to schools that in the past had to rely on faculty who did not have formal education in this field. In the future, some new Ph.D.s may have to take such positions.

Six years ago, CRA's Taulbee Survey [8] said the estimated demand in 1984-85 for 1,000 computer science Ph.D.s per year far outstripped the supply of 325 degree recipients. It recommended increasing Ph.D. production up to 10% a year. Had the increase been 10% per year, we now would be producing 575 Ph.D.s per year. Instead, the rate of increase averaged 18% per year in the past six years, and in 1991-92 there were 909 Ph.D. recipients. How long will such growth continue? Can academia, industry and the government digest this many Ph.D.s per year? Only time will tell.

Table 1. Titles of Departments

No. of Depts.	Title and College or School
93	Computer or Computing Science(s) Department
22	Electrical and Computer Engineering
13	Computer Science and Engineering
10	Computer and Information Science(s)
8	College or School of Computer Science (or CIS)
9	Electrical Engineering and Computer Science
3	Mathematical and Computer Sciences
2	Computer Science and Operations Research
2	Electrical Engineering
1	Advanced Computer Studies
1	Applied Sciences
1	Computational Science
1	Computer Engineering and Science
1	Electrical, Computer and Systems Engineering
1	Electrical Engineering Systems

(Instead of department, the terms college, division, program and school each were used at least once.)

Methodological comments

Questionnaires were sent to 140 computer science Ph.D.-granting departments and 35 computer engineering Ph.D.-granting departments in September 1992. The department titles appear in Table 1.

All 140 CS departments completed the questionnaire. Two of the 35 computer engineering departments asked to be removed from the CRA Forsythe List because they do not grant Ph.D.s in computer engineering. Two did not complete the questionnaire.

The accuracy of this report depends on how accurately the questionnaires are filled out. Joint electrical engineering/computer science and electrical engineering/computer engineering departments had a particularly difficult time completing the questionnaire because they had to extract the computer science or computer engineering information for their departments.

A section of this report analyzes data for higher-ranked departments, compared with lower-ranked and unranked departments. The ranking is based on information from a 1980 survey done under the auspices of the National Research Council [1]. (The two largest Canadian universities also are included in the top 24 departments.) The 1980 survey is outdated, but the breakdown has provided useful comparisons over the years.

Some sections of this report compare figures among computer science departments only. This is done so information from past surveys can be used to draw meaningful conclusions about growth of the field. Computer engineering figures are listed separately. Throughout this report, figures for 1970-1984 are taken from Ref. 10. The figures for 1970 through 1984 may not be accurate because not all departments completed questionnaires. For the academic years beginning 1984-85, the figures are taken from the appropriate CRA Taulbee Survey as follows: 1984-85, Ref. 2; 1985-86, Ref. 3; 1986-87, Ref. 4; 1987-88, Ref. 5; 1988-89, Ref. 6; 1989-90, Ref. 7; and 1990-91, Ref. 8. For these years, the figures are more accurate because almost all the departments completed the questionnaire.

Data on departments

A table has been added showing when departments graduated their first Ph.D. recipients. For 30 years, the computer science community has debated what our departments should be called and where in the university structure they should be located. In analyzing the survey responses, it was clear this question has not yet been resolved. In the past, Table 1 indicated the preponderance of the use of the title "computer science" or some slight variation of it. Only 25 (about 20%) of the CS departments are located solely in colleges of arts and sciences. In 19 universities, the CS department is located in a college or school of science or an institute of technology. Thirty-eight of the departments are located in engineering; engineering and applied science; or engineering and computer science. Finally, eight universities have colleges or schools of computer science, or some variation. In the future, we will refine this information.

In the earlier surveys, departments were asked whether they had graduated their first Ph.D. Although this question made a lot of sense in the 1970s, almost all departments now would answer yes. This year we asked respondents when their departments graduated their first Ph.D. The responses of 127 CS departments are presented in Table 2; the other CS departments did not respond. The CE departments were not included because many of them have existed for 50 years or more, and their response might not be for CE degrees. No effort has been made to verify this data, but it may be of some interest. There is an opportunity for some historical

Text continued on next page

• The title of the survey honors Orrin E. Taulbee of the University of Pittsburgh, who conducted these surveys from 1970 to 1984.

[1]The CRA Forsythe List is the list of all departments in the United States and Canada that grant a Ph.D. in computing—computer science (CS) and computer engineering (CE). It is maintained by the Computing Research Association. This is the fifth year computer engineering departments have been included.

[2]Four departments explicitly said they were reporting on the 1991 calendar-year basis; the rest indicated academic year or did not say.

1991-92 CRA Taulbee Survey

Table 2. When Responding Departments Graduated Their First Ph.D.

Year	# of Depts.	Year	# of Depts.	Year	# of Depts.	Year	# of Depts.
Before 1960	1	1968	7	1977	5	1986	11
1960	1	1969	7	1978	1	1987	7
1961	0	1970	3	1979	4	1988	4
1962	1	1971	7	1980	4	1989	5
1963	0	1972	0	1981	3	1990	6
1964	0	1973	8	1982	5	1991	5
1965	2	1974	4	1983	4	1992	1
1966	3	1975	3	1984	5		
1967	2	1976	2	1985	6		

Table 3. Ph.D. Production and Growth

	Year	Depts. That Returned Survey	Ph.D.s Produced	Average per Dept.	Passed Qualifier	Average per Dept.	New Ph.D. Students	Average per Dept.
CS Depts.	1984-85	103 of 109	326	3.2	755	8.2	1,177	12.0
	1985-86	117 of 118	412	3.5	858	7.3	1,170	10.0
	1986-87	123 of 123	466	3.8	1,008	8.2	1,430	12.0
	1987-88	127 of 127	577	4.5	1,113	8.8	1,497	12.0
	1988-89	129 of 129	625	4.8	1,215	9.4	1,632	13.0
	1989-90	135 of 136	734	5.4	1,173	8.7	1,434	11.0
	1990-91	137 of 137	862	6.3	1,301	9.5	1,545	11.0
	1991-92	140 of 140	909	6.5	1,221	8.7	1,666	11.9
CS&CE Depts.	1986-87	145 of 156	559	3.9	1,168	8.1	1,621	11.0
	1987-88	157 of 161	744	4.7	1,399	8.9	1,801	11.0
	1988-89	158 of 161	807	5.1	1,441	9.1	1,993	13.0
	1989-90	167 of 170	907	5.4	1,482	8.9	1,817	11.0
	1990-91	166 of 168	1,073	6.5	1,646	9.9	1,861	11.0
	1991-92	171 of 173	1,113	6.5	1,495	8.7	2,025	11.8

Table 4. Ph.D. Production in 1991-92 by Ranking

Rank	Ph.D.s Produced	Ph.D.s per Dept.	Ph.D.s Next Year	Average per Dept.	Passed Qualifier	Average per Dept.	New Ph.D. Students	Average per Dept.
All CS Depts.	909	6.4	1,038	7.4	1,221	8.7	1,666	11.9
CS 1-12	228	19.0	241	20.0	205	17.0	322	26.8
CS 13-24	144	12.0	137	11.4	183	15.2	215	17.9
CS 25-36	115	9.5	121	10.0	144	12.0	334	27.8
Other CS	422	4.0	539	5.1	689	6.6	795	7.6
All CE Depts.	204	6.5	231	7.4	274	8.8	359	11.5

Table 5. Sex and Minority Status of Ph.D.s

	CS			CE			CS&CE		
Ph.D. Minority Status	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
White	397	69	466	69	7	76	466	76	542
Black	10	1	11	0	0	0	10	1	11
Hispanic	11	4	15	2	0	2	13	4	17
Asian	284	28	312	92	8	100	376	36	412
Other or Unknown	99	6	105	23	3	26	122	9	131
Total	**801**	**108**	**909**	**186**	**18**	**204**	**987**	**126**	**1,113**

CRA Taulbee text from previous page

research on the early doctorates in computer science and engineering.

Data on students

Ph.D. production and its growth

Computer science departments produced 909 Ph.D.s in 1991-92, an increase of only 47 (5. 5%), compared with 128 (17%) last year. But this was an increase of 679 (295%) over 1980. Table 3 shows the figures on Ph.D. production for computer science and computer engineering, as well as for qualifying examination passage and sizes of incoming classes. Under the Table 3 column headed "Depts. That Returned Survey," the first number is the number of departments that responded, and the second the total number of known Ph.D.-granting departments.

As mentioned above, computer science Ph.D. production increased by 47 to 909. In last year's survey, departments expected to produce 1,098 this year. As usual, departments were overly optimistic on this point. Interestingly enough, after the number of students passing the qualifying examination increased last year from 1,173 to 1,301, the number fell to 1,221 this year. As a contrary indicator, the number of students entering a computer science Ph.D. program increased from 1,545 last year to 1,666 this year.

Ten computer science departments produced more than 20 Ph.D.s each, and the 21 most productive departments produced more than 12 each. These 21 departments produced more than half (511) of the 909 computer science Ph.D.s. At the other extreme, 70 departments produced fewer than five Ph.D.s; 28 produced fewer than two, and 14 did not produce any Ph.D.s last year. Table 4 presents data for the groups of departments in various rankings [1] in an attempt to find different than expected growth patterns.

Sex and minority status of the Ph.D.s

Table 5 gives the discouraging figures on doctorates awarded to minority students and women. Table 6 presents some of these statistics for the 23-year period beginning in 1970. Throughout the 1980s, the percentage of Ph.D. recipients who are women remained relatively constant at 10% to 14%, while the number of blacks was constant at about 1% and Hispanics at about 2%.

Citizenship of the Ph.D.s

Data on the citizenship of the new Ph.D.s is given in Table 8. The percentage of degrees given to foreigners rose to nearly 50%. That percentage had been about 40% to 45% for six years. Note, however, that the number and percentage of "unknown" citizenship decreased last year.

Table 9 shows the job placement distribution for the new Ph.D.s. The percentages are based only on the number of Ph.D.s whose job placement was known. For example, 311 computer science Ph.D.s took jobs in academia, which is 38% of the 807 whose job placement was known. The percentage of computer science Ph.D.s going into academia decreased from 42% to 38%, while the percentage going into industry remained constant at 39%.

This is the third year in a row that the percentage of Ph.D.s taking faculty positions has decreased. Three years ago it was 49%; now it is 38%. A major reason for this decrease is that significantly more new Ph.D.s are competing for fewer positions. Larger and more well-established departments are hiring fewer faculty members. In fact, 106 departments reported not hiring any new Ph.D.s.

Undergraduate and master's degrees

Many universities and colleges have undergraduate and master's programs but do not award a Ph.D. degree. So the data given below says little about computer science as a whole. Table 10 gives statistics on undergraduate and master's degrees in

Text continued on page 6

1991-92 CRA Taulbee Survey

Table 6. Sex, Minority Status and Citizenship of CS Ph.D.s Since 1970

Year	Total Ph.D.s	Female	Percent of Total	Black	Percent of Total	Hispanic	Percent of Total	Foreign	Percent of Total
1970	112	1	1%	1	1%			22	20%
1971	124	4	3%	1	1%			21	17%
1972	206	12	6%	2	1%			39	19%
1973	208	7	3%	2	1%			41	20%
1974	203	6	3 %	2	1%			46	23%
1975	256	21	8%	1	0%	**No information available until 1984-85**		68	27%
1976	246	14	6%	0	0%			57	23%
1977	208	14	7%	0	0%			68	33%
1978	223	19	9%	2	1%			51	23%
1979	248	24	10%	1	0%			65	26%
1980	230	28	12%	0	0%			82	36%
1981	235	26	11%	0	0%			79	33%
1982	244	27	11%	1	0%			83	34%
1983	256	31	12%	2	1%			86	34%
1984	274	29	10%	3	1%			87	32%
1984-85	326	32	10%	3	1%	7	2%	122	37%
1985-86	412	50	12%	6	1%	6	1%	184	45%
1986-87	466	51	11%	1	0%	8	2%	181	40%
1987-88	577	60	10%	4	1%	5	1%	238	41%
1988-89	625	87	14%	0	0%	6	1%	248	40%
1989-90	734	97	13%	3	0%	8	1%	331	45%
1990-91	862	113	13%	7	1%	19	2%	384	45%
1991-92	909	108	12%	11	1%	15	2%	425	47%

Table 7. Number of Ph.D.s with Disabilities in 1991-92

	US	Canada
CS	2	0
CE	0	0
CS&CE	2	0

Table 8. Citizenship of the Ph.D.s in 1991-92

	US	Canada	Foreign	Unknown	Percent Foreign
CS	410	44	425	30	46.7%
CE	63	1	129	11	63.2%
CS&CE	473	45	554	41	49.7%

Table 9. Employment of the Ph.D.s

	# of Ph.D.s	Unemployed	Self-Employed	Ph.D. Dept.	Non-Ph.D. Dept.	Non-CS or CE Dept.	Industry	Gov't	Not US or Canada	Unknown
CS	909	16	14	203	80	28	313	32	121	102
Percent		1.7%	1.5%	22.3%	8.8%	3.0%	34.4%	3.5%	13.3%	11.2%
CE	204	4	0	23	2	1	52	7	18	97
Percent		1.9%	0%	11.2%	.9%	0.4%	25.4%	3.4%	8.8%	47.5%

the Ph.D. departments, with columns labeled "92-93" representing expectations. Last year saw an 8.5% decrease in the number of bachelor's degrees awarded, but the number of master's degrees was almost constant.

