COMPUTING RESEARCH NEWS

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Speech restrictions on net appear likely

By Fred W. Weingarten
CRA Staff

Should a print or broadcast model be applied to communication on the Internet in terms of government restrictions on speech? The answer to that question, long debated in theory among the policy buffs in the computer community, is evidently clear to Congress.

At press time, debate over the telecommunications deregulation bill was moving toward final reconciliation between the House and Senate. Although the final conclusive vote had not been taken, actions by House conferees made it likely that the final version of the bill would contain criminal sanctions against "indecent" speech on the net that are much more stringent than for print and, because of the nature of the net, could have far greater impact.

Last fall, Sen. James Exon (D-NE) attached an amendment to the Telecommunications and Deregulation Act of 1995, S 652. This amendment was a version of a bill he had been promoting to ensure decency on the net. The Exon amendment, as it came to be known, made it a federal criminal offense to knowingly make indecent material available on the net. The amendment was added in full committee markup of the telecommunications bill without benefit of hearings and with little discussion among committee members who were focused on a complex bill that was intended to completely revise telecommunications regulation.

If the Internet community did not take Exon seriously before then, the 85-14 vote in favor of the amendment on the Senate floor in June certainly got their attention. It was too late for Senate action, but the House seemed more promising given that several influential Republicans had libertarian leanings. Shortly after the Senate vote, the Cato Institute, a conservative think tank, issued a report that labeled the Exon amendment "New Age Comstockery." House Speaker Newt Gingrich, shortly thereafter said that such restrictions were "clearly a violation of free speech and a violation of the rights of adults to communicate with one another."

Nevertheless, the House had to do more than just oppose Exon. Politically it had to advance its own solution in its bill, HR 1555. It voted overwhelmingly for an amendment offered by Christopher Cox (R-CA) and Ron Wyden (D-OR). This amendment contained no criminal sanctions or new laws regarding freedom of speech. Cox and Wyden encouraged the private sector to develop techniques to allow users to filter information. This would shield information service providers from any liability resulting from labeling or filtering.

The House action did not please all Republicans. Henry Hyde (R-IL), a 20-year member of the House, and chair of the House Judiciary Committee, began circulating a bill he called the Cyberspace Cleanup Act of 1995. In October, a coalition of groups sent a letter signed by such recognized conservatives as former Attorney General Ed Meese, Ralph Reed (executive director of the Christian Coalition), Phyllis Schlafly and Paul Weyrich. The letter proposed even tougher language, specifically ruling out defenses for access and service providers, saying they should be held fully liable for material distributed on their systems.

In the fall, Rep. Rick White, a conservative Republican freshman from the Seattle area and a member of the House Commerce Subcommittee on Telecommunications and Finance, attempted to craft a compromise for the House to bring to the House and Senate conference. Given the pressures, the assumption in the House was that substituting the Cox-Wyden amendment for the Exon amendment would be a losing proposition. Some form of criminal sanctions would have to be in the final bill.

White, who has Microsoft and Nintendo in his district, began working with industry and public interest groups to draft an acceptable compromise. Some civil liberties groups took the position that any extension of speech crime beyond that already on the books was simply unacceptable, and saw nothing to discuss.

On December 1, with a meeting of the House conferees drawing near, a "final offer" compromise was circulated to the computing community. Much to White's dismay, the informal coalition he was dealing with split deeply in its response, with industry buying off on it and higher education and the library associations holding back support. Of the many changes White had made, three were key.

1. He substituted a "harmful to minors" standard for the terms

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S&T does 'fairly well' in new budget

By Stephen Barlas
Special to CRN

Nightmares in the computing research community over potentially Draconian, Republican-initiated federal basic research cuts apparently were unjustified. Many computer research programs are expected to do fairly well in fiscal 1996, although at press time, final congressional approval of some budgets had not gone through.

"Fairly well" means funding will be about the same as in fiscal 1995. Moreover, the Republican Clinton, seven-year deficit reduction plan anticipates these research programs getting 3% inflation increases annually.

Tom Weimer, staff director of the House Science Subcommittee on Basic Research, said committee chair Rep. Robert Walker (R-PA) made it a point to ensure inflation increases for basic science programs. Walker has at the same time been a rigorous opponent of federally funded applied research. As vice chair of the House Budget Committee, he has been able to make his likes and dislikes stick.

"It hasn't been the tragedy we expected," admitted Rick Borchelt, spokesman for the White House Office of Science and Technology Policy. However, he pointed out that some basic research programs devoted to energy and the environment have been crippled or wiped out. Many of these, for example those involving environmental technologies and Superfund cleanup, will have little or no impact on computing researchers.

Bonnie Cassidy, spokeswoman for the American Association for the Advancement of Science, said, "Federal R&D figures were better than expected. But that can mean either of two things. Either there is support for R&D and it will continue to be protected, or the big cuts are yet to come."

The 1996 National Science Foundation budget, close to being approved at press time, looked likely to be up 1.3% in research and related activities. However, the Computer and Information Science and Engineering Directorate would see its funding decrease by 1.1%. NSF spokeswoman Beth Gaston said that Paul Young, the assistant director of CISE, declined to comment on the 1996 budget until the final numbers were in.

In this tepid funding environment, NSF is moving to maximize its bang from its stagnant bucks. A good example is the Supercomputer Centers program, which has supported four lead university centers over the past 12 years.

They are at the University of Illinois at Urbana-Champaign, the University of Pittsburgh/Carnegie Mellon University, the University of California at San Diego and Cornell University. Each of the four centers received $15 million in 1995, a sum that will remain at about that level in 1996, according to program director Dick Kaplan.

However, the program is being revamped, with NSF likely to reduce the number of lead centers from four to two or three. Kaplan said the new program will be "more Internet-focused." The National Science Board approved the new direction in December. Preproposals for the Partnerships for Advanced Computational Infrastructure program are due by April 1, 1996, and final proposals will be

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Opinions

Freedom of speech threatened

By Sen. Russell D. Feingold

On October 13, the US Senate appointed several members to a House Senate conference committee on the massive telecommunications bill.

The decisions of those conferees will have significant implications for users of interactive telecommunications technology and for the free speech rights of the public in general.

Attached to both the House and Senate versions of this bill are provisions that set a new and, I believe, dangerous precedent for free speech in America.

I refer here to S 652, the Senate bill that includes the Communications Decency Act, sponsored primarily by Sens. Exon (D-NE) and Coats (R-IN), and HR 1555, a House bill that includes an amendment similar to the Senate language. Both amendments attempt to control communications via computer systems, including the Internet.

I count myself among those who strongly oppose government censorship of free speech, and I am likewise concerned about placing shackles on a speech medium that is still in the early stages of development compared with other media. The Exon/Coats amendment, by subjecting certain types of constitutionally protected speech on the Internet, such as indecency, to criminal sanctions, will have a chilling effect on both the free-speech rights of Americans who use computer networks for communication and on the economic and technological development of this new communications frontier.

This is an issue complex in its politics and, more importantly, in its implications both for our constitutional rights to free speech and for the infant communications technology represented in most people's minds by the Internet.

This issue presents a difficult and troubling problem for legislators in several ways:

First, many lawmakers have yet to come to grips with this technology, so they must be educated as to the nature and extent of the problem and the available remedies. The Communications Decency Act passed the Senate with little debate and no formal congressional hearings, so few senators were aware of precisely what they were approving.

I am concerned that if an Exon/Coats-type amendment is enacted, people who use this new technology which combines the capabilities of several existing methods of communication, will actually have less protection under the law than if they chose to communicate through print, over the telephone or via radio.

For example, adults will be required to self-censor their speech so it is consistent with the indecency standards of the most conservative community and appropriate only for the youngest computer users.

Further, an enormous volume of material in print is available on the World Wide Web through the Internet. Therefore, it is certainly not outside the realm of possibility that someone could transmit the text of a novel that is already available in any bookstore or library to anyone of any age and then find federal agents on their doorstep.

Second, it is likewise difficult to explain to a lot of people, including lawmakers, that there is a significant difference between what is "obscene" and what is merely "indecent" and that the law treats these differently. The Exon/Coats amendment specifically addresses indecency. In fact, the terms are used interchangeably by those targeting obscenity and child pornography. Trying to explain that difference and trying to defend free speech opens the door to charges of coddling child pornographers, which are, of course, untrue and unfair but which are potent political poison nonetheless.

Third, there is an understandable tendency among elected officials to want to act immediately when they are presented with a problem that involves protecting children. What senators and representatives must understand is that there is a time to act and a time to show restraint. Further, they must understand that when we act, we must act with care. The federal government has enormous power to protect or to injure the basic rights of the citizens it represents. With that power comes equal responsibility to act with prudence, with forethought and with restraint. Sweeping legislation like this, passed in haste, is, to use a phrase popular with legal writers, fraught with peril.

Why does Congress believe there is a need for this? Consider the evidence to the contrary:

• Trafficking obscene materials or child pornography through interstate

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Should HPCC be reauthorized?

By Fred W. Weingarten
CRA Staff

One day many years ago, when I was a young program director at the National Science Foundation, I was walking down the hall with a colleague from the social sciences division. The NSF director passed us and said, "Hi, Rick."

My friend looked at me in shock and said, "He knows you by name?" I explained that a few weeks earlier, my boss, Kent Curtis, had asked me to work with the director on some testimony regarding computers. He looked at me sympathetically and confided with the wisdom of a longtime bureaucrat, "Survival is never letting them know your name."

That attitude is not unusual in any large bureaucracy, but in this case, it was also more understandable. NSF's support of social science research funding then, as now, existed despite much criticism. Some conservative politicians believed social science research was nothing more than a pretext for expanding social programs. Others in science policy leadership positions, mainly from the physical science disciplines, saw social science as a "soft" field lacking the rigor and objectivity of "hard science," and thought it certainly unworthy of NSF funding. Given that hostile environment, my friend's perspective was rational; every time he stuck his head up, someone would shoot at it.

We in computer science, however, were trying to be noticed and taken seriously in a science community dominated by traditional physical scientists, most of whom had never seen a computer and for whom the term "computer science" seemed an oxymoron. But we were in the early stages of growth and thought we were riding the wave of the future. What we thought we needed was visibility and the chance to tell our story. Therefore, it was great news to us that the NSF director wanted to talk about computers.

I recalled that experience recently while watching the debate over whether to reauthorize the High-Performance Computing and Communications Act, which expires in the fall. The dilemma is similar. Considering all the budget-cutting knives flying on the Hill, does the community want to keep its collective head low or should it stand up and take a chance to tell the story?

To be fair, the issue is certainly more complicated, but the underlying political question of visibility lurks underneath. And the proper answer is by no means clear.

Recall, the HPC (as it was originally called—the second "C," standing for communications, was added later) was an attempt to create a coordinated, multiagency program focused on high-end computing. The issue was not so much to get agencies such as NSF or the Advanced Research Projects Agency to fund computing research—they already did. Rather, it was to establish some broader, governmentwide objectives and to direct agencies to coordinate their own research programs accordingly. By so doing, went the argument, the program would ensure more effective expenditures of

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Expanding the Pipeline

New booklet reaches out to young women

By Dian Rae Lopez, Stephanie Sides and Ann Redelfs

This is your chance to do something to help young women realize the many benefits of choosing a computing field for their major.

This column has often reported on statistics pointing out that young women need mentoring, information and encouragement to enter the computer science and engineering (CS&E) fields. The 1994 Computing Research Association Taulbee Survey [CRA95] showed that only 18% of the undergraduate degrees offered in these fields are awarded to women.

What can you do to help increase these numbers? You can help facilitate the distribution of *Women in Computer Science*, a booklet published to encourage young women at the high school and undergraduate levels to become aware of the many options available to those who choose to major in computing fields. The booklet consists of 18 short biographies of women with careers in computing who talk about their jobs, their backgrounds and their lives. Your help is needed to make young women aware of the many exciting computing careers available to them. By using women with careers in CS&E as role models to distribute this booklet, the impact can be even greater. Women students can realize that it is possible for them to have such a career.

If you are an administrator in a college or university, this is your chance to do something to help young women in your area realize the many benefits of choosing a computing field for their major while they are undergraduates. Invite a female computer professional as a speaker and have her distribute booklets after the presentation. Encourage your female computing faculty to promote the idea of careers for women in computer science areas by giving them release time from other duties to present seminars at nearby high schools. Make the booklets available to all your undergraduate advisers. Develop strategies to reach the audience that will benefit most from a presentation of careers in CS&E. Recognize the value of such outreach activities.

If you are a male faculty member in a computing field, encourage the distribution of the booklets in your department. Make sure all your female advisees receive one. Think of ways the department can encourage more young women to consider computing majors. If you can help in any way with the distribution of the booklets, including talking with high school students, please do. There are often not enough women in CS&E to carry out such a task by themselves.

If you are a woman in the computing field, please consider volunteering to talk to groups of high school students about the variety and challenges of a career in computing. Also consider ways of reaching first- and second-year undergraduates by telling them what it is like to study computing and how many options are available to them with a CS&E major. The impact of such a booklet is made far greater when delivered by a successful female computing professional.

Readers who work in industry can encourage women in CS&E to reach out to high school and undergraduate women. An invited talk is always welcome at universities as well as in high school classrooms. Are there ways you can promote outreach from your company to young women searching for knowledge about career paths?

About the booklet

Published by the CRA Committee on the Status of Women in Computing Research, *Women in Computer Science* presents women working in a variety of computing positions. The women discuss their jobs and how they chose their careers. They tell stories of the competition and occasional isolation they faced in college, the intellectual challenges and opportunities for advancement they've enjoyed through their chosen profession and how they have balanced career with family.

Those in industry work at IBM Corp., Apple Computer Inc., Hewlett-Packard Co., Motorola Inc., Schlumberger Laboratory for Computer Science and Northern Telecom. Those in academia work at Harvard University, the University of Illinois at Urbana-Champaign, Purdue University, the University of Minnesota, the University of California at Irvine and the University of Toronto. Those in government work at the Defense Department, the National Film Board in Montreal and the Canadian Space Agency. One entrepreneur formed her own company.

Distributing the booklets

With the help of the National Science Foundation and CRA, the committee has printed 15,000 copies of the booklet. It is expected that more will be needed. To facilitate seminars, especially for high school groups, a helpful brochure (with ideas and suggestions for a successful presentation) will be prepared and distributed.

To receive a copy of the brochure or to order the booklet, send your email request to Dian Lopez at lopezdr@cda.mrs.umn.edu. Booklets may also be ordered by contacting Kimberly Peaks of CRA at tel. 202-234-2111 or via e-mail at kpeaks@cra.org.

References

[CRA95] CRA. "1994 CRA Taulbee Survey" *Computing Research News*, 7(2):7-9, March 1995.

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Mailing labels of our membership and the CRA Key Person List are available free to CRA members. The labels are available electronically or on laser labels. The labels are $25 per set for non-members. Contact Phillip Louis at tel. 202-234-2111, fax: 202-667-1066; or e-mail: info@cra.org.

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due by Aug. 15, 1996. NSF is expected to make the awards in February 1997. The program solicitation is available at http://www.cise.nsf.gov.

The House's Wilmer noted, "The Supercomputer Centers program is certainly cognizant of the budget."

One aberration from the "basic research steady/applied research down" trend is the Defense Department. While total R&D increased 5.9% to $37.2 billion, funding for basic research dropped 1.6% to $1.2 billion.

That translates into a cut in computer basic research at the Advanced Research Projects Agency. Its basic research budget resides in the Defense Research Sciences program. There are three programs: Information Sciences, Electronics Science and Materials Science.

