COMPUTING RESEARCH NEWS

The News Journal of the Computing Research Association

November 1993 *Vol. 5/No. 5*

Accreditation debate divides Canada's academic community

BY Douglas Powell

Accreditation of software graduates and professionals appears to be gathering momentum in Canada, although most of the research-oriented universities still are reluctant to participate.

The debate is significant for Canada as the software sector continues to grow at 15% to 20% annually and is plagued by a constant shortage of skilled workers.

As in the United States, accreditation of computer science programs at Canadian universities raises a number of questions and has divided the academic community. Does accreditation mean a program is good? Will it lead to conflicts over course content? How is quality assessed? What are such programs actually being accredited for? How many people actually care about accreditation?

It is difficult to develop accreditation guidelines that are rigid enough to ensure that standards are met and yet are flexible enough to ensure innovation, especially in rapidly evolving areas of technology such as design and human-computer interaction.

Further complicating matters is the certification of individuals, a measure introduced three years ago by the Canadian Information Processing Society (CIPS). To date, some 2,400 Canadians are entitled to the designation ISP, or information software professional.

CIPS established the forerunner to the current Canadian University Accreditation Council (CUAC) about 10 years ago and has underwritten the program since its inception. However, the CUAC, made up of academics and industry representatives, stresses its independence.

Les Oliver, director of the School of Computing Science at Acadia University in Nova Scotia and a member of CUAC, argues that accreditation is good for both employers and universities, especially in a discipline such as computer science.

"There is a demand pull for our own product," Oliver said. "We have to prove that it's worthwhile for universities…because the top universities are the top universities and people are going to hire them [their graduates] regardless of the standard." Accreditation of computer science programs

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Congress nibbles at NSF and ARPA funding

BY Juan Antonio Osuna and Fred W. Weingarten

CRA Staff

Following weeks of political turmoil within congressional appropriations committees, the National Science Foundation received a significant but expected shortfall in its fiscal 1994 funding request for research.

The Advanced Research Projects Agency suffered slightly more damage as its funding request for its Computing Systems and Communications Technology programs was slashed by $42 million.

House and Senate conferees met Oct. 1 to resolve funding differences in NSF. The total research budget now is $1.99 billion, lying between the House proposed budget of $2.04 billion and the Senate budget of $1.94 billion. However, the 7% increase for research and related activities—agreed to in conference—falls short of the budget request for an 18% increase.

The conferees decided to decrease Senate-proposed cuts to the High-Performance Computing and Communications (HPCC) program. The Senate originally proposed cutting $50 million from NSF's HPCC budget request. Now $12.5 million will be cut from the program.

The conference report demanded that NSF not spend beyond its current 1993 level for HPCC funding until the agency submitted a report "articulating specific and measurable goals in [HPCC]" with "timetables and milestones."

Despite these setbacks, NSF officials said the agency received a larger increase than any other agency falling within the purview of the House Appropriations Subcommittee on Veterans Affairs, Housing and Urban Development and Independent Agencies.

Conferees also agreed to give Education and Human Resources $569.6 million, which is $13.5 million more than NSF requested and 17%

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More details of NII plan released

BY Fred W. Weingarten

CRA Staff

The Clinton administration recently released a report, *The National Information Infrastructure: Agenda For Action,* which describes the administration's vision of a national broadband digital communication system and the next steps in its plans for advancing that vision into reality.

NII was one of the centerpieces of last year's presidential campaign, although few details were offered about what it would actually look like or how it would be created. Bits and pieces have appeared over the last several months—as a section of the administration's Feb. 21 technology plan and as lines in the stimulus package and budget. But nothing concrete or detailed had appeared. Although still sketchy and preliminary, the new report appears to make a significant step forward in expanding the overall vision and describing how the goals of NII will be achieved.

Vision of an NII

The report avoids specific technical definitions, instead describing the NII in terms of its uses and users. It presents an expansive vision of a high-capacity and ubiquitous communication system that touches most aspects of human life. Examples of uses for this communication system mentioned in the report include:

- Telecommuting,
- Distance learning,
- Access to private and government health and other social services,
- Access to the world's knowledge—art, science and literature,
- On-demand access to entertainment such as movies, television programming and interactive games,
- Home banking and shopping services, and
- Civic networking use by social and political groups to organize and communicate.

This overall vision is not unfamiliar to people in the computing and communication fields, especially those who have become frequent users of the Internet. However, there is much less agreement over how the government should fill in the details of that vision and develop it as an affordable, universal service. Rather than fill in those details, the report describes the creation of a high-level advisory structure and establishes a set of broad goals for government action.

Advisory structure

Two policy bodies have been created by executive order—a government task force composed of senior government officials and an advisory council of outside experts and stakeholders.

The first group, the Information Infrastructure Task Force, chaired by Secretary of Commerce Ron Brown, is responsible for "articulating and implementing the administration's vision." Most of the members of the task force will be cabinet-level officials. Much of the task force's work will occur in three subcabinet-level committees:

- The Telecommunications Policy Committee is chaired by Clarence L. Irving Jr., Commerce's assistant secretary for communications and information and head of the National Telecommunications and Information Administration. This committee will look at universal service, define it and recommend government action to achieve it.
- The Information Policy Committee is chaired by Sally Katzen, head of the Office of Management and Budget's Office of Information

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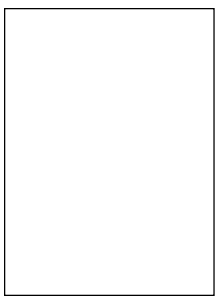
Opinions

NSB, are you going to listen?



BY Bill Wulf

The Senate Appropriations Committee has fired the latest salvo on the rationale for research funding in general, and the mission of the National Science Foundation in particular. (See Page 1.)

Both the tone and the content of the Senate report are, to say the least, startling. It threatens NSF with becoming the National Endowment for the Sciences and it threatens transferring funds to more "entrepreneurial" agencies such as NASA and the National Institute of Standards and Technology. The report demands that 60% of NSF's research be strategic in nature; suggests restructuring the National Science Board (NSB) to include mandatory industrial representation and withholds $50 million from high-performance computing and communications (HPCC) unless the foundation more clearly defines its strategic plan for this program. [A more recent conference report reduced the cut from $50 million to $12 million.]

Let's recall, however, that the underlying message is not new. Traditional congressional friends of science, like George Brown (D-CA) in the House, have been sending the message for several years that it is time to tie more of the nation's research to national goals. In large measure I think the strident tone of the Senate report is the research community's own fault. Some among us have chosen to polarize the discussion—or to refuse to even engage in it. The Senate report is at least in part a reaction to this unresponsiveness.

In my humble view this is *not* a battle that needs to be fought. But if we insist on fighting it, we'll lose. The view expressed by the NSF Commission on the Future, the "Massey Commission," was right on. Basic research and applied research *can* coexist, and NSF *can* take on a strategic mission in addition to its traditional basic science mission. A proper balance *can* be found.

In many fields, including ours, applied research can be the source of rich and intellectually stimulating problems. The knee-jerk "basic is good, applied is bad" reaction is just dumb. Worse, in the present climate it's actually damaging basic research funding.

Yes, we must be careful to maintain a proper balance. Yes, we must maintain standards of integrity and quality. Yes, that especially means protecting basic research. Vannevar Bush warned us of that 40 years ago. But recall, he was operating in an environment in which there was no federal funding of basic research. The balance certainly was out of kilter then, and perhaps it is now as well. Or perhaps not. At least we should be mature enough to admit the possibility and engage in a discussion with the overall national well-being as the goal.

That said, the Senate report language is exceptionally offensive on a number of fronts.

First, it simply underscores the increasing polarization of the (non) discussion. I fault NSF and NSB for dawdling on acting on the commission's report. As the Senate report says, the commission raised expectations, and expectations unfulfilled are a dangerous thing. We (the community) need leadership from the foundation and board, and we're not getting it.

Second, it is ironic that agencies like NASA and NIST are held up as models of "entrepreneurial vigor." Without detracting from them one iota, and with a firm conviction that making them vigorous is good for the nation, that description doesn't match what I see today. There are bright spots and dim ones in all agencies, but clearly NSF's story isn't being told well. And maybe the story for these other agencies is being overtold a bit.

Third, it is incredibly ironic—even tragic—that the HPCC budget is singled out to be held hostage. The HPCC program is among the most strategically, commercially and socially relevant at the foundation—just what Congress says it wants. Moreover, another longstanding goal of Congress has been increased interagency cooperation. HPCC has been a model of that—perhaps the most successful of the Federal Coordinating Council for Science, Engineering and Technology initiatives in that regard. The hard part of interagency cooperation is getting one agency to predicate success of its mission on the performance of another agency. By cutting the NSF HPCC budget, the Senate has undermined the confidence on which the cooperation is based. If NSF cannot hold up its end, the other agencies will go it alone.

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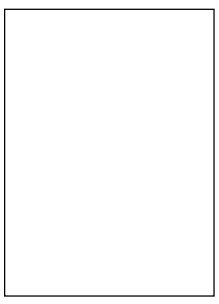
Doers and critics rarely see eye to eye



BY Fred W. Weingarten

William Levitt and Lewis Mumford hated each other.

Levitt was a hard-driving entrepreneur who, shortly after the end of World War II, brought mass production techniques to housing construction. In so doing, he created the tract housing phenomenon that permanently changed the character of suburban neighborhoods and the cities they surrounded. Mumford was an academic, a social philosopher and architecture critic who deplored what Levitt and his imitators had wrought.

In Levitt's view, he was helping to solve a massive social problem by providing affordable housing for millions of returning young veterans and their families. By using his new methods, he not only substantially cut the cost of a new home, but was able to churn them out at a speed unheard of in the pre-war construction industry. In the best capitalist tradition, Levitt made his fortune by providing that most basic of human needs—shelter.

Mumford deplored what he saw as the sterile, uniform environment of the new "Levittowns." More importantly, he warned of the major social disruptions and migrations caused by the new suburban patterns.

David Halberstam, in his book, *The Fifties,* called it "the classic confrontation of the doer and the critic."

As befits a serious policy debate, both sides had strong arguments. My parents, one of those post-war families, saw their first "development house"—purchased with no down payment and a low-interest veteran's loan—as a dream they never could have hoped for just a few years earlier. They would have had no patience at all with Mumford and his social theories.

However, the Levittowns created or amplified serious social problems, many of which still plague us. They accelerated the migration of the middle class from the city. They were, for the most part, racially and economically exclusive. In the days of one-car families and minimal public transportation, they accelerated the post-war trend of bringing women back from the paid work force and into the home.

Clearly, designers inevitably incorporate into projects, consciously and subconsciously, assumptions and values of their time. Doers also tend to be unconcerned about the long-term unintended effects of their creations. They are impatient with the carping of critics who raise such questions. Their impatience is amplified when the critics, as is often the case, are technologically uninformed and naive. It is sometimes hard to distinguish between a serious policy concern and a grade "B" science fiction movie.

These thoughts come to my mind as our nation embarks on a major restructuring of what may be the system that most defines a society: its information infrastructure.

Computing researchers tend to be doers. Some computer experts are deeply concerned about issues such as privacy, security and software vulnerability. But we tend to see information technology largely as offering great potential to enhance the lives of individuals and the institutions they form.

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Expanding the Pipeline

CRAW advances status of women in CS&E

BY Maria Klawe and Nancy Leveson

Almost three years ago the Computing Research Association announced the formation of its Committee on the Status of Women, with the authors of this article serving as the committee's co-chairs. The committee, which was quickly baptized with the somewhat unpalatable name of CRAW, held its first meeting in June 1991. In July of this year, we were delighted to turn over the leadership of CRAW to the capable hands of Fran Berman of the University of California at San Diego and Mary Jane Irwin of the Pennsylvania State University.

We are writing this article to give you an overview of what CRAW has accomplished over the last couple of years and to provide a snapshot of some of the other activities and changes affecting women. We also want to thank the computing research community as a whole, and particularly the members of CRAW, for their tremendous commitment and support.

The last two years have been highly encouraging for those interested in improving the status of women in computing research. Many individuals and groups have committed substantial time, energy and resources to projects designed to address the problems faced by women in our field. We are starting to see signs that these efforts are having a positive effect. Indeed, these efforts sometimes improve the environment for men, too. Of course, many problems remain unsolved and there are some disturbing new trends that we need to monitor carefully.

On the positive side, the percentage of female faculty, especially at the lower ranks, has increased (although it is still below the percentage of women getting Ph.D.s in computer science and computer engineering). Many chairs and other department leaders, both male and female, have demonstrated a real commitment to helping the women in their departments. Informal groups of female students and faculty have been meeting and encouraging each other. Despite a severe drop in the percentage of female undergraduate majors in the last few years, the percentage of women receiving Ph.D.s has remained steady. The shrinking of the pipeline, however, may hit us more seriously in the near future.

Many have committed substantial time, energy and resources to projects designed to address problems faced by women in our field.

CRAW was set up two years ago as a committee that did things. Our field already had numerous studies and reports on the problems faced by women. It was time for action. It is wonderful to be able to write that action occurred. In fact, lots of action. Because this is a somewhat unusual occurrence in our community of incredibly busy and overcommitted individuals, we think you might be interested in the model used for CRAW. We believe this model can be applied elsewhere to get things done.

CRAW was established with the rule that each committee member must lead one project that would address a significant problem. Moreover, the team that undertook any particular project would generally include many individuals not on the committee. The first CRAW meeting consisted of a brainstorming session to assemble the list of possible projects and to set our priorities. This was followed by the signing up of individual committee members as project leaders. Subsequent meetings where committee members would report on progress and seek advice were held about every six months. These meetings, supported by a grant from the National Science Foundation, were crucial in keeping projects moving and in resolving the myriad of major and minor issues that arose.