New graduate students in the fall of 1992

Table 11 gives enrollment figures for new students in the fall of 1992. In that table, "Ph.D. Program" stands for the number of new graduate students in Ph.D. programs, regardless of whether they intend to earn a master's degree first. The number of new graduate students in computer science increased 7% from 4,275 to 4,550; and the number of new graduate students in computer science Ph.D. programs increased 8% from 1,545 to 1,666. Table 12 gives the number of new Ph.D. students in computer science departments this year and during the past four years, with departments grouped by rank.

Data on faculty

Size and distribution

Table 13 contains statistics on departmental faculty as of January 1993. In the table, all figures are in terms of full-time equivalents. For example, two half-time appointments count as one position.

The number of faculty in computer science decreased by 1% to 2,699 after staying the same (2,724 in 1989-90 and 2,725 in 1990-91) for the first time the previous year. Although computer science produced 47 more Ph.D.s last year, the departments reported hiring 138 new faculty—only five more than the previous year. However, 173 computer science faculty were lost. In this time of financial strain, some departments had faculty lines frozen and were not allowed to hire.

Also for only the second time, the number of full professors in computer science (1,025) was greater than the number of assistant professors (861). There were 813 associate professors. The top 24 computer science departments are becoming more like other fields, with far more full professors (296) than associate professors (181) or assistant professors (179). These figures indicate that these departments may be hiring fewer new Ph.D. graduates in the future.

Women and minorities

The disappointing statistics for women and minority faculty are given in Table 14. It is no surprise that the number of blacks and Hispanics is so low. Since 1973, fewer than 1% of Ph.D. recipients have been black or Hispanic; so one cannot expect to be able to hire more than 1% as faculty members. The task of encouraging blacks and Hispanics to get into computer science has to be done at a much lower level—in high schools and colleges.

For women, the numbers show some limited progress at the junior level, but there are losses in the senior ranks. At the assistant professor level, the numbers are encouraging—the number of faculty women in computer science increased from 96 (10%) to 118 (13.7%). The number of women in computer engineering increased from 16 (8%) to 22 (10.1%). These figures are better than the production levels of only 11.8% for new Ph.D.s in computer science. Unfortunately, at the associate professor and at the full-professor levels, the percentage of women decreased from 11% to 9.8% and from 5% to 4.5%, respectively. This indicates poor retention of women in academia over the years or lack of promotion. At none of the professional levels are there enough women to have one at each rank in each department, because there are only 1.7 women per department in total.

Hiring for 1992-93

Computer science and computer engineering departments in the United States gave starting salaries for 177 of the newly hired Ph.D.s (138 were in CS departments). Table 15 gives salary information for the new Ph.D.s. Data for Canadian universities is shown separately in the table. Canadian salaries are in Canadian dollars and are on a 12-month scale. The Canadian and US dollars have different values, and there are differences in the amount of consulting that typically can be performed.

The average US salary for new computer science Ph.D. recipients increased from $47,425 in fall 1991 to $48,026 in fall 1992. This is an increase of only 1.2%, which is

Text continued on next page

1991-92 CRA Taulbee Survey

Table 10. Undergraduate and Master's Degrees

	Non-Ph.D. Degrees, Ph.D. Depts. Only	Undergraduate					Master's				
		88-89	89-90	90-91	91-92	92-93	88-89	89-90	90-91	91-92	92-93
CS	Number of Degrees	8,796	8,053	7,975	8,428	7,717	4,297	4,173	4,030	4,183	4,105
	Number of Depts. Responding	120	135	135	137	128	129	135	135	137	136
	Average per Dept.	73	60	59	62	60	33	31	30	31	30
CE	Number of Degrees	1,810	1,628	1,378	1,385	1,261	1,160	943	963	938	1,051
	Number of Depts. Responding	26	32	28	29	24	29	32	28	29	30
	Average per Dept.	70	51	49	48	53	40	30	34	32	35
CS&CE	Number of Degrees	10,606	9,681	9,353	9,813	8,978	5,457	5,116	4,993	5,121	5,156
	Number of Depts. Responding	146	167	167	166	152	158	167	167	166	166
	Average per Dept.	73	58	56	59	59	35	31	30	31	31

Table 11. New Graduate Students in Fall 1992

		Total New Grad Students	With CS Degrees	Ph.D. Program	Master's Only Program	Part-Time Master's Students
CS	Total	4,550	1,939	1,666	2,891	1,307
	Depts. Responding	140	140	140	140	140
	Average per Dept.	32.5	13.8	11.9	20.6	9.3
CE	Total	1,092	402	359	785	322
	Depts. Responding	31	31	31	31	31
	Average per Dept.	35.2	12.9	11.5	25.3	10.3
CS&CE	Total	5,642	2,341	2,025	3,676	1,629
	Depts. Responding	171	171	171	171	171
	Average per Dept.	32.9	13.6	11.8	21.5	9.5

Table 12. New Ph.D. Students in CS Departments

Depts.	Number of Depts. Responding	Total New Ph.D. Students					Average Number of Students per Dept.				
		1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
Ranked 1-12	12	360	342	344	314	322	30	29	29	26	27
Ranked 13-24	12	238	243	193	233	215	20	20	18	19	18
Ranked 25-36	12	165	215	165	150	334	14	18	14	13	28
All Other	91, 93, 99, 101, 104 (For last five years)	734	832	732	858	795	8	9	7	8	8

Table 13. Faculty Statistics, 1992-93 Academic Year

Faculty	All CS&CE Depts.		All CS Depts.		Top 24 CS Depts.		Other CS Depts.	
	Total	Average	Total	Average	Total	Average	Total	Average
Tenure-track	3,549	20.7	2,699	19.2	656	27.3	2,043	17.6
Assistant Professor	1,077	6.3	861	6.1	179	7.4	682	5.8
Associate Professor	1,042	6.0	813	5.8	181	7.5	632	5.4
Full Professor	1,430	8.3	1,025	7.3	296	12.3	729	6.2
Research Faculty	162	0.9	136	0.9	86	3.5	50	0.4
Postdoctorates	218	1.2	125	0.8	40	1.6	85	0.7
Non-Tenure-Track Teachers	430	2.5	356	2.5	61	2.5	295	2.5
Other (Such as Visitors)	209	1.2	177	1.2	45	1.9	132	1.1

CRA Taulbee text from previous page

less than the rate of inflation. Since 1985, the average salary has increased from $36,668 to $48,026 or 31%.

Table 16 lists new Ph.D. salaries, ranging from $38,000 to $53,000 or higher, and the number of computer science and computer engineering departments falling within each $1,000 increment in this range for fall 1992 and the four previous years. Salaries are rounded and presented in thousands of dollars.

Faculty salaries

Tables 17 to 24 deal with nine-month or 12-month salaries of US and Canadian computer science and computer engineering departments. Table 17 has data on the salaries of all US CS departments. Tables 18 to 21 group these departments by rank. Table 22 gives salary information for CE departments. Table 23 contains salary information for the 12 Canadian departments. Table 24 has the information for all US computer science and computer engineering departments.

The second column of the tables gives the number of faculty in each rank for which salaries were reported and the total number of faculty in the rank. Departments reported the minimum, mean and maximum salaries of assistant, associate and full professors and the number of faculty in each rank.

For the minimum and maximum salary columns, the tables show the minimum, average and maximum of these salaries. The average is given over all salaries in each faculty rank. This is the true average, not the average of the means for the departments.

Table 17 summarizes nine-month faculty salaries in US departments as of January 1993. Comparing computer science figures for the United States from 1990-91 and 1991-92, one finds that the average assistant professor salary increased from $49,514 to $50,791 (up 2.6%), the average associate professor salary increased from $57,059 to $58,287 (up 2.2%) and the average full-professor salary increased from $76,712 to $78,132 (up 1.9%). Ninety-two US departments reported a maximum full-professor salary greater than $90,000—61 of these salaries were greater than $100,000. The highest reported full-professor salary was $160,000.

Estimates of department growth by 1997-1998

The departments were asked to estimate their faculty sizes through 1997-98. Computer science departments want to increase from an average of 19.4 faculty per department up to 22.7, a 17% increase in five years. Computer science and computer engineering departments want to increase from an average of 20 faculty per department up to 23.2, a 16% increase in five years.

In 1990-91, 137 computer science departments indicated a desire to increase from 19.9 to 21.0 faculty per department in one year, but they actually experienced a decrease of 0.5 faculty members per department. This was the second year in which departments slipped back by an average of half a position, instead of growing as they had wished. Table 26 indicates that most departments—except for the very small and very large—desire about the same absolute growth.

Faculty losses

Table 27 gives statistics on faculty losses. The number of retirements and deaths in computer science departments decreased from 35 to 27 last year, but that number had been 14 or below in the years before that. Because this represents only 1% of the total faculty, one must assume that in the future such numbers will be two or three times larger. Losses due to other reasons also are shown.

Comments

CRA's goal this year was to bring the CRA Taulbee Survey in-house to its Washington office, but this effort was only partially successful. As those who participated in the survey know, the survey forms were redesigned, and further enhancements will be made before the next survey. Because of what we learned doing the survey in-house this year, the process for entering and analyzing the data also will be

Text continued on page 9

1991-92 CRA Taulbee Survey

Table 14. Women, Minorities and Persons with Disabilities on CS and CE Faculties

		Total	Female	Percent	Black	Percent	Hispanic	Percent	Disabled	Percent
CS	Assistant Professor	861	118	13.7%	14	1.6%	17	1.9%	1	.1%
	Associate Professor	813	76	9.3%	1	.1%	8	.9%	3	.3%
	Full Professor	1,025	47	4.5%	2	.2%	15	1.4%	2	.2%
	Total	**2,699**	**241**	**8.9%**	**17**	**.6%**	40	**1.4%**	**6**	**.2%**
CE	Assistant Professor	216	22	10.1%	4	1.8%	6	2.7%	1	.4%
	Associate Professor	229	8	3.4%	1	.4%	2	.8%	0	.0%
	Full Professor	405	6	1.4%	2	.4%	3	.7%	1	.2%
	Total	**850**	**36**	**4.2%**	**7**	**.8%**	**11**	**1.2%**	**2**	**.2%**

Table 15. New Ph.D. Salaries for Fall 1992

	All US CS&CE Depts.	All US CS Depts.	Top 24 US CS Depts.	Other 104 US CS Depts.	12 Canadian CS Depts.
Total Ph.D.s Hired	177	138	38	100	17
# Depts. Reporting Salaries	65	52	10	42	5
Minimum	$40,000	$40,000	$45,000	$40,000	$44,000
Average (of the Averages)	$47,975	$48,026	$48,681	$47,870	$49,550
Maximum	$55,000	$53,332	$52,500	$53,332	$53,000

Table 16. New US Ph.D. Salaries for Fall 1992 and Four Previous Years

Salary (in Thousands):		38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53+
Number of Depts. in:	1988-89	2	2	5	13	3	19	11	14	0	2	1	0	0	0	0	0
	1989-90	0	1	1	1	7	14	12	1	11	8	3	1	1	1	2	0
	1990-91	0	0	1	2	2	3	8	15	20	6	9	4	1	1	1	1
	1991-92	0	0	0	2	1	0	3	8	5	7	11	4	6	4	1	0
	1992-93	0	0	1	1	2	1	1	6	10	9	5	9	10	4	3	3

Table 17. Nine-Month Salaries, 124 of 128 US CS Departments

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	756 of 771	$32,760	$47,679	$66,100	$50,791	$44,700	$53,836	$94,179
Associate	685 of 698	$18,750	$52,003	$66,823	$58,287	$46,548	$64,130	$86,160
Full	868 of 887	$37,813	$62,237	$89,200	$78,132	$50,628	$92,990	$160,000

Table 18. Nine-Month Salaries, 11 of 12 CS Departments Ranked 1-12, United States Only

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	87 of 101	$41,200	$48,964	$55,000	$53,229	$51,950	$56,871	$64,000
Associate	83 of 92	$28,400	$53,690	$63,000	$60,570	$63,350	$67,036	$75,600
Full	159 of 174	$38,000	$63,815	$86,300	$83,461	$100,300	$112,330	$129,564

Table 19. Nine-Month Salaries, 12 of 12 CS Departments Ranked 13-24, United States Only

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	78 of 78	$42,499	$49,134	$61,400	$50,913	$48,499	$54,731	$67,000
Associate	89 of 89	$47,250	$56,636	$64,700	$59,205	$58,498	$66,942	$82,400
Full	122 of 122	$37,813	$63,720	$87,000	$80,670	$86,064	$106,803	$131,500

Table 20. Nine-Month Salaries, 11 of 12 CS Departments Ranked 25-36, United States Only

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	85 of 86	$45,000	$49,071	$52,400	$52,351	$48,135	$55,379	$60,910
Associate	76 of 80	$18,750	$51,793	$62,080	$61,735	$58,047	$67,890	$77,570
Full	98 of 102	$39,400	$66,008	$85,300	$88,481	$90,900	$120,475	$160,000

Table 21. Nine-Month Salaries, 90 of 92 CS Departments Ranked Higher Than 36 or Unranked, United States Only

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	506 of 506	$32,760	$47,176	$66,100	$50,083	$44,700	$53,194	$94,179
Associate	437 of 437	$35,924	$51,166	$66,823	$57,035	$46,548	$62,935	$86,160
Full	489 of 489	$46,872	$61,398	$89,200	$73,599	$50,628	$85,618	$128,472

Table 22. Nine-Month Salaries, 30 of 31 CE Departments, United States Only

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	203 of 210	$32,200	$45,787	$55,200	$50,282	$41,593	$52,292	$63,090
Associate	221 of 226	$34,000	$50,328	$60,600	$57,216	$48,000	$61,940	$80,460
Full	371 of 397	$43,000	$60,035	$80,000	$73,929	$59,800	$96,037	$146,042