The 1995 budget was $87.6 million, minus a midyear ARPA-wide decrease of a relatively small amount that ARPA spokeswoman Jan Walker was not sure of. The 1996 budget will be $81.3 million. Walker did not know which basic research programs will be cut.

Yet the ARPA Computing Systems and Communications Technology program, which has an applied research focus, will get an increase, from $390 million in 1995 to $392.3 million in 1996.

It is difficult to tell at this point how the individual Energy Department laboratories made out. Only one thing is certain. The three weapons laboratories—at Sandia, Los Alamos and Livermore—made out fairly well, all things considered, because they received the full Defense funding they expected for 1996. Some of the other labs did not receive as much Pentagon funding as they expected.

DOE's budget for High-Performance Computing and Communications did decrease in 1996. Michael Saltzman, a budget analyst in DOE's Budget Analysis Division, was able only to estimate that decrease, saying it is $3 million to $5 million below the $122 million 1995 budget.

Jeannie Wilson, a staff member on the House Appropriations Subcommittee on Energy and Water, said there is still considerable sentiment in the House for eliminating DOE

Association News

1996 ACM Fellows named

The Association for Computing Machinery will honor 53 ACM members for outstanding achievements in their fields of work and their significant contributions to ACM. These new inductees will join the 187 current ACM Fellows, bringing the total to 240 ACM Fellows from around the world.

The 1996 ACM Fellows are:

W. Richards Adrion, Univ of Massachusetts
Alfred V Aho, Columbia University
Narendra Ahuja, University of Illinois
Kurt Akeley, Silicon Graphics Inc.
Ruzena Bajcsy, University of Pennsylvania
Gregor Bochmann, University of Montreal
Anita Borg, Digital Equipment Corp.
Balakrishnan Chandrasekaran, Ohio State Univ
Bernard Chazelle, Princeton University
Narsingh Deo, University of Central Florida
George G Dodd, General Motors Corp.
Jose Encarnacao, Technical Univ of Darmstadt
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Blum to receive Turing Award

Manuel Blum, a computer scientist at the University of California at Berkeley will receive the Association for Computing Machinery's A.M. Turing Award in February.

Blum was honored "in recognition of his contributions to the foundations of computational complexity theory and its applications to cryptography and program checking," an ACM press release said.

Blum is the University of California at Berkeley's Arthur J. Chick Professor in Electrical Engineering and Computing Sciences, a department in which he has served since 1968. Blum was born in Caracas, Venezuela, in 1938 and began his academic career at the Massachusetts Institute of Technology, where he received his B.S., M.S. and Ph.D. degrees. Blum is renowned for his work on computational complexity, automata theory, inductive inference, cryptography and program result checking. During his career, Blum has received numerous awards, published 47 technical papers and advised 26 Ph.D. students.

"Manuel Blum is a profound thinker," said ACM president Stuart H. Zweben, chair of the Department of Computer and Information Science at Ohio State University. "His seminal work, insights and approaches have brought about new avenues of research in the area of computational complexity and established foundations for what people can compute."

The ACM A.M. Turing Award is given annually for technical achievements in the field of computing deemed by a jury of leading professionals to be of lasting and significant importance to the computing community. It is accompanied by a prize of $25,000, contributed by IBM.

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commerce or solicitation of minors is already a criminal act, regardless of the medium used.

• Law enforcement already has been aggressive in its pursuit of child pornographers and sexual predators who troll in cyberspace for victims. We have seen numerous press accounts of investigations and arrests of people who have turned to the Internet to pursue unlawful activities. Rather than vilifying the medium, Congress needs to recognize that computer technology is just another tool used by those who seek to victimize children.

• Further, there is software already available to filter and block the reception of materials that, for example, parents might find objectionable for viewing by their children. This was made abundantly clear during Senate Judiciary Committee hearings on this issue, chaired by Sen. Grassley (R-IA) in September.

Such technology provides parents with far more flexibility to screen out all offensive materials from which they wish to protect their children and is far less restrictive than an outright ban on protected speech.

Some of these points are addressed by a bipartisan amendment to the House bill sponsored by Reps. Cox (R-CA) and Wyden (D-OR). The Cox/Wyden amendment recognizes that First Amendment protections apply to online communications, just as they do to other communications technologies and other media by prohibiting regulation of content on the Internet by the Federal Communications Commission.

The Cox/Wyden amendment also recognizes the existence of technology to provide for parental control of children's access to unwanted material on computer networks and even promotes the development of such technologies. It also encourages online service providers to be their own police regarding control of offensive materials carried over their systems.

Having the Cox/Wyden amendment in the same bill as the Hyde amendment creates an immediate contradiction, yet some lawmakers either chose to ignore these inconsistencies or were simply ignorant of them. Perhaps they want to have it both ways—to be viewed as tough on crime and yet purport to uphold the principles of the First Amendment.

The Exon/Coats amendment passed overwhelmingly in the Senate, as did similar language in the House. But the House also passed the Cox/Wyden amendment overwhelmingly. The conference committee may adopt both, which would be unfortunate.

What price do we pay for government regulation of speech on computer networks? For one thing, certain communications—specifically, those labeled "indecent," as differentiated from those considered "obscene"—between and among adults are protected by current law. But under the pending legislation, they would be criminal acts if they were conducted via an online system and children accessed them.

For another, we must accept a chilling effect on the development of the technology itself, a large step backward. Parents are unlikely to demand screening software if Uncle Sam is willing to step in with criminal sanctions. Online providers are likely to be more cautious in their promotion of the free flow of information if they believe they will land in a federal court. Finally, individuals and entrepreneurs will not take the risk of going online with new information or products with the heavy hand of government looming.

I have urged the conference committee not to take that step and to strip the telecommunications bill of such unconstitutional and unnecessary provisions. Given the nature of politics, however, I am skeptical they will have the vision or foresight to do so.

Russell D Feingold is a Democratic senator from Wisconsin.

For Your Information

Deadline for applications

By Phillip Louis
CRA Staff

This promises to be one of the Computing Research Association's most productive and innovative years yet.

We are now accepting applications for our Distributed Mentoring Project. If you know of students or professors who might be interested, have them contact us for an application (e-mail: info@cra.org). The deadline for submitting an application is Feb. 1, 1996.

The Institutional Infrastructure Workshop, sponsored by the National Science Foundation, is scheduled for June 1996. Also in June is the Effective Teaching Workshop, a successful workshop for new faculty members that was introduced last year. The location for this workshop has not yet been determined.

Our flagship conference—the CRA Conference at Snowbird—is July 14-16. The conference will include the Department Chairs Workshop and the Research Managers Workshop.

Thank you for completing the 1995 CRA Taulbee Survey. The response rate was higher than it has been for several years.

As always, we solicit your continued support of CRA. If you know of other institutions, professional societies, colleagues or students who might benefit from our services and activities, please have them contact us: Computing Research Association, 1875 Connecticut Ave. NW, Suite 718, Washington, DC 20009. Tel. 202-234-2111; fax: 202-667-1066; e-mail: info@cra.org; Web: http://cra.org

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"indecency" and "obscenity" that appeared in other versions.

This term has found legal acceptance as a legitimate exception to the First Amendment ban on regulation of speech. However, courts have made it clear that it may not be implemented in such a way as to indirectly force adult speech to be held to a harmful-to-minors standard.

2. He substituted "transmit for purposes of display" for "makes available."

3. He strengthened the defenses section to exempt those who are just providing connections.

White characterized his proposal as better than the alternatives, including the Hyde amendment. This was understandable in that the tightened language seemed to make the bill acceptable to industry. The problems universities and libraries had were more serious and, despite being accused of being "purists" and "absolutists," these organizations had some justification in making their objections.

For example, the language still seemed to require universities to segregate their students into two groups: those under 18 years old and those over 18. They had to ensure that net access available to those under 18 was filtered to a harmful-to-minors standard. The "display" language seemed to say that terminals for adults could not be located in public space where a minor might walk by and see what was on a screen.

Libraries moving to digital formats for their research holdings would have to label those deemed by legal definitions to be "harmful" or perhaps even keep them off the net altogether. For university libraries, the idea of labeling material and screening legitimate holdings for purposes of restricting access is

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Association News

Board nominees sought

The Computing Research Association is seeking nominations for its Board of Directors.

Every spring, CRA's member organizations elect about a third of our board members. However, candidates are not required to be CRA members. It is important that the CRA Board represent the interests of the entire computing research community, and it is our policy to solicit a broad range of candidates.

Please contact the person you are nominating before submitting his or her name. Nominees will receive information on CRA and its activities. This year, nominees will be required to write a brief (100-word) statement supporting their nomination. In previous years, either the nominator or the nominee could write the statement.

Our board is a working board, and all members are expected to actively participate in CRA. Although we have a small professional staff at our headquarters, board members are involved in all our major projects. Recent projects have included:

• planning the biennial CRA Conference at Snowbird,

• conducting the annual CRA Taulbee Survey,

• coordinating the Grace Hopper Celebration of Women in Computing, and

• increasing the participation of women in computing research with the help of National Science Foundation grants.

Please inform nominees that board members are asked to attend at least two board meetings per year. Members are asked to pay their travel costs to the meetings.

We understand that these time demands can be daunting to overburdened researchers. But research in computer science and computer engineering is facing major challenges as the political environment for government support changes. In the United States, Canada and many other countries, computing has been identified as a technology of critical social importance. This increased political attention places new demands on our field and offers new opportunities.

To receive a copy of the nomination form, contact Joan Bass of CRA at tel. 202-234-2111 or e-mail: jbass@cra.org. The deadline for submitting nominations is March 1, 1996.

CRA invites nominations for service-related awards

The Computing Research Association invites nominations for the 1996 CRA Distinguished Service Award and the A. Nico Habermann Award. Nominations should be no longer than two pages and describe the contribution that is the basis of the nomination.

CRA Distinguished Service Award

CRA makes an award, usually annually, to a person who has made an outstanding service contribution to the computing research community. This award recognizes service in the areas of government affairs, professional societies, publications or conferences, and leadership that has had a major impact on computing research.

Letters in support of the nomination are welcome but not required.
Deadline: Nominations must be received by F15, 1996.

A. Nico Habermann Award

CRA makes an award, usually annually, to a person who has made an outstanding contribution to aiding members of underrepresented groups within the computing research community. This award recognizes work in areas of government affairs, educational programs, professional societies, public awareness and leadership that has had a major impact on advancing these groups in the computing research community.

Letters in support of the nomination are welcome but not required.
Deadline: Nominations must be received by F15, 1996.

Send nominations for both awards to:
CRA Service Awards
Computing Research Association
1875 Connecticut Ave. NW, Suite 718
Washington, DC 20009
Tel. 202-234-2111; fax: 202-667-1066
E-mail: info@cra.org

CRA AWARD FOR OUTSTANDING UNDERGRADUATES

The Computing Research Association is pleased to announce the second annual CRA Undergraduate Award program, which recognizes undergraduate students who show exceptional promise in an area of importance to computing research. At press time, the following companies are sponsors of this award: Hewlett-Packard Co., the NEC Research Institute Inc. and the Xerox Palo Alto Research Center.

A cash prize of $1,000 will be awarded to each of two undergraduate students, one female and one male, who are majoring in computer science, computer engineering or an equivalent program. A number of other outstanding candidates will receive certificates of honorable mention. The awards will be presented at a major computing research conference. The two first-prize winners will receive financial assistance toward their travel to the conference. CRA encourages home departments to provide similar assistance to the other winners.

Nominations for this award must be submitted by the candidate's department chair by **Feb. 15, 1996**. Each year, a department may nominate no more than one female and one male candidate. More information on the nomination procedure and the criteria for selecting winners is listed below.

Nomination procedure

A nomination package consists of the following items:
1) Nomination form
2) Nominee's resume (two-page maximum)
3) Nominee's transcript of academic record
4) Nomination letter by department chair (two-page maximum)
5) Letter of support from one other supporting nominator (one-page maximum)
6) One-page description of student's research or other achievements

Four copies of the nomination package should be sent to:
CRA Undergraduate Award Competition
Computing Research Association
1875 Connecticut Ave. NW, Suite 718
Washington, DC 20009

To be considered for the competition, the complete nomination must be received by Feb. 15, 1996. Department chairs should ensure that only one nomination is submitted in each category (female student, male student). Multiple nominations from the same department for a single category will not be considered.

Criteria for selection of winners

1) Evidence of unusual talent in some area of computing research as demonstrated by one or more of the following:
   a) significant research contributions, individually or as a member of a team
   b) creation of highly innovative software or hardware design
   c) demonstration of exceptional leadership or vision in a field of computing research
   d) other evidence of extraordinary interest, excellence or commitment to computer science and engineering, including industrial experience, participation in special programs and mentoring or tutoring of other students
2) Outstanding academic record

CRA Award for Outstanding Undergraduates 1995-96 Nomination Form

Name of nominee _____
Sex _____
Program of study _____
Year in program _____
Department _____
University _____
Academic year address, telephone _____
_____
Permanent home address, telephone _____
_____
E-mail address _____
Name of department chair _____
Name of supporting nominator _____
Signatures:

_____
Department chair Date

_____
Supporting nominator Date

Education News

Criticism of undergrad curricula justified

BY Peter J. Denning

(The following is the condensed version of a statement Denning made at a recent National Science Foundation hearing on undergraduate education in computer science and engineering. To request the full text of Denning's comments, send e-mail to jbass@cra.org.)

> *Many faculty do not like the notion that students, parents and employers are their customers—but they are, and their discontent is being felt.*

By all accounts, undergraduate education in computer science and engineering (CS&E) is flourishing. There are 154 CS&E departments in the United States that grant Ph.D. degrees and several times that number that grant B.S. degrees. Enrollments have been steady or increasing for the past several years, as public interest in computing has increased with the explosion of the Internet, World Wide Web, computational science and information-based engineering.

There is strong agreement on the basics, the core of the discipline, as registered in the 1989 ACM/IEEE report *Computing as a Discipline* and incorporated into the guidelines of the Computer Science Accreditation Board.

We share a growing concern for cooperation with industry, reflected in our growing use of senior design projects and the 1994 call to CS Department chairs for faculty to spend at least a year in industry as a condition of tenure.

We responded well to the 1994 National Research Council report *Computing the Future*, which called for more attention to be paid to the undergraduate curriculum. For example, we are getting better at offering an "introduction to computing," where we are developing a new view of computation based on interactions with machines rather than programming.

In the lower divisions, we are beginning to employ undergraduate teaching assistants to provide supplemental instruction and help for peers, lessening failure rates and increasing retention without decreasing faculty involvement. We are including more team projects, more student presentations and more written reports.

After a slow start, we are now responding in numbers to cross-disciplinary work, especially in computational science, biotechnology, quantum computing, information retrieval in the humanities and graphics for the arts. We are making good use of educational technologies such as Lotus Notes, interactive TV, CD-ROM, class Web pages, Internet searching, computer-based lab projects, simulations and workbenches.

We are engaged in lively debates on how much to increase instruction in basic systems integration and how to teach students to design for human concerns, debates whose outcomes can only have positive effects on curricula.

Remaining trouble spots

I mark the 1988 publication of Charles Sykes's best seller, *ProfScam*, as the beginning of the modern art of university bashing. A dozen or so additional books and innumerable editorials have since appeared on the same subject. The principal complaints include:

- faculty are more interested in research than in teaching,
- graduates lack competence in their fields,
- tuitions and costs are rising faster than inflation without a corresponding increase in value,
- faculty spend too little time in the classroom and
- faculty hide behind tenure and academic freedom rather than address problems.