Despite the rule, not all of the original committee members ended up leading a project. Also, with 14 members on our committee, it was difficult to schedule meetings that everyone could attend. Moreover, some members found it impossible to make the necessary time commitment because of obligations to other equally important projects. Over time we replaced inactive members with individuals committed to specific activities. The result was a group of highly committed individuals who collectively felt a tremendous sense of accomplishment in the progress that was made. And it was a lot of fun. There was inherent pleasure in being part of a team that was working on something both difficult and important. It was a wonderful opportunity to get to know people from other areas of computing research.

CRAW's activities

One of the committee's ongoing activities is a regular column in *CRN* that discusses issues affecting women in computing research. Fran Berman was coordinating this activity, and now Leah Jamieson of Purdue University has taken over. Via these columns, many of CRAW's projects have been (or will be) described in detail, so we'll only briefly mention them now.

The committee's first big project—supported by CRAW's original NSF grant—was the creation of a database of female researchers in computing. This database now contains more than 600 entries. It is being used (with the appropriate permission from the individuals involved) for a variety of purposes including identifying candidates for program committees, editorial boards, awards and job opportunities. Joan Feigenbaum of AT&T Bell Laboratories is heading this project.

Another major CRAW project, led by Joseph O'Rourke of Smith College, is the CRA Distributed

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Nevertheless, we doers need our critics—even some from our own community. The more central computer technology is to American life, the more responsibility we have to legitimize and support serious research on social impacts and information policy.

Nothing could (or should) be done to stop journalists and politicians from mentioning sensational instances, real or imagined, of technological failure. We cannot change the fact that most journalists and politicians do not have scientific or technological backgrounds. There are two things we can do:

• We need to build a foundation of solidly grounded research and theory, as well as a cadre of experts, against which the political debates and journalistic coverage can be tested and informed. It is my experience that most reporters and politicians want more information.

• We need to better educate computing majors at both the graduate and undergraduate level about the policy and social implications of their work. Those policies and public reactions to information technology could profoundly shape the environment in which they will work. (I am not speaking here of the initial attempts at "Computers and Society" texts that have appeared on publishers' lists recently. These, with rare exception, have nothing to do with the course I am thinking about.)

To bring about the change I propose will be difficult for a number of reasons.

First, as suggested above, doers and critics do not always see eye to eye. It is easier to reject the legitimacy of either perspective than to deal with it as a serious part of a political debate.

Second, the methods and tools used by those who study the impacts of computers and information policy differ from those used by their hard-science colleagues. The researchers studying social impacts may incorporate methods of the social sciences, even philosophy.

Their collaborators may be political scientists and theorists, social psychologists, historians, economists, journalists and lawyers. In many cases, it will be hard to bring them into departments and even harder to

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Expanding the Pipeline

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Mentor Project, which recently was funded by NSF. Starting in 1994, this project will match at least 20 female computer science undergraduates with female faculty members. Each student will have the opportunity to spend the summer working with a successful female computer scientist.

Studies have shown that such opportunities are a primary factor in influencing female students to become successful researchers. Because most computer science departments have so few female faculty, it is rare that undergraduate students have a chance to work with a female faculty member in their area of interest. The goal of this project is to overcome this lack of role models and encourage more women to go on to graduate education and a research career.

Two particularly successful events occurred last May. The first was the Workshop on Academic Careers for Women held at the Federated Computing Research Conference in San Diego. Organized by Cindy Brown (then at Northeastern University) and supported by NSF, this day-long event attracted over 120 junior faculty and graduate students to hear leading female computer scientists and engineers explain the intricacies of getting tenure and grants, initiating research and teaching activities and coping with time and social pressures. Attendees raved about the workshop; many described it as one of the most useful experiences that they ever had.

The second event was the Windows of Opportunity Symposium for Female Students in Computing, which was held in Washington, DC, and organized by Dianne Martin of George Washington University. This symposium brought together 200 female undergraduate and graduate students working in the NSF Computer and Information Science and Engineering discipline areas. Participants also thought this symposium was tremendously important to them.

Another important resource for academic computing researchers is Systers Academia, an electronic network for female faculty and graduate students. Systers Academia, established and monitored by Nancy Leveson, now has about 500 members and provides advice to Ph.D. students and junior faculty members. It also serves as a communication channel for women pursuing academic careers.

Significant progress has been made on several other ongoing CRAW projects. These include a report being assembled by Mary Vernon of the University of Wisconsin at Madison describing strategies and experiences of female computing researchers who combined career and family responsibilities. This report will be extremely valuable as an information source for women currently in the field. It also will help attract women to the computing research field because one of the major concerns of young women in choosing careers is whether they will be able to raise a family.

Another important initiative, led by Sandy Baylor of the IBM T.J. Watson Research Center, is the creation of a booklet of graduate fellowships available to women in the computing discipline. Maria Klawe is leading an effort to establish annual awards for outstanding male and female undergraduate students in computing. Fund raising for these awards is underway.

What else is CRAW planning? The columns in *CRN* will continue. Workshops similar to the successful FCRC workshop are planned under the leadership of Jan Cuny of the University of Oregon and Dianne Martin. A careers booklet for high school students is being developed by Dian Rae Lopez of the University of Minnesota at Morris. The Grace Murray Hopper Celebration is being organized by Anita Borg of Digital Equipment Corp. This conference, which will be held in Washington, DC, next June, will have presentations by senior women in industry, academia and government.

We know Janie and Fran will make sure that CRAW continues to be productive, and we're delighted to continue to be part of the team.

Maria Klawe is professor and head of the Department of Computer Science at the University of British Columbia in Vancouver, Canada, and vice chair of the CRA Board of Directors.

Nancy Leveson is the Boeing Professor of Computer Science and Engineering at the University of Washington in Seattle and is a member of the CRA Board of Directors.

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I am glad the cuts in the Senate appropriations were reversed in the House and Senate conference. I hope this attempt to slash research funding is finally the event that triggers the research community to engage in the dialogue and constructively shape a new relationship with society. Those of you who see this as black and white, basic science versus the troglodytes, are wrong. By taking that position you are making the situation worse. Much worse.

In fact, there is a lot of understanding of and respect for basic science on the Hill; one former Senate staffer likes to say that the issue is everyone's second priority. That is not incompatible with a desire to have some of the country's best and brightest minds focused on strategic problems—including the problem of determining the strategic priorities.

As with most things, this should be a question of balance, and we need to participate in finding the balance point. If we choose not to participate, a balance point will still be selected. But it is far less likely to be in a place that is best for society.

NSB, are you listening?

Bill Wulf is the AT&T Professor of Engineering and Applied Science at the University of Virginia. He was formerly an assistant director of NSF, and he currently chairs the Computer Science and Telecommunications Board of the National Research Council.

Habermann was effective advocate for women in CS

BY Susan Gerhart, Nancy Leveson and Caroline Wardle

Most people are familiar with Nico Habermann's distinguished research and leadership career at Carnegie Mellon University and the National Science Foundation (NSF). But not as many people may know of his deep commitment to increasing the number of women in computer science research and the activities he encouraged and supported at NSF toward reaching this goal. At this sad time following his death, it seems fitting to review some of the accomplishments that are the result of his interest and involvement.

Habermann headed NSF's Directorate for Computer and Information Science and Engineering (CISE), which supports research, infrastructure and education for US computer and information science. Many computing professionals are influenced by NSF programs through training (past and continuing) of faculty, through student fellowships, from access to equipment, use of curriculum materials and participation in research and educational programs. Habermann went out of his way to look for qualified women for senior positions in CISE and to convince them that taking such a position would be good for them and the field.

Just as important, he was concerned about the future of the CISE disciplines and the participation of women in these disciplines. With the encouragement of a special task force he established at NSF, Habermann adopted a goal that by the year 2000, 45% of graduate students in CISE disciplines would be women.

To meet this goal, funds were allocated within CISE programs for projects proposed by universities and groups such as the Computing Research Association (CRA) Committee on the Status of Women in Computing Research.

Habermann took a personal interest in these projects and attended workshops and planning meetings to emphasize the importance of such efforts and to personally show his support. The following are

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People in the News

Milt Rose dead at 68

By William S. Dorn, Herbert J. Greenberg and Glenn Ingram

Milton E. Rose, a lifelong supporter of applied mathematics, died Aug. 22 in Denver following a brief illness. He was 68 years old.

Milt, a student of Richard Courant, was awarded a Ph.D. in mathematics from New York University in 1953. After completing his doctorate, Milt worked at the Courant Institute, the Office of Naval Research, the Brookhaven National Laboratory and the Lawrence Radiation Laboratory. In 1963 he was named head of the National Science Foundation's Mathematical Sciences Section.

In 1967 NSF officials decided to greatly expand the agency's support of computing. Milt was selected as the first head of the Office of Computing Activities, a post he held for three years. During his tenure at that office, he was instrumental in providing support for US universities and was a significant force in the rapid development of computing and computer science in academia.

As head of that office he recruited to government service a veritable who's who of computing: Don Aufenkamp, Kent Curtis, Joe Fennel, Tom Gallie, Glenn Ingram, John Lehmann, Arthur Melmed, Ottis Rechard, Vince Swoyer and Rick Weingarten (CRA's executive director), to name just a few.

In 1969 Milt left NSF and spent brief periods at Colorado State University and the University of Denver. In 1971 he became chief of the Mathematics and Computing Program at the Energy Research and Development Agency (ERDA), a post he held until 1977. For one year during his stay at ERDA he was on leave at the California Institute of Technology working with Herb Keller.

In 1977 Milt was named director of the Institute for Computer Applications in Science and Engineering at NASA Langley, a post he held until his retirement in 1986.

Because of Milt's good taste and critical judgment in applied mathematics, many able young applied mathematicians received encouragement when it was sorely needed.

Milt managed to keep up his own lifelong interest in numerical analysis until literally the last days of his life. He happily lived to see his last article, "An Enthalpy Scheme for Stefan Problems in Several Dimensions," appear in *Applied Numerical Analysis*, vol. 12 (1993), pp. 229-238.

One of Milt's firm beliefs was that administrative appointments were as crucial to an organization's success as were professional appointments. Consequently, he exercised as much care in the selection and care of secretaries as he did with the technical and professional staff at NSF. One result of this attitude was that he could recruit top-notch secretaries in Washington, where the folklore was that such help was not possible. Another result was that he presided over an organization that worked in constant harmony and with great efficiency.

Milt was a member of the American Mathematical Society, the Society for Industrial and Applied Mathematics and the Association for Computing Machinery. He was born in Newark, NJ, on May 22, 1925, and is survived by a brother, three children and a grandchild.

William S. Dorn is a professor of mathematics and computer science at the University of Denver.

Herbert J. Greenberg is an Emeritus Professor of Mathematics at the University of Denver.

Glenn Ingram is retired from the National Institute of Standards and Technology.

Milt was one of my mentors

By Fred W. Weingarten

CRA Staff

Milton Rose brought computing and computer science to the National Science Foundation. He also brought me to Washington.

In the mid-1960s, as head of NSF's Mathematics Section, Milt began a facilities program that helped research universities obtain and upgrade their scientific computers. He also began to slip grants out to researchers working in a fledgling field no one else in NSF had ever heard of—computer science. A mathematician himself, Milt was a firm believer in the future of computer science and the importance of computing as a fundamental tool for science. Strong support by a respected mathematician such as Milt was critically important to the acceptance of computing grants by the establishment scientists who populated the foundation's management at that time.

Milt was ready when President Johnson directed NSF to expand its programs of support for computing. The president was prodded by reports from his science adviser's office on the importance of educational and research computing. Milt established, then ran for many years, NSF's Office of Computing Activities (OCA). Much of what the Computer and Information Science and Engineering Directorate presently does has its roots in OCA and its innovative programs.

Milt also took a chance on hiring a young computer scientist finishing up a postdoctoral appointment with Sid Fernbach at Lawrence Livermore Laboratory. OCA and its programs were growing quickly, and even a young newcomer like me was handed a lot of responsibility and challenge. For better or worse, Milt was the reason I got hooked on science and information policy and have spent so many years in this city working those issues. That path led to the Computing Research Association. I will always be grateful for the chance to know him and work for him.

Habermann from Page 4

fiscal 1992 and 1993 awards that are contributing to the 45% goal:

Workshop on Expanding Opportunities for Women in CISE, October 1992. Susan Conry of Clarkson University organized a two-day workshop in Colorado to identify and examine mechanisms for attracting and retaining women in academic careers in the computing sciences. The workshop addressed issues such as professional support and development, the pipeline dropout problem, academic faculty careers, visibility of women in the field and partnerships between academia and industry. A report will be available shortly; contact Conry at Clarkson University.

Workshop on Academic Careers for Women in CISE, May 1993. Cindy Brown of Northeastern University and the CRA Committee on the Status of Women in Computing Research conducted a one-day workshop immediately prior to the Federated Computing Research Conference in San Diego. Workshop activities focused on women in CISE disciplines who were starting or ready to start academic careers.

Over 150 women attended the workshop. Sessions addressed the tenure process, obtaining an academic position, building a research program, obtaining external funding, teaching, making connections with people in the field and time management. A transcript of this workshop is available by ftp at ics.uci.edu (in the directory pub/mentoring-workshop). A hard copy is available from CRA.

Habermann looked for qualified women for senior positions in CISE and convinced them that taking such a position would be good for them and the field.

Windows of Opportunity Symposium for Female Students in Computing, May 1993. CRA presented a two-day symposium in Washington, DC, for 200 undergraduate and graduate female students. The students, studying in CISE areas, were nominated by their institutions. The symposium, chaired by Dianne Martin of George Washington University, had several goals. One was to increase the community's interest in and awareness of the need for participation of women in CISE disciplines. A second goal was to provide the students with the opportunity to meet senior women in academia, industry and government and hear about their careers and accomplishments. A third goal was to help students to make professional contact with fellow students and start building a network of colleagues.

Distributed Research and Mentoring Project for Undergraduate Females in Computer Science and Computer Engineering. Joseph O'Rourke of Smith College and the CRA Committee on the Status of Women in Computing Research are organizing a project to match female undergraduate students with female professors in CISE research areas so the students can participate in a summer of research at the mentor's institution. About 20 to 30 matches will be made each summer during 1994 and 1995.