Table 23. 12-Month Salaries, 12 of 12 Canadian CS Departments (Canadian Dollars)

	# Reporting	Reported Salary Minimums				Reported Salary Maximums		
Faculty Rank	Salary Data	Min.	Mean	Max.	Avg. of all Salaries	Min.	Mean	Max.
Assistant	78 of 78	$31,639	$49,145	$62,870	$54,394	$48,000	$61,345	$72,280
Associate	104 of 104	$40,815	$59,093	$76,726	$68,681	$64,000	$79,383	$121,108
Full	123 of 123	$52,748	$73,885	$90,167	$88,026	$82,380	$104,808	$145,204

1991-92 CRA Taulbee Survey

Table 24. Nine-Month Salaries, 154 of 159 US CS and CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums Min.	Mean	Max.	Avg. of all Salaries	Reported Salary Maximums Min.	Mean	Max.
Assistant	959 of 981	$32,200	$47,301	$66,100	$50,688	$41,593	$53,527	$94,179
Associate	906 of 924	$18,750	$51,668	$66,823	$58,029	$46,548	$63,692	$86,160
Full	1,239 of 1,284	$37,813	$61,812	$89,200	$76,904	$50,628	$93,574	$160,000

Table 25. Desired Faculty Growth

		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	Five-Year Increase
CS	Faculty Size	2,716	2,860	2,966	3,051	3,114	3,182	466 (17.1%)
	Average Size	19.4	20.4	21.1	21.7	22.2	22.7	
CS&CE	Faculty Size	3,430	3,597	3,722	3,814	3,890	3,970	540 (15.7%)
	Average Size	20.0	21.0	21.7	22.3	22.7	23.2	

Table 26. Average Desired Five-Year Growth of Faculty in CS Departments

	By Department Rank 1-12	13-24	25-36	Rest	By Department Size (Number of Faculty) 1-9	10-19	20-29	30-39	40-49
Number of Depts. in 1992-93	12	12	12	104	10	79	33	13	5
Average Dept. Size in 1992-93	29.6	24.5	22.1	17.3	7.1	14.5	25.1	34.1	44.8
Average Dept. Size in 1997-98	32.8	29.0	25.0	20.5	9.0	17.9	28.8	38.1	46.0
Average Five-Year Increase in Faculty	3.1	4.5	2.8	3.2	1.9	3.3	3.6	4.0	1.2
Projected Growth	10.6%	18.3%	12.7%	17.6%	26.7%	23.3%	14.5%	11.7%	2.6%

Table 27. Faculty Losses in 1991-92

	CS&CE Departments With Ph.D.	No Ph.D.	Total	CS Departments With Ph.D.	No Ph.D.	Total
Died	5	0	5	5	0	5
Retired	39	5	44	19	3	22
Visitors Returning to Employer	15	2	17	14	2	16
Teaching Elsewhere	64	2	66	54	2	56
Left for Non-Academic Position	55	1	56	45	1	46
Returned to Graduate School	0	1	1	0	1	1
Other	28	2	30	25	2	27
Total	**206**	**13**	**219**	**162**	**11**	**173**

CRA Taulbee text from page 7

easier and more accurate next time. David Gries and Dorothy Marsh, who had done the report at Cornell University for many years, offered their support this year.

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Earl Schweppe is a professor of computer science at the University of Kansas. He was secretary of the ACM Curriculum Committee on Computer Science in the 1960s during the preparation of Curriculum 68.

Dropouts from page 2

program. However, lack of funds made this impossible.

There were many other recommendations, including providing more hands-on help in the labs and monitoring inexperienced students. Again, lack of money stifled real progress. Funds were used to better staff the labs rather than to pay for more assignment graders. This meant that the 1992 batch of students had no idea how well they were doing until they received their first test results half way through the course.

Some changes were made, however. They included improving the course prospectus, replacing the textbook and rewriting the first few lectures. Assignments were redesigned to make them more accessible for women. Faculty were urged to make themselves more available to students. That they did so was apparent from the 1992 survey results.

The proportion of women enrolled in COMP 102 has grown from 23% in 1990 to 27% in 1992. While not a direct result of our research, the increase probably reflects the efforts of vocational-advice officers in schools and of the university liaison officer in recruiting students.

The rise in enrollment also suggests that the department's reputation for attrition has not suffered. Perhaps, too, young women now are more aware of the benefits of having a serious computing course, regardless of whether they are majoring in computer science.

Although it would have been nice to report that our action-based research had been effective, there is little evidence to support such a claim. In 1992, there was a record-high attrition rate of 32% for women and 18% for men from the time of enrollment and until the last day students could drop the class and get tuition refunded (two weeks after the close of enrollment). In part, the rise in attrition could be attributed to stern warnings about the rigors of the course that I recommended faculty give to new students.

Of all students enrolled after the first two weeks, 64% of the women dropped out, failed the final exam or did not take the exam, whereas the statistic for men was only 37%. How can this discrepancy be explained?

Gender and computers

The field of computing is viewed as a male domain, not only in the public world of business, finance, scientific research and the military, but also in the private world of the family, where the computer has edged its way in. Women attracted to computing have to be assertive to compete successfully. Peer groups, parents and even teachers are likely to label them as unfeminine or different.

A toys-for-boys attitude prevails among adult men who are not computer scientists. The subculture attracts young boys who want to belong to a group of congenial, like-minded people. A host of clubs, journals and electronic bulletin boards cater to the computer culture. Membership into this subculture affirms masculinity and shapes career aspirations that propel young men into college computer courses. They become intimate with computers at an early age.

Most young women—and even some young men—who enter the college computer culture face unfamiliar jargon, and even dress and behavior. One woman was rather alarmed when the student next to her started talking to his terminal. "He was a bit of a…you know, a 'geek,' one of these people who you'd describe as computer people. He said he had a terminal at home, and he just used to sit there all weekend and play with it."

A couple of the women said they were annoyed and embarrassed when men sent them pornographic screen displays. Another was dismayed when students working nearby replaced the Macintosh's trash can with a little Garfield. "I couldn't figure out how they put this Garfield there. I just thought about it for hours—how they got this Garfield and I couldn't. I just didn't have a clue how they did it. It was really funny."

Perhaps, many students with little computing experience but a good

Continued on page 20

Policy News

NSF yields to demands to help stimulate economy

By Juan Antonio Osuna
CRA Staff

The National Science Foundation (NSF) has yielded to demands from Congress that it concentrate more on programs with economic benefit.

In a 1992 report, the Senate Appropriations Committee directed NSF to generously fund programs that could stimulate the economy, while denying the agency a request for a 17% overall budget increase for research and related activities.

In devising its fiscal 1993 budget plan, NSF had to figure out how to boost programs that are economically beneficial while withstanding a $14 million overall cut in research funding. (NSF received only $1.859 billion for research in fiscal 1993 compared to $1.873 billion in fiscal 1992.)

In its report, the Appropriations Committee demanded NSF "take a more active role in transferring the results of basic research from the academic community to the marketplace."

Because policy experts view high-performance computers as critical tools for industries ranging from biotechnology to engine design, NSF allocated $225 million for the High-Performance Computing and Communications program, which is a 12.5% increase over 1992.

The HPCC program draws funds from many government agencies and from many NSF directorates. A large chunk of HPCC money comes from the NSF Computer and Information Science and Engineering (CISE) Directorate.

Because the 1993 budget plan allows CISE only a 1.3% overall increase, it must allocate a greater proportion of CISE money for HPCC activities. In fiscal 1992, 86.9% of CISE money went to HPCC, whereas 89.5% of its money goes to HPCC in the 1993 plan.

The current plan also draws more money from other NSF directorates to fund the HPCC program. The outcome is that computing research programs unrelated to HPCC will suffer. Funds for CISE base programs unrelated to HPCC will decline 8%.

Also, then-NSF Director Walter Massey noted in the plan that the congressional appropriation of $111 million for the agency's staffing needs is insufficient. "Even after we severely restrict travel, training, automation and other discretionary administrative expenditures, we still may need to furlough our employees later in the fiscal year."

New faces abound on science subcommittee

Final appointments have been made to the House Science, Space and Technology Subcommittee on Science. Of the 14 members appointed, 10 are new to the subcommittee and seven are new to Congress. Freshman constitute one-half of the subcommittee, compared with only one-quarter of Congress.

The subcommittee's hierarchy did not change drastically—Rep. Rick Boucher (D-VA) continues as chair. But the next ranking Democrat is a newcomer to the subcommittee—Rep. Ralph M. Hall (D-TX), who also chairs the House Science, Space and Technology Subcommittee on Space. Also, Rep. Sherwood L. Boehlert (R-NY) will replace Ron Packard (R-CA) as ranking minority member. Boehlert previously served as ranking minority member on the House Investigations and Oversight Subcommittee.

The House Science Subcommittee members are, in ranking order:

Democrats

Rick Boucher, Virginia, 9th District, Chair
*Ralph M. Hall, Texas, 4th District
Tim Valentine, North Carolina, 2nd District
Glen Browder, Alabama, 3rd District
**James A. Barcia, Michigan, 5th District
**Don Johnson, Georgia, 10th District
**Anna G. Eshoo, California, 14th District
**Eddie Bernice Johnson, Texas, 30th District
**David Minge, Minnesota, 2nd District

Republicans

Sherwood L. Boehlert, New York, 23rd District, Ranking Minority Member
*Joe Barton, Texas, 6th District
*Sam Johnson, Texas, 3rd District
**Nick Smith, Michigan, 7th District
**Peter I. Blute, Massachusetts, 3rd District

(indicates new member to subcommittee; ** indicates new member to Congress)*

New science adviser named

John H. Gibbons has been confirmed as President Clinton's science adviser and director of the Office of Science and Technology Policy. Gibbons had been director of the congressional Office of Technology Assessment (OTA) since 1979.

Gibbons is a Washington insider and has a great deal of experience working on science and technology (S&T) policy in a political environment. To many observers, his selection confirms the assumption that the science adviser's role in the new administration will not be the traditional one of representing the scientific community. White House S&T policy will originate directly from the president and vice president, and Gibbons' job will be to advise top administration officials and provide staff support.

Gibbons took over at OTA during a time of great political turmoil. He is widely regarded as rescuing the agency from oblivion by focusing its efforts on studies in direct support of immediate legislative issues. Although OTA is subject to political pressures, under Gibbons it achieved a reputation for accuracy, objectivity and tight analysis.

Gibbons received his doctorate in physics from Duke University in 1954, after earning a B.S. in mathematics and chemistry from Randolph-Macon College. He worked 19 years at the Oak Ridge National Laboratory in Tennessee. In 1973 he left to serve as director of energy conservation at the Federal Energy Administration. In 1974 he became director of the Energy, Environment and Resources Center at the University of Tennessee, where he worked until he went to OTA.

Walter Massey is leaving NSF

Walter Massey announced late in January that he was leaving the National Science Foundation (NSF) to take the position of senior vice president and provost of the University of California system.

Although some observers professed no surprise, there had been speculation about whether Massey would stay on as part of the new administration.

Massey's departure comes at a critical time for NSF, when science and technology policy is ready to undergo major restructuring. As policymaking was becoming centralized in the White House, the NSF director did not seem to play a large role in the debate. In the confirmation hearings for new science adviser John H. Gibbons, the words "basic research" hardly were mentioned, and NSF was never discussed—except in a comment by Sen. Fritz Hollings (D-SC), who said, "They had better get the message." Hollings is chair of the Senate Committee on Commerce, Science and Transportation, which oversees NSF's budget authorization.

During his tenure at NSF, Massey focused on improving the nation's competitiveness by supporting fundamental scientific and engineering research. He also assisted the president's science adviser by serving as the co-chair of an Ad Hoc Working Group on Research-Intensive Universities and the Federal Government. The group's report identified trends and issues affecting relations between the government and research universities.

Future from page 1

are rumors that the transition team was less than warm to the prospect of NSF being a major player in the new S&T game. Such a grim future would be a far cry from the original intention that NSF be the key civilian agency responsible for the health of science and NSF's National Science Board provide a major voice in civilian science policy.

One can invest too much meaning in these supposed signals. Major players have yet to be heard from, and NSF has many friends and a lot to offer. There will be a debate, and it will start in at least two arenas.

The Senate and the House will be considering NSF's reauthorization. NSF has been operating under a five-year authorization that expires this year. In theory, it is the authorization that establishes broadly, and sometimes in detail, the parameters of the agency's mission. The authorizing committees were expected to begin this process with public hearings in early March.

The Senate Committee on Appropriations prodded the authorizing committees last year and essentially told NSF to stop wasting money on research that did not contribute directly to the social (meaning economic) welfare of the United States. Such language creates battles between authorizing and appropriations committees, across turf lines that are indistinct. But, beyond setting up turf battles, it also is a clear sign of congressional concern over NSF's mission.

The message was reinforced by a 12% cut in funding appropriated for research. The administration had requested a 17% increase. NSF fully expected that number to be trimmed, but still expected to retain a reasonable amount of growth. The cut will be painful.

NSF appropriations will be important to watch this year. The committees have indicated that their willingness to give NSF money will depend on NSF's responsiveness to public needs, particularly economic growth.

The research community should be concerned with the appointment of the new NSF director. Who is selected and how soon the selection is announced will be important indications of the administration's view of the agency and its future plans.