These writers clearly struck a resonant chord. Not only have their works been best sellers, but the tune has resounded in state legislatures, produced sharp cuts in higher education and the federal research budget, and produced new laws that attempt to bring faculty and their administrations to account for their reluctance to address well-known problems.

These criticisms add up to customer dissatisfaction with universities on a massive scale. Many faculty do not like the notion that students, parents and employers are their customers—but they are, and their discontent is being felt. The successes, improvements and innovations I listed earlier demonstrate real progress.

If we make an honest report card for ourselves, we can see we have a way to go before we will win back the full confidence and loyalty of our customers. Of the complaints listed above, the first three remain as trouble spots:

1. Research. University research is a big enterprise seen by most faculty as integral to the mission of a university. For promotions and tenure, faculty still place more emphasis on research than on any other factor. Few undergraduate students come into contact with faculty research. The complaint that students learn more about advanced technologies from the Discovery Channel than from their professors has considerable merit.

We can go a long way toward resolving this problem by finding ways to connect research to undergraduate curriculum. Some of these ways will involve technologies that facilitate the feedback path from research to curriculum, while others will involve new faculty practices such as organizing technology shows or engaging undergraduate students in their own research projects. The NSF Engineering Directorate took an early lead to change this through its Coordinated Research Curriculum Development program, which has spread to other directorates.

2. Student competence. In response to pointed criticism by business people, we have made good progress with team projects, senior design projects, co-op programs and more emphasis on good presentations and written reports. But few of us can give a cogent answer to the questions: At what must the educated engineers (computer scientists) of the 21st century be competent? How will we know computer scientists are competent?

Few CS&E undergraduate programs have made a clear statement of their promises to students about the kinds of competence they will have on graduation. Few still have any means of demonstrating that students are competent. The rising crescendo of calls for certification of software engineers is a reaction to our ineffectual curricula in software engineering and our lack of standards of competence for software engineers. Until we address these questions—in cooperation with business people—we will be forever playing catch-up and responding to pointed criticisms.

3. Tuition. As faculty, we do not pay much attention to reducing the costs of education. We see that as the job of the administrators. When we do think about it, we speak of using information technology to improve communication with students, automate parts of the process such as keeping records or grading, provide more engaging learning environments and reach more students through distance learning. We complain when undergraduate class size reaches 50 students, but seldom consider how to organize to effectively teach 500 students.

The fourth and fifth areas on the list are not real trouble spots in practice. Most faculty I know spend 15 to 20 hours a week on each class: three hours in the classroom, plus many hours preparing, coaching students, grading and giving feedback. Virtually everyone is using e-mail to permit students to have access to them around the clock; faculty accessibility is becoming less of a complaint.

Most criticisms of tenure are actually expressions of frustration about our apparent lack of interest in addressing the real problems of our effectiveness in research, conferring competence and teaching. The growing wave of post-tenure review processes being mandated by state legislatures may render tenure a fond memory in the next decade.

New trouble spots

Two areas to which we are not paying much attention could become trouble spots. I suggest that we pay serious attention to them before they turn into real problems.

1. Demise of the university. Four assumptions lie behind our historical concept of a university: 1) the library, 2) a community of scholars drawing on each other's knowledge in different disciplines, 3) teachers working with small groups of students and 4) a period of schooling that helps transform adolescents into adults and that grants a credential for entering work.

Information technology is undermining these assumptions itself. First, digital libraries will soon become a reality and make the content and services of libraries available at every desktop. The unique role of a university library will disappear.

Second, as the quantity of scientific records has increased, more scientists have become specialists of increasing depth in narrower fields. The university has divided into specialties in departments and subdepartments. The local community of scholars has been replaced with a global professional community of specialists held together by telephone, fax, Internet and conferences.

The individual professor has become the on-campus representative of the specialist community. Most educational technologies are tools to help the "solo individual" navigate in a complex world of specialties. Few of these technologies promote the kinds of local community that used to characterize the university.

Third, mass education has largely done away with the small undergraduate class. A typical class costs close to $40,000 to produce and often requires 40 students just to break even. Commercial firms are beginning to make education offerings at prices lower than universities, with stronger promises of certifiable competence—for example, Novell network engineer.

A few examples already exist of a master teacher leveraging himself effectively for thousands to tens of thousands of students—for example, Covey's Seven Habits Course. More of this can be expected as entertainment moguls meld their skills with those of flamboyant professors.

Fourth, specialties change so rapidly that most people can expect to change careers every 10 to 20 years during their working lives. It is no longer true that four years of university prepares one for life. This is producing a massive growth of interest in professional education that universities are unable or unwilling to accommodate.

Our immediate response to these threats has been to invest more heavily in information technology at universities. This provides temporary relief but does not change the underlying phenomenon: Information technology is rendering the university obsolete.

What roles can universities fulfill that people would find valuable? How do we begin to position ourselves for these new roles? These are

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Policy News

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computing research dollars. In addition, by linking those dollars with an explicit and politically acceptable public purpose, the program would—it was hoped—provide a basis for increased funding for computing research across the board.

Although they might quibble with details, I think most observers would judge the process a success in terms of those goals. The programs have grown rapidly within some of the participating agencies. Although it is difficult to attribute cause and effect in politics, there is little doubt in my mind that this budget growth is in great part due to public and political support of HPCC. Furthermore, coordination is much tighter among the agencies, although friction and turf battles still exist. Under the encouragement of Don Lindberg, former HPCC coordinator, and his successor, John Toole, the agencies have begun to work together more closely than they have in the past.

The basic argument against asking for reauthorization is that agency-by-agency HPCC activities now fit well within each agency's mission, and the coordination, dependent on White House leadership, has become embedded in agency culture. (That argument also was made by President Bush to a Democratic Congress, and it was not persuasive to then-Sen. Al Gore.)

The strategic reasons for deferring are twofold. First, the focus of the program has broadened immensely, to the point where it covers much of the government's investments in computing research. It has become much too large and widely framed to be encompassed under the narrow rubric of high-performance computing.

Second, there is understandable concern about opening up a congressional debate over government funding of computing research in general. Not only is Congress looking for excuses to cut the budget, but computing research is one of those fields that sits uncomfortably close to industry products and applications. It is easier to argue the importance and economic benefit from research in the area, but the argument has to be framed carefully to avoid looking like the dreaded "industrial policy."

Suppose Congress voted down a renewal bill. Would NSF, ARPA and the other agencies be expected to close down all programs in computing research—programs they now support under existing charters? It's a scary thought.

Yet it's hard to argue for standing pat on the status quo, which, quite frankly, looks dreadful for science. Under most budget proposals, overall science funding will decrease by about 30% to 40% over the next five to seven years. Some of the science agencies have been spared deep cuts this year, but that is for two reasons:

Budget cutters went after particular targets this year: the Commerce Department's Advanced Technology Program and certain environmental and energy research

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Report: comprehensive budget for R&D needed

The president and Congress should base funding decisions for R&D projects on the United States' worldwide position in the area upon which each project focuses, according to a report released in November by the National Academy of Sciences and the National Academy of Engineering.

The report, drawing heavily on the findings of a 1993 NAS report, said assessments of the US position in a given field of R&D should dictate whether its funding in that field should be increased or decreased.

It noted that decreasing budgets will force the government to cut funding in some areas while emphasizing others and recommended a funding methodology that would ensure US preeminence in selected fields. Funding in the remaining fields of research should be structured to keep the country poised to take advantage of important discoveries in those areas.

"Only in this way can the president and Congress determine the levels of investment for important, high-priority areas; make the trade-offs needed to free up funds for new initiatives; and incorporate the results of systemic program and agency evaluations," the report said.

The Senate Appropriations Committee last year asked NAS, NAE and the Institute of Medicine to report on the criteria that should be used to properly allocate funds to R&D activities. The resulting 97-page report, *Allocation of Federal Funds for Science and Technology*, noted that funding pressures are even greater now than when the committee requested the work.

The document called for some fundamental changes in R&D budgeting, beginning with a redefinition of the R&D budget itself. Traditionally, that budget is estimated at $70 billion annually. NAS/NAE found that almost half of that is spent on activities such as testing and evaluation at NASA and the departments of Defense and Energy.

It called on the president and Congress to redefine R&D as "those activities that produce or expand the use of new knowledge or enabling technologies." It estimated this at $35 billion to $40 billion a year.

The foremost recommendation of the report called on the president to present a comprehensive federal science and technology budget that would include areas of increased or reduced emphasis. Traditionally, R&D budgets are not presented as an integrated whole, making it difficult to cut funding because so much R&D work is interdependent, the report said.

It also criticized those who

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antithetical to their role on campus.

These concerns posed a dilemma for higher education. Should it support the White language as the best alternative in the real world of politics, as White himself argued in a net posting? Should it oppose the amendment or simply withhold support for any of the amendments? For a variety of reasons, the higher education community chose the latter course.

What happened on December 6, when House conferees met to choose an alternative to the Senate bill, was classic Congress. Much to everyone's surprise, the White amendment passed even though a few days earlier White had been branded a pornographer by the family values groups for attempting to compromise. So far so good, at least for the White supporters.

Then, according to one report, one member of the committee decided the amendment could be improved if they substituted "indecency" for "harmful." That amendment passed by a 16-15 vote, and in one stroke undid most of the good work White had done in trying to craft an acceptable compromise. Furthermore, the change passed because of the favorable votes of two liberal Democrats on the committee.

As it stands as of this writing, either the Exon or the White proposal (as amended) will be part of the telecommunications bill. Opponents of the measure hope for one of two things to happen:

First, the telecommunications bill could fail to become law either because it dies in conference or because President Clinton vetoes it. Most observers would not expect the president to veto the bill simply because it contains Exon-like language, but other parts of the bill also cause the administration heartburn. So neither failure nor veto is a totally vain hope.

Second, civil liberties groups will immediately challenge the law in court and, they hope, get a court to set aside that portion until later rulings at the appellate or Supreme Court level. One member of the conference committee, expressing resignation and frustration, reportedly said to a public interest observer "Start preparing your briefs."

In the long run, however, the issue is not going away. Some friends of Internet free speech have nonetheless likened the existence of "objectionable" material on the Web to the nuclear waste and safety issue in nuclear power. Right or wrong, it creates a clear and worrisome negative image for the public to rally around to attack information technology

Policy News

Congress considering HPCC Act renewal

(The following is an edited statement made by Edward D. Lazowska at an October hearing of the House Science Subcommittee on Basic Research on the High-Performance Computing and Communications Act. Lazowska is chair of the University of Washington Department of Computer Science and Engineering and chair of the Computing Research Association's Government Affairs Committee.)

> *If we fail to invest in research in information technology today, we will lose our leadership tomorrow.*

The High-Performance Computing and Communications (HPCC) Act is now about 4 years old and will expire in less than a year. It is an appropriate time to ask what the program has achieved and where we should go from here. As a research society, CRA has closely followed the HPCC Act from its original inception through its implementation as a program.

Overview

Before commenting in detail on the HPCC Act, I would like to make two general points.

1. CRA strongly endorses the findings of the National Research Council's report *Evolving the High-Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure*. In particular, we would emphasize the following:

• There has been mind-boggling progress in information technology, which pervades most aspects of our lives and our economy.

• The nation that leads in information technology enjoys enormous competitive advantages.

• America owns this leadership today, thanks to a successful and complex interplay between government, academia and industry in support of research. The track record is crystal clear.

• The government's role is also clear. Industry can afford to look ahead only a few years. But as a nation, we must invest for the long term. This fundamental basic research takes place in universities, with government support.

• The HPCC program is a major success. In particular:

a) The emphasis on "high-performance" is appropriate. Cutting-edge information technology is a window on the future. Today's high-performance technology will be the home, office or schoolroom computer of 10 years from now.

b) The emphasis on parallel computing is appropriate. Although there is much more to be done, parallel computing's viability is clear. Many important problems throughout science and engineering have been tackled, and most vendors have some sort of multiprocessor offering.

c) Interagency coordination and cooperation is working exceedingly well. More than any other scientific field, computing research cuts across many agencies. There is no clear lead agency in computing. HPCC represented a bold attempt to create, in a sense, a virtual agency. It is a mechanism for coordinating the programs of diverse agencies, which serve diverse missions but which all have some interest in advancing the state of computing and communications technology. From our perspective outside of government, this experiment is providing greater coherence and direction to the various programs with which we work.

2. CRA believes that continued authorization of the HPCC program—continued funding in these critical research areas and continued strengthening of the interagency process—is essential to the nation for the following reasons:

• The HPCC program is the nation's research and education program in information technology. It is a coordinated, multiagency initiative that supports nearly all our nation's fundamental research and graduate education in information technology. HPCC is much more than the support of supercomputer centers, although the centers have grown into multidimensional institutions that make a variety of contributions to science and engineering. HPCC is much more than research on the highest-performance machines, although these systems are indeed "time machines" that offer an invaluable window into the future. Instead, HPCC is—and always has been—systems, software, networking, human resources and research on information infrastructure technology and applications.

• The interagency coordination fostered by the HPCC Act has been a model success in coordinating the efforts of multiple agencies with multiple approaches. This close coordination can be seen in several specific program initiatives, including the supercomputer centers, the gigabit test beds and the digital library initiative.

• The HPCC program has proven to be appropriately flexible and adaptable. Fundamental research is inherently unpredictable. The program has adapted and evolved in many ways, including an increased focus on software and high-speed digital communications and the addition of the Information Infrastructure Technology and Applications element to the program structure.

• A strategic plan for the future exists. The cooperation and coordination stimulated by the HPCC program has been extended to a strategic planning effort on the part of the National Science and Technology Council's Committee on Information and Communications. The plan, *America in the Age of Information*, identified six strategic areas "to focus fundamental information and communications research and to accelerate development in ways that are responsive to NSTC overarching goals, agency mission goals and our nation's long-term economic and defense needs."

The strategic focus areas are global-scale information infrastructure technologies, high-performance/scalable systems, high-confidence systems, virtual environments, user-centered interfaces and tools, and human resources and education. CRA believes such multiagency planning and program implementation efforts are excellent.

• The role of universities is critical. Federally supported university research has played a key role in essentially every aspect of modern information technology: time-sharing, computer networking (the Internet), high-power workstations, computer graphics, database technology, very large scale integrated circuit design, reduced instruction-set computing processor architectures, input/output systems based on redundant arrays of inexpensive disks and parallel computing—to name a few.

Universities look to the future. The HPCC program has been a huge success in allowing them to push the frontiers of their research further into the future. It is important to emphasize that university research carried out under HPCC avoids picking winners and losers. The purpose of publicly funded research in high-technology fields is to advance basic knowledge and create new opportunities that, in the medium and long term, industry exploits.

The HPCC Act

The act was organized around four principal sections: systems, software, the National Research and Education Network (NREN), and basic research and human resources. Since that time, the program has been expanded to a fifth component, information infrastructure technology and applications, which emphasizes research on leading-edge applications of information systems in areas of high potential impact, such as education, libraries and public health as well as the technological infrastructure to support them.

1. Systems. When the HPCC program was first being formulated in Congress and the White House, it focused primarily on the largest high-end systems, known as supercomputers. But even at the time the HPCC Act was enacted, the program's focus was broadening to a wider range of architectural goals. The emphasis was not so much on bigger, faster systems based on traditional architectures, but on exploring new, experimental architectures. In particular, researchers were exploring basic questions about the viability of the highly parallel, scalable computer systems and examining different architectural concepts that seemed to have merit. Now we have a better idea of the most promising architectural lines.

Significant challenges remain, particularly the one of how to scale parallel systems to higher numbers of processors. Performance at the chip level is improving at 50% per year, meaning that the performance potential far outweighs our knowledge of how to assemble chips together into productive systems and manage the flow of work through them.