NSF Graduate Research Fellowships. There will be a Women in Engineering and CISE Award in the Graduate Fellowship program in fiscal 1994. The eligibility requirements have been modified to take into account that women may have interrupted their careers.

We all miss Habermann, but he has left a lasting legacy. Many women will be affected by his dedication to full participation of women in science, by the kinds of activities he actively encouraged and by his setting of the 45% goal for women in CISE.

The work Habermann supported will continue, but the leadership vacuum created by his death must now be filled by the community. Proposals for activities will have to be initiated and carried out by individuals and groups. We hope the memory of what he accomplished and the momentum that has been achieved will continue in his absence.

We believe Habermann would have been happy to know that in celebrating his life and work, people are making an extra effort to strive for full participation of women in CISE.

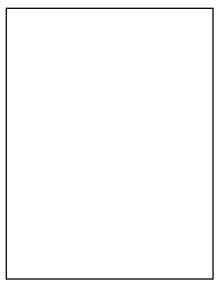
Caroline Wardle is a program director in NSF's Computer and Information Science and Engineering Directorate.

Susan Gerhart is division director of NSF's Division of Computer and Computation Research.

Nancy Leveson is the Boeing Professor of Computer Science and Engineering at the University of Washington in Seattle and a member of the CRA Board of Directors.

People in the News

Board member is appointed



Mary K. Vernon

Associate professor of computer science at the University of Wisconsin at Madison

Vernon received a B.S. degree with departmental honors in chemistry and M.S. and Ph.D. degrees in computer science from the University of California at Los Angeles.

Vernon's research interests include techniques for parallel system performance analysis, and parallel architectures and systems.

She received a National Science Foundation Presidential Young Investigator Award in 1985 and an NSF Faculty Award for Women in Science and Engineering. She has served on several NSF advisory committees, including the 1993 Blue Ribbon Panel on High-Performance Computing and the Advisory Committee for the Computing and Information Science and Engineering Directorate.

Vernon currently is on the editorial board of the IEEE *Transactions on Software Engineering* and she has served on the Board of Directors of ACM SIGMETRICS and the Computer Science Advisory Board of the Computer Measurement Group.

Backus honored by NAE

Retired IBM Fellow John Backus recently was named as the recipient of the 1993 Charles Stark Draper Award, the highest honor of the National Academy of Engineering (NAE). The award carries a $375,000 stipend and a gold medal.

Backus was cited for his development of Fortran, the first general-purpose, high-level computer language, which ushered in the computer software revolution.

"Before John Backus, only a handful of specialists could use the computer," said NAE President Robert M. White. "Today, everyone from preschoolers to postgraduates can use the computer."

Backus, named one of the first IBM Fellows in 1963, spent most of his career at IBM's San Jose Research Laboratory and Almaden Research Center. He retired in 1991.

"This is a richly deserved tribute," said IBM Chair Louis V. Gerstner Jr. "John Backus' pioneering work with Fortan not only altered the course of computer history, it also helped establish a tradition of technological leadership at IBM—a tradition that carries on to this day."

Fortran opened up the world of computers to a wide variety of scientists and engineers. By drastically simplifying computer programming with little or no loss in machine efficiency, Fortran enabled non-programmers to make direct use of computers. Fortran also had a profound effect on other high-level languages, including many of today's state-of-the-art languages, and is still the most highly used language among engineers today.

The award will be presented to Backus Feb. 22 in Washington, DC.

Hartmanis, Stearns win award

Juris Hartmanis, Cornell University chair and professor of computer science and a member of the Computing Research Association Board of Directors, has been named co-winner of the 1993 Association for Computing Machinery Turing Award in computational science.

Hartmanis, currently on sabbatical in Germany, was honored for co-founding the field of computational complexity with Richard E. Stearns, a computer scientist at the State University of New York at Albany.

"Arcane though computer science may sometimes appear to the world at large, scientific work of the sort done by Hartmanis and Stearns gives backbone to the technology underlying the entire information technology industry of today and tomorrow," said Gwen Bell, ACM president and head of the Computer Museum in Boston.

Hartmanis and Stearns originated the field of computational complexity when they worked together at the General Electric Research Laboratory, now the G.E. Research and Development Center, in the early 1960s. Their seminal 1965 paper, "On the Computational Complexity of Algorithms," marked the start of the modern era of complexity theory, a Cornell statement said.

The theory makes it possible to determine and compare speed and performance of computer algorithms and programs without actually running them on a computer. A scientist can count the number of machine instructions needed to run the program and determine the speed and efficiency of that program. Hartmanis and Stearns later expanded the theory to include other computing resources, such as the amount of memory needed to perform a task.

"This work created a new discipline by providing scientists with a framework for discussing the intrinsic difficulty of a task," said John Hopcroft, Cornell's associate dean of engineering and former chair of the Computer Science Department. "It is hard to imagine a researcher in computer or information science whose work is not influenced by that of Hartmanis and Stearns."

The Turing Award is given annually for technical achievements in computing deemed to be of lasting and significant importance to the computing community. The award, and a $25,000 prize contributed by AT&T, will be presented at ACM's Computer Science Conference in Phoenix in March.

Van Dam receives 1993 ACM Karlstrom award

Andries van Dam of Brown University was selected as the 1993 winner of the Association for Computing Machinery Karl V. Karlstrom Outstanding Educator Award.

Van Dam is the L. Herbert Ballou University Professor of Computer Science at Brown. He was a founder of that department and its chair for nine years. He introduced computer science to high schools in 1962 and in 1968 he helped form the standard ACM university curriculum. He pioneered the electronic classroom and the use of animation and hypermedia for teaching. His former students are department chairs at the Massachusetts Institute of Technology, Princeton University, the University of Washington and the University of Waterloo, as well as leaders in industry. All five of his eligible students have National Science Foundation Presidential Young Investigator Awards.

He has held 30 consultancies, authored or co-authored five books and 80 papers, and given 150 invited lectures. His graphics text is the standard in the field. He is a founder of ACM SIGGRAPH.

The ACM Karlstrom Award is awarded annually to an outstanding educator who is appointed to a recognized educational baccalaureate institution; is recognized for advancing new teaching methodologies, or effecting new curriculum development or expansion in computer science and engineering; or who is making a significant contribution to ACM's educational mission.

A prize of $5,000 is supplied by Prentice-Hall Publishing Co. The award will be presented at the annual ACM Computer Science Conference.

The following are edited excerpts from a nomination letter submitted by John D. Gannon of the Department of Computer Science at the University of Maryland, and Edward D. Lazowska of the Department of Computer Science and Engineering at the University of Washington:

Andy has been an international leader in the development of undergraduate and graduate curricula in computer graphics, his principal research area. He has fostered innovative teaching methods at Brown, not only in computer science, but in the application of computing technology in other disciplines. Last but most important in our minds, Andy's personal investment in Brown students—particularly undergraduates—over nearly three decades has yielded an enormous pool of men and women who have followed in his footsteps as educators, researchers and developers.

Through Andy's research interest in "computer books," he has developed systems that promote the connectivity of ideas and aid in the search for and creation of information. He collaborated with Ted Nelson to produce an early prototype of hypertext to explore ideas of non-sequential reading and writing. A version of Andy's WYSIWYG hypertext editing system was installed in the Brown library more than 20 years ago and was used to teach poetry classes in the English Department.

Andy's Interactive Graphical Documents system was a very early hypermedia system, combining graphics and animation with text.

In the mid 1980s, Andy helped to found Brown's Institute for Research in Information and Scholarship (IRIS). IRIS developed the Intermedia hypermedia system and provided resources for Brown faculty to develop hypermedia course materials.

Brown's Computer Science Department, which Andy helped found and which he chaired for two terms, is nationally recognized for its innovative electronic classrooms and software. Andy established and equipped a lecture theater at the same time he was running a research program that evolved into the five-site NSF Science and Technology Center in computer graphics.

Andy is an inspirational and demanding teacher who has devoted a significant portion of his career to teaching undergraduates. He has regularly taught Brown's introductory computer science course in order to inspire new generations of students. He gets undergraduates involved as undergraduate teaching assistants and as participants in group-independent research projects in which they build significant software systems.

This process has produced generations of students who left Brown genuinely excited both about computer science and about computer science education.

DEC founder awarded medal

Kenneth H. Olsen, founder of the Digital Equipment Corp., was one of a handful of top scientists who received the National Medal of Technology on Sept. 30.

The award is considered the nation's highest honor in science and technology. President Clinton attended the ceremony to hand out 17 medals in science and technology.

Olsen is known for revolutionizing the computer industry by introducing the minicomputer, which provided a low-cost alternative to the mainframe.

Policy News

Legislation roundup

Mickey Leland Telecommunications and Education Assistance to Africa Act of 1993 (HR 2703)

Sponsor: Jack Fields (R-TX) **Date**: 07/21/93
Status: Referred to House Energy and Commerce Subcommittee on Telecommunications and Finance on Sept. 3.
Description: The bill requires the National Telecommunications and Information Administration to conduct a study on the feasibility of establishing a satellite-based educational network to provide educational programming to African children.

Untitled (HR 175)

Sponsor: Don Edwards (D-CA) **Date**: 01/05/93
Status: Passed the House (367-6) on March 29 and referred to the Senate Judiciary Subcommittee on Technology and the Law on April 29.
Description: The bill amends Title 18 of the US Code, authorizing the FBI to obtain certain telephone subscriber information, including name, address, length of service and billing records, provided there is "reason to believe" the subscriber is a foreign counterintelligence agent.

Untitled (HR 2912)

Sponsor: Ron Wyden (D-OR) **Date**: 08/06/93
Status: Referred to the House Foreign Affairs Subcommittee on Economic Policy, Trade and the Environment on Aug 10.
Description: The bill liberalizes controls on the export of telecommunications equipment and technology in order to promote democracy and free communication and to enhance economic competitiveness.

Women's Educational Equity Act of 1993 (HR 1793)

Sponsor: Patricia Schroeder (D-CO) **Date**: 04/21/93
Status: Referred to the House Education and Labor Subcommittee on Postsecondary Education and Training on May 11.
Description: The bill amends the Elementary and Secondary Education Act of 1965 to ensure gender equity in education; it provides grants for model equity programs and training programs for teachers.

Untitled (HR 1831)

Sponsor: Susan V. Molinari (R-NY) **Date**: 04/22/93
Status: Referred to the House Education and Labor Subcommittee on Elementary, Secondary and Vocational Education on May 11.
Description: Similar to HR 1793, the bill amends the Elementary and Secondary Education Act of 1965 to establish gender-equity teacher training programs and to ensure gender equity in education programs.

National Information Infrastructure Act of 1993 (HR 1757)

Sponsor: Rick Boucher (D-VA) **Date**: 04/21/93
Status: Passed the House (326-61) on July 26. Referred to the Senate Labor and Human Resources Subcommittee on Education, Arts and the Humanities on Sept. 14.
Description: The bill calls for the Federal Coordinating Council for Science, Engineering and Technology to direct an interagency program involving NASA, the National Science Foundation and the departments of Commerce, Energy, Defense and Health and Human Services. NSF is charged with leading other federal agencies to assist schools, libraries and local governments in connecting to the National Research and Education Network. Test bed projects would connect hospitals, doctors and researchers to information systems that allow them to share patient records and medical research.

Local Exchange Infrastructure Modernization Act of 1993 (HR 1312)

Sponsor: Rick Boucher (D-VA) **Date**: 3/11/93
Status: Referred to the House Judiciary Subcommittee on Economic and Commercial Law on March 24.
Description: The bill amends the Communications Act of 1934 to enhance universal telephone service; increase the availability of advanced information services; assure a seamless nationwide network; and assure adequate communication for the public health, safety, defense, education, national security and emergency preparedness.

Telecommunications Policy Coordination Act of 1993 (HR 1613)

Sponsor: Cardiss Collins (D-IL) **Date**: 4/1/93
Status: Referred to the House Energy and Commerce Subcommittee on Telecommunications and Finance on April 26.
Description: The bill establishes an Office of Telecommunications Policy within the executive office, the director of which would establish an advisory committee.

Technology Education Assistance Act of 1993 (HR 2728)

Sponsor: Thomas C. Sawyer (D-OH) **Date**: 7/23/93
Status: Referred to the House Education and Labor Subcommittee on Select Education and Civil Rights on Aug. 11.
Description: The bill authorizes a grant program to improve the use of technology in schools at all levels and establishes a Educational Technology Council within the Education Department.

Rural Telemedicine Development Act of 1993 (HR 3070)

Sponsor: Larry LaRocco (D-ID) **Date**: 09/14/93
Status: Referred to the House Committee on Energy and Commerce on Sept. 14.
Description: The bill amends the Public Health Service Act to provide grants for the development of rural telemedicine.

Continued on Page 9

Clinton removes export barriers

The computer industry applauded President Clinton's decision Sept. 29 to lift export-control barriers on high-speed computers.

The threshold for exportable computers will be raised immediately from 12.5 MTOPS (million theoretical operations per second) to 194 MTOPS. After the administration completes trade negotiations with Japan, it plans to raise the threshold to 500 MTOPS.

"The administration has recognized the serious effect outdated policies have on American jobs and has demonstrated that it can do what it takes to keep America competitive," said James Unruh, chair of Unisys Corp. and of the Computer Systems Policy Project.

The White House said the change should free $30 billion in exportable computer products. The decision came from the 19-agency Trade Promotion Coordinating Committee formed by Congress in 1992.

NSF panel plans future of HPC

The National Science Foundation's Blue Ribbon Panel on High-Performance Computing released a report Oct. 15 recommending new directions in computing policy.

The report recommends a "pyramid" model for distributing computing resources, where teraflops are at the top and desktops at the bottom. It covers funding issues, the National Science Board, high-performance computing centers and education and training.