The research community needs to react to these issues. No agency has a basic right to exist; its legitimacy stems from being necessary to perform an important and authorized government function. One of the most difficult challenges to those trying to change the government can be breaking the iron embrace between agencies and their traditional constituents. Remember Eisenhower's warning. It will not work if the community reflexively defends NSF simply because it has become used to NSF and the flow of money.

Arguments that smack of entitlement also will not succeed. We must address the very real concern that the appetite of the science community for funding has outgrown society's ability to pay.

We do, however, have a strong case to make:

• The assertion of Vannevar Bush that fundamental research ultimately leads to a wide and unpredictable

Continued on page 11

Policy News

Blue ribbon panel assessing future of HPC

By Juan Antonio Osuna
CRA Staff

Just as the waxing and waning of computing technologies bring life and death to whole industries, so do these fluctuations affect the livelihood of government institutions and programs.

It is this kind of instability that has prompted the National Science Foundation (NSF) to take an in-depth look at the current state of high-performance computing in hopes of forecasting its future evolution.

At NSF's request, a panel of industry, academic and government experts will spend the next few months assessing trends in high-performance computing. In late January, the 14 members of the Blue Ribbon Panel on High-Performance Computing met to plan a strategy for a report to be released in May.

The first step is to solicit opinions from industry, academic and government experts. The question of exactly how opinions will be solicited sparked debate at the meeting.

Some members suggested electronically posting requests so anyone could respond, while others said such a tactic would result in saltatorial discussions too overwhelming to summarize.

"If we are unwilling to go through what people have to say, then we are not doing our jobs," said James A. Sethian of the University of California at Berkeley. "We're talking about taxpayers' money… We have an obligation."

To the suggestion that employees at supercomputing centers summarize the opinions of its users, Sethian countered, "That's like asking the Democratic Party how the people feel."

In the end, the panel decided it would solicit responses electronically, as well as by requesting the opinions of recognized experts.

The panel also discussed specific questions the report will address. Some of the questions include:

• What is the future mission of the national supercomputing centers?

• What is NSF's role in teaching users about high-performance computers and the public about the social benefits of the emerging technologies?

• What emerging technologies in high-performance computing should NSF pay special attention to?

• How should NSF balance the high-performance computing needs of various disciplines?

• What are proper forms of international collaboration?

Members of the Blue Ribbon Panel on HPC

Lewis Branscomb (Panel Chair)
John F. Kennedy School of Government
Harvard University

Theodore Belytschko
Department of Civil Engineering
Northwestern University

Peter Bridenbaugh
Alcoa Technical Center

Teresa Chay
Department of Biological Sciences
University of Pittsburgh

Jeff Dozier
Ctr. for Remote Sensing/Environmental Optics
University of California at Santa Barbara

Gary S. Grest
Corporate Research Science Laboratory
Exxon Research & Engineering

Edward F. Hayes
Vice President for Research
Ohio State University

Barry Honig
Dept. of Biochemistry and Molecular Biology
Columbia University

Neal Lane
Provost
Rice University

William Lester Jr.
Associate Dean
University of California at Berkeley

Gregory J. McRae
Chemical Engineering Department
Massachusetts Institute of Technology

James A. Sethian
Department of Mathematics
University of California at Berkeley

Burton Smith
Tera Computer Co.

Mary Vernon
Computer Science Department
University of Wisconsin

NSF relocating its headquarters

The National Science Foundation (NSF) will begin moving its headquarters to Arlington County, VA, in early May. The agency is consolidating its four current offices.

The relocation culminates several years of planing and several months of negotiations with the General Services Administration (GSA) and the Office and Management and Budget. The relocation process will take eight to 12 months to complete.

The new building will provide 450,000 square feet of space, significantly more than its current four offices, which total 307,000 square feet. The new location is designed to meet computer and communication needs. It will provide a voice-mail system and links to computer networks and the Washington Inter-Agency Telephone System.

GSA will fund the relocation for this fiscal year, and NSF will seek repayment of any funds taken from future budgets.

The new NSF location at 4201 Wilson Blvd. in Arlington is near the Ballston subway stop on Metro's Orange Line.

Future from page 10

variety of social benefits still holds. Furthermore, the more basic the research, the less one can make decisions based on any criteria other than scientific quality.

• Research at all points in the spectrum is a seamless web. It makes no sense to express concern about technology transfer and then adopt policies that separate and downplay a vital part of the fabric.

• The NSB Commission report points out a good direction for NSF—a continuing lead responsibility for broad support of fundamental science and engineering research, coupled with an aggressive program of directed research support in high-priority areas.

Others in the community may have better or more persuasive arguments. What is most important is that we begin to express them, not just through CRA, but as constituents. As mentioned in earlier *CRN* articles, Bob Traxler, retired chair of the House Appropriations Subcommittee on VA, HUD and Independent Agencies, which handled NSF appropriations last year, complained that not a single person in the scientific community objected to the cuts. There were reasons for that silence beyond mere reticence. Regardless, we have to do better than that this year.

Cray Research CEO nominated for deputy secretary of Commerce

President Clinton has nominated John A. Rollwagen, chair and CEO of Cray Research Inc., to become the new deputy secretary of Commerce.

"The Department of Commerce will play a leading role in the development of a high-skill, high-wage economy," Clinton said. "Having presided over a high-skill, high-wage corporation for 15 years, John Rollwagen can help us bring this about."

Rollwagen, 52, had been president of Cray Research since 1977 and CEO since 1980. He also is a founding member of the Computer Systems Policy Project, a group of industry leaders formed to address policy issues.

In 1987, President Reagan appointed him as a member of the Advisory Committee for Trade Negotiations; and in 1990, he was reappointed by President Bush. Rollwagen also serves on the High-Performance Computing Subcommittee for the President's Council of Advisers of Science and Technology.

Upon Rollwagen's January resignation from Cray, John F. Carlson was elected president and CEO at Cray Research by its board of directors. Carlson, 54, has been associated with Cray Research since 1976.

Gore from page 1

for 1994 and $180 million for 1995. The act differs from Gore's High-Performance Computing Act of 1991 in that authorization for funds extends only until 1995 rather than 1997.

The introduction of the legislation on the first day of the 103rd Congress suggests the bill's sponsors plan to work quickly and closely with the new administration.

The bill's sponsors include Sens. Hollings, George Mitchell (D-ME), Jay Rockefeller (D-WV), Donald Riegle (D-MI), Joseph Lieberman (D-CT), Jeff Bingaman (D-NM), John Kerry (D-MA) and Carol Moseley Braun (D-IL).

Rep. Rick Boucher (D-VA), chair of the House Science, Space and Technology Subcommittee on Science, was expected to introduce a bill in early March that will parallel the information infrastructure parts of the Senate bill. The manufacturing sections of the Senate bill were introduced in the House as HR 820.

Universities urged to set priorities

Because federal funding for scientific research is becoming tighter, major reforms are needed in the way academic research is conducted, a report released in late 1992 said.

The President's Council of Advisers on Science and Technology (PCAST) released the report, *Renewing the Promise—Research-Intensive Universities and the Nation*, which urged universities to prioritize research and cut activities that are inferior.

PCAST warned that it is "unreasonable to expect that the system of research-intensive universities will continue to grow." D. Allan Bromley was head of PCAST under the Bush administration.

PCAST said universities should re-emphasize teaching, collaborate more with each other and with industrial laboratories, and avoid long-term projects for which funding is uncertain.

The report was produced by six university representatives appointed by the Bush administration. It was based on testimony from nearly 200 academic scientists and administrators.

CRA has a limited number of the PCAST reports available on request for our members' organizational representatives.

1994-95 Fulbright competition opens

Applications are available for the 1994-95 Fulbright Scholar Program. The Fulbright program includes about 1,000 grants for research, university lecturing and combined research and lecturing in nearly 135 countries. Eligibility requirements include US citizenship and a doctorate or comparable professional qualifications.

The deadline for submitting an application is Aug. 1. For more information, contact the Council for International Exchange of Scholars, 3007 Tilden St. NW, Suite 5M, Box NEWS, Washington, DC 20008-3009. Tel. 202-686-7877.

Policy News

Industry executives push for an information infrastructure

BY Juan Antonio Osuna
CRA Staff

A coalition of industry executives met with members of the Clinton administration in mid-January to discuss strategies for building a national information infrastructure.

"We believe the creation of an information infrastructure must be a national priority, and we are willing to work with government to see that it gets done," said John Sculley, CEO of Apple Computer Inc. and chair of the Computer Systems Policy Project (CSPP). "The development of an information infrastructure will raise the standard of living for all Americans and enable our country to prosper in a competitive global economy."

Composed of CEOs from major computer corporations, CSPP recommended in a report, *Perspectives on the National Information Infrastructure: CSPP's Vision and Recommendations for Action,* that a National Information Infrastructure Council coordinate activities among government agencies and industry.

CSPP said the council should be chaired by Vice President Gore and should consist of top government and industry leaders. The report asked that Congress appropriate adequate funds for the council and for R&D.

The report noted that the High-Performance Computing and Communications program "could provide a foundation for something more. If properly designed, HPCC research could advance the development of technologies to help solve a wide range of social and economic problems," the report said.

A national information infrastructure should be affordable to everyone, allow easy access to government information and provide a common carrier for all types of businesses, large and small, CSPP said.

The report suggested that citizens could use computer networks to find out "about their entitlement to health, education, housing and Social Security benefits" and to "register to vote, renew their drivers licenses and pay their taxes."

Finally, the report identified 11 policy principles that should govern a national information infrastructure:

1. Everyone should have access.
2. The First Amendment should apply to all electronic communications.
3. The privacy of consumers should be protected.
4. Networks should provide security mechanisms.
5. Users should be entitled to confidentiality.
6. Network usage should be affordable to everyone.
7. Principles of intellectual property should apply to all electronic information.
8. Federal regulations should encourage the development of new technologies.
9. Networks should offer maximum interoperability.
10. Service providers should allow fair and open access to enhance competition.
11. Information service carriers and distributors with no editorial control should not be held liable for the contents of electronic information.

Look who's coming to the demonstration

BY Maria Klawe and John Rice

Scientists, especially science professors, have been unhappy about the low level of understanding about their field in the "outside world." It is time for computing researchers to start doing something about this situation. Important people in the outside world are politicians and policymakers. They influence the funding for research and education on both the national and state levels.

The Department of Computer Science at the University of British Columbia has benefited greatly from inviting political leaders—the Canadian equivalents to federal cabinet members, state legislators, congressional staff, mayors and state government officials—to visit the department. It is important to find out a politician's interests and match them with some activity in the department. Providing a photo opportunity during the visit is always a plus. Activities that could get a politician to visit include:

• a personalized tour of the department that includes demonstrations of labs and a discussion of the key objectives and directions of the department,

• a visit by public school students (for interests in education),

• opening a new lab or installing a new computer (for interests in technology),

• visits by industrial affiliates or company personnel (for interests in the economy and industry), and

• an awards ceremony for students or faculty; create a ceremony for an award if necessary.

The objective is not to make politicians more sophisticated about research but rather for them to obtain an impression of the contribution that academic computer science departments make to society, and what computer science professors actually do.

You do not need to start with politicians already at the pinnacles of power, such as governors or senators. The idea is to have a steady, broad infusion into the political system of knowledge about computing research and education.

During the visits the politician becomes more informed about and aware of computing. Perhaps the city councilor you invite will be governor someday, but such good luck is not critical to the long-term impact of these visits. Another positive aspect is that the department personnel (faculty, students and staff) become more aware of politics and become known to the political system.

Having a politician visit your department is a lot more fun than you might imagine—and can reap many rewards in the future. We encourage you to give it a whirl.

John Rice is chair of the CRA board of directors and chair of computer science at Purdue University.

Maria Klawe is a CRA board member and head of the Computer Science Department at the University of British Columbia.

Can electronic tools improve group collaborations?

BY Douglas Powell
Special to CRN

Oceanography is one of the disciplines in which scientists already have figured out how to collaborate. Working in groups scattered throughout the world, oceanographers study a basic global phenomena and have a well-developed predisposition to collaborate. Even the ships used in experimentation are cooperative efforts. So how can electronic tools help these individuals work, publish papers, enhance their scientific reputations and become better integrated in their community? Can computer networks help oceanographers become more productive?

Yes, said Sara Kiesler and a team from Carnegie Mellon University. In a study to be published in *Communications of the ACM*, Kiesler and her co-workers found a positive correlation between the use of electronic mail among the well-funded, active North American oceanographers at coastal universities and their overall scientific productivity.

However, Kiesler also discovered that researchers on the edges of oceanography—those who may be younger or geographically located in the middle of the country—seemed to obtain even more benefit from computer communications than those researchers located on the coasts.

But, in science or in business, what works well for one group may be a disaster for another. That is why Kiesler and other innovative teams of computer scientists, engineers, psychologists and sociologists are examining the way work is actually done, and then developing tools to help do the job. "People are thinking about this," John King of the University of California told the 600 delegates to the fourth biannual North America Conference on Computer Supporter Cooperative Work (CSCW) held in Toronto last fall.

For both business and governments, the challenge is to reap benefits from massive investments in new technologies. According to Paul Attewell of the City University of New York, the US government spent $154 billion for computer hardware, software and services in 1990—and that does not include expenses for communications. Yet many studies seem to show that "information technology is not helping the bottom line," he said.

For scientists working with grant-giving agencies for multidisciplinary and team-based research, anything that aids collaboration would be welcomed. Many scientists are looking to the CSCW community for solutions. Products like Lotus Notes already have entered mainstream corporate environments, and there are numerous developments on the horizon, including computer-supported desktop videoconferencing, scheduling technologies and collaborative writing tools. "[But] if something involves a computer, you can't go wrong by overestimating the difficulties," said Sid Huff of the University of Western Ontario.