2. Software. The focus at the time was on "grand challenge" computational science. In the intervening years, progress has been made in many computationally demanding areas of basic scientific research.

Over the last four years, however, our vision has broadened substantially. First, as we have progressed in our understanding of the design of scalable parallel architectures, there is an ever greater need to progress on our fundamental understanding of software and algorithms. Although important hardware challenges remain, a proportionally greater emphasis is needed on software. If these advanced architectures will likely be the basis of future everyday desktop systems, research undertaken now on software and algorithms for these leading-edge systems will build the foundation for using them efficiently and effectively in the next century.

Although computational science "grand challenges" remain exciting and important to explore, we now are looking at a wider range of national challenges, applications crucial to the evolution of the nation's information infrastructure.

3. NREN. Five years ago, the Internet was still an academic research network used by university researchers and students. Even then, however, the base of users was broadening to undergraduate schools, libraries, K-12 education and civic networks—so-called "freenets." At the time it was far from clear that NREN would ever be much more than such a specialized system.

The National Science Foundation now has nearly completed the process of spinning the Internet off to the private sector. The Internet continues to grow at an explosive rate. The media frequently run stories about the Internet and the World Wide Web. Commercial firms are fighting each other in the courts over network domain names and packet-switching communications technol-

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Policy News

Republicans fail to shut down Commerce

By Stephen Barlas
Special to CRN

Despite an initial frenzy of freshman Republican emotion, GOPers seemed to have failed to shut down the Commerce Department in 1995. They did eliminate some key Commerce programs, chipped away at some others and scared Commerce into merging still others.

Although they likely will remain open in 1996, Commerce's agencies are scurrying to respond to Republican antipathy. Nowhere is that clearer than at the National Institute of Standards and Technology, home to eight different laboratories, vaunted centers for basic research. The Commerce dismantling bill introduced by Rep. Dick Chrysler (R-MI) would have sold off those labs to the private sector, even though there are senior Republicans—primarily House Science chair Rep. Robert Walker (R-PA)—who are protective of the labs because of their basic research mission.

NIST is already moving preemptorily to protect the labs from a renewed Chrysler assault in 1996. According to NIST spokeswoman Anne Enright Shepherd, top officials at the Gaithersburg, MD, agency want to combine the Computer Systems Laboratory and the Computing and Applied Math Laboratory into one new Information Technology Lab. The concept has been approved by top NIST officials but has not gone to either Commerce's hierarchy or to the Office of Management and Budget. Both would have to approve the consolidation. Those would be the only two labs merged.

The Computer Systems Laboratory helps set the direction for federally funded computer system research, among other things. Shepard says that Shukri Wakid, the director of that lab and acting director of the second, was not interested in talking about how the new Information Technology Lab would differ from the two old ones, should the reorganization happen.

The budget for all eight NIST labs was $246.9 million in fiscal 1995. Congress provided the same amount for 1996.

Though Commerce is still standing, its Advanced Technology Program (ATP) is not. Congress refused to provide any funds for the program in 1996. President Clinton had wanted $491 million for this program, which provides federal grants to companies for the development of risky technology. The 1995 budget was $340.5 million.

One of the burgeoning ATP focus areas had been component-based software. A first round of winners was announced in December 1994 and a second in September 1995. Awards are generally for three years, with NIST providing around $2 million over that period—unless there is a megagrant—and the companies matching the federal funds from NIST. David Fisher, the program director for the software grants, said pre-fiscal 1996 funds are available for at least the first-year funding for the second-round grants and maybe for the second year of the first-round grants.

The Republicans also took a big bite out of the National Telecommunications and Information Administration's (NTIA) information infrastructure grants. Funding for that program will fall from $36 million in 1995 to $21.5 million in 1996. The 1995 award winners were announced November 9, with the money going to 117 public institutions in 47 states.

The 13 universities in the higher education category received $4.2 million. But academic programs were represented in nearly all the other categories, such as community networking, economic development and health. "Proposals to dismantle the Commerce Department would eliminate the only federal program that is helping to alleviate the gap between those who are prepared for the Information Age and those in real danger of being left behind," NTIA administrator Larry Irving said when the grants were announced.

Though it did not pass Congress, the House actually passed Chrysler's bill twice, as part of the first budget reconciliation bill and as an amendment to the first debt-ceiling bill. Both bills passed the House in November. However, both times the Senate passed different versions of the bills, each minus the Chrysler amendment, among other things. And when both bills came back to the House for a second vote, the Chrysler amendment was dropped. That meant the House Republican leadership viewed Commerce's dismantling as too controversial an issue to stick with, at least with time running out in the 1995 session.

Sen. Spencer Abraham (R-MI) sponsored the Commerce dismantling bill on the other side of the Hill. It never came up for a floor vote there. An aide to Abraham said Senate Majority Leader Bob Dole (R-KS) has committed to bringing the bill up for a vote. The aide could not say whether that would happen in late December 1995 or early 1996. The latter was much more likely. Moreover, the aide indicated that Abraham was still shy some Republican votes to actually pass the bill.

Julie Rice, a Commerce Department spokeswoman, explained that the business community was slow to react when Chrysler first introduced his bill earlier in 1995. "At first, they didn't take the bill seriously," she said. But once corporate America began to chime in, senior congressional Republicans took note, blunting the momentum of the Chrysler bill, which had been championed primarily by freshman Republicans.

But a Commerce official, who asked to remain anonymous, said the Republicans simply ran out of time. The official pointed out that Dole is a strong supporter of the dismantling. "I don't want anyone to think Commerce is out of the woods," the official said.

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important questions that deserve thoughtful examination. I suspect we are underestimating the speed at which the traditional university is approaching disintegration. I see at least two new roles for the university:

• *Professional education.* The university can extend its educational offers to cover the 4-5 years of professional life and not limit its primary focus to the four years immediately preceding professional life. It can offer smaller programs leading to certificates of competence. People will mark their themselves by an evolving portfolio of certificates rather than as the holder of a B.S., M.S. or Ph.D. degree. These programs can reach into much higher levels of competence than now covered by any university program.

• *Community building.* The university can be a counterforce against the march of increasing specialization and fragmentation. It can regain its old capacity to foster community involvements, entrepreneurship and solidarity.

These suggestions are painfully brief; my intent is only to point to a direction for future, in-depth investigations.

2. Effective teaching in the age of the Internet. In the last few years, effective teaching has come to occupy a high place in the concerns of every faculty member—as it should. Our notions of teaching are strongly influenced by our notions of learning, which have been heavily imbued with vocabulary from information technology and cognitive science during the past generation.

The customer-relation problems I discussed earlier are not caused by inadequate understanding of learning but by inadequate understanding of teaching. They have been exacerbated by the rapid advances of information technology, which draw attention to the processes of learning.

How many of you as teachers have been offered training (or even forums) in teaching effectiveness at any time in the past five or 10 years? Did you accept the offer?

We as a profession should undertake an investigation of effective teaching in the age of the Internet. I use the phrase "way of the teacher" to describe the attitudes, skills and practices of the effective teacher in this setting.

The way of the teacher asks us to think deeply about who we need to become to be capable of educating people so they are competent in life and work in the 21st century. Before we can say who we must become, we need to understand who we are now. We are specialists who like to congregate with our professional communities. Although we admire or loathe the giants of our industry, we do not move in their circles; we orbit them, not they us.

Many of us feel increasingly disconnected from their worlds. We see our job as teachers to transmit information to students. We are the authorities who choose what to transmit, verify that it has been received and generate more of it through our research. We do not see students, parents and employers as customers. Only funding agency program managers routinely command such treatment from us.

We focus on the processes of learning and look to cognitive science for laws of learning that we might use to optimize the process and support through information technology. Most of the breakdowns that frustrate us and leave us unsettled are related to this information-oriented way of being.

The way of the teacher begins with a map of the human being, not a schematic of an information-learning process. A new map can rest on premises such as the following:

• We are beings who construct narratives about ourselves and those around us based on our experiences and conversations we have with others.

• We coordinate, communicate and learn in language. Breakdowns—events that interrupt our progress toward our goals—are the moments at which we do most of our learning.

• Learning in the workplace is hardly different from learning elsewhere.

• The Internet is a communication space that vastly enlarges the scope of our discourse and transactions. It also enlarges the number of breakdowns we encounter and the kinds of things we can learn.

• Technology is equipment and tools that augment human capabilities and enrich the space of actions we can take together.

• Design is a conversation we have with others in which we plan and describe technologies that may be implemented and put to practice.

We can build a new way to approach the bases of effective teaching: education, communication, reading, listening, seductive writing, trust, compassion, fear and self-esteem, service, assessment, diversity, seriousness, humor, invention, innovation, historical sensibility, coaching, educational technology, professional education and lifelong learning.

The goal of such an investigation would be a powerful new map showing effective teaching as a set of skills and practices that can be learned, not a gift given to a few select teachers.

Peter J. Denning is associate dean for computing for the School of Information Technology and Engineering at George Mason University in Fairfax, VA.

1995 CRA Taulbee Survey

Preliminary faculty salaries from survey

Salary information from the 1995 CRA Taulbee Survey on the Production and Employment of Ph.D.s and Faculty in Computer Science and Computer Engineering

For 25 years, the Computing Research Association and its predecessor—the Computer Science Board—have been charting the growth of Ph.D. production and employment of computer scientists and computer engineers in the United States and Canada.

Each September, this survey is mailed to all organizations included on the CRA Forsythe List of departments that offer a Ph.D. in computer science or computer engineering.[1]

Beginning last January, we changed our publication strategy for the survey.

The CRA Taulbee Survey[2] has a long and reputable history. It has resulted in a long-term data history of the development of computing research as a graduate academic discipline. Since its inception, CRA has worked to ensure a nearly 100% response rate. This has never been an easy task, and in recent years it has become increasingly difficult to achieve and still meet our publication deadline for the January issue of *CRN*.

The field has become much larger and more complex in its structure. There are more responses to verify and respondents for us to track down. At the same time, the demands for new data and analyses from our own community and from policy makers have made the job of filling out the survey more time-consuming.

Because of these delays—and to ease the reporting burden on our respondents—we have decided to publish the survey results in two parts. This month *CRN* carries statistics on faculty salaries because there is a high demand for making this data available in January and because the data is published as statistical averages that are less likely to be affected by incomplete responses.

The complete survey will be published in the March issue of *CRN*.

If your institution has not yet completed the survey, we strongly urge you to do so and return it by the end of this month. It is vitally important we have an accurate survey. Academic departments and industrial laboratories depend on this data for their planning, and government science agencies frequently make program and budgeting decisions based on this type of demographic information.

Rankings

For Tables 1-9, which group Computer Science Departments by the rank of 1-12, 13-24 and 25-36, we based our ranking on information from a 1995 assessment of research doctorate programs in the United States done under the auspices of the National Research Council.

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

The departments ranked 13-24 are Brown University, Yale University, University of California at Los Angeles, University of Maryland at College Park, New York University, University of Massachusetts at Amherst, Rice University, University of Southern California, University of Michigan, University of California at San Diego, Columbia University and the University of Pennsylvania.[3]

The departments ranked 25-36 are the University of Chicago, Purdue University, Rutgers—the State University of New Jersey, Duke University, University of North Carolina at Chapel Hill, University of Rochester, State University of New York at Stony Brook, Georgia Institute of Technology, University of Arizona, University of California at Irvine, University of Virginia and Indiana University.

Salary tables

For Tables 1-9, each department was asked for the minimum, mean and maximum salary for each category of professor. Because tables show the minimums and maximums of the minimums and maximums reported by each department, these figures reflect salaries of individual professors. Also shown are the means of the minimums and maximums reported by each department. Finally, the average of all salaries is the average of the means reported by each department. If a department gave only a partial answer for a category of professor, it was discounted. All Canadian salaries are in Canadian dollars.

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

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

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

Table 1. Nine-Month Salaries, 98 Responses of 137 US CS Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	418 of 422	$33,300	$51,215	$66,000	$53,603	$42,500	$56,404	$73,800
Associate	584 of 594	$36,941	$56,603	$97,250	$62,120	$51,529	$68,376	$97,250
Full	704 of 724	$47,871	$68,358	$100,000	$83,530	$54,500	$105,942	$186,900

Table 2. Nine-Month Salaries, 10 Responses of 12 US CS Departments Ranked 1-12

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	58 of 62	$52,000	$55,358	$63,000	$57,347	$54,970	$62,918	$73,800
Associate	67 of 68	$49,050	$58,765	$64,750	$65,594	$69,700	$75,256	$86,790
Full	139 of 141	$55,600	$71,129	$81,500	$91,599	$111,078	$130,012	$160,620

Table 3. Nine-Month Salaries, 10 Responses of 12 US CS Departments Ranked 13-24

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	44 of 44	$52,181	$54,276	$61,500	$56,527	$53,813	$59,225	$69,500
Associate	69 of 69	$54,247	$61,555	$70,700	$66,172	$63,000	$72,235	$87,600
Full	122 of 123	$60,377	$71,823	$85,500	$95,076	$106,300	$130,524	$186,900

Table 4. Nine-Month Salaries, 10 Responses of 12 US CS Departments Ranked 25-36

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	38 of 38	$50,800	$53,268	$54,500	$55,454	$55,518	$58,021	$63,600
Associate	65 of 65	$55,980	$60,282	$67,800	$63,972	$62,697	$68,306	$79,700
Full	83 of 87	$60,300	$70,097	$86,400	$86,910	$83,880	$112,479	$167,000

Table 5. Nine-Month Salaries, 68 Responses of 101 US CS Departments Ranked Higher than 36 or Unranked

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	278 of 278	$33,300	$49,875	$66,000	$52,396	$42,500	$54,793	$73,000
Associate	383 of 392	$36,941	$55,133	$97,250	$60,914	$51,529	$66,988	$97,250
Full	360 of 373	$47,871	$67,211	$100,000	$80,245	$54,500	$98,276	$157,200

1995 CRA Taulbee Survey

Table 6. Nine-Month Salaries, 8 Responses of 14 US CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	41 of 41	$50,000	$52,759	$57,000	$54,648	$52,000	$56,493	$60,480
Associate	53 of 54	$52,018	$58,874	$64,076	$64,529	$61,800	$70,389	$77,300
Full	65 of 66	$69,336	$72,426	$77,950	$87,971	$72,099	$109,847	$138,430

Table 7. 12-Month Salaries, 11 Responses of 16 Canadian Departments (Canadian Dollars)

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	58 of 58	$43,000	$52,212	$62,252	$57,086	$52,984	$61,330	$69,538
Associate	149 of 154	$52,000	$60,574	$76,086	$69,985	$58,000	$81,516	$125,233
Full	138 of 138	$63,000	$77,492	$108,488	$89,668	$84,165	$111,857	$159,539

Table 8. Nine-Month Salaries, 106 Responses of 151 US CS and CE Departments

Faculty Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
Assistant	459 of 463	$33,300	$51,322	$66,000	$53,673	$42,500	$56,410	$73,800
Associate	637 of 648	$36,941	$56,759	$97,250	$62,277	$51,529	$68,516	$97,250
Full	769 of 790	$47,871	$68,632	$100,000	$83,820	$54,500	$106,207	$186,900

Table 9. Salaries of Newly Appointed Faculty, 42 Responding CS and CE Departments

Dept. Rank	# Reporting Salary Data	Reported Salary Minimums			Avg. of all Salaries	Reported Salary Maximum		
		Min.	Mean	Max.		Min.	Mean	Max.
US: CS 1-12	5 of 5	$54,325	$55,606	$57,600	$55,606	$54,325	$55,606	$57,600
CS 13-24	3 of 3	$50,000	$52,252	$55,600	$53,446	$51,157	$55,152	$58,700
CS 25-36	3 of 3	$50,000	$53,000	$56,000	$53,100	$50,000	$53,200	$56,400
CS Other	29 of 30	$36,000	$49,761	$54,000	$49,941	$36,000	$50,121	$56,000
CE	4 of 6	$50,000	$52,875	$57,000	$52,875	$50,000	$52,875	$57,000
CS&CE	**44 of 47**	**$36,000**	**$51,071**	**$57,600**	**$51,289**	**$36,000**	**$51,548**	**$58,700**
Canadian: CS&CE	12 of 12	$27,500	$42,514	$56,202	$45,639	$43,000	$48,889	$56,202

Hearing from Page 8

ogy is an important component of the communications service and hardware industry.