The report is based on solicited opinions from industry, academic and government experts. To order a copy, call the NSF at tel. 202-357-9498.

Appropriations from Page 1

more than was appropriated in 1993.

The earlier Senate report on NSF appropriations sparked debate in the research community. Not only did that report threaten $50 million in HPCC funding, but it also broadly directed NSF to focus on "strategic" research.

The Computing Research Association and several of its members protested in letters to key representatives. The report also drew a reaction from Vice President Gore, who visited appropriations subcommittee chairs in person. Rep. George Brown (D-CA), chair of the House Committee on Science, Space and Technology, and Rep. Rick Boucher (D-VA), chair of the Science Subcommittee, sent letters to the appropriations chairs.

A senior staffer for the Senate Committee on Commerce, Science and Transportation said the report's harsh language "speaks for most of us in Congress."

Once again, the debate about NSF's role in research has been marked by inflamed rhetoric on both sides of a growing gulf between the academic and political communities.

Meanwhile, the House Appropriations Subcommittee on Defense took a jab at ARPA's Computing Systems and Communications Technology programs, slashing nearly $100 million from ARPA's budget request. However, the Senate committee reduced the cut to $42 million in its markup.

The effects of the cuts are a matter of contention. The Senate subcommittee claimed that, because the requested increase was so large—nearly 50%—the final figure represents a 15% increase for ARPA's part in HPCC. But some ARPA sources argue the cuts are real and painful, partly because the Senate committee removed $30 million from the scalable hardware programs.

The why behind the cuts is complex and involves battles between the committee and ARPA, critical reports by the Congressional Budget Office and the General Accounting Office, lobbying by computer companies not funded by ARPA and a general lack of federal dollars.

Overall, defense R&D funding is decreasing. Given the political climate, ARPA no doubt stuck out its neck by originally requesting a nearly 50% increase for HPCC.

1994 CRA Conference at Snowbird
July 10–12 ◆ Snowbird, Utah

The 1994 CRA Conference at Snowbird will include the Department Chairs Workshop and the Research Managers Workshop. The CRA Conference at Snowbird is the flagship conference for academic and research laboratory administrators interested in computing research issues. If you would like to receive information about the conference when it becomes available, fill out this form and return it to CRA.

Name _____
Title/Position _____
Organization _____
Department _____
Address _____
City _____ State _____
ZIP+4 _____ E-mail Address _____

CRA Conference at Snowbird, Computing Research Association,
1875 Connecticut Ave. NW, Suite 718, Washington, DC 20009.
Tel. 202-234-2111; Fax: 202-667-1066; E-mail: plouis@cra.org.

Policy News

Cryptography debate simmers in the Capitol

BY Juan Antonio Osuna
CRA Staff

These days, President Clinton, Congress and a few corporations are showing keen interest in cryptography—an emerging, though still immature field for public policy debate.

It is no secret that many ordinary forms of communication are susceptible to eavesdropping—cordless and cellular telephones, local area networks, even Internet electronic mail. Experts increasingly see encryption as the solution to these vulnerabilities and as an integral part of the evolving national information infrastructure.

The buzzwords "privacy" and "security" are popping up more frequently in policy-making. This past summer the House passed the National Information Infrastructure Act of 1993 (HR 1757), which, among many other things, specifically directs research funds to "ensure the security and privacy of transmissions over the Internet."

While the NII bill has sparked little debate about privacy, which was only one small aspect of the bill, the House dedicated several hearings to privacy and security issues. Appearing before the Energy and Commerce Subcommittee on Telecommunications and Finance, witnesses over the summer ranged from Whitfield Diffie, co-inventor of public-key cryptography, to Emmanuel Goldstein, editor of *2600*, a magazine read by hackers and phone "phreaks."

On the executive side, interest in cryptography has been no less intense. In April, Clinton introduced a plan known as Clipper that was intended not only to address privacy but also excessive privacy, a concern of law enforcement and national security officials who fear criminals and terrorists will be the first to exploit encryption technology to evade surveillance.

Under the Clipper scheme, two federal agencies would escrow portions of each key needed to decrypt each chip. With a proper wiretap warrant, a federal, state or local police officer would need to retrieve each portion of the key from each escrow agent to decrypt a call.

Immediately after the Clipper announcement, AT&T told of plans to sell a Clipper phone. And in September, the administration revealed the two escrow agencies: the Treasury Department and the National Institute of Standards and Technology.

Clinton's debut into the privacy arena has received anything but applause from the public. In fact, public recalcitrance began only hours after the April announcement, when messages flooded Internet newsgroups such as sci.crypt, expressing reactions ranging from skepticism to indignation.

"The Clipper appears to be an attempt by the government to ensure that it will always be able to tap telephones and other forms of communications at will," Steve Smith of Agincourt Computing wrote via Internet. "We remember the abuses of J. Edgar Hoover, Richard Nixon, John Mitchell and Ed Meese," he wrote. "Are they the worst that the United States will ever have? We would be foolish to think so."

It is no secret that many forms of communication are susceptible to eavesdropping—cellular telephones, local area networks, even Internet E-mail.

Many of the Internet discussions were echoed formally at a series of hearings before NIST's Computer Security and Privacy Advisory Board.

"The government will have the capacity to hear everything we say and read everything we write," Kate Martin of the American Civil Liberties Union said before the board. "This represents a basic shift in government power."

Other critics included representatives from Computer Professionals for Social Responsibility, the Electronic Frontier Foundation (EFF), the Software Publishers Association and the Business Software Alliance.

Many industry groups focused on how Clipper would affect the United States' ability to sell cryptographic products in a worldwide market. Some experts said they would rather the government lift export barriers against selling DES and RSA products abroad and perhaps even ditch Skipjack, Clipper's algorithm, in favor of DES. Because DES already is in widespread use around the world, using it would enhance interoperability, which is essential to a product's success in a global market, the groups said.

Late in September, a final punch was delivered by EFF, which submitted a statement based on comments solicited from members.

"We oppose the proposed FIPS [Federal Information Processing Standard] in all of its parts. Well over 200 EFF members are also critical of the proposed FIPS. We believe this demonstrates the depth of public concern about the implementation of key escrow systems," an EFF letter to NIST stated.

Those in favor of Clipper include numerous law enforcement officials and at least one prominent academic computer scientist—Dorothy Denning of Georgetown University.

"I believe this initiative appears to be an excellent approach," Denning said. Without an escrow system, she added, "it would be irresponsible for the government to promote cryptography."

Denning advocates going a step beyond Clinton's proposal by outlawing encryption that does not escrow keys. "Congress should consider legislation now," she said, "not five years down the road, once the voluntary system has failed."

A month before the presidential announcement, Denning published an article in *Communications of the ACM* proposing a key-escrow plan similar to the Clipper scheme. However, Denning said she was not consulted about or involved with the Clipper plan.

To be sure, new communications technology has made the criminal more capable and the police ill-equipped. However, several witnesses at the NIST hearing complained that the FBI has failed to make a case about the magnitude of criminal misuse of encryption. "The government has got to justify this kind of far-reaching scheme," Jan Lori Goldman of the ACLU said.

Concerns also delved into the technical realm. One cryptographic expert, Silvio Micali of the Massachusetts Institute of Technology, focused on key-escrowing, a relatively new concept in the field of cryptography. Micali said the government has failed to address problems in key management. He then presented his own scheme as an alternative.

Having gathered both political and technical opinions, the Computer System Security and Privacy Advisory Board issued a resolution Sept. 2 that raised "serious concerns" about Clipper as an encryption standard.

These concerns included uncertainty about Clipper's purpose, export-control issues, lack of software implementation, key management problems, the need for more public information, the uncertain economic impact of Clipper and the legal complexities of key escrowing.

The resolution also said, "Congress, as well as the administration, should play a role in the conduct and approval of the results of the review."

September's two-day board meeting came just over a month after a five-person, independent panel issued an interim report that scientifically evaluated the Skipjack algorithm.

Georgetown's Denning served on the panel and conducted a series of experiments on computers at the National Security Agency, the agency that developed Skipjack years ago. The interim report technically praised Skipjack, which it said is superior to DES.

When the advisory board questioned Denning as to the conditions of the experiments, she noted that all experiments were conducted using NSA software and hardware. When questioned by the board, Denning said she was the only person who actually went to NSA's headquarters.

However, Denning denied that the absence of the other panelists negatively affected the independent nature of the review. She said the other panelists helped design the experiments and would examine other issues such as key management that will be discussed in the final report.

The other four reviewers are Ernest Brickell of Sandia National Laboratories, Stephen Kent of BBN Communications, David Maher of AT&T and Walter Tuchman of Amperif Corp.

It is unlikely that Clipper will find its way into the mass market anytime soon. However, the events of the past six months suggest that cryptography has found its way into the consciousness of policymakers, executive officials and the mass media. And it is only a matter of time before cryptography establishes itself as a familiar policy issue.

These policy shifts also bring responsibilities to computing researchers. The Aug. 24 *Federal Register* announced a NIST cooperative R&D consortium that solicits comments from academic and industrial parties interested in developing "secure software encryption with integrated cryptographic key escrowing techniques."

The technology must "resist unauthorized replacement or modification as well as reverse engineering…[and] withstand unauthorized attempts to obtain or change cryptographic keys," the announcement said.

Research in the area of key escrowing is in its infancy. Will a software-based escrow system that can resist tampering or reverse engineering ever become a reality? Will Clipper or some future hardware mutation ever be resistant? Will law enforcement officials ever be able to keep dangerous technologies out of the hands of criminals? Will the public ever find key-escrowing politically palatable? The computing community and society at large have just begun to ask these questions. The answers won't come for some time.

Policy News

Gore proposes to upgrade government

BY Juan Antonio Osuna
CRA Staff

Vice President Al Gore's National Performance Review (NPR) report proposed that the federal government vastly improve its information systems to better serve the public.

Released in early September, *From Red Tape to Results: Creating a Government that Works Better and Costs Less* focused on streamlining federal bureaucracy and making government information more electronically accessible to businesses and citizens.

Achieving NPR's goals will take more than technology, as there are many policy issues yet to be resolved. Two such issues, privacy and security, were raised by Sally Katzen before a House hearing on information technology and government efficiency on Oct. 7.

Katzen, the administrator for the Office of Management and Budget's Office of Information and Regulatory Affairs, devoted more than a page of her 15-page written testimony to outlining the following recommendations on privacy and security:

- Develop a crisis response clearinghouse;
- Develop encryption and digital signature standards for sensitive, unclassified data;
- Encourage security research and development;
- Implement a comprehensive federal Internet security plan;
- Establish a Data Protection Board with a 12-month Privacy Study Council entrusted with developing administrative and legislative guidelines; and
- Create an interagency task force for ensuring uniform privacy protection standards among federal agencies.

These and other issues are closely connected with NPR's proposals for improving government services.

Describing one such service, Katzen testified: "The kiosk would request the individual's Social Security number and other personal information and then print out a summary of the individual's Social Security contribution, as well as the benefits to which she or he would be entitled as a veteran."

These information kiosks could be accessible at "a shopping center or a public library, through a home or business computer, or via an 800 number," Katzen said.

Protecting the privacy of Social Security information while at the same time offering user-friendly access at a public library or through an 800 number presents many technical and social challenges.

The government must be able to ensure that the right people access the right data. The government could issue millions of access codes or establish stiff penalties for abuse. But these solutions do pose great challenges.

Although the administration does not have all the answers, it has begun to focus on these questions by recommending a broad strategy for finding solutions.

And privacy and security aren't the only challenges facing federal officials. The issue of intellectual property is raised by NPR's proposal that the government develop and market databases to businesses. How will this affect the public's access to information? What kind of legislation would protect citizens' right to know while encouraging businesses to use government data?

Also formidable is the government's goal of developing electronic interfaces that would make government forms, which now intimidate many people, easier to use.

Policymakers are considering the social aspects of computing. At the October hearing on information technology, Rep. Eddie Bernice Johnson (D-TX) said, "Whatever we do, we must put on a human face."

Gore's technology goals

• Create a new executive-branch National Science and Technology Council to direct science and technology policy and to combine the functions of the Federal Coordinating Council for Science, Engineering and Technology; the National Space Council; and the National Critical Materials Council.

• Establish a Privacy Protection Board and an interagency task force to create uniform privacy protection practices among federal agencies.

• Offer more benefits to the public electronically such as federal retirement benefits, Social Security, unemployment insurance, food stamps and welfare payments.

• Develop standards through the National Institute of Standards and Technology and protocols for electronic signatures to facilitate transfer of electronic funds and other benefits.

• Develop and market databases to businesses, using the National Technical Information Service as a model.

• Allow agencies to purchase more computer equipment without having to get authorization from the General Services Administration.

• Make a greater effort to train federal employees in using information technology.

• Allow people to pay taxes by credit card and to avoid filing duplicate tax information with federal, state and local agencies.

(To get the full report, ftp to sunsite.unc.edu and cd to /pub/academic/political-science/National_Performance_Review.)

Legislation from Page 7

Telecommunications and Information Infrastructure and Public Broadcasting Facilities Assistance Act of 1993 (HR 2639)

Sponsor: Edward J. Markey (D-MA) **Date**: 7/14/93
Status: Referred to the House Energy and Commerce Committee on Oct. 14.
Description: The bill promotes the development of the national telecommunications and information infrastructure and the construction and planning of public broadcasting facilities. It offers matching grants to health care providers, educational institutions, research facilities, libraries, museums, state and local governments and other social service providers for expanding networks and information infrastructure.

Rural Health Improvement Act of 1993 (S 1143)

Sponsor: Max Baucus (D-MT) **Date**: 06/22/93
Status: Referred to the Senate Committee on Finance on June 22.
Description: The bill seeks to improve the delivery of health care services in rural areas by creating an assistant secretary for rural health and by establishing a grant program for the use of interactive telecommunications systems.