"CSCW is the new frontier for information technology development in the 1990s," said Ron Baecker of the University of Toronto, who co-chaired CSCW '92. "The challenge is to design collaborative systems that support workgroups, whether they are brainstorming, writing, designing or even programming."

Consider the process of writing an academic paper. Studies have shown that scientists rarely write together or share the same computer screen; writing is done separately, and people use different methods. Matters are further complicated when research teams are spread out among different institutions and countries. As a paper goes through numerous revisions, it often is necessary to know where and why a co-author made a change. Usually the solution is to use highlighter pens on hard copy, or upper case letters in computerized text. Neither method is efficient.

Although software exists to aid collaborative writing, a new generation of products is being developed that tailor text editors to individual needs, rather than forcing individuals to conform to one standard approach. A team at Carnegie Mellon University led by Christine Neuwirth has developed a software system, flexible diff, that finds and reports differences (diffs) between versions of text. However, by focusing on human interface design issues, Neuwirth says flexible diff can alter

Continued on page 13

Policy News

CRA submits statement to NSB commission

The following is a statement CRA submitted to the National Science Board's Special Commission on the Future of the National Science Foundation.

The Computing Research Association (CRA) would like to commend the National Science Foundation (NSF) director and the National Science Board for initiating the long-range strategic planning process for NSF that resulted in the formation of this special commission. A basic re-examination of the purposes and structure of government funding for research can be an important mechanism for maintaining and strengthening NSF's central role in support of civilian science and engineering. We also would like to thank the commission for providing this opportunity for CRA to submit comments reflecting the perspective of the computing research community, both in academia and in industry.

CRA is an association of nearly 200 US and Canadian university departments of computer science and computer engineering, and major industrial laboratories engaging in basic computing research.

Clearly, as Massey has stated, major changes have occurred since NSF originally was established—changes in the nature of scientific and engineering research and in the social, economic and political forces that shape federal R&D policy. A critical question is how those changes may alter or expand NSF's missions and affect the way those missions are carried out. The computing research community expects to actively engage in the debate over that question, and this statement is a starting point for what we expect to be a much longer dialogue.

Key observations

In this initial statement, we offer some key observations on the importance and the role of computing research in the nation's research agenda, and follow that with five recommendations.

Computing research is a broadly defined field, encompassing areas known variously as computer science, computer engineering, software engineering, information science and computational science.

In the 50 years since their invention, computers and a wide range of other electronic information technologies, including high-speed data communication systems, have become vital parts of the nation's (and the world's) economy and social structure, and vital to our national security. Computers and software appear near the top of every "critical technologies" list. US computer, software and information services industries are world leaders. The industries are successful in the world market, with annual revenues approaching $200 billion. Computing also is the enabling technology for many dramatic results in other areas of science and engineering, and is responsible for many important advances in a wide range of other product areas.

Impressive as this past growth has been, the future holds even more promise. Over the next decade, we will be building a broadband information infrastructure that will totally transform the way individuals and government, manufacturers and service providers operate. The infrastructure will provide access to an array of computational and information databases. Artificial intelligence, in the form of microelectronic chips and software, will be embedded in everyday devices, homes, buildings and even bridges and roads.

This technological success historically has been a remarkable example of technology transfer between government-funded research and commercial applications. Dating back to World War II, government-funded research has flowed directly into hardware and software development. For many decades, government agencies were leading users of computers and triggered major advances in applications and programming languages, particularly in the area of high-performance computing. The results of these programs, in many cases, fed directly into commercial hardware and software development.

This success historically has rested on a small, but vigorous, basic research program in computing. Growth in technological capability will be even more dependent on basic research in the future. Systems are becoming more complex to build, and their more sensitive applications demand reliable and secure operation. The advent of parallelism and ultra-high-speed data communication networks adds new dimensions of complexity, both to the sophistication of potential applications and to the need to understand the basic principles underlying the technology.

NSF support has been crucial over the years in developing computer science and engineering as a broad-based academic research field. Mission agencies such as DARPA always have played an important role in supporting specific areas and laboratories in computing research. NSF, however, has succeeded in the difficult job of supporting the development and growth of computing research as a basic scientific and engineering discipline.

The research process has come to rely on an advanced infrastructure of computers and communications technology. In some fields, computation has become the third research modality—of equal importance in understanding the real world as are theory and experiment. Furthermore, many areas of experimental and natural science generate data in unprecedented quantities—in amounts that simply could not be captured, archived and analyzed without information technology. Finally, communication systems are being used for new forms of scientific collaboration and sharing of information and ideas.

Major changes have occurred since NSF originally was established—changes in the nature of scientific and engineering research and in the social, economic and political forces shaping R&D policy.

Recommendations

1. NSF should continue, but significantly expand, broadly defined computing research support so that the support level reflects the importance of computing to the economy and national well-being. Such support should expand the knowledge base and develop the necessary human resources. Without such an increased emphasis, particularly in light of expected declines in defense-related R&D funding, research support in the computing areas will not be adequate to support the nation's future economy, security and social well-being.

2. NSF should maintain an appropriate balance between basic and applied research, particularly in special initiatives such as High-Performance Computing and Communications (HPCC) and Advanced Manufacturing. Even the most basic research in computing is, by its nature, close to the technology, and potential applications are often just over the horizon. Yet, as in most sciences, basic research in computing moves forward best when researchers are left undirected and free to follow their own intuition about where the greatest potential lies. This element of the research process needs to be maintained and even strengthened.

3. NSF needs to continue to develop and support the computational infrastructure, such as networks, computers and other specialized facilities, and the software supporting the broader R&D and education community. If a major goal of government is to see that R&D in all fields better serves social needs, developing and sustaining the research and educational infrastructure is a necessity.

4. NSF should encourage interdisciplinary research in computing and its application to other sciences. NSF historically has found it difficult (though certainly not impossible) to fund research on the borders between disciplines. Computing is a science that promises great benefits to other fields if such barriers can be broken down. The grand-challenge efforts of the HPCC program point in this direction. The collaborative program in computational biology between the Computer and Information Science and Engineering Directorate and the Biological Sciences Directorate is one example of how such barriers might be broken.

5. NSF needs to expand support for the collection of computing research statistics. It is an old and often repeated complaint that we do not have enough accurate metrics describing the scientific enterprise. The National Science Board, in its recent report on industrial technology, called for more and better statistics. We endorse that call. Clearly, the R&D enterprise will be asked to provide more substantive evaluation of its efforts. Better measures of the process and of the effect of government programs on the process would be helpful both to policymakers and to the computing research field.

It is expected that over the next decade, NSF will play a major role in the restructuring of the nation's information infrastructure. This infrastructure will bring enormous economic and social benefits.

However, creating and using the infrastructure effectively will require that NSF expand its efforts to develop a solid foundation of fundamental knowledge in computer science, computer engineering and related fields. NSF also will have to develop the necessary human resources to support this structural change.

CSCW from page 12

what and how changes are reported and tailor the technology to the social and cognitive needs of different users.

Many researchers in the CSCW community say such flexibility in software and other supporting media is crucial if the United States is going to leverage the investment in national, fiber-optic research networks. "Plans for the NREN [National Research and Education Network] seem to assume there is a generic scientist out there, and they all need this infrastructure and then they can go with it," Kiesler said. "But to us, different kinds of disciplines and scientists are organized differently; they study very different kinds of phenomena…The phenomena you study have something to do with how the science is organized, and that has something to do with the use of networks."

Underlying the development of these tools are theories about how people work and interact. "There are useful theories of social behavior that can aid the design process," said Jolene Galegher, a professor in the English Department at Carnegie Mellon University. In a study of MBA students assigned a collaborative project, Galegher and Robert Kraut of Bellcore (the research arm of the regional Bell operating companies), examined contingency theory, which maintains that tasks involving uncertainty—such as collaborative writing—require a medium that permits interactive and expressive communication. In other words, the medium must fit the message.

What Galegher and Kraut found is that communication constraints affected the process but not the final product. For assignments that required

Continued on page 16

Education News

Prototype system puts technical reports on line

BY Kurt Maly, James French, Edward Fox and Alan Selman

Shortly before CRA's Snowbird Conference '92 last July, a simple request for information on electronic publication of technical reports generated an enormous amount of network traffic. We found there were at least 30 different efforts to disseminate information electronically and at least as many departments that were interested in doing it.

As more high-quality reports are produced at research organizations, and as department operating budgets decrease, it is becoming more difficult for departments to keep faculty informed about research at other universities. Charging for reports merely would escalate costs across the research community. Thus, a system that would enable researchers to use their workstations to access technical reports available within their own department and elsewhere has obvious appeal. In the larger sphere of activity, a number of organizations, such as textbook publishers and computer societies, are studying new technologies for electronic publishing and multimedia access to information and the copyright-protection issues that arise from these technologies.

Given the large interest, a workshop was held at Snowbird with the primary charge of developing a recommendation as to what the research community, as a group, should do. We quickly realized that having 30 or so different systems may not be any better than having no solution at all. In short, we decided on a solution using existing technology so all computer science departments connected to the Internet could participate. Although the system uses existing technology, research groups and interested organizations still will have to develop more sophisticated solutions to the long-term problem. We now have a prototype system available that will be beta tested with about 10 to 15 universities.

A system that would enable researchers to use their workstations to access technical reports available within their own department and elsewhere has obvious appeal.

The system consists of a central index kept on a server (and on a back-up machine for fault tolerance) that can be accessed by participating departments. The server stores relevant information on technical reports in an easily accessible format. Each participating site contributing technical reports to the system will store its own technical reports locally in PostScript, dvi, G4 or ASCII form and will receive a copy of the software that will handle interactions between the site and the central index facility. Faculty need not be involved in maintaining the index. The system is designed to be easy to use and maintain.

Users anywhere on the Internet can access the index facility through a standard interactive interface with Boolean queries about the university, author, date, key word and CR categories. For each match, the interface displays a record containing the title, authors, university, technical report number, key words and if desired, the abstract. The local interface will display—or store for local printing—a selected report after applying the appropriate filter.

To participate, a contributing site needs to install software we will distribute, and require all researchers to submit to the department their approved technical reports and other relevant information as a PostScript, dvi, G4 or ASCII file. The department may choose to use its own local mechanism for storing these technical report files and may only provide a local index acceptable to the master index server. Or the department may use software we provide to generate this local index and maintain local technical reports.

To participate, a researcher who wants to search for and access a technical report needs to have access to the Internet and a wide area information server client (XWAIS, SWAIS or PCWAIS).

Obviously, we will not capture all technical reports, and some may not be complete because charts and photographs may not be included. However, most documents easily can be converted into PostScript, and figures developed in most drawing systems can be included in TeX documents. Even if we capture only 60% of the available reports, we will be better off than we are now. One year after start-up, we would expect about 100 sites to participate and to have up to 5,000 technical reports available to users.

If you are interested in participating in the beta test or wish to be kept informed of developments, please send E-mail to maly@cs.odu.edu, fox@fox.cs.vt.edu, selman@cs.buffalo.edu or french@virginia.edu.

Kurt Maly is chair of the Computer Science Department at Old Dominion University. James C. French is a computer science research assistant professor at the University of Virginia at Charlottesville. Edward A. Fox is associate professor of computer science and associate director for research for the Computing Center at Virginia Polytechnic Institute and State University. Alan Selman is a professor and chair of the Computer Science Department at the State University of New York, Buffalo.

NSF seeks proposals for enhancing faculty

BY Doris K. Lidtke

The National Science Foundation's Division of Undergraduate Education (DUE) is seeking proposals for undergraduate faculty enhancement. Research computer scientists are in the unique position of being able to affect the quality of education at many institutions by conducting workshops and short courses for faculty members involved in undergraduate education.

Because faculty members are the key element in undergraduate computer science programs, it is critical that faculty are intellectually vigorous and excited about the discipline, are well-informed about recent developments in computing, and regard teaching undergraduates as an important and rewarding activity. It is a particular challenge in computing for faculty in undergraduate institutions to meet these goals. NSF, in cooperation with colleges and universities, provides leadership and financial assistance to encourage leaders in the field to take a systematic interest in the currency and vitality of faculty members and to help them enhance their capabilities and skills. Computer science researchers are encouraged to develop and run workshops and short courses for faculty in two- and four-year institutions.

The Undergraduate Faculty Enhancement (UFE) program tries to meet professional development needs of faculty who teach undergraduate students. These faculty members need to be familiar with recent advances in the field, new experimental techniques and ways of incorporating these advances and techniques into undergraduate instruction. Faculty members also need to gain experience with new hardware and software and evaluate their suitability for instructional use. They need opportunities to synthesize knowledge that cuts across computing and other disciplines.

Finally, they need opportunities to interact intensively—during and after a project—with experts in the field and with colleagues who are active scientists and teachers. The UFE program makes grants for regional and national seminars, short courses, workshops, conferences and similar activities for faculty members. Grants will be made for developing and conducting activities that help a large number of faculty members learn new ideas and techniques and use the knowledge and experience gained to improve their own instructional capabilities.

Sessions vary in length, but typically run from a few days to a few weeks. Follow-up activities are required and usually span at least one academic year. Recent awards have funded workshops and short courses in parallel computing, software engineering, programming paradigms, supercomputing, materials development for new curricula, graphics and object-oriented programming. An average award is $60,000 and involves about 20 undergraduate faculty members.