NSF, in its concern for the health of US science, needs to ensure that as the Internet becomes commercialized, the needs of researchers and students for specialized advanced data communications services are met. A major research responsibility also remains. As fast as researchers find ways to increase the speed of the networks, increased traffic and demands on new applications consume resources. Thus, there remains an ongoing research agenda in extremely high-speed, large-scale data networking, an agenda that should remain in the next-generation act. Such an agenda would include the following:

• Scaling. For all its growth, the Internet is still relatively small compared with an information infrastructure that would serve all of society. Problems of scaling become even more complex as applications, such as the World Wide Web, are developed that gobble up increasing amounts of communications resources.

• Quality of service. The Internet originally was designed and built as a research network. To be fully usable in a commercial and public arena, its performance must be made more predictable and reliable.

• Security. If valuable assets or sensitive private information are to be transferred over the network, it must be made more secure, and ways to protect information in an insecure environment need to be developed.

• Accounting. Although this may seem to be a simple administrative matter, we have only begun to explore how to measure, manage and account for the flow of information through extremely high-speed networks. Without new insights into how to accomplish this task with minimal overhead, administrative processes could more than double the cost of data transmissions, simply to allow for accounting.

• Technical and legal issues. Many policy and legal issues are being raised as the infrastructure moves more broadly into commercial use, issues such as intellectual property protection, privacy, access to government information, and the First Amendment and censorship. Many of these issues have at least in part a technological component. Careful research could help by identifying possible technological solutions or by clarifying the technological nature of the problem.

4. Basic research and human resources. When the original bill was being considered, CRA repeatedly pointed out the need for a focus on basic research as the necessary underpinning for any HPCC program. So strongly did we feel about this that we insisted that basic research needed to be specifically identified in a fourth section of the bill, even though the other sections arguably could be read to include fundamental investigations. Happily, Congress agreed with us.

We think the need for strong support of basic research is unchanged. If anything, the focus is even more on the need for such fundamental work.

5. Information infrastructure technology and applications. This area of interest has emerged as a fifth program element. I'll elaborate briefly on just two examples of national challenges: educational technology and digital libraries.

Interest is growing in educational technology. The House Science Committee recently held joint hearings with the Senate Labor and Human Resources Committee to explore the potential of information technology to transform education. In those hearings, computer scientists, including Seymour Papert, drew an ambitious and futuristic vision of how information technology could fundamentally transform learning. There is no question that information systems in the future will have the potential to play an enormous role in education. Nor do we doubt that a lot of fundamental computing research needs to be pursued before we can tap that potential.

Similarly, in the area of digital libraries, we face a significant basic research agenda. Despite all the excitement that rightfully attended the evolution of the World Wide Web, information on the Web has been likened to taking all the books in a large library and dumping them at random on the floor. We don't know how to organize and search for information in such a massive distributed environment. We don't know how best to display it, to use it, to protect intellectual property rights for proprietary data while maintaining access to public information or to protect the privacy of users.

Recommendations

1. We believe that a reauthorization of the HPCC Act would be an important statement by Congress of the need to continue the nation's long-standing commitment to fundamental research in the computer field. It would serve to set general priorities within the computer field and to provide a foundation for interagency coordination. CRA would support such a bill.

2. The focus of the research program needs to be broad but concentrated on fundamental research on the design and use of advanced, leading-edge parallel, scalable computer systems; extremely high-speed data communications; and the connections between the two. In particular, there is an important basic research agenda that underlies so-called national challenges, which will be a basic framework for the nation's infrastructure—education, library, health, government services and so on.

3. The authorization needs to be flexible, allowing the program to adapt quickly as new research targets of opportunity appear.

We understand that money is tight and that there are many claims on it. We also understand the enormous pressures Congress finds itself in when trying to preserve research funding. But we are beginning to realize the enormous return on 50 years of investment in computing research. The information industry is still the fastest growing—and now biggest—sector of our economy.

We cannot let our investments in the basic research that underpins this field falter. If we fail to invest in research in information technology today we will lose our leadership tomorrow. And once lost, it would be difficult, if not impossible, to recapture.

Professional Opportunities

CRN Advertising Policy

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

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

The rate is $2 (US) per word. Purchase orders, money orders and checks are acceptable *(please do not send cash)*. All CRA members receive at least 200 free words per dues year. Advertisers may also request that their Professional Opportunities ads be sent to CRA's jobs@cra.org mailing list and posted for two months on CRA's Jobs Index Web page. This service is free to advertisers.

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

Computing Research News is published six times per year: in January, March, May, September, November and December. Professional Opportunities ads with application deadlines falling within the month of publication will not be accepted unless the ad says applications will be accepted until the position is filled. Advertising copy must be received at least one month before publication. The deadline for the March issue is 1 February 1996.

University of Arizona
Department of Computer Science

Applications are invited for the position of lecturer or senior lecturer beginning August 1996. Lecturer candidates must hold a graduate degree in computer science or a closely related field, should have a strong commitment to excellence in teaching and must have substantial experience teaching computer science at the university level. Compensation is competitive and depends on experience and qualifications. This is a non-tenured position, with appointment for a fixed term of three years and reappointment possible at the end of this period.

Duties of this position include teaching undergraduate computer science courses in areas such as software and software design, machine organization and architecture, data structures or foundations of computing. Duties also include academic advising of students, service on department committees involved in undergraduate life and development of new curriculum and instructional laboratories.

The CS Department at Arizona has a dozen graduate faculty, with a history of awards in teaching excellence, research accomplishment, influential software distribution and substantial external funding. Areas of research and curriculum include software systems, programming languages, compilers, operating systems, networks, parallel algorithms, database systems, computational biology and theory of computation. There are approximately 40 doctoral students, 40 master's and 85 undergraduate majors in the department's programs. In addition to a broad range of equipment necessary to computing research and instruction, the department supports its instruction and research programs through an exceptional professional laboratory staff. For more information about the department, see the Web site at http://www.cs.arizona.edu.

Applicants must send a curriculum vitae and the names of at least three references to Faculty Recruiting Committee, Department of Computer Science, Gould-Simpson Building, Room 721, 1040 E. Fourth St., The University of Arizona, Tucson, AZ 85721. A majority of the references should be able to comment directly upon the candidate's teaching experience and abilities. Applications will be reviewed beginning Jan. 15, 1996, but the position will remain open until filled.

The University of Arizona is an equal employment opportunity, affirmative action, ADA-compliant employer.

University of Arizona
Department of Computer Science

Applications are invited for ten-track faculty positions beginning August 1996. These positions are at the assistant professor level, although appointments at higher levels will be considered for highly qualified candidates. The key criterion in applicants is quality. Assistant professor candidates must hold a doctorate in computer science or a related field, have a commitment to excellence in teaching and have demonstrated strong potential for excellence in research.

The CS Department at Arizona has a dozen graduate faculty, with a history of research accomplishment, influential software distribution and substantial external funding to individual faculty that exceeded $2.5 million last year. Major funding has included two NSF Institutional Infrastructure grants over the past decade and a Research Infrastructure grant funded this year. Research areas include software systems, programming languages, compilers, operating systems, networks, parallel algorithms, database systems, computational biology and theory of computation. There are approximately 40 doctoral students, 40 master's and 85 undergraduate majors in the department's programs. In addition to a broad range of equipment necessary to computing research, the department supports its instruction and research programs through an exceptional professional laboratory staff. For more information about the department, see the Web site at http://www.cs.arizona.edu.

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Duke University
Department of Computer Science

We invite applications and nominations for two positions, starting September 1996: a tenure-track or tenured position in experimental systems and a tenure-track position in artificial intelligence. Areas of primary interest in experimental systems include high-speed networks, software development environments, operating systems, databases and object-oriented systems, multimedia, parallel processing, graphics and algorithm animation, compilers, programming languages, and computer architecture and digital systems design. Areas of primary interest in artificial intelligence include robotics and intelligent systems, natural language processing, planning, knowledge representation, reasoning systems, learning, automatic programming, collaborative agents, multimodal communication, and AI architectures and languages.

The department has major research efforts and funding in the areas of systems and architecture, algorithms, scientific computing and artificial intelligence. Facilities include a CM-5 parallel computer, more than 120 computers and high-performance graphics workstations and access to a variety of supercomputers through MCNC in nearby Research Triangle Park. A newly funded research instrumentation project will bring in networks of workstations for collaborative computing. The department also is connected to the North Carolina Information Highway, the first fully integrated and functioning high-speed statewide network in the United States.

The department relocated in 1994 into spacious new quarters in the $80 million Levine Science Research Center, a state-of-the-art facility devoted to interdisciplinary research in computer science, environmental science, biomedical science and engineering, and medicine.

The Durham, NC, area, which was rated in recent years by *Money* and *Fortune* magazines as the best place in the United States to live and work, offers a wide variety of professional, cultural and recreational attractions.

Applications should include a curriculum vitae, a list of publications and copies of the most important publications. A Ph.D. in computer science or a related area is required. Applicants also should request at least four letters of reference to be sent directly to the faculty search chair. To guarantee full consideration, applications and letters of reference should be received by Feb. 1, 1996, by Professor Alan Biermann, Faculty Search Chair, Department of Computer Science, Duke University, Durham, NC 27708-0129.

Duke University is an affirmative action, equal opportunity employer.

University of Massachusetts, Amherst
Department of Computer Science

The Department of Computer Science invites applications for tenure-track faculty positions at the assistant professor level. Applicants must have a Ph.D. in computer science or a related area and should show evidence of exceptional research promise. Our primary interest is in candidates whose research interests are related to the general area of information retrieval. This includes a wide range of topics such as retrieval models, text and multimedia representation, indexing and object management for information retrieval, interfaces for information retrieval, browsing and visualization, information routing and filtering, distributed information retrieval, data mining using text databases and networked information discovery. Candidates with research interests in other systems-related areas may also be considered depending upon the number of positions available. Reference Search #37931.

We also invite applications for grant-funded research scientist (Search #37932) and postdoctoral research associate (Search #37933) positions in all areas of computer science. Applicants should have a Ph.D. in computer science or related area and should show evidence of exceptional research promise.

To apply, send a letter with your curriculum vitae and names of at least three references to Search #(fill in number from above), c/o Chair of Faculty Recruiting, Department of Computer Science, LGRC, Box 34610, University of Massachusetts, Amherst, MA 01003-4610. Review of vitae began Jan. 1, 1996, and will continue until available positions are filled. Salary commensurate with education and experience; comprehensive benefits package offered. Positions available subject to funding.

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

Lehigh University
Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science seeks applicants for a tenure track position in computer science. Candidates must have a Ph.D. in computer science or related areas. A strong commitment to teaching as well as evidence of innovative research through appropriate publication is required.

We offer programs in computer science, including the Ph.D., with associated programs in electrical engineering and computer engineering. Please send curriculum vitae and names of at least three references, together with their postal and e-mail addresses, to Professor Samuel Gulden, Faculty Search Committee, Department of Electrical Engineering and Computer Science, Lehigh University, Bethlehem, PA 18015. E-mail: slg3@lehigh.edu.

Lehigh University is committed to recruiting and retaining women and minorities.

University of New Mexico
Department of Computer Science

Applications are invited for a tenure-track assistant professor position in the Computer Science Department to begin fall 1996. Applicants must have a doctorate in computer science or a closely related field. The department requires demonstrated research and scholarship accomplishments as well as commitment to teaching excellence at both the graduate and undergraduate levels. Applicants must have a strong background in experimental computer science. The department recently received a five-year NSF Research Infrastructure award to integrate current activities around computer science research issues fundamental to successful development of the National Information Infrastructure. Individuals with research interests related to this focus are particularly encouraged to apply.

The department currently has 16 faculty members and offers B.S., M.S. and Ph.D. degrees in computer science. There is excellent access to computing facilities for both research and instruction. Research funding is strong, approaching $4 million per year. Current research programs focus on adaptive systems, automated reasoning, computer security, experimental algorithmics, high-performance computing, human-computer interaction and intelligent databases.

The department maintains close relationships with the Santa Fe Institute and the National Laboratories at Sandia and Los Alamos. Joint work with Sandia recently established a new supercomputing performance record. In addition, UNM is the prime contractor for the Maui High-Performance Computing and Visualization Center. For more information about the department, consult http://www.cs.unm.edu.

Review of applications will begin Jan. 15, 1996, and continue until the position is filled. Please send curriculum vitae, research statement and names of at least three references to Professor James D. Hollan, Chair, Computer Science Department, University of New Mexico, Albuquerque, NM 87131.

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

Cornell University
Department of Computer Science

Tenure-track assistant professor: Applications are invited for tenure-track positions beginning August 1996. These positions are at the assistant professor level, although appointments at the associate and full professor levels 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 accomplishment at a very high level as well as outstanding 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, multimedia systems, numerical analysis and scientific computing, programming languages and methodology, and robotics and computer vision. REF: AP#1.

Non-tenure-track assistant professor: Three-year, non-tenure-track position at the assistant professor level beginning August 1996 to teach introductory computer science courses, and assist in coordinating and teaching in the Master of Engineering program. Applicants should have a Ph.D. in computer science, substantial teaching experience and a demonstrated commitment to teaching. REF: AP#2.

Research: Research positions in scientific computing and software systems. REF: #3.

Further information about the department is available on the World Wide Web at URL: http://www.cs.cornell.edu/.

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. Please include the reference number with applications.

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

University of Washington
Department of Computer Science and Engineering

Applications are invited for one tenure-track opening and for a possible lecturer position, starting in the 1996-97 academic year.

For the tenure-track position, we seek outstanding applicants who add to our research strengths, particularly in computer graphics or related areas. A moderate teaching load allows time for quality research and close involvement with students. We expect candidates to have a strong commitment to both research and teaching, and an outstanding record for their level.

The lecturer position is for an outstanding teacher to collaborate with current faculty in teaching the introductory course sequence and more advanced undergraduate courses, and to provide overall management for the introductory sequence. Candidates should have an exceptional record of classroom instruction and curricular innovation that can further enhance our undergraduate offerings.

Please send a letter of application, a resume and the names of four references to Faculty Recruiting Committee, Department of Computer Science and Engineering, University of Washington, Box 352350, Seattle, WA 98195-2350.

The University of Washington is building a culturally diverse faculty and encourages applications from female and minority candidates. The university is an equal opportunity, affirmative action employer.

Professional Opportunities

Clemson University
Department of Computer Science

The Department of Computer Science seeks applicants for two tenure-track faculty positions and one non-tenure-track lecturer position for fall 1996. For the tenure-track positions, strong preference will be given to applicants in the areas of distributed systems, graphics and software engineering. Applicants should hold or expect to receive the Ph.D. degree in computer science or a related field by the appointment date. Evidence of accomplishment or strong potential for accomplishment in both teaching and research are expected. For the lecturer position, applicants should hold the M.S. degree in computer science and provide evidence of a strong commitment to high-quality undergraduate instruction.

