Help Wanted: The IT Workforce Gap

At The Dawn Of A New Century

By Louise Arnheim

It was nearly two centuries ago that Thomas Jefferson asked Meriwether Lewis and William Clark to chart an overland route to the Pacific Ocean. The famed “expedition” was based on Jefferson’s assumption that such a route could be charted and his shrewd calculation that America’s standing position would be greatly improved if it could.

With that same adventurous spirit, a Presidential Adivisory Committee envisions expeditions and similar ventures into unchartered domains of information technology (IT). Their findings are outlined in the “Interim Report to the President: New Federal Research Initiatives: Creating an Effective Management Structure” (http://www.hpc.gov/ac/interim). The report’s authors are the twenty-five members of the President’s Information Technology Adivisory Committee (PITAC). While the report’s primary purpose is in influence FY 2000 funding levels for federal R&D, its 1998 release is intended to “get discussion going,” says PITAC co-chair Ken Kennedy.

In the September issue of Computing Research News, CRA Board Chairman Edward Lazowska urged the computing research community to rally behind the report’s major ideas. In this issue, CRN takes a closer look at these ideas, and previews some of the likely hurdles they will face between now and next year’s millennium budget vote.

Federal IT-R&D

PITAC’s principal conclusion, that federal funding for information technology is “dangerously inadequate,” suggests an economic future where the United States’ “robotic technological edge” is significantly diminished. In this regard, Jerry Arztman is outgoing AIAA’s Director of the Directorate for Computer and Information Sciences and Engineering (CISE), National Science Foundation (NSF), calls the report “a timely warning that this country is not investing enough in computer science and engineering research to maintain U.S. world leadership in information technology.”

Overall, the Committee calls for $1 billion for IT over the next five years. But aside from funding levels for a few select proposals, the interim report abstains from naming specific budget figures (the Committee does, however, endorse the President’s FY ’99 budget for R&D, as well as the 21st Century Research Fund). According to Kennedy, it is likely that the final report (expected early next year) will supply such numbers.

However, increasing dollar amounts is not PITAC’s only concern. The interim report also calls for fundamental changes in the modes and management of federal R&D. For example, much of the report talks about federal R&D machinery in need of realignment -- from the current emphasis on applied research to a renewed appreciation for basic research; from sponsoring short-term single-investigator studies to investing in long-term, multiple investigator studies; and from the current concentration on hardware to an intensive effort to develop software.

To maintain this balance across the wide spectrum of federal agencies engaged in IT-related R&D, PITAC says a single agency is needed to keep watch. “The only currently feasible candidate” for this role, PITAC concludes, is the NSF. Accordingly, new IT funding would then be divided almost equally between NSF and other agencies within NSF itself, more than half of new funding would be put towards the modes cited above (the remainder would be allocated to “traditional programs within CISE -- expanded as appropriate to projects of larger size and longer duration”). PITAC also recommends more IT representation on the National Science Board.

The Triennial Federated Computing Research Conference (FCRC)

Atlanta, GA April 30 - May 7, 1999.
Visit our website www.cra.org/Activities/conferences/fcrc.html for more details

PITAC’s Interim Report: Expenditures Of An IT Kind

PITAC continued on Page 8

CRA National Study of IT Worker Shortage

Many of CRA’s members are reporting anecdotal data that suggests there is a significant shortage of information technology workers in the United States. A cademic departments are experiencing tremendous increases in the number of recruits on campus to hire their graduates, as well as increases in graduate students and faculty members being attracted away to industrial jobs. And yet our industrial members are reporting their difficulties in filling positions. To investigate this growing concern and suggest national solutions, CRA is undertaking a study of the alleged shortage of information technology (IT) workers in the United States. The National Science Foundation (NSF) is funding the effort.

The national policy debate over the IT worker shortage has an interesting history. Over the past two years, a trade association, Information Technology Association of America (ITAA), produced two reports arguing that there is a serious shortage of information workers in the United States. The first study is Help Wanted: The IT workforce Gap at the R&D level, Feb. 1997. Stuart Anderson, ITAA. The second study is Help Wanted 1998: A Call for Collaborative Action for the New Millennium, Feb. 1998. ITAA and the Virginia Polytechnic Institute and State University (Virginia Tech). Concern that the United States might have a deficit of hundreds of thousands of IT workers, coupled with an apparent worsening of the problem, captured the attention of the U.S. Department of Commerce. It too released its own report with findings similar to the first ITAA report. The Commerce report was roundly criticized by the U.S. General Accounting Office (GAO), which faulted the statistical methods used in gathering the data put forward by ITAA and the Commerce Department, and questioned the basic shortage reported by both.

Proposed legislation in the U.S. Congress to raise the cap on the number of H-1B visas was given out each year has attracted national policy attention to the worker shortage issue. H-1B visas are a kind of temporary visa used by a number of high-tech companies, among others, to employ foreign workers. The largest numbers of H-1B workers, by far, come from India. The ITAA and most of the computer industry have lined up in favor of increasing the cap, while the labor unions and others have lobbied against the increase. This issue, for example, has pitted members of the IEEE Computer Society, many of whom work in industry and can see the signs of the shortage, against the IEEE’s SA organization (the lobbying arm for the IEEE in Washington), which is trying to protect jobs for U.S. electrical engineers.