The program especially is interested in projects that increase the participation of women, underrepresented minorities and persons with disabilities, as well as faculty members who have not been professionally active recently. Another high priority within the UFE program is activities for faculty members teaching prospective elementary, middle and secondary school teachers. A special component of UFE emphasizes coalitions between two- and four-year institutions.

In addition to the UFE program, the division serves as NSF's focal point for undergraduate education, conducts leadership activities and manages leveraged support programs for improving undergraduate instructions. DUE recently released a new integrated program announcement (NSF92-135) describing grant opportunities in undergraduate science, mathematics, engineering and technology for all types of institutions, universities and two- and four-year colleges.

The *DUE Program Announcement* may be obtained from NSF's electronic mechanism, STIS, via Bitnet (pubs@NSF) or Internet (pubs@NSF.gov). It also can be ordered by telephone (202-357-7861) or by fax (703-644-4278); request publication NSF92-135. The next closing date for the UFE program is May 3.

Other division programs include:

• *Instrumentation and Laboratory Improvement.* Instrumentation grants to support the improvement of laboratory courses in science, mathematics and engineering at the undergraduate level; Leadership Projects in Laboratory Development to support the development of national models for undergraduate laboratory instruction. The next closing date is Nov. 15.

• *Course and Curriculum Development.* Support the development of improved and innovative introductory-level undergraduate courses and curricula in the sciences, engineering and mathematics. The next closing date is June 7.

Doris K. Lidtke is program director for the Division of Undergraduate Education in the National Science Foundation's Directorate for Education and Human Resources.

Education News

Novel program helps new faculty with teaching

By David A. Patterson

Every fall, hundreds of new computer science and computer engineering Ph.D. recipients join universities and begin teaching the next generation of computer scientists. These new teachers spend considerable time and energy, yet receive little instruction in effective teaching.

Recently I tried an experiment to help a new faculty member at Berkeley, and it was quite successful. By starting with a complete set of videotapes of lectures and the lecture notes of an outstanding teacher, this fresh Ph.D. recipient received nearly the highest teaching ratings in the department. And he spent half the traditional class-preparation time of new faculty. Thus this new faculty member had more free time during his first year than is traditional for new faculty, and CS&E students received better instruction than would have been expected.

This experiment worked so well that I wanted to see if it would generalize to a national level. This suggestion was met with enthusiasm at the Computing Research Association's December board meeting. So the University of California at Berkeley, CRA and University Video Communications have agreed to sponsor a pilot program to make tapes available in the fall.

The Videotape Mentor Program should be of interest to new faculty members, departments hiring new faculty or departments with graduate students that soon may be joining academia. E-mail any questions about the program to teaching@cs.berkeley.edu.

The problem

In the 1990-91 academic year, 312 new computer science Ph.D. recipients started teaching CS&E courses. For many of them, this is their first real teaching experience, and they most likely received no training on how to lecture. As a result, most of these new faculty members spend an inordinate amount of time their first year preparing lectures and, by trial and error, develop their teaching style. The quality of the teaching in this first year is uneven, at best. Even though new faculty often are given a colleague's lecture notes, most spend a full day preparing for each lecture. So lecturing three times a week leaves little time for anything else. This enormous time is spent in part because of a lack of confidence—because they have no experience to guide them on such issues as how long lectures will take and how to handle questions.

The experiment

Last spring, Thomas Anderson, a fresh Ph.D. graduate from the University of Washington who was doing work in operating systems, was assigned to teach an undergraduate course in operating systems. Although he volunteered to be a teaching assistant while he was a graduate student, this was Anderson's first time to give lectures. He received a copy of course lecture notes from John Ousterhout. We had videotapes of Ousterhout's lectures of that course, so as an experiment, I made a copy of the tapes for Anderson to use while preparing lectures.

Using the tapes had immediate benefits. A 50-minute tape had much more material than Ousterhout's three pages of notes per lecture, and Anderson found he spent only half a day preparing for the next lecture, while other new faculty were spending a full day. Anderson's self-confidence also was enhanced considerably because he knew how an outstanding teacher would present the material. From my perspective, I was hoping Anderson would pattern his style of teaching after an excellent teacher and pick up the good ideas Ousterhout learned from his 10 years of teaching.

Student reaction to Anderson's teaching was positive. Berkeley asks students to rate instructors on a 7-point scale, with 7 being extremely effective, 4 being moderately effective and 1 not at all effective. Anderson taught two sections of the undergraduate course, and the ratings were 5.8 and 6.3. Not only are these considerably above the average instructor rating of 5.0, I believe this is the highest rating of any new faculty member teaching his or her first undergraduate class. Here are written comments from undergraduates in his first class:

- "Tom Anderson is an intensely organized and professional educator. I'm amazed how well he taught this course, given his experience. One of the three best instructors I've had."
- "I think one of the greatest things a professor can do is get the students excited and interested in the subject material, and Tom has succeeded in doing that."
- "The best professor I had at Cal. He is enthusiastic, passionate about teaching, clear, willing to help, and he gives excellent lectures."

A pilot program

It is possible Anderson is simply a natural—a gifted teacher who would have received outstanding ratings no matter what we did. Even if that is true, Anderson believes his self-confidence was boosted and his preparation time was reduced by reviewing the tapes. To more rapidly discover the national value of this approach, under CRA auspices, I am running a pilot program to determine if tapes of outstanding teachers will improve teaching skills and save time for new faculty. Here are the tapes available in this first offering:

1. Manuel Blum, Efficient Algorithms and Intractable Problems, for juniors and seniors;
2. Randy Katz, Components and Design Techniques for Digital Systems, for juniors and seniors;
3. John Ousterhout, Operating Systems and Systems Programming, for

Continued on page 16

Canadian News

Network proposal released

BY Douglas Powell
Special to CRN

After four years of consultation and negotiation, a proposal to establish a national electronic highway of ever-increasing capacity in Canada—culminating in a gigabit backbone by the turn of the century—finally has been released.

According to the formal business plan released in January, the Canadian Network for the Advancement of Research, Industry and Education (CANARIE) will become operational this year. The plan calls for upgrading the existing CaNet backbone to T1 speeds from 56 Kbits/sec and establishing a high-speed experimental test network.

Phase 2 of the proposal, which begins in 1995, calls for the experimental network to become operational, with the on-going development of new products and services, as well as the continual enhancement of the national network.

"CANARIE will showcase Canadian developments in hardware, software and related services; the foundation of tomorrow's broadband communications and multimedia information world," said William G. Hutchison, managing partner of information technology at Toronto-based Ernst and Young Management Consultants and chair of the CANARIE executive committee. "One of its important objectives will be to give Canadian information technology firms a competitive edge in creating new products and services for export markets."

Total direct and indirect investment for Phase 1 in 1993 and 1994 will be $115 million, with a proposed participation by the federal government of $28 million. The direct and indirect investment in Phase 2 is estimated at $470 million, an amount that will be refined during Phase 1, Hutchison said.

"Investments are being made around the world in advanced national and multinational communications networks such as that conceived by the CANARIE project," said Bill Etherington, president and chief executive officer of IBM Canada Ltd. "This investment will better position Canadian institutions to fully participate in the new world economy."

One possible hitch, which appears to have been resolved, is the relationship between CANARIE and the existing CaNet. According to Ken Fockler, executive director of CaNet Networking Inc., the CANARIE initiative will be "very beneficial for Canada through its planned enhancements of Canada's existing R&D and educational network," and CaNet is "pleased to be associated with CANARIE."

Although not finalized, some form of government support appears forthcoming, based on past comments and high-level government support. "CANARIE is getting support and has changed dramatically," said former Minister of Science William Winegard. "It certainly caught the fancy of my cabinet colleagues."

New Minister of Science Tom Hockin agreed, but cautioned that while he is a strong supporter of CANARIE, "there are a lot of decisions and steps required to make it a reality." An October 1992 report on competitiveness commissioned by the federal government also voiced support for CANARIE, stating, "We must link Canada by building a high-speed, broadband electronic information highway."

Douglas Powell is with the Information Technology Research Center at the University of Waterloo.

New Minister of Science is appointed in Canada

BY Douglas Powell
Special to CRN

Canada's new Minister of Science, 55-year-old Tom Hockin, says that linking science and technology to job creation is his first priority, and that it is up to the scientific community to better articulate the links between science and economic development. "I don't think we will be able to sustain the proper level of funding for science, as a country, if the scientists approach it with a psychology of entitlement," said Hockin, who holds a Ph.D. in government from Harvard.

"What they have to do is earn the attention of industry and government by saying this is what we produce, by way of improvement for the human condition and the jobs that are created," Hockin said. "That is a bit of a tough theme, but I am going to be carrying it. I believe they can do it. In my speeches I'm going to be selling their case that way, but I will not sell it on the basis that because scientists have studied a long time and done a lot of research papers, they should have money."

Hockin's appointment came one week after William Winegard, Canada's Minister of Science for the past four years, announced in late December that he would not run again in a federal election, expected later this year. First elected to the House of Commons in 1984, Winegard was re-elected in 1988 and named federal Minister of State (a junior minister) for Science and Technology, in January 1989. In 1990 he became Canada's first full Minister of Science during the formation of the superministry, Industry, Science and Technology Canada. Citing family reasons, the 68-year-old Winegard said, "I'll probably spend a lot more time watching my grandsons play hockey."

The change comes in the wake of mixed news for the Canadian scientific community. A pledge in the 1992-93 federal budget to increase university granting council funding by 4% a year through 1995-96—in what was seen as a major Cabinet victory for Winegard—was withdrawn by the federal finance department in early December. Instead, the budget of the granting councils has been frozen at 1992-93 levels.

"Sure I was disappointed," said Winegard, an engineer and former president of the University of Guelph. "The battle was whether we were going to get the 10% cut that everyone else was getting. Although the professorials may not agree, I was happy to get the percentage increases we got for the granting councils every year. And compared to what else was going on in government, they did very well."

It also was announced in December that the federal Network of Centers of Excellence program would be extended beyond 1993-94, when it was slated to end. How much money will be available and whether all 18 centers will survive has yet to be determined.

Three of the federal centers are devoted to information technology—MicroNet, the Institute for Robotics and Intelligent Systems and the Canadian Institute for Telecommunications Research. Hockin, who also will continue as Minister of State for Small Business and Tourism, said he is looking forward to working closely with President Clinton's science adviser, John H. Gibbons, and hosting the next meeting of the G-7 science ministers this spring.

Douglas Powell is with the Information Technology Research Center at the University of Waterloo.

Tapes from page 15

juniors and seniors; and

4. Dave Patterson, Computer Architecture, for seniors and graduate students.

All of these instructors have won the competitive Distinguished Teaching Award from the Academic Senate of the University of California, and two instructors have won national teaching awards (Ferst Teaching Medal from Sigma Xi and Karlstrom Outstanding Educator Award from ACM).

These tapes are $300 per set (plus tax and shipping). Ordering one set of tapes from other organizations can cost up to $750, and companies are charging $5,000 to $10,000 for a set of tapes to be shown to faculty. Reasons for the low cost include batch processing orders and tape duplication, combining two lectures onto a single VHS tape, Berkeley faculty and video services donating their traditional royalties, Berkeley paying for these initial mailings, and University Video Communications' willingness to not only avoid profits, but take a chance on losing money. A course will include between 22 and 27 VHS tapes, depending on the number of lectures per week.

Lecture notes for these four courses are available for anonymous FTP at ftp.cs.berkeley.edu. You can get a copy of the notes whether or not you order the tapes.

If you would like to order the tapes, send E-mail before May 15 to teaching@cs.berkeley.edu. Checks must be received by June 15. Tapes will be shipped by July 15. If you prefer, you can send a credit card number by E-mail. These tapes are recordings of what happened in Berkeley classrooms, and are not intended (or permitted) to be shown to students in place of an instructor. By ordering the tapes, you are agreeing to participate in a survey at the end of the fall 1993 term to determine the effectiveness of the tapes and the program.

If the results of the pilot program are as positive as the Berkeley experiment, CRA will help expand and organize the program and select videotapes of outstanding CS&E teachers from across North America.

David A. Patterson is chair of the Computer Science Division at the University of California at Berkeley and is a member of the CRA board.

CSCW from page 13

students to integrate knowledge from different fields, the researchers found that students chose more interactive media to get the job done. Contingency theory, Galegher said, is useful but ultimately is too limited because it assumes there is some "concrete objectively known thing in information technology." Instead, Galegher said he prefers adaptive structure, where people are recognized as active, cognizant agents who can perceive their world in a variety of ways.

For these new technologies to be successful, many believe organizational structures must change. Collaboration, multitasking and flattened hierarchies are nice buzzwords, but in reality present significant challenges. Ron Baecker said it was not yet known if CSCW technologies can catalyze a change in social structures.

"Electronic mail can be used in some organizations to cut down hierarchies and open communication across levels," Baecker said. "In other organizations it can be used as an instrument of control."

This is especially significant in the academic research institute. There are several ongoing studies of how collaborative tools can be used to bolster the research activities of groups such as oceanographers or molecular biologists, said Richard Harper of Rank Xerox Cambridge EuroPARC.

He has studied the nature of work in several research labs in Europe, England and the United States and has concluded that the social organization of research laboratories is resistant to change. His study sample is small and may not be representative, however.

"It may not be appropriate to use research labs to test systems designed to alter social relations, because these places may simply be too static to make it worthwhile." Harper said.

Douglas Powell is with the Information Technology Research Center at the University of Waterloo.