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

Applicants should send a curriculum vitae and names of three references to the Faculty Search Committee, Department of Computer Science, Clemson University, Clemson, SC 29634-1906. Screening will begin Jan. 31, 1996, and continue until the positions are filled.

Clemson University is an equal opportunity, affirmative action employer.

University of Toronto
Department of Electrical and Computer Engineering

The Department of Electrical and Computer Engineering of the University of Toronto is currently expanding its computer engineering program to meet the growing demand for engineers in the areas of software, communications and information technology. It is expected that some 20 positions will be filled over a four-year period.

This year the department invites applications for tenure-stream assistant professor positions in communications networks, systems software, software systems and electronics. There is particular interest in applicants who have designed, built and/or experimented with complex software systems, such as communications, distributed, parallel, operating, embedded or real-time systems.

Exceptional candidates in other areas should consult information on hiring priorities of the department on the Web pages at http://www.ece.toronto.edu/hiring/html.

Applicants should send a curriculum vitae, a statement concerning teaching and research interests and a list of three references by Jan. 31, 1996, to Professor Safwat G. Zaky, Chair, Department of Electrical and Computer Engineering, University of Toronto, Toronto, Ontario M5S 1A4 Canada.

In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Toronto is committed to employment equity and encourages applications from women, visible minorities, aboriginal people and physically challenged people.

University of Central Florida
Department of Computer Science

The University of Central Florida (UCF) seeks applications for two tenure-track positions in computer science at the level of assistant professor. We are interested in all strong candidates who have demonstrated research strength in the discipline. We have particular interest in applicants with research in one of the following: artificial intelligence (natural language understanding, knowledge acquisition and cognitive modeling); architecture, VLSI, parallel and distributed computing; programming languages and systems; and database. Post-Doctoral or industrial experience is desirable.

The University of Central Florida is a young dynamic institution with a student population of approximately 27,000. The Computer Science Department is one of the largest departments on campus, offering the bachelor's, master's and Ph.D. degrees. It currently has 23 full-time faculty and 247 graduate students. Our faculty's research interests include parallel computation, VLSI, artificial intelligence, computer vision, networking technology, graphics and simulation, databases, and design and analysis of algorithms.

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

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

Applications will be reviewed beginning Aug. 16, 1996, and until the positions are filled. Interested, qualified applicants should send resumes and names of at least three references to Dr. Rebecca Parsons, Chair, Faculty Search Committee, Department of Computer Science, University of Central Florida, Orlando, FL 32816-2362. Tel. 407-823-2341; fax: 407-823-5419; e-mail: search@cs.ucf.edu; URL: http://www.cs.ucf.edu.

UCF is an equal opportunity, affirmative action employer. As an agency of the state of Florida, UCF makes applications materials available for public review.

Wright State University
Department of Computer Science and Engineering

Applications are invited for tenure-track appointments at the assistant, associate and full professor levels. The department offers B.S., M.S. and Ph.D. programs in computer science and computer engineering. An earned Ph.D. in computer science, computer engineering or a closely related field is required, with evidence of scholarship in the field. Senior applicants should have a distinguished record that demonstrates leadership in research and teaching. Although there is interest in candidates with systems expertise and experience in artificial intelligence, databases, parallel processing, robotics, software engineering and networking, all high-quality applicants will be considered.

The department has 20 faculty members, 400 undergraduates and 130 graduate students. It is housed in a new building with excellent laboratories.

Applications should include rank sought, a curriculum vitae, a brief statement of research and teaching interests and goals, copies of the candidate's three strongest publications, documentation of teaching ability and names of three to five references who are sending recommendations directly to the committee. Send applications to Search Committee, Department of Computer Science and Engineering, Wright State University, Dayton, OH 45435; tel. 513-873-5131. Consideration of candidates will begin immediately.

WSU is an equal opportunity, affirmative action employer.

Stanford University
Department of Computer Science

Stanford University's Department of Computer Science seeks applicants for a tenure-track faculty position at the assistant professor level. Specific areas of interest include, but are not limited to, natural language, human-computer interaction, theory, programming languages and systems.

Applicants should have a Ph.D. in a relevant field awarded within the past five years and should have a strong interest in both teaching and research. The successful candidate will be expected to teach courses, both in the candidate's specialty area and in related subjects, and to build and lead a team of graduate students in Ph.D. research.

Applications, including a resume, a publications list and the names of five references, should be sent by Feb. 15, 1996, to Professor Monica Lam, Search Committee Chair, Stanford University, Room 307, MC 9030 Gates Computer Science Building 3A, Stanford, CA 94305.

Stanford University is an equal opportunity, affirmative action employer and welcomes nominations of women and minority group members and applications from them.

University of Missouri, Rolla
Department of Computer Science

The Department of Computer Science invites applications for a tenure-track position at the level of assistant professor. Employment will begin Aug. 15, 1996. Qualifications for the position include an earned doctorate in computer science before Aug. 15, 1996. The faculty member is expected to teach undergraduate and graduate courses, engage in research in distributed files and databases, and have an interest in software engineering.

Research in the department is active in the areas of parallel and distributed computing, scientific computing, software engineering and intelligent systems. The University of Missouri at Rolla is the primary science and engineering campus of the University of Missouri system and as such provides opportunities for interdisciplinary research with faculty members in other departments. The UMR Intelligent Systems Center also provides interdisciplinary research opportunities, and faculty members may become research investigators in that center. The department grants the B.S., M.S. and Ph.D. degrees and currently has about 100 graduate students.

Departmental hardware includes a variety of workstations: Sun, Sun SPARC 20, IBM, SGI and NeXT, as well as an iPSC/860 32-processor multicomputer. A range of software is available for use by students and faculty.

The committee will begin reviewing applications Feb. 15, 1996. Applications will be accepted until April 1, 1996. Applicants should send a curriculum vitae and a statement of research and teaching interests, and arrange to have three letters of reference sent to Chair, Faculty Search Committee, Department of Computer Science, University of Missouri-Rolla, Rolla, MO 65401. Tel. 314-341-4492; e-mail: csdept@cs.umr.edu.

For additional information, you may access the department's home page at http://www.cs.umr.edu.

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

George Mason University
Department of Computer Science

We invite applications for faculty at the ranks of assistant professor and associate professor. We are particularly interested in persons who are dedicated to teaching, research and professional service. Our priorities in research are computer networks and their applications, computer graphics, graphical user interfaces and multimedia computing. Applicants should be prepared to teach in these areas, plus other areas of computing. Appointments start Sept. 1, 1996.

George Mason University is located in Fairfax County, VA, 17 miles west of Washington, DC. The Department of Computer Science is 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 government and industrial interaction in this region.

To apply, send a letter of application, a resume, samples of two of your recent written works and the names of four references. The application letter should state 1) your professional objectives, 2) your experiences and goals in research, 3) your experiences and effectiveness in teaching and 4) how you would contribute to cross-disciplinary teaching and research at George Mason University. All of these items should be submitted together for proper consideration of your application.

Send all material to Chair, Recruitment Committee, Department of Computer Science, Mail Stop 4A5, George Mason University, Fairfax, VA 22030-4444. Send inquiries to recruit@cs.gmu.edu. The application deadline is Feb. 15, 1996.

The university is an equal opportunity, affirmative action employer.

Washington State University
School of Electrical Engineering and Computer Science

The School of Electrical Engineering and Computer Science is soliciting applications for a junior faculty position at the assistant professor level and for a senior faculty position at the associate or full professor level. Responsibilities include initiation and supervision of research programs and instruction at undergraduate and graduate levels. Applicants should have an earned Ph.D. in computer science or in a closely related field. We seek outstanding and accomplished candidates in specific areas of research that include databases, networks, computer architecture and software engineering.

Screening of applications will begin Jan. 15, 1996, and continue until the positions are filled. Positions start Aug. 16, 1996.

Washington State University has offered the Ph.D. in computer science since 1970 and also offers B.S. and M.S. degrees. The School of EECS has more than 40 faculty (approximately 15 with primary interests in computer science and engineering) and 60 computer science graduate students. To find out more about the School of EECS and faculty research interests, please see our Web page at http://www.eecs.wsu.edu. WSU has about 17,000 students and is located in Pullman, a quiet university town in the southeast corner of the state. It is about 75 miles south of Spokane and 280 miles southeast of Seattle.

Applicants should send a cover letter clearly stating the rank they are applying for, curriculum vitae and the names and addresses of three references qualified to comment on the applicant's research and teaching qualifications to Chair, Computer Science Search Committee, School of Electrical Engineering and Computer Science, Washington State University, Pullman, WA 99164-2752.

WSU is an equal opportunity, affirmative action educator and employer. Protected group members are encouraged to apply.

University of California, Davis
Department of Computer Science

The Department of Computer Science at the University of California at Davis invites applications for tenure-track faculty positions to begin fall 1996. Applicants are expected to demonstrate an exceptional record and promise in research and teaching. The department expects to hire two additional faculty this academic year. We are particularly interested in:

1) Architecture, as related to high-performance computing.

2) Large-scale information systems or related tools for creatively processing the emerging information flood. Specific areas include, but are not limited to, techniques for storing and processing large quantities of information in distributed or network environments, multimedia applications involving large data sets, database systems, scientific and engineering applications, and security of large-scale information systems.

3) Computer systems, with a focus on the interactions between operating systems, programming environments, architectures or languages/compilers. Both formal methods and experimental approaches are encouraged.

The department currently has 16 faculty, 80 graduate students and undergraduate CS programs in Letters and Science, and Engineering. The department has a substantial research facility covering all major areas of computer science. The Davis campus is the third largest in the University of California system. Davis is a pleasant, family-oriented community with a mild climate. It is within easy driving distance of the Sierra Nevada mountains, Berkeley, San Francisco and Silicon Valley.

Please consult our Web page for additional information and application procedures: http://www.cs.ucdavis.edu/. Or send e-mail to apply@cs.ucdavis.edu.

These positions are open until filled. For full consideration, applications should be received by March 1, 1996.

UC Davis is an equal opportunity, affirmative action employer.

Purdue University
Department of Computer Sciences

The Department of Computer Sciences at Purdue University in West Lafayette, IN, invites nominations and applications for the position of department head.

Established in 1869, Purdue is Indiana's land-grant university. The West Lafayette campus, located one hour northwest of Indianapolis and two and one half hours southeast of Chicago, has an enrollment of 35,000 students. Within the School of Science there are seven departments, including the Department of Computer Sciences.

Founded in 1962, the Department of Computer Sciences has 37 faculty members, 25 professional staff, approximately 470 undergraduate students and approximately 110 graduate students. Sponsored computer science research expenditures during fiscal 1994-95 were about $3.7 million. Descriptions of faculty research projects and additional information about the department are available at http://www.cs.purdue.edu.

The successful candidate will possess outstanding leadership and administrative abilities and will have distinguished research and teaching records appropriate for a tenured full professorship. The selected candidate will be an innovative individual with a thorough understanding of the present status of the profession and a clear vision of the future of computer science. Further, the successful candidate will be able to join with the faculty to ensure that learning activities of the highest quality flourish at all levels, from undergraduate education to graduate research. The selected candidate will be able to maintain a rapport with a diverse group of faculty, staff, administrators, students, parents, alumni and corporate representatives.

Applications will be considered until the position is filled.

Nominations, inquiries and applications should be directed to Professor Wayne R. Dyksen, Chair, Head Search Committee, Department of Computer Sciences, Purdue University, West Lafayette, IN 47907. E-mail: headsearch@cs.purdue.edu.

Purdue University is an equal opportunity, affirmative action employer. Minority and women candidates are especially encouraged to apply.

Kent State University
Department of Mathematics and Computer Science

Kent State University invites applications and nominations for the position of chair of the Department of Mathematics and Computer Science. Kent is a spacious, residential campus serving more than 22,000 students, situated in a small university town within 30 miles of the Cleveland metropolitan area. The Department of Mathematics and Computer Science is situated

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Professional Opportunities

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in the College of Arts and Sciences and houses programs through the doctoral level in applied mathematics, computer science, pure mathematics and statistics. It currently consists of 23 faculty in the mathematical sciences and 11 in computer science at the Kent campus and 20 faculty in the mathematical sciences at the regional campuses.

The department recently moved to a new building and has an extensive network connecting SIMD and MIMD parallel processors, servers and more than 140 workstations and X terminals for faculty and student use.

Applicants for the position must have an earned doctorate, an international research reputation as evidenced by publications, a successful history of grant activity and other academic and scholarly achievements. In view of the composition of the department, applicants should have a strong research reputation among computer scientists and mathematical scientists. They must have the ability and vision to guide the department into the 21st century by developing and maintaining, in both disciplines, a strong program of scholarship, publications and grantsmanship, an effective advising system and a strong teaching program. In addition, applicants should have the ability to work well within the university community and to foster interdisciplinary research and cooperation with industry. The successful applicant will be encouraged and supported in maintaining an active research program. The salary will be competitive.

Screening of applicants will begin in F1, 1996, for a start date of July 1, 1996, and will continue until the position is filled. Please submit a letter of nomination or full resume, including a list of publications, a statement of interest regarding the post, and the names, addresses, telephone numbers and e-mail addresses of at least five references to Chair, Search Committee, Department of Mathematics and Computer Science, Kent State University, Kent, OH 44242. Fax: 216-672-7824. Further information about the department is available on the World Wide Web at URL http://www.mcs.kent.edu/.

Questions and inquiries can be sent by e-mail to chair-search@mcs.kent.edu.

Kent State University is an affirmative action, equal opportunity employer

University of Michigan
Department of Electrical Engineering and Computer Science

Applications are solicited for several faculty positions in the Computer Science and Engineering (CSE) Division at all ranks. Qualifications include an outstanding academic record, a doctorate or equivalent in computer engineering or computer science and a strong commitment to teaching and research. Particular areas of interest include multimedia, computer networks, software for distributed computing, compiler-based computer architecture and VLSI/CAD.

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

The university is a non-discriminatory, affirmative action employer

Yale University
Department of Computer Science

The Yale Computer Science Department may be filling a junior faculty position starting in the 1996-97 academic year. We are particularly interested in applicants in the areas of programming languages and systems, artificial intelligence and numerical analysis. Applications should be submitted before March 15, 1996.

Duties would include teaching graduate and undergraduate courses. Applicants are expected to engage in a vigorous research program.

Candidates should hold a Ph.D. in computer science or related discipline.

Send curriculum vitae and have at least three letters of reference sent to: Faculty Recruiting Committee, Department of Computer Science, Yale University, PO Box 208285, Yale Station, New Haven, CT 06520-8285.

Qualified women and minority candidates are encouraged to apply. Yale is an affirmative action, equal opportunity employer

University of California, Santa Barbara
Department of Computer Science

The Department of Computer Science at the University of California at Santa Barbara invites applications for a junior tenure-track faculty position. Candidates must demonstrate exceptional promise. The College of Engineering and the Department of Computer Science have embarked on a multiyear plan to strengthen the department in experimental computer science. Applicants in all areas of computer science are welcome; however, special emphasis will be given to software systems research.

The Department of Computer Science is part of an expanding College of Engineering, which encompasses more than 100 faculty in various engineering disciplines. Excellent instruction and research computing facilities are available. UCSB is a major research institution and member of the nine-campus University of California system, widely regarded as the most distinguished system of public higher education in the United States. Graduate degrees in computer science are offered at the M.S. and Ph.D. levels.

Applicants should hold a doctoral degree in computer science or a related field; appointments are scheduled to begin in 1996-97. Send resume and names of at least four referees to Recruitment Committee, Department of Computer Science, University of California, Santa Barbara, CA 93106-5110.