Telecommunications Infrastructure Act of 1993 (S 1086)

Sponsor: John Danforth (R-MO) **Date**: 6/9/93
Status: Referred to the Senate Commerce Subcommittee on Communications on July 14; hearings held on Sept. 8.
Description: The bill seeks to enhance the development of the national telecommunications infrastructure by fostering competition. It pre-empts any state or local laws governing the telecommunications industry; forces telecommunications providers to sell services on a nondiscriminatory basis without any restrictions on the customer reselling those services; allows the Federal Communications Commission to set telecommunications standards; allows cable companies to offer telecommunications services only if provided through a subsidiary; and allows telephone companies to offer video or other information services only if provided through a subsidiary.

DOE National Competitiveness Technology Partnership Act of 1993 (S 473)

Sponsor: J. Bennett Johnston (D-LA) **Date**: 3/2/93
Status: Placed on Senate Legislative Calendar on June 24.
Description: The bill links the Energy Department laboratories with private-sector laboratories and implements a National Information Infrastructure program by amending the High-Performance Computing Act of 1991. It creates a coordinated interagency program that would develop partnerships, deploy information technologies and educate people on how to use the technologies.

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Levittowns from Page 3

offer them tenure.

As we are all aware, budgets are tight in academia. Given a rare, new slot, what department chair would be willing to use it on someone not in a core area? Pressures exist from higher up, also. When I was at the National Science Foundation, I ran a program on social impacts within the computer science division. When approached at the end of one year for reserve money, our assistant director, a chemist, referred to my program as the "biggest reserve in the foundation."

In his view, if the division had money to spend on social impacts research, it could not be hurting for funding. Fortunately for the program, neither Kent Curtis nor John Pasta held that view.

On the other hand, not every department needs a researcher in computer impacts and policy on its faculty. We do not need 150 more positions opened immediately, just a few more than there are now.

External research funding, a necessary consideration in many departments, is becoming available. The Boucher Bill, HR 1757, explicitly authorizes and directs NSF to support research on the social impacts of high-performance computing and communications. Private foundations are becoming interested in policy questions surrounding the national information infrastructure.

Meanwhile, industry may be becoming more concerned about policy issues. In particular, there seems to be a need to create bridges at the policy level between the computing field and such areas of application as education, health, government information systems and industrial manufacturing.

In each case, we are asking: What are the real potentials and pitfalls of this new infrastructure, and what are the key policy decisions that will help us sort one from the other?

As a field, computing research has come to the center of public attention in the past three years. Society expects much from us, and it also has many corresponding fears. We must be substantively engaged in the policy debates, no matter how messy. To do so, we need a better basis of understanding about how computers interact with people and institutions.

Decisions will be made regardless of our participation. We need to help improve their quality.

Policy News

CRA urges Senate to support ARPA program

The following is a letter that was sent Oct. 1 by Fred W. Weingarten, CRA's executive director, to Sen. Daniel K. Inouye (D-HI), chair of the Senate Appropriations Subcommittee on Defense.

On behalf of the Board of Directors of the Computing Research Association (CRA), I am writing to urge you to support full funding of the Advanced Research Projects Agency's High-Performance Computing and Communications program.

CRA represents and informs the computing research community. Its members are roughly 200 industrial research laboratories and Ph.D.-granting departments of computer science and computer engineering. Under the leadership of a 28-member board of directors and a professional executive director and staff, CRA works actively with its membership, with Congress, with government agencies and with industrial groups such as the Computer Systems Policy Project to ensure America's continued leadership in the critical area of computing technology.

We view cuts to ARPA's High-Performance Computing Research program budget as exceedingly detrimental, both to the defense mission of the agency and to the broader role of ARPA in the interagency HPCC program.

The cuts are particularly hard to understand in light of the enormous success of past computing research efforts at ARPA and other federal agencies. Let me cite a few examples:

- ARPA-funded research by computer scientists and engineers at a few universities and industrial research laboratories led to the invention of the RISC (Reduced Instruction Set Computer) chip, a technology that underlies the current design of most US-built computer workstations. The 1993 US market for these systems has been estimated at nearly $9 billion, and it continues to grow rapidly.
- The designers of ARPAnet invented the packet-switched data transmission technology that is the basis for the Internet of today, as well as many commercial data communication services. An advanced form of this technology undoubtedly will underlie the future national information infrastructure envisioned by the Clinton administration.
- Graphics research funded by ARPA led directly to US dominance in the computer graphics hardware and software industry, as well as underpinning several thriving new application industries in entertainment and computer-aided design.

The total US information sector revenues for 1990 (the last year for which full numbers are available) have been estimated at nearly $900 billion. The growth rate of 7.5% exceeded that of the GDP by a full percentage point and suggests that this year's revenues will exceed $1 trillion. Given the extraordinary contribution of this technology to the nation's present and future economic health, it is counterproductive, to say the least, to slash funding that sustains the long-term research base in such a strategic area.

The HPCC program will become a vital and strong program that will be a cornerstone to President Clinton's technology policy.

We understand that Congress has had concerns about the management and directions of these programs. CRA has been working with executive branch agencies and Congress to help develop clearer and more sustainable program objectives and management structures.

Our experience encourages us to believe that with leadership from the White House, HPCC will become a vital and strong program that will be a cornerstone to the president's technology policy.

We urge you to restore full funding. Please let me know if CRA can provide any information or assistance to your subcommittee in its deliberations, either now or over the longer term as you work on these important issues.

NII from Page 1

and Regulatory Affairs. This committee will use focused working groups to examine issues surrounding intellectual property and privacy and government information issues.

- The Applications Committee is chaired by Arati Prabhakar, director of the National Institute of Standards and Technology. This committee will look at the needed technological underpinnings for applications in areas such as manufacturing, education, health care, government services and libraries.

The task force and its committees are composed solely of government officials. To reach out to the private sector, President Clinton issued an executive order to establish an Advisory Council on the NII. The council will consist of not more than 25 members appointed by the secretary of Commerce.

Nominations have been widely solicited from industry and from associations and public interest groups. Members of the council are expected to be named by Dec. 1. Members are expected to include several industry CEOs as well as representatives of a variety of public interest and user groups.

Goals and limits

The report contains a list of goals for government policy-making and limits to government involvement. This section of the report appears partly to be a response to industry concerns that the government would build or heavily regulate NII. Those concerns became visible at the administration's "Economic Summit" in an exchange between Robert Allen, CEO of AT&T, and Vice President Gore over whether the government or the private sector should build NII. The report said NII is to be built primarily by the private sector and proposes several goals for government:

1. Promote private sector investment.
2. Extend the "universal service" concept to ensure that information resources are available to all at affordable prices.
3. Promote technological innovation and new applications.
4. Promote seamless, interactive and user-driven operation.
5. Ensure information security and network reliability.
6. Improve management of the radio frequency spectrum.
7. Protect intellectual property rights.
8. Coordinate with other levels of government and with other bodies.
9. Provide access to government information and improve government procurement.

None of these goals will be easy to achieve. Some, like universal service, have not even been defined for the new NII environment. Influencing an estimated $400 billion investment in a new telecommunications system will pose immense political challenges.

With this report the administration characteristically is placing its bet on the idea that the public process of debate and deliberation will generate enough political consensus and momentum to overcome political barriers.

Legislation from Page 9

Emerging Telecommunications Technologies Act of 1993 (S 335)

Sponsors: Daniel Inouye (D-HI) and Ted Stevens (R-AK) **Date**: 2/4/93
Status: Reported out of the Senate Committee on Commerce on May 25 with an amendment in the nature of a substitute.
Description: A companion bill to HR 707. Unlike the House bill, the Senate one directs the FCC to assign frequencies to companies using competitive bidding.

National Network Security Board Act of 1993 (S 237)

Sponsor: Larry Pressler (R-SD) **Date**: 1/27/93
Status: Referred to the Senate Committee on Commerce on Jan. 27.
Description: The bill creates a National Network Security Board within the Federal Communications Commission for monitoring and investigating disruptions in long-distance and local telephone systems.

Telecommunications Network Security and Reliability Reporting Act of 1993 (S 238)

Sponsor: Larry Pressler (R-SD) **Date**: 1/27/93
Status: Referred to the Senate Committee on Commerce on Jan. 27.
Description: The bill requires the Federal Communications Commission to report annually on the security of the nation's telecommunications networks.

Electronic Library Act of 1993 (S 626)

Sponsor: Bob Kerrey (D-NE) **Date**: 3/22/93
Status: Referred to the Senate Committee on Commerce on March 22.
Description: The bill establishes state-based electronic libraries. The National Science Foundation—in consultation with the Education Department, the Commerce Department, the Advanced Research Projects Agency and the Library of Congress—would issue grants to states for developing electronic libraries.

Library of Congress Fund Act of 1993 (S 345)

Sponsor: Claiborne Pell (D-RI) **Date**: 2/4/93
Status: Placed on Senate Legislative Calendar on May 26.
Description: The bill allows the Library of Congress to sell information products and services. The price paid by users would be determined by the cost of "production and distribution."

Technology for Education Act of 1993 (S 1040)

Sponsor: Jeff Bingaman (D-NM) **Date**: 5/27/93
Status: Referred to the Senate Committee on Labor and Human Resources on July 21; hearings held same day.
Description: The bill seeks to enhance the use of new technologies in education and sustains a technologically literate work force with specific sections on the Internet, an Electronic Dissemination Network and a program titled "High-Performance Educational Computing and Telecommunications Networks."

Technology for the Classroom Act of 1993 (S 264)

Sponsor: Jeff Bingaman (D-NM) **Date**: 1/28/93
Status: Referred to the Senate Committee on Labor and Human Resources on Jan. 28.
Description: Authorizes funds for implementing communication technologies in schools.

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Canadian News

Funding for NCE program cut in half, then restored

BY Douglas Powell

A Canadian science funding program that received laudatory reviews and was endorsed by politicians and researchers across the country was renewed, but funding for it was cut in half.

In the midst of a federal election campaign, one where all parties lay claim to the rhetoric of enhanced R&D tied to future economic performance, such a prospect seemed even more ludicrous than usual. So three weeks after the decision to cut funding was announced, full funding was restored to the four-year-old Networks of Centers of Excellence (NCEs) program, which includes three centers devoted to aspects of information technology research: microelectronics, telecommunications and artificial intelligence.

Beginning in 1989, 15 NCEs in areas such as robotics and intelligent systems, human genetic diseases and high-performance concrete were established with a five-year, $240 million (Canadian) commitment. The idea was to bring together the best researchers from institutions across the country to focus on collaborative research and transfer the results to Canadian industry. An independent review in December 1992 gave high marks to the NCEs. So did an all-party government committee in May 1993 that declared the NCE program should be made permanent and renewed at a funding level equal to or greater than that provided in the first four years.

However, Minister for Science Rob Nicholson announced in early August that the program would receive an additional four years of funding beginning in April 1994, but funding would be slashed to $125 million. He also told the NCEs to secure more money from non-federal sources, especially industry. "The decision…reflects the government's fiscal strategy and its priority that the networks continue to build close ties to industry and commercialize their research results," said Nicholson, who recently assumed the science portfolio in a pre-election cabinet shuffle.

Shortly thereafter, the governing Conservative Party called a general election for Oct. 25, 1993. As the election rhetoric heated up, so did the criticism of the reduced funding. "This is a cut for research in Canada, and it comes at the wrong time," said Arthur Carty, dean of research at the University of Waterloo, which is involved in six of the NCEs. "It's bad news for the research community, and it's a bad step for R&D in Canada."

In a speech in late August, Prime Minister Kim Campbell announced the restoration of full funding for the program—$197 million for four years. The decision so surprised officials in the Science Ministry that it took them a week to issue a statement.

"The decision to increase the program budget responds to demands from the academic and industrial research communities for continued strong federal support of this innovative and productive program," Nicholson said.

A key component for the NCEs—which are networks of the best researchers scattered across the country, rather than a group at one institution—is the development of a high-speed computer communications network. At the same time the NCEs were being cut and then restored, the federal government announced financial support for the first phase of the Canadian Network for the Advancement of Research, Industry and Education (CANARIE). With $26 million from the federal government and $89 million in direct and indirect support from the private sector and other levels of government, researchers across Canada finally may start communicating at T1 speeds. The first step in implementing CANARIE is to upgrade the existing national backbone, CAnet, from 56 Kbit/sec to 1.5 Mbit/sec.

Also included in the plan were proposals for the creation of experimental test networks and laboratories, and the development of advanced software, products and services by 1995.

Phase 2 of the proposal, covering the period between April 1995 and March 1998, calls for the experimental network to become operational, the ongoing development of new products and services and the continual enhancement of the national network at a cost of $450 million. Phase 3 will require an additional $600 million and is slated for completion in March 2000.

The 15 existing NCEs had until Oct. 29, 1993, to submit proposals for renewal. Depending on how many receive continued funding, a competition for new NCEs may be held later. The next round of funding commences April 1, 1994. The NCE program currently involves more than 800 of Canada's top researchers; 1,300 graduate students and 400 postdoctoral fellows in engineering and the natural, medical and social sciences; and over 140 companies. The program is managed jointly by the Natural Sciences and Engineering Research Council, the Medical Research Council and the Social Sciences and Humanities Research Council, in collaboration with Industry and Science Canada.

Douglas Powell is a graduate student at the University of Guelph in Ontario, Canada.

Accreditation from Page 1

also ensures that departments are allocated the necessary resources from their university, he said.

Accreditation is being driven by several factors, especially the need for high-quality business software. As the market continues to grow, so do the demands for software quality. (The Software Publishers Association recently reported that US and Canadian application software sales reached $1.6 billion in the second quarter of 1993, an increase of 13.9% from the same quarter last year.)

At the core of the accreditation debate is the growing recognition that the software industry, like any other knowledge-based endeavor, relies heavily on people. And there is a constant need for more of the best. As summed up last year in *The Economist,* "Technologies pass rapidly from one company to another. Only that intangible, vital quality—the environment of active brains and productive skills in which companies operate—is non-transferable."