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. Tel. 202-234-2111; fax: 202-667-1066; E-mail: jbass@cs.umd.edu. 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 and will be printed in bold, (2) the second line must contain the name of the department or unit and will be printed in italics 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. Any headings or text requested in all uppercase will be set in bold and counted as two words.

The rate is $2 per word (US currency). A check or money order *(please do not send cash)* must accompany the ad copy. Purchase orders are acceptable. All CRA members receive at least 200 free words per dues year.

Professional Opportunity display ads cost $30 per column inch. The ad must be submitted in camera ready, offset (positives or negatives) or mechanical form. Please call for information on placing display ads for products or services.

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 will not be accepted. (An ad published in the May issue must show an application deadline of June 1 or later.) Advertising copy must be received at least one month before publication. (The deadline for the May issue is April 1.)

University of Delaware

Department of Computer and Information Sciences

The University of Delaware, centrally located on the East Coast within day-trip distance of New York, Philadelphia, Baltimore and Washington, DC, is recruiting for possible visiting or limited-term faculty positions in the Department of Computer and Information Sciences beginning Sept. 1, 1993.

A Ph.D. degree or its equivalent and excellence in research and teaching are required. Applicants close to finishing their Ph.D. requirements also are encouraged to apply. Candidates are sought in all areas of computer science, but special interest exists for candidates in artificial intelligence, theory of computation, networks, algorithms, compilers, symbolic mathematical computation and computer systems.

The department offers bachelor's, master's and doctoral degrees, and has 15 tenure-track faculty and five visiting faculty, along with more than 80 graduate students, 51 of whom are full-time. The department has excellent research computing facilities and is well-connected, with gateways to major networks.

Candidates should send a curriculum vitae to Professor Adarsh Sethi, Recruiting Committee Chair, Department of Computer and Information Sciences, University of Delaware, Newark, DE 19716. In addition, candidates should have three letters of reference sent directly to the above address. All applications must be received by April 1.

The University of Delaware is an equal opportunity employer that encourages applications from qualified minority group members and women.

University of Maryland, Baltimore County

Department of Computer Science

The Department of Computer Science at the University of Maryland, Baltimore County (UMBC), invites applications for several tenure-track openings at the level of assistant professor. We are particularly interested in candidates in architecture and graphics interface technology. Other areas of strong interest include software engineering, operating systems, parallel and distributed processing, databases, computer networks and scientific computation. Senior applicants with an exceptional record of research and teaching also may be considered.

The department consists of 16 full-time faculty and 24 adjunct faculty. We offer B.S., M.S. and Ph.D. degrees in computer science, and have about 140 graduate and 700 undergraduate students. The department recently moved into a new building and has completely renewed its computational facilities.

The UMBC campus has 10,000 students and is joined at the graduate level with the University of Maryland at Baltimore (UMAB), located a few miles away in downtown Baltimore. The resulting University of Maryland Baltimore Graduate School has a strong research program with more than $100 million a year in external research funding, and includes Maryland's medical, law and dental schools. UMBC is located in the Baltimore–Washington corridor, providing easy access to both metropolitan areas and numerous federal agencies, industrial research centers and consulting firms.

Your application, curriculum vitae and three letters of reference should be sent to Faculty Search, Computer Science, University of Maryland, Baltimore, MD 21228-5398. Tel. 410-455-3000; fax: 410-455-3000. Send E-mail to search-info@cs.umbc.edu for more information and to search@cs.umbc.edu for general inquiries.

UMBC is an affirmative action, equal opportunity employer.

University of Maryland, College Park

Institute for Advanced Computer Studies

Applications and nominations are invited for the position of director of the Institute for Advanced Computer Studies (UMIACS) at the University of Maryland, College Park campus. The director provides both academic and administrative leadership for the institute and reports directly to the dean of the College of Computer, Mathematical and Physical Sciences.

UMIACS is a research institute that supports multidisciplinary work in computing sciences. The institute has six permanent faculty, 37 rotating faculty (representing nine departments), postdoctoral scientists, graduate students and a technical and administrative staff. Areas of research include (but are not limited to) artificial intelligence, database systems, high-performance computing, numerical analysis, operating systems, parallel algorithms, software engineering and theory of computing. Currently, its Parallel Computing Laboratory houses a Maspar MP1 and a TMC CM-5. The institute receives significant support from the state of Maryland and from various granting agencies and companies. Its 1993 combined budget is about $5.2 million. The institute shares a new building on the College Park campus with the Institute for Systems Research, the Center for Automation Research and the Departments of Computer Science and Electrical Engineering.

The director is a senior member of the University of Maryland faculty and is selected and appointed by the university to a five-year, renewable term. A candidate should have an earned doctorate, be eligible for appointment in the Computer Science Department at the rank of professor with tenure, have successful experience as a teacher and a distinguished record of scholarly research, and have demonstrated leadership ability and management skills. It is highly desirable that candidates demonstrate experience in interactions with multiple disciplines.

Applications should include a curriculum vitae and the names, addresses and telephone numbers of at least four references. For best consideration, submit applications before April 15 to Professor Steven I. Marcus, Institute for Systems Research, 2167 A.V. Williams Building, University of Maryland, College Park, MD 20742.

The University of Maryland is an equal opportunity, affirmative action employer. Women and minority candidates are encouraged to apply.

University of Chicago

Department of Computer Science

Junior and senior positions are available in the Department of Computer Science. Our preference is for candidates with expertise in one of the areas of experimental computer science, such as programming languages or distributed systems, but we will consider exceptionally strong applicants from all areas.

Send curriculum vitae and three letters of reference to Professor Janos Simon, Chair, Department of Computer Science, University of Chicago, 1100 E. 58th St., Chicago, IL 60637. Inquiries can be directed to chair@cs.uchicago.edu.

The University of Chicago is an equal opportunity, affirmative action employer.

Columbia University

Department of Computer Science

The Columbia University Department of Computer Science is anticipating one tenure-track opening. We invite applications from exceptional candidates at all ranks and in all areas, exclusive of vision and robotics, but we are particularly interested in areas that complement current departmental research interests.

Our department of 19 tenure-track faculty and two lecturers emphasizes research and attracts excellent Ph.D. students, virtually all of whom are fully supported. Departmental facilities include numerous Sun 4 servers, Sun, Hewlett-Packard, DEC, IBM and NeXT workstations, plus state-of-the-art experimental equipment. The department is in the second year of an NSF CISE infrastructure grant, and we will purchase a parallel processor this year. We are within an hour's drive of the research laboratories of AT&T, Bellcore, IBM, 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 rent-controlled 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. Interest and ability in teaching undergraduates and graduates is necessary. Please submit a summary of research interests, resume, E-mail address and the names of at least three references to Professor Kathleen McKeown, 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.

University of Missouri–Rolla

Department of Computer Science

The Department of Computer Science at the University of Missouri–Rolla is seeking qualified applicants to join an aggressive, interdisciplinary group of faculty in computational mathematics for parallel and distributed computing.

Applicants for a junior position must demonstrate evidence of their ability to perform research and have had prior involvement in group research activities. Candidates must have a Ph.D. in a relevant area and a strong interest in both teaching and research.

Applicants for a senior position must have a demonstrated record of research and funding emphasizing research team leadership as the principal investigator. The position is tenure track. The successful candidate will be expected to contribute to the departmental and interdisciplinary research efforts.

The committee will begin reviewing applications April 1. Applicants should send a curriculum vitae and a statement of research and teaching interests (and arrange to have three letters of reference sent) to Dr. Lenore Mullin, Faculty Search Committee, Department of Computer Science, University of Missouri–Rolla, Rolla, MO 65401. Tel. 314-341-4491; E-mail: csdept@cs.umr.edu.

UM–Rolla is an equal opportunity, affirmative action employer, and it especially encourages applications from minorities and women.

Johns Hopkins University

Department of Computer Science

The Johns Hopkins University invites applications for a faculty position in the Department of Computer Science. Appointments at all ranks will be considered. We are particularly—but not exclusively—interested in candidates in the following research and teaching areas: software engineering, distributed computing, databases, computer graphics and visualization, and artificial intelligence.

All applicants are expected to have an outstanding research record, commitment to quality teaching and the ability and willingness to develop a research program of the highest quality.

Applicants should send a comprehensive resume and names of at least three references to Faculty Search Committee, Department of Computer Science, Room 224, New Engineering Building, Johns Hopkins University, Baltimore, MD 21218-2694. Fax: 410-516-6134; E-mail: faculty_position@cs.jhu.edu.

The Johns Hopkins University is an equal opportunity, affirmative action employer.

Continued on page 18

Professional Opportunities

Ads from page 17

University of Wisconsin at Milwaukee

Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science at the University of Wisconsin, Milwaukee, is seeking qualified applicants to fill tenure-track junior faculty positions. Candidates should have outstanding promise in, and strong commitment to, research as well as teaching. The areas of interest are artificial intelligence, software engineering, programming languages and operating systems.

The department offers undergraduate and graduate programs in computer science. Currently, the department has well-recognized strengths in data security, cryptography, parallel and distributed computation, knowledge representation and theory. We are committed to continuing the development of computer science in our university and establishing it as an outstanding program.

The university is located in a very pleasant neighborhood not far from the shores of Lake Michigan. Candidates are requested to send a resume and the names of at least three references to Professor K. Vairavan, Co-Chair for Computer Science, Department of Electrical Engineering and Computer Science, University of Wisconsin–Milwaukee, Milwaukee, WI 53201.

The university is an affirmative action, equal opportunity employer. Women and minorities are encouraged to apply. Unless confidentiality is requested in writing, information about the applicants will be released on request. Finalists cannot be assured confidentiality.

Oregon Graduate Institute

Department of Computer Science and Engineering

The Oregon Graduate Institute of Science and Technology invites applications for a new faculty position in the Department of Computer Science and Engineering. Applicants must have a Ph.D. in computer science or related field and experience in graduate education and research. Areas of interest include functional programming languages, formal methods for software design and development, high-performance computing, database and operating systems, and neural networks and spoken-language understanding systems.

OGI is a private research university located a few miles west of Portland, OR. Because OGI offers only graduate degrees, faculty have no undergraduate teaching responsibilities. The department currently has 17 full-time faculty members.

To apply, send a brief description of research interests, the names of at least three references and a resume to Professor Richard B. Kieburtz, Department Head, Department of Computer Science and Engineering, Oregon Graduate Institute of Science and Technology, 19600 NW von Neumann Drive, Beaverton, OR 97006. E-mail: csedept@cse.ogi.edu.

OGI is an equal opportunity employer and welcomes applications from women and minority candidates.

University of New Mexico

Department of Computer Science

Nominations and applications are invited for the position of chair of the Department of Computer Science, to start as early as August 1993. The successful applicant will have a Ph.D. in computer science or related field, a demonstrated commitment to excellence in teaching and research and strong ties to the academic computer science community. Prior administrative experience is desirable.

The department offers B.S. (accredited by CSAC), M.S. and Ph.D. degrees. It has 15 full-time faculty, with 100 graduate and 200 undergraduate students. The department runs a network of more than 60 workstations and X terminals, plus specialized graphics equipment, including a Silicon Graphics Inc. 4D/340VGX. Research is conducted in AI, database systems, graphics and visualization, massively parallel computing, theoretical computer science, user interfaces and other areas. Research funding has tripled over the last three years.

The University of New Mexico enrolls 25,000 students. Proximity to the Sandia and Los Alamos National Laboratories, the Air Force Phillips Laboratory and the Santa Fe Institute afford unique collaborative opportunities. Albuquerque offers a low cost of living, a mild climate year round and easy access to outdoor activities.

Review of applications begins April 1, but the position is open until filled. Please send curriculum vitae and references to Professor Mohsen Shahinpoor, Chair, Computer Science Chair Search Committee, College of Engineering, University of New Mexico, Albuquerque, NM 87131.

The University of New Mexico is an affirmative action, equal opportunity employer.

Clemson University

Department of Computer Science

The Department of Computer Science at Clemson University invites applications and inquiries for faculty positions at the rank of assistant professor. Candidates must have demonstrated a capability for research and graduate-level teaching in one or more areas of non-numerical computer science or information systems. Applicants with expertise in database systems, operating systems or software engineering are of special interest.

Clemson University is a state-assisted, land grant university with an enrollment of about 17,000 students. The Department of Computer Science offers B.A., B.S., M.S. and Ph.D. degrees in computer science and a B.S. degree in computer information systems. The department currently has 25 full-time equivalent faculty positions and about 300 undergraduate and 150 graduate majors.

Applicants should submit a resume and have at least three letters of recommendation sent to A.J. Turner, Chair, Faculty Search Committee, Department of Computer Science, Edwards Hall, Box 341906, Clemson, SC 29634-1906.

Tel. 803- 656-3444; E-mail: turner@cs.clemson.edu.

Review of applications began March 1 and will continue until a suitable candidate is selected.

Clemson University is an equal opportunity, affirmative action employer.

University of South Carolina

Department of Computer Science

The Department of Computer Science at the University of South Carolina, Columbia, invites applications for tenure-track faculty at the rank of assistant professor to begin in the fall. Candidates for the position must demonstrate ability in relevant research and scholarship and significant teaching ability. A doctorate in computer science or a closely related field is required. Well-qualified applicants in all research areas will be considered, but preference will be given to parallel processing and computational science.

The department offers B.S., M.S. and Ph.D. degrees to about 150 graduate students and 280 undergraduate students. Current research areas include data compression, scientific visualization, parallel computation, artificial intelligence, theoretical computer science, educational technology and fault tolerance.