The University of California is an equal opportunity, affirmative action employer

University of Southern California
Department of Computer Science

Applications are invited for a tenure-track faculty position in software engineering. The SE program performs leading research in software architectures; software environments and software requirements engineering; software process, performance, reliability and cost models; and computer language definition and processing.

The CS Department is ranked in the top 12 computer science departments nationally and offers B.S., M.S. and Ph.D. degrees. Candidates should have a strong research record, a vigorous commitment to teach and a strong desire and capability to build a sponsored research program. Application and career goals, a short curriculum vitae and a short list of key publications should be sent to the search chair: Professor Barry Boehm, Computer Science Department, University of Southern California, Los Angeles, CA 90089-0781.

Application deadline is F. 15, 1996, but early applications are encouraged.

USC is an equal opportunity, affirmative action employer

Princeton University
Department of Computer Science

The Department of Computer Science at Princeton University invites applications for an assistant professor or tenure-track position in the areas of graphics, multimedia or experimental systems. Candidates for more senior ranks with exceptional records of research will also be considered.

Applicants must demonstrate superior research and scholarship potential as well as teaching ability. A Ph.D. or equivalent in computer science or related areas is required. Successful candidates at all ranks are expected to pursue an active research program and to contribute significantly to the teaching programs of the department.

Applications should include a resume and the names of at least three people who can comment on the applicant's professional qualifications. Applications should be sent to Chair, Search Committee, Department of Computer Science, Princeton University, 35 Olden St., Princeton, NJ 08544-2087.

The committee will begin considering applications in February 1996.

Princeton University is an equal opportunity, affirmative action employer

University of Colorado, Boulder
Department of Computer Science

Applications are invited for a junior tenure-track faculty position in the areas of artificial intelligence or software and systems. The department is particularly interested in candidates in the areas of human-computer interaction, human and machine learning, neural networks, databases, computer networks, distributed systems, programming languages and software engineering. Applicants should have a Ph.D. in computer science or a related field and show strong promise in both research and teaching.

The Computer Science Department at the University of Colorado has 22 faculty and about 200 graduate students. It has strong research programs in artificial intelligence, numerical and parallel computation, software and systems and theoretical computer science. The computing environment includes a multitude of computer workstations and a large variety of parallel computers. The department has been the recipient of two consecutive five-year Institutional Infrastructure (previously CER) grants from the National Science Foundation supporting its computing infrastructure and collaborative research among its faculty.

Applicants should send a current curriculum vitae and the names of four references to Professor Gary J. Nutt, Chair, Department of Computer Science, Campus Box 430, University of Colorado, Boulder, CO 80309-0430. One-page statements of research and teaching interests would also be appreciated. Review of applications began Jan. 1, 1996, but all applications postmarked before March 1, 1996, are eligible for consideration. Earlier applications will receive first consideration. Appointment can begin as early as August 1996.

The University of Colorado at Boulder strongly supports the principle of diversity. We are particularly interested in receiving applications from women, ethnic minorities, disabled persons, veterans and veterans of the Vietnam era.

North Carolina State University
Department of Computer Science

The Department of Computer Science invites applications for a tenure-track opening at the level of assistant professor to begin Aug. 16, 1996. Qualifications for the position include a Ph.D. in computer science and strong commitments to teaching and to research in the area of object technologies. We are specifically seeking someone with a background in one or more of the following areas: OO analysis and design methodologies; design, implementation and evaluation of OO languages and environments; and distributed object systems.

Located in the College of Engineering, the department offers degrees at the B.S., M.S. and Ph.D. levels. The 27 tenure-track faculty in the department have attracted research funding from various governmental and industrial organizations, including AFOSR, NSF, ONR, IBM and Northern Telecom.

The university is located in Raleigh, which is emerging as a hotbed of object technology nationwide. Research Triangle Park, 15 miles away, is home to the IBM Programming Systems Laboratory, whose products include IBM Smalltalk and VisualAge. Knowledge Systems Corp. in the nearby town of Cary is the largest Smalltalk consulting firm in the world, and more than a dozen OT companies, such as Hatteras Software and Objix Systems Development, have been founded locally. Leading international companies such as Object Technology International and The Object People have established offices in Raleigh. Other large companies in the area, such as Bell Northern Research and SAS Institute Inc., are major users of object technology. The department is currently expanding its OO education program to include courses developed and taught jointly with leading practitioners from industry.

Overall, the Triangle area is home to more than 150 software companies, and the state as a whole features more than 1,100. Many of these companies have been started by alumni of our department, and there is strong support for software-oriented research within the department and the college.

Interested parties should send their curriculum vitae, including citizenship information and visa status, and names of four references to Object Technologies Recruitment Committee Chair, Department of Computer Science, North Carolina State University, Raleigh, NC 27695-8206.

Applicants should ensure that their materials arrive no later than Feb. 29, 1996; applications received after that date risk not being considered. For additional information about the department, please contact OTsearch@csc.ncsu.edu or access the department's home page at http://www.csc.ncsu.edu.

NCSU is an equal opportunity, affirmative action employer

University of Illinois, Chicago
Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science invites applications for tenure-track faculty at all levels as well as instructors. A Ph.D. in computer science, computer engineering or its equivalent is required for tenure-track positions. We are especially interested in the systems area, including compilers, programming languages, operating systems, networking, parallel and distributed computing, architecture, vision and all areas of computer engineering, including CAD, VLSI and fault tolerance. Candidates should have outstanding research and teaching potential.

UIC is an emerging Research-I university, one of 88 top-ranked institutions nationwide. The EECS Department has 50 faculty members and 500 graduate students and offers BS, CE and EE degrees. The department has annual research expenditures of more than $4.8 million from sources including NSF, AFOSR and ARO. The department's computing resources include more than 200 workstations and more than 25,000 square feet of research space, much of it in the new Engineering Research Facility. For more information about the department, visit our Web page at http://www.eecs.uic.edu.

The UIC campus is located near downtown Chicago and is close to other research institutions, universities and Chicago's high-tech corridor. Chicago offers all the cultural amenities of a major city and a wide range of affordable housing.

For fullest consideration, send a curriculum vitae and the names and addresses of at least three references to Professor Jon Solworth, Search Committee Chair, Department of EECS (M/C), 851 S. Morgan St. (Room 1120 SEO), Chicago, IL 60607-7053.

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

University of California, Berkeley
Department of Electrical Engineering and Computer Sciences

The University of California at Berkeley invites applications for tenure-track positions in electrical engineering and computer sciences beginning in fall semester 1996.

The department expects two to four faculty positions. Applications for appointments at the assistant professor level will be given highest preference, but other levels also will be considered.

Applicants should have received (or be about to receive) a doctoral degree in computer science, electrical engineering, computer engineering or a related field. All areas of research in computer science and electrical engineering will be considered.

A principal requirement is demonstrated excellence in research. In addition, potential for excellence in teaching and leadership are important requirements. Successful applicants will be expected to set up a quality research program and to teach both graduate and undergraduate courses in their general area of specialty. Interested persons should send a resume, a select subset of papers, a one- to two-page statement of their future research plans and interests and the names of three references by Jan. 31, 1996, to the appropriate address below. In addition, the applicant should ask the three references to send letters directly to the same address. These letters will not be requested directly by the department.

Applications submitted after the deadline will not be considered; earlier applications are encouraged.

Electrical engineering applications: Professor David Messerschmitt, Chair, Department of Electrical Engineering and Computer Sciences, 231 Cory Hall, University of California, Berkeley, CA 94720-1770.

Computer science applications: Professor Robert Wilensky, Chair, Computer Science Division, 381 Soda Hall, University of California, Berkeley, CA 94720-1776.

The University of California is an equal opportunity, affirmative action employer

University of North Carolina, Chapel Hill
Department of Computer Science

Applications are invited for one or more tenure-track positions at any rank to begin in August 1996.

We seek candidates who have demonstrated leadership in building novel experimental hardware systems of significant complexity and technical challenge. The successful candidate will work closely with the research faculty of the department's Microelectronic Systems Laboratory (MSL) on research, curriculum design and additional future hiring. Excellent teaching and research leadership skills are required.

Candidates must hold or expect to hold a Ph.D. before starting employment, or must present an equivalent level of professional accomplishment. Our main interest is in candidates in hardware systems, but outstanding candidates who would strengthen existing research groups in the department will be considered.

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

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

Indiana University
Department of Computer Science

The Indiana University Computer Science Department seeks candidates for director of educational development, an open-ended, high-level administrative position. The position is subject to final approval by the university.

We are looking for an outstanding computer scientist with long-term interest in developing and administering innovative computer science programs in undergraduate education, distant education and professional training. Programs already under development include a challenging departmental honors program and a professional master's program that combines

Professional Opportunities

the B.S. and the M.S.

In addition to developing and managing state-of-the-art educational initiatives in cooperation with the faculty, the director will also assist the chair and the associate chair for education in overseeing the department's educational administration.

Candidates must have a Ph.D. in computer science or a related area and a demonstrable interest in and commitment to dynamic development of educational programs and technologies.

The department occupies a recently renovated, spacious limestone building and has extensive state-of-the-art computing facilities. The attractive wooded campus of Indiana University is located in Bloomington, voted one of the most cultural and livable small cities in the United States, and a mere 45 minutes from the Indianapolis airport.

To be given full consideration, applications must be received by March 15, 1996.

Please send a detailed curriculum vitae and a list of references to Educational Director Search, Computer Science Department, Indiana University, Bloomington, IN 47405. Internet: edu-search@cs.indiana.edu.

Williams College
Department of Computer Science

Applications are invited for two visiting positions at the assistant professor level for the 1996-97 academic year. One will be a one-year full-time position; the other a one-semester part-time position. Candidates should possess a Ph.D. in computer science or a closely related discipline, and should have a commitment to excellence in teaching and research. Applicants with the background to teach compilers, programming languages or other advanced electives in applied areas are preferred, but other areas will be considered.

Williams is a highly selective, coeducational liberal arts college of 2,000 students located in western Massachusetts.

Applicants should send a curriculum vitae and a list of three references, including at least one qualified to comment on teaching effectiveness, to Professor Thomas J. Murtagh, Chair, Department of Computer Science, Bronfman Science Center, Williams College, Williamstown, MA 01267. Applications received by Feb. 15, 1996, will receive full consideration. Requests for additional information may be sent to tom@cs.williams.edu.

Williams College is an equal opportunity, affirmative action employer. Women and members of minority groups are strongly encouraged to apply

Rochester Institute of Technology
Department of Computer Science

Applications are invited for a full-time, tenure track position at the assistant professor level, beginning in September 1996. (Funding is pending.)

The department offers the B.S. and M.S. degrees in computer science. The B.S. program is accredited by CSAB. It currently has 15 full-time faculty and more than 500 students. Applicants should be prepared to participate in both programs, in a department that emphasizes a strong commitment to teaching as well as to consistent professional development.

A minimum of a master's degree and teaching experience is required. However, a Ph.D. in computer science is preferred. Industrial experience is highly desirable. For further information by e-mail: csdept@cs.rit.edu; or on our Web page: http://www.cs.rit.edu/~csdept/search.

RIT is an equal opportunity, affirmative action employer and invites and encourages applications from women and minorities.

University of Delaware
Department of Computer and Information Sciences

The University of Delaware, centrally located on the East Coast, within day-trip distance of New York, Philadelphia, Baltimore and Washington, invites applications for two tenure-track assistant professor positions in the Department of Computer and Information Sciences beginning Sept. 1, 1996. One position will be in the area of systems and the other in the area of artificial intelligence or IT. The systems position, excellent candidates are sought in computer architecture, operating systems, parallel and distributed computing and compilers. For the AI position, excellent candidates are sought in planning, multiagent systems, machine learning, knowledge representation and automated reasoning. Responsibilities of these positions include research, pursuit of external funding, supervision of graduate student research, and graduate and undergraduate teaching. A Ph.D. degree or its equivalent is required.

The department offers bachelor's, master's and doctoral degrees and has 14 tenure-track faculty, three visiting faculty and five research faculty, along with about 100 graduate students, a majority of whom are pursuing the Ph.D. The department has excellent research computing facilities and close ties with government and private research labs.

Candidates should send a curriculum vitae to Dr. Sandra Carberry, Chair, Faculty Search Committee, Department of Computer and Information Sciences, University of Delaware, Newark, DE 19716. In addition, candidates should have three confidential letters of reference sent directly to the above address or by e-mail to csfacsch@cis.udel.edu. All applications received by Jan. 16, 1996, will be considered.

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

Mississippi State University
Department of Computer Science and NSF Engineering Research Center

Applications are invited for tenure-track faculty positions at the rank of assistant professor or associate professor beginning in 1996. The primary areas of research interest are distributed computing, graphics and visualization, and software engineering for high-performance computing. Others areas of interest may be considered.

The department has 18 faculty and offers programs leading to the B.S., M.S. and Ph.D. degrees. Several faculty participate in activities of the NSF Engineering Research Center for Computational Field Simulation. Complete position announcements and information about the university, the department and ERC can be found at WWW/URL http://www.msstate.edu.

Interested individuals should send a letter of application, a curriculum vitae and the names of at least three references to Dr. Donald W. Dearholt, Head, Department of Computer Science, Box 9637, Mississippi State University, MS 39762.

MSU is an affirmative action, equal opportunity employer

Oregon Graduate Institute
Department of Computer Science and Engineering

The department seeks faculty with strong research credentials in the areas of networking or graphics and multimedia systems. Applicants should have prior faculty or postdoctoral research experience, although exceptional candidates who are anticipating completion of a Ph.D. may also be considered.

OGI is an independent graduate school with no undergraduate programs. Teaching loads are light, but the quality of teaching and research is valued highly. The department currently has 18 full-time faculty and 50 doctoral students, and external research funding approaching $6 million annually. More information can be found at http://www.cse.ogi.edu.

To apply, send a brief description of research interests, the names of at least three references and a resume with a list of publications to: Chair Recruiting Committee, Department of Computer Science and Engineering, Oregon Graduate Institute, PO Box 91000, Portland, OR 97291-1000. E-mail: csedept@cse.ogi.edu.

OGI is an equal opportunity employer and particularly welcomes applications from women and minority candidates. Appointment is subject to the availability of funding

Tulane University
Department of Computer Science

Tulane University seeks a computer engineering or computer science faculty member to begin in the 1996-97 academic year

Tulane is an AAU university located in a historic residential area of New Orleans. The Department of Computer Science is in the School of Engineering and offers bachelor's degrees in computer science and computer engineering, and master's and doctorates in computer science. Highly selective in our student recruiting, we have especially strong graduate and undergraduate students.

For this faculty position, we seek proven research credentials. For computer engineering we are interested in the following areas: neural nets, adaptive systems, genetic algorithms, robotics, machine learning, machine planning or a closely related area. For computer science, we seek faculty with expertise in programming languages, software engineering or theory. Any commitment to quality teaching is also required. An earned doctorate in computer engineering, computer science or a closely related field is necessary by the beginning of the fall semester. Also required is an ability to interact with both computer science and computer engineering students. Salary is commensurate with expertise.

Tulane is situated in the heart of New Orleans' most historic area. Stately antebellum homes, the New Orleans streetcar, the Audubon Zoo, the Jazz Festival, the French Quarter, world-famous food and endless music and art options provide an active extracurricular environment for faculty and students alike.

Please apply by Feb. 15, 1996. Reply to Johnette Hassell, Chair, Department of Computer Science, Tulane University, New Orleans, LA 70118. E-mail: hassell@cs.tulane.edu; Web: http://www.cs.tulane.edu.