Another problem for accreditation schemes is that producing quality software is a highly creative activity that is difficult to accurately measure. According to a study at the University of Pennsylvania released earlier this year, thought outweighs action during software development by nearly a 4-to-1 margin, both in terms of time and tasks.

While university accreditation is designed to ensure that quality people come out of Canadian universities, what about the quality of the country's 150,000 software workers (about 50,000 directly in the software industry and another 100,000 as in-house workers)?

One approach is the CIPS Certification Council, which approves members for the ISP designation, based on educational background and number of years of information systems work.

Paul Bassett, senior vice president for research at Toronto-based Netron Inc. and co-chair of the Certification Council, said the ISP designation is intended to raise the standards and level of professionalism in the industry. "The average level of IS competence is appallingly low," he said. "ISO 9000 and other international standards are increasingly required to do business in the international marketplace. Software is no different. [We] want a true profession that has teeth."

Another approach was launched on Sept. 30, 1993. The industry-led Software Human Resource Council (SHRC) unveiled a $12 million (Canadian) action plan to draw on university expertise for the retraining of software workers.

The idea is to contract with university faculty to develop courses that meet the specific requirements of individual businesses. The courses could be delivered during office hours on the company's premises and eventually lead to graduate-level degrees.

Paul Hession, president of SHRC, said the first joint ventures will be announced over the next three months, although negotiations have yet to be finalized. SHRC also is working with CIPS to define an occupational standard for the software professional in Canada. "I don't see it [accreditation] as a real impediment, but an evolution," he said. "Accreditation needs to be cranked up in terms of its significance."

Douglas Powell is a graduate student at the University of Guelph in Ontario, Canada.

Legislation from Page 10

Gender Equity in Education Amendments of 1993 (S 1465)

Sponsor: Tom Harkin (D-IA) **Date**: 09/15/93
Status: Referred to the Senate Committee on Labor and Human Resources on Sept. 15.
Description: The bill amends certain education laws regarding gender-equity training, dropout prevention and gender-equity research and data.

Rural Telemedicine Development Act of 1993 (S 1088)

Sponsor: Tom Harkin (D-IA) **Date**: 06/10/93
Status: Referred to the Senate Agriculture, Nutrition and Forestry Subcommittee on Rural Development and Electrification on July 1.
Description: A companion bill to HR 3070.

Computer Abuse Amendments Act of 1993 (S 1488)

Sponsor: Joseph R. Biden Jr. (D-DE) **Date**: 09/23/93
Status: Placed on Senate Legislative Calendar on Sept. 27.
Description: One component of a collection of anti-crime legislation, the Computer Abuse act refines criminal provisions for computer abuse.

National Competitiveness Act of 1993 (S 4)

Sponsor: Ernest Hollings (D-SC) **Date**: 1/21/93
Status: Placed on Senate Legislative Calendar on July 28.
Description: The bill increases US economic competitiveness in critical areas of technology such as advanced manufacturing, wind engineering and high-performance computing and networking. The bill contains a section titled, "Information Infrastructure and Technology Act," which 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 worker productivity and coordinate the building of a national information infrastructure to serve all citizens.

Professional Opportunities

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The rate is $2 per word (US currency). Purchase orders, money orders and checks are acceptable *(please do not send cash)*. All CRA members receive at least 200 free words per dues year.

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Washington University, St. Louis

Department of Computer Science

The Computer Science Department at Washington University is expanding its research program and invites applications for regular (tenure-track) faculty positions at the assistant, associate and full-professor levels. Applicants should hold a Ph.D. or doctor of science degree in computer science and have a strong commitment to and record of accomplishment in research.

Washington University is a leading national university with about 11,000 students and exceptional professional schools in medicine, engineering, business, law, architecture, social work and fine arts. It has an endowment of $1.5 billion and annual federal research support of approximately $150 million. The Computer Science Department is in the School of Engineering and Applied Science and has about 200 undergraduate majors, 90 graduate students and 15 faculty. The department had approximately $4 million in external research funding in 1992-93. The department plans to grow to at least 20 faculty by the end of the decade in order to expand its research and graduate programs, while continuing to enhance its already outstanding undergraduate program.

The department and its associated research laboratories have exceptional facilities to support computing research, including more than 150 workstations and file servers, and a variety of specialized equipment, including a Sun System 2000 multiprocessor, a Convex supercomputer and a complete computer visualization laboratory. An experimental four-node ATM network has been constructed to demonstrate multimedia networking applications ranging from full-rate video distribution to electronic radiology. This is now being upgraded to support multimedia networking to every faculty member's office.

The department seeks outstanding candidates whose research is directed toward solving important problems in computer science and technology. A major research focus in the department over the next several years will be distributed multimedia computing and communication systems. Consequently, we are particularly interested in individuals with an interest in distributed computing, advanced user interfaces, computer engineering and communication networks. The department also has strong research interests in artificial intelligence and the computational sciences. Applications from outstanding candidates in these and other areas also are welcome.

Washington University is located on a pleasant 168-acre suburban campus adjacent to Forest Park, one of the largest municipal parks in the country and home to the St. Louis Zoo, the Art Museum and the Science Center. St. Louis is a delightful place to live, with many fine residential neighborhoods, a minimum of urban hassles and all the amenities one expects of a major metropolitan area, including a world-class symphony orchestra, an excellent baseball team, one of the world's most beautiful botanical gardens and a rich and varied theater community.

Qualified applicants should send a curriculum vitae and the names and addresses of at least three references to Dr. Jonathan Turner, Chair, Department of Computer Science, Campus Box 1045, Washington University, One Brookings Drive, St. Louis, MO 63130-4899.

Applications will be considered as they are received. Those received after Feb. 1, 1994, may not receive full consideration.

Washington University is an equal opportunity, affirmative action employer.

University of Michigan

Electrical Engineering and Computer Science Department

The Department of Electrical Engineering and Computer Science at the University of Michigan invites applications for positions at all levels in its Computer Science and Engineering Division.

Our emphasis is on the areas of computer networking, multimedia and distributed systems, operating systems, programming languages, computer vision, robotics and intelligent manufacturing, and compiler-based computer architecture. Exceptional candidates in other areas of computer science and engineering also will be considered. All candidates who apply should have an interest in teaching and a strong research orientation.

Send your resume and the names of at least three references to Professor Toby J. Teorey, Chair of the Faculty Search Committee, CSE Division, EECS Department, University of Michigan, 1301 Beal Ave., Ann Arbor, MI 48109-2122.

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

North Carolina State University

Department of Computer Science

The Department of Computer Science at North Carolina State University invites applications for a tenure-track position as assistant professor. The department offers B.S., M.S. and Ph.D. degrees in the College of Engineering.

Persons applying must have a Ph.D. in computer science or a related area. Applicants also must have a strong commitment to excellence in teaching and excellence in research in both the applications and theory of high-speed networks. Examples of related specialties include the design and analysis of protocols, parallel and distributed computing, real-time systems, multimedia, network-based video, computer-based education, mobile computing and communications, computer-supported collaboration and internetworking.

The ideal candidate will have the energy and ambition to capitalize on some of the unique opportunities we can offer. These include participation in the Computer Science Multimedia Laboratory, other centers on campus and interaction with local high-technology industry. Research Triangle Park is a major hub for research, development and the manufacture of communication products. North Carolina currently is deploying the first statewide ATM network.

Interested candidates should send their curriculum vitae (including citizenship and visa status) and names of four references to Chair, High-Speed Networks Recruiting Committee, Department of Computer Science, Box 8206, North Carolina State University, Raleigh, NC 27695-8206.

This position will be filled by August 1994. For additional information, please contact hsn_search@adm.csc.ncsu.edu.

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Arizona State University

Department of Computer Science and Engineering

Arizona State University invites nominations and applications for the position of chair of the Department of Computer Science and Engineering in the College of Engineering and Applied Sciences.

Arizona State University is a major research university composed of 13 colleges. More than 10,000 of its 42,000 students pursue graduate studies. ASU is a multicampus university widely recognized as one of the most rapidly emerging major research institutions in the United States. The main campus is near the heart of metropolitan Phoenix in the city of Tempe. Phoenix is a cosmopolitan, culturally diverse area of approximately 2 million people. The College of Engineering and Applied Sciences has 11 academic departments and schools and eight research centers. Enrollment in the college includes 4,405 undergraduate students and 2,252 graduate students (396 Ph.D.s), with 220 tenured or tenure-track faculty members. The College of Engineering and Applied Sciences has been recognized for its innovative Engineering Excellence Program, a three-way partnership between state government, industry and the university.

The department consists of 25 faculty offering a B.S. in computer science, a B.S.E. in computer systems engineering, professional and thesis-oriented master's degrees and a Ph.D. The program has an enrollment of nearly 600 undergraduate students, 250 master's students and 60 Ph.D. students. Annual research expenditures are $1.1 million. Departmental research interests span advanced architectures, artificial intelligence, computer graphics and geometric design, computer languages, database systems, operating systems and software engineering. In addition to university and college computing facilities, the department operates four current technology undergraduate instructional laboratories and several workstation-based research laboratories. Technical support is provided by staff from Engineering Computing Services and from Information Technology, the university's computer infrastructure unit. In January 1993 the department moved into the newly opened Goldwater Center for Engineering and Science.

The chair reports to the dean of the College of Engineering and Applied Sciences, provides intellectual leadership to the department, promotes the development of a shared vision of academic excellence within the department and represents the department to the academic community at large. The chair takes an active role in faculty development and works with faculty across the department to identify and pursue innovation in teaching, research opportunities and a broad range of external funding sources. The chair promotes cultural diversity throughout the department.

Candidates must have an earned doctorate in computer science, computer engineering or a closely related field, and must be qualified for a tenured full professorship in the department. Candidates must have a distinguished record of academic scholarship in both teaching and research. Candidates must provide evidence of strong leadership, management, communication and interpersonal skills and must have an outstanding record of external support.

Send nominations and applications to Peter E. Crouch, Chair, Search Committee for the Chair of Computer Science and Engineering, College of Engineering and Applied Sciences, Arizona State University, Tempe, AZ 85287-5506. Internet: Peter.Crouch@asu.edu.

Candidates must supply a curriculum vitae, a letter of interest and the names, addresses and telephone numbers of at least five references. Questions and inquiries may be submitted by E-mail but applications and nominations must be received by post.

The search committee will begin reviewing applications on Dec. 1, 1993. Applications received after that date will be reviewed on a biweekly cycle, as necessary, until the position is filled. The preferred starting date is July 1, 1994, but the date is negotiable. Salary is competitive.

Arizona State University is an equal opportunity, affirmative action employer.

University of Florida

Department of Computer and Information Sciences

The Computer and Information Sciences Department invites applications for tenured or tenure-track positions at the senior and junior levels in software engineering, programming languages, parallel processing and related areas. Applicants must possess a doctoral degree in computer sciences or equivalent and show a strong record and commitment to teaching and research in these areas. The positions are available in the 1994-1995 academic year.

Applicants should send their resumes and the names and addresses of

Professional Opportunities

four references to Professor Sartaj Sahni, Chair, Faculty Search and Screen Committee, Computer and Information Sciences Department, 301 CSE, University of Florida, PO Box 116120, Gainesville, FL 32611-6120. Tel. 904-392-1211; E-mail: sahni@cis.ufl.edu. The closing date is Jan. 10, 1994, or until the positions are filled.

The University of Florida is an equal opportunity, affirmative action employer. This faculty search will be conducted in compliance with Florida's Government in the Sunshine law.

University of Illinois, Urbana-Champaign

Department of Computer Science

The Department of Computer Science, UIUC, anticipates one or more full-time tenure or tenure-track appointments. Successful candidates will be expected to initiate and carry out independent research and to perform academic duties associated with our B.S., M.S. and Ph.D. programs.

Qualifications: Ph.D. in computer science or a closely related field (or imminent completion of degree), outstanding academic credentials and an ability to teach effectively at both the graduate and undergraduate levels. Salary is open and based on qualifications. The starting date is Aug. 21, 1994.

To ensure full consideration, applications must be received by Dec. 31, 1993, although a search will continue until positions have been filled. Send resume including names of three references to Duncan H. Lawrie, Head, Department of Computer Science, UIUC, 1304 W. Springfield Ave., Urbana, IL 61801. Tel. 217-333-6454.

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

Purdue University

Department of Computer Sciences

Purdue University is establishing an interdisciplinary graduate program in computational science and engineering. It is expected to eventually involve perhaps 20 departments, 75-100 faculty and more than 100 graduate students. The Department of Computer Sciences seeks a highly qualified person dedicated to both research and teaching at the assistant professor level to support this program. Areas of specialization considered appropriate include scientific computing, high-performance computing, geometry systems, mathematical software, applications of computing to science and engineering, and related areas. The department currently has a number of substantial research projects in this area.

The CS Department has state-of-the-art Unix systems as well as direct access to equipment in the Purdue University Computing Center (PUCC). The CS Department facility includes several large Sun file and compute servers, a 64-processor Ncube 2, nearly 200 workstations from Sun, Silicon Graphics and Hewlett-Packard, and a complete video production facility. The PUCC facility has Intel, IBM, Cyber 205 and ETA-10 supercomputers. Purdue is a member of the Concurrent Supercomputing Consortium, which operates a 512-processor Intel Paragon. A new CS&E lab is to be established with graphical and multimedia computing facilities.

Applications are solicited for appointments to begin in late August 1994. Send curriculum vitae and the names of three references by March 1, 1994, to Chair, Personnel Committee, Department of Computer Sciences, Purdue University, West Lafayette, IN 47907.

Purdue University is in a college town of about 25,000, part of the Lafayette metropolitan area of about 125,000 people. The schools are excellent, commuting is easy, the cost of living is reasonable and there is a full range of athletic and cultural events at the university. Salaries are competitive and Purdue has one of the best packages of fringe benefits of any university.

Purdue University is an equal opportunity, affirmative action employer.