Interested applicants should submit a curriculum vitae and names and addresses of three references (please include telephone numbers and E-mail addresses, if possible) to Search Committee, Department of Computer Science, University of South Carolina, Columbia, SC 29208. E-mail: csci@cs.scarolina.edu.

Applications will be accepted until the position is filled. The University of South Carolina is an equal opportunity, affirmative action employer.

State University of New York at Buffalo

Department of Computer Science

The Department of Computer Science may have an opportunity to hire faculty at the assistant or associate professor level. We will consider only those candidates who demonstrate exceedingly high research promise. We are seeking candidates in applied and experimental areas of computer science, as well as candidates who will collaborate with researchers in other disciplines. We especially are keen on attracting faculty in the area of parallel systems in order to continue to build our current base in parallel computing and systems. Successful candidates must complete all requirements for the Ph.D. degree in computer science or a closely related field before assuming duties.

The department currently has 15 tenure-track faculty, three full-time lecturers and eight research and adjunct faculty members. Primary research areas include artificial intelligence, complexity theory, computer vision, numerical linear algebra, parallel algorithms, pattern recognition, programming languages, systems and VLSI. Department members are actively engaged in interdisciplinary research with the Advanced Scientific Computing Graduate Group, Cognitive Science Center, Medical Foundation of Buffalo, NSF National Center for Graphic Information and Analysis, USPS Center for Excellence in Document Analysis and Recognition, and Vision Graduate Group. Departmental computing facilities include a network of Sun workstations, Intel's Hypercube, Symbolic machines, an Encore Multimax and several image processing and graphics systems.

Send applications, including a cover letter, curriculum vitae, a one-page research statement and names and addresses of three references to Professor Sreejit Chakravarty, Chair, Recruiting Committee, 226 Bell Hall, Department of Computer Science, State University of New York, Buffalo, NY 14260. Tel. 716-645-2863; fax: 716-645-3464; E-mail: sreejit@cs.buffalo.edu.

SUNY is an equal opportunity, affirmative action employer.

University of Central Florida

Department of Computer Science

The University of Central Florida seeks applications for two tenure-track positions in computer science. Both positions will be at the level of assistant professor. We are interested in all strong candidates who have demonstrated research strength in artificial intelligence or computer architecture.

Within the area of artificial intelligence, we especially are interested in candidates whose work includes the

Continued on page 19

Professional Opportunities

Ads from page 18

solution of problems from natural language and the representation and acquisition of knowledge from natural language. Within the area of computer architecture, we particularly are interested in candidates whose research includes either VLSI or high-performance computer architectures. Post-doctorate or industrial experience is desirable.

We are a young, dynamic university with about 21,000 students. The Computer Science Department is one of the largest departments on campus, offering bachelor's, master's and Ph.D. degrees. The faculty research interests include parallel computation, VLSI, artificial intelligence, computer vision, networking technology, graphics and simulation, databases, and design and analysis of algorithms.

The university is located in Orlando, the center of Florida's strong software development industry. The campus is adjacent to the Central Florida Research Park, which houses the Naval Training Systems Center; the Army's Simulation, Training and Instrumentation Command; and several university research organizations, including the Institute for Simulation and Training and the Center for Research in Electro-Optics and Lasers. Computer science faculty work closely with and receive substantial research support from these groups and from the NASA Kennedy Space Center, located within 50 miles of the campus.

Central Florida affords an excellent standard of living. Orlando ranks among the 10 most livable cities in the United States, and has a variety of attractions and restaurants. We have a strong public school system, easy access to the beaches and a climate that makes it possible to enjoy the outdoors all year long.

Applications are invited through April 16. Interested, qualified applicants should send resumes and names of at least three references to Dr. Terry J. Frederick, Chair, Department of Computer Science, University of Central Florida, Orlando, FL 32816-2362. Tel. 407-823-2341; fax: 407-823-5419; E-mail: fred@cs.ucf.edu.

The university is an equal opportunity, affirmative action employer.

University of Texas at Austin

Department of Computer Sciences

The Department of Computer Sciences at the University of Texas at Austin invites applications for tenure-track positions at the assistant professor level, particularly in the areas of (1) experimental systems, including compilers, operating systems, databases, languages, networks and architectures, and (2) theory of computation (algorithms). Outstanding candidates at senior levels will be considered for positions at the associate or full professor levels, depending on qualifications.

Applicants must hold or be making satisfactory progress toward a Ph.D. or equivalent in computer science or a related area, with a reasonable expectation of completion by Aug. 31, 1993. Offers of employment are contingent on completion of requirements for the degree by that date. Successful candidates are expected to pursue an active research program, perform both graduate and undergraduate teaching and supervise graduate students. Effective communication skills are an important criterion for evaluation of faculty candidates at UT Austin.

The department is ranked among the top 10 computer science departments in the country. It has 40 faculty members across all areas of computer science, including artificial intelligence, database systems, parallel processing, real-time systems, scientific computing and theory of computation. Austin, the capital of Texas, is located on the Colorado River, at the edge of the Texas Hill Country. Live music and outdoor recreation are among the many attractions of this beautiful area. Austin also is a center for high-technology industry, including MCC, Sematech, Motorola, IBM, AMD, Tandem, TI and others.

Applicants should submit a curriculum vitae, a statement of research interests and representative publications by March 31 to Faculty Recruitment Committee, Department of Computer Sciences, University of Texas at Austin, Austin, TX 78712-1188. Letters of reference will be solicited separately.

Women and minority candidates especially are encouraged to apply. The University of Texas is an equal opportunity, affirmative action employer.

University of Southern California

Electrical Engineering/Systems Department

The Electrical Engineering/Systems Department invites applications for several tenure-track positions. Preference will be given to senior-level applicants who have demonstrated a leadership ability in building strong research programs and who have distinguished teaching and research records.

Three areas of interest include communication networks for multimedia applications, with an emphasis on the lower layers of the OSI network model (physical, link protocol, and routing/signaling aspects); statistical communication and signal processing algorithms and its VLSI/CAD implementation; and computer-aided design for digital systems.

Applications must include a comprehensive resume, a list of three-to-five professional references and a letter of interest clearly indicating the position designated above for which you are applying. Please send material to Chair, EE/Systems Search Committee, EE/Systems Department, Los Angeles, CA 90089-2560.

USC is an affirmative action, equal opportunity employer, and it encourages and welcomes applications from women and minorities.

University of Virginia

Department of Computer Science

The Department of Computer Science invites applications and nominations for faculty positions of all ranks. The university, founded by Thomas Jefferson in 1819, is located in Charlottesville, a city of 80,000 located in the foothills of Virginia's Blue Ridge Mountains. The department currently has 150 undergraduate majors, 56 master's students, 46 Ph.D. students, and 18 full-time faculty and a strong research program.

Applications in all areas of computer science will be considered. Salary and rank will be commensurate with experience. Applicants must have a Ph.D. degree in computer science. Excellence in research and teaching is required. Candidates for the senior positions must have an established research and leadership record.

Please send a resume and the names of three references to Dr. Anita K. Jones, Department of Computer Science, Thornton Hall, University of Virginia, Charlottesville, VA 22903. Virginia is an equal opportunity, affirmative action employer.

Continued on page 20

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Conference News

Computing researchers to meet at federated conference in May

The first Federated Computing Research Conference, FCRC '93, will be in San Diego May 14-22. The conference will bring together nine conferences and workshops that represent a variety of computing research disciplines.

Two years ago, CRA received a National Science Foundation grant to explore the feasibility of a major research conference for computing and make the initial plans for such a meeting. Although many members of the research community were reluctant to give up the benefits of the smaller, more specialized meetings, they believed the field was intellectually mature enough to benefit from a larger, more diverse research meeting. However, the community did not want to create another conference, which is why the hybrid, federated approach was explored.

By providing a common time and meeting place for several established meetings, FCRC '93 is retaining the intellectual benefits and research identities of the smaller constituent meetings, while providing greater visibility for the field. FCRC '93 also is providing the opportunity for researchers to meet with their peers in other specialties. Because of the unified nature of the conference, researchers will be able to learn about important findings in other specialized subfields.

Each participating conference will be administered independently, and each organizing group will be responsible for its meeting's structure, content, proceedings and special events. All FCRC '93 attendees will register for at least one participating conference and will be able to buy proceedings from the other meetings. During their "home" conference—to the extent facilities allow—attendees will be free to sit in on other meetings.

Each morning will start with a plenary lecture on a topic in computing research. The conference features two plenary social events.

The plenary speakers are Richard Karp of the University of California at Berkeley, Maurice Wilkes of Olivetti Research Ltd., Guy L. Steele Jr. of Thinking Machines Corp, and László Babai of the Universities of Chicago and Eotvos. A yet-to-be-selected federal policymaker also will deliver an address.

In planning FCRC '93, CRA received financial help from NSF and support and assistance from other sponsoring organizations. The Association for Computing Machinery has been particularly active in providing support and planning expertise.

Contact Phil Louis at CRA to request a registration package. Tel. 202-234-2111; fax: 202-667-1066; E-mail: plouis@cs.umd.edu. Anyone who previously received information on any of the participating conferences automatically will receive the registration package.

Participating research meetings

• 25th Annual ACM Symposium on the Theory of Computing (STOC)
Sponsor: ACM Special Interest Group on Algorithms and Computation Theory
Contact: David S. Johnson, AT & T Bell Labs, dsj@research.atl.com

• Ninth Annual ACM Symposium on Computational Geometry
Sponsors: ACM SIGACT and ACM Special Interest Group on Graphics (SIGGRAPH)
Contact: Chee Yap, Courant Institute, yap@yap.cs.nyu.edu

• Fourth ACM Symposium on Principles and Practices of Parallel Programming (PPoPP)
Sponsor: ACM Special Interest Group on Programming Languages (SIGPLAN)
Contact: Marina Chen, Yale University, chen-marina@cs.yale.edu

• Eighth Annual Conference on Structure in Complexity Theory
Sponsor: IEEE Technical Committee on Mathematical Foundations of Computing
Contact: Steve Mahaney, University of Arizona, srm@cs.arizona.edu

• Workshop on Parallel Algorithms (WOPA '93)
Sponsor: University of Maryland Institute for Advanced Computer Studies (UMIACS) and the Defense Advanced Research Projects Agency
Contact: Uzi Vishkin, University of Maryland, vishkin@umiacs.umd.edu

• 20th Annual International Symposium on Computer Architecture
Sponsors: ACM Special Interest Group on Computer Architecture, IEEE Computer Society and the IEEE-CS Technical Committee on Computer Architecture (TCCA)
Contact: Lubomir Bic, University of California at Irvine, bic@cj2.ics.uci.edu

• Seventh Workshop on Parallel and Distributed Simulation (PADS)
Sponsors: ACM Special Interest Group on Simulation (SIGSIM), IEEE Computer Society, IEEE-CS Technical Committee on Simulation (TCSIM) and the Society for Computer Simulation (SCS)
Contact: David Jefferson, University of California at Los Angeles, jefferso@cs.ucla.edu

• ACM/ONR Workshop on Parallel and Distributed Debugging
Sponsors: Office of Naval Research, ACM SIGPLAN and the ACM Special Interest Group on Operating Systems
Contacts: Bart Miller, University of Wisconsin, bart@cs.wisc.edu
Joan Francioni, University of Southwestern Louisiana, jf@cacs.usl.edu

• CRA Workshop on Academic Careers for Women
Sponsor: CRA's Committee on the Status of Women
Contact: Cynthia Brown, Northeastern University, brown@corwin.ccs.northeastern.edu

Dropouts from page 9

science and math background take COMP 102, the "serious" course, in order to improve their chances in the job market. They avoid COMP 130, known as the "veggie" course, for fear of smearing their records. It also may be that young women do not want to fall under the derogatory label "computer bunny."

Besides financial barriers within the department, other conditions hinder reform: worsening economic recession, student-fee increases and the effects of administrative change in university policy.[1] Undoubtedly, the former two barriers are likely to affect women more than men. Although statistics show both men and women increasingly are vulnerable in this course, it is not clear why. Perhaps, even more students would have dropped out or failed without the changes.

Affirmative action in the shape of an introductory course is necessary. What also is needed is some soul-searching by faculty. Membership into the computer subculture engenders unconscious forms of sexism and generally excludes outsiders unfamiliar with the computer culture. Computer science teachers should take special care to create a relaxed learning environment for those new to the field.

[1] In 1990 and 1991, it was university policy to allow students to change courses or have their money refunded for four weeks after the end of enrollment. In 1992, it was only two weeks, a very short period in which to assess how well-suited individuals are to the course.

Claire Toynbee is a senior lecturer in sociology at Victoria University of Wellington in New Zealand. She may be contacted at E-mail: scarab@vuw.ac.nz.

Ads from page 19

Seminar on digital libraries planned

The Computing Research Association is sponsoring a congressional computing research policy seminar on digital libraries. The seminar is April 23 in Washington, DC. CRA's occasional series of seminars informs key policymakers about the challenges and opportunities presented by computing research. The speakers are David A. Patterson and Edward L. Ayers.

Patterson is professor and chair of the Computer Science Division at the University of California, Berkeley. He was a leader in the development of the reduced instruction set computer architecture. More recently, he has been exploring new designs supporting the management of very large, complex databases.

Ayers is a professor of history at the University of Virginia. A specialist in the history of the American South, he is the author of the book, *Promise of the New South: Life After Reconstruction,* published last fall. The book was a History Book Club main selection, a National Book Award finalist and winner of a prize from the Organization of American Historians. Ayers now is working on a history of a Northern and a Southern community through the era of the American Civil War. It will be available electronically and include a fully accessible digital archive.