We are committed to providing opportunities to all qualified persons. For example, 30% of our Ph.D. production has been female. We urge all interested persons to apply

University of Texas, San Antonio
Division of Computer Science

Applications are invited for the position of director of the Division of Computer Science at the University of Texas at San Antonio (UTSA). The division director is the chief administrator of the Division of Computer Science and reports to the dean of the College of Sciences and Engineering.

The Division of Computer Science offers the B.S., M.S. and Ph.D. degrees in computer science, supporting a dynamic and growing program with more than 400 undergraduate and 70 graduate students. Major laboratories include workstation clusters with high-speed switches to support innovative experimental research in computer systems. Currently, the division has 13 faculty and is expected to grow significantly in the next few years. See http://www.utsa.edu for additional information on the Division of Computer Science and its faculty.

Candidates must have earned a doctorate in computer science or a related area and must qualify for appointment as a tenured professor. Proven administrative leadership, demonstrated achievement in research and teaching excellence are requirements for the position. Preference will be given to applicants with research interests in application, system design and/or experimental areas of computing.

UTSA is a comprehensive, metropolitan university that is one of the fastest growing universities in the state. The city of San Antonio combines a rich, cultural heritage with a modern focus on education, research and technology. UTSA is a primary contributor to the region's economic vitality and quality of life through its service to the multicultural population of San Antonio and South Texas.

The position is a full-time, 12-month appointment beginning Sept. 1, 1996. Salary is commensurate with qualifications and experience.

Applications should include a letter of interest, a resume and the names, addresses, telephone numbers and e-mail addresses (if available) of at least five references. Send to: Chair, Computer Science Director Search Committee, Office of the Dean, College of Sciences and Engineering, 6900 North Loop 1604 West, the University of Texas at San Antonio, San Antonio, TX 78249-0661. Applications must be received by March 1, 1996.

UTSA is an equal opportunity, affirmative action employer. Minorities and women are encouraged to apply

Northeastern State University
Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science is seeking applicants for a tenure-track position beginning in August 1996. An M.S. degree in computer science is required; a Ph.D. in computer science or a related field is desirable. The applicant should have an interest in architectures, operating systems or software engineering. The computer science degree program is based on the CSAM guidelines.

Applicants should send three letters of reference, unofficial transcripts and resume to Dennis Bearpaw, Director of Personnel Services, Northeastern State University, Tahlequah, OK 74464. Review of applications will being March 1, 1996, and will continue until the position is filled.

An equal opportunity employer, Northeastern State University (9,000 students) is located in northeast Oklahoma approximately 70 miles east of Tulsa.

For more information, write or call Dr. Daniel Hansen, Chair, Department of Mathematics and Computer Science, Northeastern State University. Tel. 918-456-5511, ext. 3814; e-mail: hansen@cherokee.nsuok.edu; Web: http://www.nsuok.edu.

University of Rochester
Department of Computer Science

The Computer Science Department at the University of Rochester invites applications for a tenure-track position in the systems area at the rank of assistant professor. 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/robotics, natural language/knowledge representation), parallel systems and theory of computation. Approximately 40 students are enrolled in the Ph.D. program. There is no professional master's program. A selective undergraduate major began in 1995.

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. Women and members of minority groups are strongly encouraged to apply

University of Maryland, College Park
Department of Computer Science

The University of Maryland at College Park (UMCP) Department of Computer Science is seeking faculty members at all ranks. Truly outstanding candidates in all areas will be considered, but we are especially seeking candidates in the areas of software engineering, databases and graphics.

The department is located in the suburban area of Washington, DC, in close proximity to many large governmental and industrial laboratories and within easy access to Baltimore and Annapolis. The department has 39 faculty members and maintains strong degree programs at both the undergraduate and graduate levels. Major research projects are funded in the areas of artificial intelligence, computer networking, computer vision, database systems, distributed systems, human-computer interaction, numerical analysis, high-performance computing, real-time systems, software engineering, and theory and analysis of algorithms.

Candidates who are interested should send a

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1996 CRA Conference at Snowbird
July 14–16 ◆ Snowbird, Utah

The 1996 CRA Conference at Snowbird will include:
- the Department Chairs Workshop.
- 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, return this form 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: info@cra.org.

Professional Opportunities

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curriculum vitae, research summary and at least three letters of recommendation to University of Maryland at College Park, Department of Computer Science, A.V. Williams Building, Room 4179, Attention: Recruiting Committee, College Park, MD 20742-3255.

If you would like more information on the department, it is available on the web at http://www.cs.umd.edu. For full consideration, your application must be received by Oct. 1, 1996. Electronic applications will not be accepted.

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

University of North Dakota
Department of Computer Science

Applications are invited for one, possibly two, positions at all levels in the Computer Science Department at the University of North Dakota. The first one is a visiting position; the second one, still pending approval, is a tenure-track position. Both commence Aug. 16, 1996. A Ph.D. (or A.B.D. for the visiting position at the assistant professor level) in computer science is required. Applicants must have good communication skills, commitment to excellence in teaching, broad teaching interests and ongoing scholarship (for the tenure-track position). Duties for the visiting position include teaching undergraduate courses only. For the tenure-track position, preference will be given to candidates specializing in applied areas such as databases, graphics, modeling and simulation, software engineering, networking, or parallel and distributed systems. Research interests will be a major determining factor in the selection process.

The department has more than 200 undergraduate and graduate students and nine faculty members. It offers undergraduate and master's degrees. (The B.S. is accredited by CSAB.) Students and faculty have access to outstanding facilities and equipment, including a Cray J90, workstations, high-end PCs and X terminals. For more information on UND and the department, see http://www.und.nodak.edu.

The deadline for applications is March 1, 1996. Applicants should send a letter of application, a current curriculum vitae that includes a statement of citizenship or immigration classification, and arrange for three letters of reference to be sent (must be sent via US mail on original letterhead) to Dr. Mahir S. Ali, Chair, Box 9015, UND, Grand Forks, ND 58202-9015.

Texas A&M University
Department of Computer Science

The Department of Computer Science invites applications for tenure-track faculty positions at the assistant, associate and full professor levels. Research areas of particular interest are artificial intelligence and robotics. However, exceptional candidates from all areas of specialization will be considered.

Candidates should have a Ph.D. in computer science, computer engineering or a closely related field, a strong commitment to both research and teaching and demonstrated ability to perform research and acquire external funding appropriate to the rank being sought.

Texas A&M University is a leading national university with approximately 43,000 students and exceptional professional schools in medicine, veterinary medicine, engineering, business and architecture. Texas A&M was the first university with land-grant, sea-grant and space-grant designations. It has annual federal research support of approximately $322 million. The Computer Science Department is in the College of Engineering and has 28 faculty members including three NSF PYI/NYI/Career award recipients. The department has a rapidly growing research program and has had more than $2 million in external research funding annually for the past several years, including an NSF infrastructure grant.

The department and its associated research laboratories in AI and robotics have exceptional facilities. Areas of significant research within the department include artificial intelligence; robotics; algorithms, languages and computability; computer systems and architecture; fault tolerant computing; computational science and engineering; real-time computing; software systems; vision and graphics; and VLSI design and testing

Texas A&M University is nestled on a pleasant 5,200-acre campus in the "golden triangle of Texas." It is a short driving distance to the major cities of Austin, Houston and Dallas-Fort Worth. College Station is a desirable place to live, with many fine residential neighborhoods, low home prices and a minimum of urban hassles.

Applicants should send a statement of research and teaching interest, a complete resume and the names of at least three references, their addresses (including e-mail) and telephone/fax numbers to: Faculty Search Committee, Department of Computer Science, Texas A&M University, College Station, TX 77843-3112. Applications will be accepted until the positions are filled.

Applications from minority and women candidates are especially encouraged. Texas A&M University is an affirmative action, equal opportunity employer committed to diversity

Spanning Tree Technologies Inc.
Information Scientist Positions

Spanning Tree Technologies Inc. invites applications for junior and senior information scientist positions to start in 1996 and 1997. These positions require a Ph.D. in computer science, mathematics, statistics or engineering and documented professional activity in the form of publications, awards, funded research or patents. Senior positions require a history of industrial experience or interaction.

Applicants must have substantial experience or in-depth knowledge in one area below and general knowledge and experience in two others.

Security: network security, secure hardware, compartmented mode systems, software quality safety engineering

Cryptology: public and private key, secure hash functions, random number generators, protocols for digital signatures and key certificates.

Data analysis: signal or image processing, data classification, information mining, statistical analysis, cryptoanalysis, anomaly detection, text analysis.

Algorithms: discrete mathematics, data structures, empirical analysis, software problem-solving environments.

Established in 1994 (as InfoStructure Services & Technologies Inc.), Spanning Tree Technologies focuses on providing state-of-the-art security and information analysis products and services to corporations, government agencies and software developers. Spanning Tree specializes in environments with assets held by computer networks such as with electronic commerce and the Internet. More information is available at http://www.spanning.com.

The primary task of scientists is to create intellectual property in the form of patents and prototypes through research and development. Scientists support sales and marketing efforts through speaking and publishing. Scientists spend 10% of their time contributing to company consulting services. Continuous professional development is required.

To apply, please send your curriculum vitae or resume by US mail (only) to: Dr. Greg Shannon, Spanning Tree Technologies, 2501 N. Loop Dr., ISU Research Park, Ames, IA 50010. Include summary information about your past and current research projects, at least three references, citizenship, availability constraints, phone number, fax number and e-mail address. All application materials should total no more than eight pages. We will acknowledge your application and inform you if we plan to contact your references.

Spanning Tree offers competitive compensation including stock options and generous benefits.

Spanning Tree also seeks technical staff for project management, product design, programming, testing and support. Contact technical@spanning.com for more information.

Spanning Tree is an affirmative action, equal opportunity employer

Indiana University
Cognitive Science Program and Department of Computer Science

The Cognitive Science Program and the Computer Science Department at Indiana University seek applicants for a joint faculty position, with rank open. Start date may be as early as fall 1996, pending funding approval.

We are looking for outstanding researchers at the forefront of the field, with ability to contribute to both cognitive science and computer science. Research area is open, including for instance, neural net modeling, logic, reasoning, representation and information, language and discourse, robotics, computational vision and speech, visual inference, machine learning and human-computer interaction.

The prospective faculty's office and laboratory will be based in the Computer Science Department, which occupies a recently renovated, spacious limestone building and has extensive state-of-the-art computing facilities. Responsibilities will be shared with the Cognitive Science Program, one of the largest and most esteemed programs in the world today. The attractive wooded campus of Indiana University is located in Bloomington, voted one of the most cultural and livable small cities in the United States.

To be given full consideration, applications must be received by Feb. 15, 1996. The application should contain a detailed curriculum vitae, copies of recent publications, brief statement of interests and future directions, and either three letters of recommendations or a list of three references. Two copies of the application file must be sent (letters of reference may be sent to either address) to Cognitive Science Search, Computer Science Department, Indiana University, Bloomington, IN 47405; and Cognitive Science Search, Cognitive Science Program, Psychology Department, Indiana University, Bloomington, IN 47405. Internet: cogsci-search@cs.indiana.edu or iucogsci@indiana.edu.

Applications from women and minority members are specifically encouraged. Indiana University is an affirmative action, equal opportunity employer

Florida State University
Computational Science and Engineering Program

Applications are being sought for a faculty position in the College of Arts and Sciences at Florida State University, to begin in August 1996. This position is one of several opened in conjunction with FSU's initiative in Computational Science and Engineering, which is an interdisciplinary program of graduate education and research founded upon the recognition that fundamental progress in science and engineering depends increasingly on progress in the science of computation itself. Information about the Florida State University can be found at http://www.fsu.edu.

The position is open with regard to both rank and department. It is expected to be awarded in an area of computational mathematics or applied computer science. The successful applicant must have a Ph.D. and a significant academic or research record in a field closely associated with modern high-performance computing.

Applicants should send a resume and arrange for three letters of recommendation to be sent to: R.C. Lacher, Search Committee, Department of Computer Science, Florida State University, Tallahassee, FL 32306-4019. E-mail: lacher@cs.fsu.edu. The deadline for applications is March 15, 1996.

The Florida State University is an equal opportunity, affirmative action employer and it especially encourages applications from women and minorities.

George Mason University
Department of Information and Software Systems Engineering

The Department of Information and Software Systems Engineering (ISSE) at George Mason University invites applications for potential tenure-track positions at all levels, in the field of software systems engineering.

Applicants for assistant professor positions should have a Ph.D. in computer science, software engineering or a related field and must have a strong commitment to teaching, scholarship and sponsored research support. Applicants for senior positions must have established records in these areas. Visiting faculty positions may also be available.

ISSE is one of six departments in GMU's School of Information Technology and Engineering (SITE). SITE has approximately 90 faculty and ISSE has 12 full-time faculty. The department offers M.S. and Ph.D. programs; specialties include information systems, software systems engineering and information technology

The ISSE Department is dedicated to creating a world-class community of scholars. We are particularly interested in the areas of software requirements engineering, software project management, software reuse and software engineering environments. Our faculty have wide-ranging research interests, including software requirements, design and testing; formal methods; and software process models. The department has three research centers: Software Systems Engineering, Information Systems Integration and Evolution, and Secure Information Systems.

State-of-the-art computing facilities include internetworked Sun SPARCStations, Apple Macintoshes, two SITE SPARCServer 1000 servers and instructional workstations and access to GMU DEC Alpha computers and the Internet. For more information regarding Fairfax, GMU and ISSE, please visit our web site: http://www.isse.gmu.edu/hiring.html.

George Mason University is located in Fairfax, VA, about 15 miles southwest of Washington, DC. It is near many government agencies and industrial firms specializing in software and information-intensive products and services.

For full consideration please, send a detailed resume together with the names of four references, published papers and other support material to: Chair, Faculty Recruitment Committee, MS 4A4, ISSE Department, Science and Tech Building 2, Room 430, George Mason University, Fairfax, VA 22030-4444. Applications are sought on or before Feb. 1, 1996.

GMU is an equal opportunity, affirmative action employer

S&T Funding from Page 7

advocate distinctions between the concepts of basic and applied research. It said such distinctions are difficult to make and are rarely decisive in defining the federal role in R&D. It also disputed the notion of a national Department of Science because it would separate federal research from the departmental missions it would support.

In other recommendations, the report extolled the virtues of competitive merit review and research performed at universities; favored projects and people over institutions; urged international cooperation on large, expensive projects; advised keeping national labs focused on agency missions; and expressed skepticism about government involvement in commercial aspects of technology development.

Presidential Science Adviser John Gibbons said in a written statement that the report proposed fundamental changes that will be difficult to enact.

The report is available on the World Wide Web at http://www.nas.edu/nap/online. It may also be obtained from the National Academy Press at 2101 Constitution Ave. NW, Washington, DC 20418; tel. 1-800-624-6242.

Reauthorization from Page 7

programs. Those easier targets will not likely be available in the future. Also, in the budget plan, the deepest cuts are saved for a few years downstream.

This line of argument says that unless the field begins to make very public and political arguments, US science will die a slow and lingering death of a thousand cuts. Computing research has a particularly good story to tell. Some form of renewal would be a good framework under which to tell that story

The reauthorization likely would not focus on HPCC, per se, but on some broader, more general framework—for instance, information infrastructure and applications, to borrow an administration term.

It is a dilemma, and our friends in the White House and Congress are wrestling with it now. Do we hunker down and hope the winds shift before severe damage is done, with all the risks that entails? Or do we stick our heads up and engage in a fight that could well be lost? Does it even make sense to try to "sell" computing research funding on such programmatic concepts? Or is it now an established discipline that should be viewed simply as part of the nation's portfolio? We don't have much time before we'll have to decide on our answers