Ohio State University

Department of Computer and Information Science

The Department of Computer and Information Science at Ohio State University is seeking a distinguished computer scientist to serve as department chair. Candidates from all areas of computer science will be considered. Applicants should have an established record of scholarship, research and leadership qualities.

The Department of Computer and Information Science has strong academic programs at the bachelor's, master's and doctoral levels. It currently has approximately 35 tenure-track faculty members representing a broad range of research interests and nine full-time computer support staff members.

A state-of-the-art building to house the department is under construction; the expected completion date is 1994. Metropolitan Columbus exceeds 1 million in population, and it is an important information technology hub.

Applicants should send a resume, including the names and addresses of at least six references, to Chair, Search Committee, Department of Computer and Information Science, Ohio State University, Columbus, OH 43210.

Ohio State University is an equal opportunity, affirmative action employer. Qualified women, minorities, Vietnam-era veterans, disabled veterans and individuals with disabilities are encouraged to apply.

Georgia Institute of Technology

College of Computing

The Georgia Institute of Technology's College of Computing provides research and educational leadership in the field of computing by combining a strong intellectual core of computer science with programs that involve substantial interdisciplinary interactions. With a current academic faculty of 40 and a research faculty of 16, the college offers degrees at the undergraduate and graduate levels. Enrollment is 425 at the undergraduate level, 120 at the master's level and 135 at the Ph.D. level. The college offers a state-of-the-art computing facility enhanced by area-specific equipment in a variety of research and teaching labs.

The college invites applications for faculty positions at all ranks in all areas of computer science, particularly in our current areas of need, which include operating systems, programming languages and compilers, computer architecture and theory, and in interdisciplinary thrust areas such as scientific computation and visualization. Georgia Tech is located in Atlanta and is a unit of the University System of the State of Georgia.

Candidates should send complete resumes and names of at least three references, preferably by Dec. 15, 1993, or until positions are filled, to Professor Umakishore Ramachandran, Chair, Faculty Search Committee, College of Computing, Georgia Institute of Technology, Atlanta, GA 30332-0280. Tel. 404-894-5136; fax: 404-894-9846; E-mail: recruiting@cc.gatech.edu.

Georgia Tech is an affirmative action, equal opportunity employer and applications from women and underrepresented minorities are strongly encouraged.

Georgia Institute of Technology

College of Computing

The Georgia Institute of Technology's College of Computing seeks distinguished scholars to fill two endowed chairs, one in advanced telecommunications and information systems technologies and the other, the John P. Imlay Jr. Chair, in the general area of software systems.

Our emphasis in filling these positions will be on a record of achievement and the ability to lead intellectually and organizationally. A successful candidate for either position may be a traditional academic scholar or may have pursued the majority of his or her career in industry and established a reputation in ways beyond research publications. A candidate's work will demonstrate originality, the ability to communicate and the preservation and presentation of results in a manner consistent with the academic tradition of communicating new knowledge to future generations.

For a more detailed description of either position, contact Professor James Foley (E-mail: foley@cc.gatech.edu), Advanced Telecommunications Chair Search Committee, or Professor Richard LeBlanc (E-mail: rich@cc.gatech.edu), Imlay Chair Search Committee. Write to either care of the College of Computing, Georgia Institute of Technology, Atlanta, GA 30332-0280.

Georgia Tech is an equal opportunity, affirmative action institution.

Michigan State University

Department of Computer Science

The Department of Computer Science invites applications for one anticipated tenure-stream position at the assistant or associate level (position number ENG 2), rank and salary commensurate with experience. Applications also are invited for one anticipated visiting position at any level (position number ENG 128), rank and salary commensurate with experience.

Candidates from all areas of specialization in computer science or computer engineering will be considered. However, the department has a special interest in candidates in the areas of software engineering, software systems and theory. The research foci of the department include artificial intelligence and knowledge-based systems, computer architecture and design automation, networks and performance, parallel and distributed computing systems and algorithms, pattern recognition and image processing, database systems and formal methods for software systems. Candidates should have a Ph.D. in computer science or computer engineering and have a strong interest in both research and teaching. The appointments will begin in August 1994. The visiting position will be for one academic year. For full consideration, applications should be submitted by Feb. 1, 1994. However, applications will be accepted until the positions are filled.

As a unit within the College of Engineering at Michigan State University, the department offers bachelor of science, master of science and doctor of philosophy degrees. The department currently has 25 tenure-stream faculty and an enrollment of 150 graduate students and 380 undergraduates. Special support is available from within the college and university to initiate research by new faculty members. Faculty offices are connected to the MSUnet, which provides access to an array of campus computing resources, including the facilities of the College of Engineering and the department's Pattern Recognition and Image Processing Laboratory, Intelligent Systems Laboratory, High-Speed Network and Performance Laboratory and Advanced Computing Systems Laboratory. The equipment in the department includes more than 150 high-end workstations, a 45-node BBN TC-2000 parallel processor and two workstation clusters interconnected through high-speed switches.

Michigan State University enjoys a park-like campus of 2,100 developed acres and 3,100 acres of experimental farms, outlying research facilities and natural areas. The campus is adjacent to East Lansing and to the capital city, Lansing. The Greater Lansing area has approximately 250,000 residents. The communities have fine school systems and place a high value on education.

Applicants should send a letter of intent (specifying the position number of interest), resume, the names of three references and a statement of research and teaching interests to Faculty Search Committee, A714 Wells Hall, Michigan State University, East Lansing, MI 48824-1027. E-mail: search@cps.msu.edu

Michigan State University is an equal opportunity, affirmative action institution. Disabled persons have the right to request and receive reasonable accommodation.

Concordia University

Department of Computer Science

We are looking for new faculty members with strong research records or demonstrated excellent research potential to fill one or more tenure-track positions at the assistant or associate professor rank.

Applicants must have the interest and ability to teach effectively at both the undergraduate and graduate levels. Successful candidates are expected to carry out independent research and perform other academic duties associated with the bachelor's, master's and Ph.D. programs. Priority will be given to the following areas: 1) programming languages and systems, 2) software engineering and 3) database systems. However, truly exceptional candidates from any area of computer science are encouraged to apply.

The university is located in Montreal, which is known for its cultural diversity and beauty. The department houses approximately 600 undergraduates, 90 master's and 35 Ph.D. students. While the undergraduate program emphasizes both fundamental knowledge and practical skills, the graduate research program concentrates on artificial intelligence, combinatorics, computer algebra, database systems, distributed computing, large-scale scientific computing, pattern recognition, programming languages, software engineering and VLSI architecture. There are 29 full-time faculty positions supporting these activities.

The department has established CENPARMI (Center for Pattern Recognition and Machine Intelligence) with a specialization in pattern recognition and related expert-systems research. Members of the department research groups in mathematical computing and VLSI architecture belong to two inter-university research centers: CICMA (Centre Interuniversitaire en Calcul Mathmatique Algbrique) and GRIAO (Groupe de Recherche Interuniversitaire en Architecture de Haute Performance et VLSI). The department has members in Micronet, a network of Centers of

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Professional Opportunities

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Excellence. CICMA promotes research in algebraic computing, combinatorics and computational group theory. Recently, the department set up a small parallel computing facility as a start-up platform to develop and focus interest in this area. We expect to upgrade this facility in the coming years. To promote the development of new faculty members, the university has the FRDP program to provide seed grants for research in the first three years.

Concordia is committed to employment equity and encourages applications from women, aboriginal peoples, visible minorities and disabled persons. All things being equal, female candidates shall be given priority. Although the primary language of instruction is English, proficiency in French will be considered an asset.

Interested applicants should send a resume and the names of at least three references to Chair, Department of Computer Science, Concordia University, 1455 de Maisonneuve West, Montreal, Quebec H3G 1M8 Canada. Fax: 514-848-2830; E-mail: hiring@cs.concordia.ca.

In accordance with Canadian immigration requirements, priority will be given to citizens and landed immigrants of Canada.

University of South Carolina

Department of Computer Science

The Department of Computer Science at the University of South Carolina at Columbia invites applications for tenure-track faculty at the rank of assistant professor. Appointments are subject to availability of funding and administrative approval.

Candidates 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.

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.

The department offers B.S., M.S. and Ph.D. degrees to approximately 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.

The University of South Carolina provides equal opportunity and affirmative action in education and employment for all qualified persons regardless of race, color, religion, sex, national origin, age, disability or veteran status. The University of South Carolina System has designated as the ADA and Section 504 coordinator the executive assistant to the president for equal opportunity programs.

University of Rochester

Department of Computer Science

The Computer Science Department at the University of Rochester invites applications for a tenure-track position at the rank of assistant professor. Applicants in systems are particularly desired. Candidates must have received, or be about to receive, a doctorate in computer science or a related discipline and must demonstrate exceptional potential for both research and teaching.

Our department is small (12 faculty), with a strong record of research publication and external funding. We offer an outstanding research environment, with excellent students and facilities, and an unusually close-knit and collegial atmosphere. Current research interests include artificial intelligence (vision and robotics; natural language and knowledge representation), parallel systems and theory of computation. Approximately 45 students are enrolled in the Ph.D. program. There is no professional master's program. Plans are underway to establish a selective undergraduate major.

Applicants should send a curriculum vitae, copies of relevant papers and the names and addresses of at least three references to Faculty Recruiting Committee, Department of Computer Science, University of Rochester, Rochester, NY 14627-0226.

The University of Rochester is an equal opportunity, affirmative action employer, and it encourages applications from women and members of minority groups.

University of Minnesota

Department of Computer Science

The Department of Computer Science at the University of Minnesota seeks highly qualified faculty members at all ranks. Areas of primary interest are computer architecture, software engineering, multimedia and distributed systems, and geometric and symbolic computing. Exceptional candidates in all areas of computer science will be considered. However, a Ph.D. in computer science or related disciplines, commitment to teaching, distinguished research experience and a demonstrated ability to define new and innovative research directions are required.

The Minneapolis-St. Paul area is a major center for advanced technology and computer industry. Faculty in the Department of Computer Science have access to outstanding computer facilities both within the department and at the various high-performance computing centers on campus, including the Minnesota Supercomputer Institute, the Geometry Center and the Army High-Performance Computing Research Center.

Applicants should send curriculum vitae (including publications), a research summary and the names of at least three references to Chair, Faculty Recruiting Committee, Department of Computer Science, 4-192 EE/CS Building, University of Minnesota, 200 Union St. SE, Minneapolis, MN 55455.

The anticipated starting date is Sept. 16, 1994. Salary and rank are open and are based on qualifications. Applications must be received by Jan. 14, 1994. Interviews may take place before the closing date, but final decisions will not be made before Jan. 14.

The University of Minnesota is an equal opportunity educator and employer.

Southern Methodist University

Department of Computer Science and Engineering

The Department of Computer Science and Engineering invites applications for a full-time tenure-track faculty position. Rank and salary for this position are competitive and commensurate with qualifications. A Ph.D. and evidence of excellent research accomplishments or potential are required. Areas of highest interest include artificial intelligence, compilers, multimedia, networks, operating systems, programming languages and software engineering.

SMU is a private university with approximately 8,000 students. The department, in the School of Engineering and Applied Science, works closely with the Departments of Electrical Engineering and Mechanical Engineering. The department presents a balanced program of research and education at all levels and has been offering Ph.D. degrees since 1970. The department has extensive contacts with computer-related and engineering-oriented industrial firms that distinguish Dallas as one of the top centers for high technology.

Send resume, including the names of three references, to Professor Margaret H. Eich, Search Committee, Department of Computer Science and Engineering, Southern Methodist University, Dallas, TX 75275-0122. Applications will be accepted until Dec. 31, 1993.

SMU is an equal opportunity, affirmative action, Title IX employer. Applications from women and minorities are particularly encouraged.

Johns Hopkins University

Department of Computer Science

The Johns Hopkins University invites applications for faculty positions in the Department of Computer Science. Appointments at all ranks will be considered. We are particularly—but not exclusively—seeking candidates with experimentally oriented research and teaching interests in the following areas: distributed and parallel computing (hardware and software) systems, databases, computer graphics and visualization. It also should be understood that it is highly unlikely a position would be offered to a candidate in the theory of computer science or artificial intelligence areas.

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 curriculum vitae 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 and affirmative action employer.

Northwestern University

Robert R. McCormick School of Engineering and Applied Science

The Department of Electrical Engineering and Computer Science is seeking outstanding candidates to fill a distinguished chair (Trustee Professorship) position in computer science. The objective is to achieve a stature in theory, systems or software engineering that is comparable to the prominence we've gained in artificial intelligence with the Institute for the Learning Sciences (ILS).

Candidates with strengths in distributed computing and/or multimedia and who are interested in working with the ILS or the Center for Information and Telecommunication Technology are of special interest to us. The chair will have the opportunity to continue the expansion in EECS, which began five years ago, with the potential availability of junior faculty positions. We are looking for candidates with outstanding credentials and proven records of accomplishments in academia or industry.

Applications and nominations should be sent to Professor A.H. Haddad, Chair, Department of EECS, Northwestern University, Evanston, IL 60208-3118. Tel. 708-491-3641; fax: 708-491-4455; E-mail: ahaddad@eecs.nwu.edu.

Northwestern University is an equal opportunity, affirmative action educator

Professional Opportunities

and employer. Applications from women and minorities are especially encouraged. Employment verification required upon hire.

University of Wisconsin, Milwaukee

Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science at the University of Wisconsin at Milwaukee is seeking qualified applicants to fill one or more tenure-track junior faculty positions.

Candidates should have outstanding promise in, and a strong commitment to, research and teaching. The areas of interest are software engineering, operating systems, and software systems and languages.

The department offers undergraduate and graduate programs in computer science. The department currently has well-established strengths in data security, cryptography, parallel and distributed computation, artificial intelligence 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, along with 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 at Milwaukee, Milwaukee, WI 53201. The cutoff date for applications is Jan. 19, 1994. Additional information may be obtained from E-mail: kv@cs.uwm.edu.