CRA has been concerned about the misunderstandings that have been expressed by some of the participants in this H-1B debate and repeated in the national press. One particularly common misunderstanding was that the worker deficit could be overcome if only the universities would produce the requisite number of computer science and engineering graduates. It is clear that this reasoning is faulty on at least two grounds. First, the ITAA and Department of Commerce reports give a broad definition of IT workers, which includes virtually anyone who works in an IT organization; but degree recipients in computer science and engineering are not typically the people who hold many of these jobs, such as help desk support or web designer. Second, these organizations do not track the employment of foreign workers. To correct this, CRA is developing a database that will supply such numbers.

In the September issue of CRN, Feb. 1998, CRA took a closer look at these findings and put them into perspective, arguing that the ITAA reports were internally consistent, but that the misunderstandings that have been expressed by some of the participants in this debate and repeated in the national press are not supported by the data.

CRA National Study Continued on Page 3
Expanding the Pipeline

By Joan Francioni

We have all heard about the relatively low percentage of women and minorities in computer science and engineering (CS & E) at all stages of the educational pipeline. As a result of C R A’s past successes in encouraging the nomination of women, an unprecedented number of women were nominated for the CRA-W program this year, resulting in the highest number of women-nominated students ever. The gender diversity of the candidates and the success of the program this year are encouraging signs of progress in the field.

Many of the programs in the CRA-W program are designed to provide research experiences for female students and to encourage them to pursue a career in computer science. The programs cover a variety of areas, including undergraduate, graduate, and postdoctoral research opportunities.

Activities for High School and Undergraduate Students

**A Women in Computer Science** careers book has been designed to motivate young women at the undergraduate and high school levels to consider a career in the field of computer science. The book contains biographies of eighteen successful women who have chosen interesting and rewarding careers in the field. The biographies represent a variety of occupations, ethnic backgrounds, achievement levels, and geographic locations. They also include family and/or outside activities of the women, such as employment and volunteer interests.

The book is available online at [http://www.cis.uic.edu/women/](http://www.cis.uic.edu/women/). The book is also available as a hard copy, and the website contains links to other resources for women interested in computer science.

**Activities for High School Students**

For high school students, there are numerous opportunities to engage in computer science research and explore potential career paths. One such opportunity is the **Summer Research Experience for High School Students**, which provides students with the opportunity to work with scientists and engineers on real-world projects.

**Activities for Undergraduate Students**

For undergraduate students, there are many programs available to help them gain research experience and prepare for graduate studies. The **CRA-W Student Research Opportunities Program** provides funding for students to work with mentors on research projects.

**Activities for Graduate Students**

Graduate students are also encouraged to participate in research and gain valuable experience. The **CRA-W Graduate Student Research Opportunities Program** provides funding for students to work with mentors on research projects.

**Activities for Postdoctoral Researchers**

Postdoctoral researchers are an important part of the research community and are often responsible for leading research projects. The **CRA-W Postdoctoral Research Opportunities Program** provides funding for researchers to work with mentors on research projects.

**Activities for Faculty and Administrators**

Faculty and administrators are encouraged to participate in the CRA-W program to help support the nomination and selection of women for research opportunities. The **CRA-W Faculty and Administrator Resources** provide guidance and support for faculty and administrators who are interested in participating in the program.

**Activities for Members**

Members of the CRA-W program are encouraged to contribute to the nomination and selection of women for research opportunities. The **CRA-W Members' Resources** provide guidance and support for members who are interested in participating in the program.

**Activities for Partners**

Partners play a crucial role in the CRA-W program, providing funding and support for research opportunities. The **CRA-W Partnerships** provide funding and support for research opportunities.

**Activities for the Public**

The CRA-W program also provides resources for the public to learn more about the field of computer science and the role of women in the field. The **CRA-W Public Resources** provide information and resources for the public.

**Activities for the Media**

The CRA-W program provides resources for the media to report on the progress of the program and the role of women in the field. The **CRA-W Media Resources** provide information and resources for the media.

**Activities for the Curriculum**

The CRA-W program also provides resources for educators to integrate computer science and the role of women into their curriculum. The **CRA-W Curriculum Resources** provide guidance and support for educators who are interested in integrating computer science and the role of women into their curriculum.

**Activities for the Industry**

The CRA-W program also provides resources for the industry to integrate computer science and the role of women into their research and development efforts. The **CRA-W Industry Resources** provide guidance and support for the industry.

**Activities for the Government**

The CRA-W program also provides resources for the government to support the nomination and selection of women for research opportunities. The **CRA-W Government Resources** provide guidance and support for the government.

**Activities for the Non-profit Sector**

The CRA-W program also provides resources for the non-profit sector to support the nomination and selection of women for research opportunities. The **CRA-W Non-profit Resources** provide guidance and support for the non-profit sector.