The university is an affirmative action, equal opportunity employer. Women and minorities are encouraged to apply. The names of those applicants who have not requested that their identities be withheld and the names of all finalists will be released on request.

North Carolina State University

Computer Science Department

The Computer Science Department invites applications for a tenure-track position at the level of assistant professor. Persons applying must have a Ph.D. in computer science and a strong commitment to excellence in teaching and research in artificial intelligence or a related area. The position is to be filled by August 1994.

The department offers the B.S., M.S. and Ph.D. degrees in the College of Engineering. Current faculty members of the AI group are interested in the broad areas of constraint-based reasoning, machine learning, computational linguistics, natural language dialogue systems and applications in concurrent engineering and molecular biology. External funding of more than $950,000 from sources such as NSF, IBM, EPRI and NIEHS/NIH supports the research activity of the group.

The university also offers a graduate minor in artificial intelligence. Many departments at the university have faculty with interests in AI. Consequently, there are a number of opportunities for collaborative research. The department has close ties with organizations in the nearby Research Triangle Park, the home of high-technology companies such as IBM and Bell Northern Research and research institutions such as EPA and NIEHS/NIH. Many of these companies and institutions have an active interest in collaborative AI research.

Interested candidates should send their curriculum vitae (including citizenship information and visa status) and names of four references to AI Recruitment Committee Chair, Computer Science Department, North Carolina State University, Raleigh, NC 27695-8206. For additional information, please contact aisearch@adm.csc.ncsu.edu.

NCSU is an equal opportunity, affirmative action employer.

University of Maryland, College Park

Computer Science Department

The Computer Science Department of the University of Maryland, College Park (UMCP), seeks first-rate faculty members at all ranks. Exceptional candidates in all areas will be considered, but we are especially seeking candidates in the areas of computer systems, programming languages and software engineering.

The department is located in suburban Washington, DC, in close proximity to many large governmental and industrial laboratories and within easy access of Baltimore and Annapolis. It has close to 40 faculty members and maintains strong degree programs at both the undergraduate and graduate levels. Major research projects in areas such as artificial intelligence, computer networking, computer vision, database systems, distributed systems, human-computer interaction, numerical analysis, parallel processing, performance evaluation, software engineering and theory and analysis of algorithms are funded at an annual level of about $5 million.

Candidates should send a curriculum vitae, a research summary and the names of at least three references to the Recruiting Committee, c/o Professor Satish K. Tripathi, Chair, Department of Computer Science, University of Maryland, College Park, MD 20742. In addition, please ask your references to send their recommendation letters directly to the address noted above. For full consideration, applications must be received by Feb. 1, 1994.

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

George Mason University

Department of Information and Software Systems Engineering and Department of Computer Science

The Departments of Computer Science (CS) and Information and Software Systems Engineering (ISSE) at George Mason University expect to have positions available for the 1994-1995 academic year and invite applications for tenure-track positions at all ranks, permanent and visiting. Applicants should have a Ph.D. in computer science, information systems, software engineering or a related field. All applicants must be committed to teaching and research, and applicants for senior positions must have an excellent record of publications and sponsored research support.

For the computer science position we are particularly interested in distributed computing, computational sciences, multimedia computing and user interfaces. For the software systems engineering position we are interested in the areas of software process modeling, software environments, software project management, requirements engineering and software reuse. For the information systems position we seek individuals in the areas of intelligent network management, network security, digital libraries and heterogeneous distributed information systems.

CS and ISSE faculty are supported by grants and contracts from ARPA, NSF, NASA, AFOSR, ONR, Rome Labs, the Defense Information Systems Agency and the National Computer Security Center/ National Security Agency. Research facilities include the Center for the New Engineer and centers focusing on secure information systems, software systems engineering, artificial intelligence, distributed computing and image analysis.

George Mason University is located in suburban Fairfax, VA, 16 miles southwest of Washington, DC. The CS and ISSE departments are in the School of Information Technology and Engineering, which has made a commitment to engineering education in a world shaped by information technologies. There are numerous opportunities for governmental and industrial interaction in this region.

For full consideration, please send a letter of application, a detailed resume, the names of four references, two samples of recent work and published papers. The application letter should state: 1) your professional objectives, 2) your professional experience and research objectives, 3) relevant teaching experience and 4) the position for which you wish to be considered. All of these items should be submitted together to ensure timely consideration of your application. Send all material to Mail Stop 4A4, Chairs—Faculty Recruitment Committee, CS & ISSE Departments, George Mason University, Fairfax, VA 22030-4444. The application deadline is Feb. 1, 1994.

The university is an affirmative action, equal opportunity employer.

Cornell University

Computer Science Department

Applications are invited for tenure-track positions beginning August 1994. These positions are at the assistant professor level, although appointments at the associate and full-professor level will be considered for highly qualified applicants. Applicants should have a Ph.D. in computer science or in a closely related field. The department requires demonstrated research accomplishments at a very high level as well as teaching ability and leadership qualities.

The Department of Computer Science at Cornell University encompasses a wide range of research areas, including algorithms, applied logic and semantics, artificial intelligence, computing theory, concurrency and distributed computing, databases, information organization and retrieval, numerical analysis and scientific computing, programming languages and methodology, and robotics and vision.

Research positions in scientific computation and software systems also are anticipated to become available.

Applicants should submit a curriculum vitae and the names of at least three references to Chair, Faculty Recruiting Committee, Department of Computer Science, 4130 Upson Hall, Cornell University, Ithaca, NY 14853-7501.

Cornell University is an equal opportunity employer and welcomes applications from women and ethnic minorities.

Lehigh University

Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science at Lehigh University seeks applicants for a tenure-track faculty position in the area of computers in manufacturing. Candidates must have a Ph.D. in computer engineering, computer science or electrical engineering. We require a strong commitment to teaching and evidence of innovative research through appropriate journal publications. Preference will be given to junior faculty, but we would consider senior faculty with an impressive record of publication and funding in the fields of interest. Other areas of research may be considered.

The department offers programs leading to a Ph.D. degree in electrical engineering, computer science and computer engineering. Send E-mail to eecs@eecs.lehigh.edu for more information about the department.

Candidates are encouraged to respond rapidly by sending a curriculum vitae and names of at least three references to Dr. Alastair McAulay, Chair and Chandler Weaver Professor, Faculty Search Committee, Department of Electrical Engineering and Computer Science, Lehigh University, 19 Memorial Drive W., Bethlehem, PA 18015.

Lehigh University is an affirmative action, equal opportunity employer. Women and minorities are encouraged to apply.

Auburn University

Department of Computer Science and Engineering

The Department of Computer Science and Engineering invites applications for tenure-track faculty positions beginning September 1994. Responsibilities include research, graduate student supervision and graduate and undergraduate teaching. Candidates with a Ph.D. in computer engineering are strongly preferred, although candidates with a Ph.D. in computer science or a closely related field also will be considered.

Two positions will be available at the assistant professor level for candidates with specialties in software engineering and computer networks respectively. A position will be available at the associate professor level for a candidate with a successful research record in computational geometry and its applications to other engineering disciplines.

The department currently has 11 full-time faculty members and supports strong undergraduate and graduate programs. Faculty research areas include parallel computation, software engineering, artificial intelligence, computer networks and human-computer interaction.

Departmental resources include a network of Sun workstations linked to the College of Engineering's Sun network. Parallel computing research is supported by a network of 16 T800 Transputers accessible from any of the department's workstations. Network access also is available to the general computer facilities of the university and to the Alabama Supercomputer Network's Cray Research and Ncube supercomputers.

Auburn University, with over 21,000 students, is Alabama's land-grant university. It is located 100 miles southwest of Atlanta.

Applicants should send a curriculum vitae and the names, addresses and telephone numbers of three references to Professor Stephen B. Seidman, Head, Department of Computer Science and Engineering, Auburn University, AL 36849-5347. Questions can be E-mailed to seidman@eng.auburn.edu. Review of applications will begin Dec. 15, 1993, and will continue until the positions are filled.

Auburn University is an affirmative action, equal opportunity employer. Women and minorities are encouraged to apply.

Association News

CRA serves its members and the CS community

The Computing Research Association (CRA) is an association of US and Canadian academic departments of computer science and computer engineering and industrial laboratories engaging in basic computing research. The mission of CRA is to represent and inform the computing research community and to support and promote its interests. CRA helps strengthen research and education in the computing fields through publications, meetings, surveys and other professional activities. Through various communications programs, CRA seeks to improve public and policymaker understanding of the importance of computing and computing research in our society.

In the 1992-93 dues year, CRA had a membership consisting of more than 180 North American Ph.D.-granting and non-Ph.D.-granting departments of computer science and computer engineering and eight non-academic research laboratories. Three professional societies—the Association for Computing Machinery, the American Association for Artificial Intelligence and the Society for Industrial and Applied Mathematics—were affiliated professional society members.

The CRA board of directors, elected by the dues-paying member institutions, is a distinguished group of leaders in computing research from both academia and industry.

Meetings

• The biennial *CRA Conference at Snowbird* July 10-12 will include the Department Chairs Workshop for academic and research laboratory administrators interested in computing research issues and the Research Managers Workshop for industrial lab managers.

• The *Federated Computing Research Conference '93* was a major research meeting that was held for the first time in May. The conference brought together eight existing specialized research meetings that previously convened at different places and times. A CRA Workshop on Academic Careers for Women also was part of the conference. FCRC provided new opportunities for computing researchers to work with one another across boundaries.

Publications

• One of CRA's goals is to help the computing research community become better informed and speak more effectively on science and technology policy issues. *Computing Research News* is the only publication of its kind devoted to covering issues affecting the computing research community. It has become an invaluable source of information on government policy in the United States and Canada.

Surveys and reports

• The annual *CRA Survey on the Production and Employment of CS&E Ph.D.s and Faculty (formerly the CRA Taulbee Survey)* is the principal source of information on the production and employment of Ph.D.s and faculty in computer science and computer engineering in North American. The survey, which is printed in *CRN*, is one of the most accurate and complete surveys of its kind in the science and engineering disciplines. It is an invaluable aid to government, academic and industrial organizations that need to better understand the issues and trends affecting the computing research academic pipeline.

CRA also sponsors other assessment and survey projects including maintenance of the *CRA Forsythe List*, a complete, up-to-date listing of all Ph.D.-granting programs in computer science and computer engineering.

Human resources

• Several activities focus on strengthening the role of women and minorities in the research disciplines. The *CRA Committee on the Status of Women in Computing Research* was formed to assess the needs of women in computing research and develop programs to encourage and support women who wish to enter the field and advance their research careers. CRA, with NSF support, has initiated several projects including a *CRN* column on expanding the pipeline, a database of women in computer science and a symposium for female students in computing. Also with NSF support, we have started a student mentoring program.

Science policy

CRA is continuing its occasional series of *congressional computing research seminars.* The seminars are designed to expose congressional and administration policymakers to interesting areas of computing research and increase their understanding of the importance of using basic research to address social problems.

CRA played a key role in encouraging Congress to pass the High-Performance Computing Act of 1991. CRA particularly was outspoken on the need for a balanced program that supports basic research and human resource development. CRA will be active in the ongoing debate over national technology policy and the national information infrastructure.

1993-94 Computing Research Association members

(As of Oct. 20, 1993)

Academic Members

Arizona State University (CS)
Auburn University (CS&E)
Boston University (CS)
Brandeis University (CS)
Brown University (CS)
California Institute of Technology (CS)
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Clemson University (CE)
Clemson University (CS)
Colorado State University (CS)
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Cornell University (CS)
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George Washington University (CS)
Georgia Institute of Technology (CS)
Indiana University (CS)
Iowa State University (CS)
Kansas State University (CS)
Kent State University (CS)
Lehigh University (EECS)
Michigan State University (CS)
North Carolina State University (CS)
North Dakota State University (CS)
Northeastern University (CS)
Northwestern University (EE&CS)
Ohio State University (CIS)
Old Dominion University (CS)
Oregon Graduate Institute (CS)
Oregon State University (CS)
Pace University (CS)
Pennsylvania State University (CS)
Polytechnic University (CS)
Portland State University (CS)
Purdue University (CS)
Rensselaer Polytechnic Institute (CS)
Rutgers, State Univ. of New Jersey (CS)
Santa Clara University (CE)
Simon Fraser University (CS)
Southern Methodist University (CE&CS)
State University of New York, Albany (CS)
State University of New York, Buffalo (CS)
Syracuse University (CS)
Texas A&M University (CS)
University of Alabama (CS)
University of Alberta (CS)
University of Arizona (CS)
University of British Columbia (CS)
University of California, Berkeley (CS)
University of California, Davis (CS)
University of California, Los Angeles (CS)
University of California, Riverside (CS)
University of California, San Diego (CS&E)
Univ. of California, Santa Barbara (CS)
University of Chicago (CS)
University of Cincinnati (CE)
University of Colorado, Boulder (CS)
University of Delaware (CIS)
University of Florida (CS)
University of Houston (CS)
University of Illinois, Chicago (CS)
Univ. of Illinois, Urbana-Champaign (CE)
Univ. of Illinois, Urbana-Champaign (CS)
University of Kansas (CE)
University of Kentucky (CS)
University of Maryland (CS)
Univ. of Maryland, Baltimore County (CS)
University of Massachusetts, Amherst (CS)
University of Michigan (EECS)
University of Missouri-Rolla (CS)
University of Montreal (CS)
University of Nebraska, Lincoln (CS)
University of New Mexico (CS)
Univ. of North Carolina, Chapel Hill (CS)
University of Oklahoma (CS)
University of Oregon (CIS)
University of Pennsylvania (CIS)
University of Rochester (CS)
University of South Carolina (CS)
University of South Florida (CS&E)
University of Southern California (EES)
Univ. of Southwestern Louisiana (CE&CS)
University of Tennessee, Knoxville (CS)
University of Texas, Arlington (CSE)
University of Texas, Austin (CS)
University of Texas, El Paso (CS)
University of Toronto (CS)
University of Tulsa (CS)
University of Utah (CS)
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