**Activities for the Education Sector**

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**Activities for the Professional Societies**

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**Activities for the Supporters**

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**Activities for the Volunteers**

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Data from two CRA surveys, the Salary Survey of Computer Science Researchers in Industrial Laboratories and the Taulbee Survey, have been compiled in a graph that compares industrial and faculty starting salaries. Figure 1 plots the mean minimum, mean, and mean maximum salaries from the two surveys, both conducted in late fall 1997. The results indicate that, roughly speaking, the mean 12-month industrial salary is about 143 percent of the mean 9-month university salary in these fields.

CRA's Industry Committee, recognizing the need for a survey that explicitly addressed the issue of salaries paid to computer science researchers employed in industrial computer science laboratories, proposed that the industrial salary survey be initiated. In November 1997, CRA conducted the first survey with nine companies, representing 835 individuals, participating. CRA staff analyzed the results and, because of the proprietary nature of the information, the summary data were distributed in January 1998 only to the companies that participated in the survey. The survey asked for minimum, average, and maximum starting salaries for computer science Ph.D.s in computer science research positions at the experience levels of 1 to 5, 6 to 10, 11 to 15, and 16 to 20 years over a 12-month period. The experience level is plotted in Figure 1 at the points 3, 8, 13, and 18 years. (The 12-month salaries include the estimated value of bonuses and stock plans as determined by each respondent.)

The industrial salary data were compared to the data reported from the annual CRA Taulbee Survey. This survey covers the enrollment, production, and employment of Ph.D.s in CS & CE, and salary and demographic data for faculty in CS & CE in North America. Preliminary salary data for faculty are published in Computing Research News January, and the full results of the survey appear in the March edition. These data are used not only by academic institutions, but also by federal agencies, researchers, and the computing industry as well. Last year, 135 departments responded to the Taulbee Survey.

The data used from the Taulbee survey assigns experience levels of 3, 9, and 22 years to associate, assistant, and full professors, respectively. (Experience levels were not used for Ph.D.'s in the Taulbee Survey, which is why they needed to be assigned.) Figure 1 shows the 9-month salaries for the top 12 institutions with the exception of the starting salaries at the experience level point of 0, which were taken over from the Taulbee Survey.

The 1998 CRA Taulbee Survey is currently underway; responses are due on November 13. The second CRA survey of industrial lab salaries will begin in early November, with results available in January 1999 to companies that participate.

National Study from page 1

are speaking of current deficits that already number 200,000 and are growing, while the annual national production of bachelor's degrees in computer science and engineering is only about 25,000; thus there is no chance that these graduates could fill all of the positions.

CRA approached the NSF's Directorate for Computer and Information Science and Engineering (CISE), suggesting that it support a study of the IT worker shortage, with a particular emphasis on the supply issues. The study would be conducted in partnership with CRA-affiliated computer professional societies AAAI, ACM, IEEE Computer Society, SIAM, and USENIX. NSF agreed to support the study, provided that it is "objective and scientific." To achieve these goals, the study has been designed to involve a broad spectrum of people from both academia and industry to serve on the study group and to review national and state plans, and to take a new and unbiased look at all the relevant data that can be collected from various public and private sources. Under the direction of CRA Board Member Peter Freeman and CRA Executive Director William R. Sprague, the study group began its work in May 1998. There is an ambitious schedule to produce a final report no later than March 1999, as that the findings can be considered in the national policy debate in the first congressional session of the new year.

One of the first things that the steering committee (comprised of representatives from our affiliate societies, plus several others -- a complete list of the study group is on page 9) did was meet with government employees who have been concerned about the IT worker issue in order to find out what kinds of information and recommendations would be most helpful to them. Discussions with representatives of NSF, the GAO, the Defense Advanced Research Projects Agency (DARPA), the Office of Science and Technology Policy (OSTP), and Congressional committees on science and technology issues suggested that the study should focus on a reevaluation of existing data, new categorizations of information workers to be used in future data-gathering, and seed-corn issues in selected areas of computing such as computer mining and networking, among others.

The steering committee met several times to figure out what value it could add to the debate. In order to collect and interpret the data surrounding this issue, the steering group contracted with the Commission on Professionals in Science and Technology to procure data, and with a labor economist familiar with the IT labor market to assist with the interpretation. The study group was broadened to include people familiar with various aspects of the issue: formal education of various kinds from community college through graduate school, continuing and alternative education, underrepresented groups in computing, past IT worker shortages, previous seed-corn issues and national responses to them, industrial recruiting and job skill issues, and relevant labor issues.

A few meetings to discuss strategies and approaches, the study group was divided into three subcommittees to analyze and draft preliminary recommendations. Stuart Zweben and Steve Johnson are, respectively, leading groups studying the supply and demand issues, while Paul Davis is heading a group that is examining contextual issues such as the international marketplace, underrepresented groups, seed-corn issues, and other exogenous factors. The three subcommittees will report back to the full study group on mid-November to hash out recommendations. By the end of the year the two principal investigators will have a first draft of the report, which will go out for extensive review in early 1999.

It is too early to report any findings at this time. Look for results of the study in the March or May 1999 issues of Computing Research News and on the CRA webpages http://www.cra.org.
Policy News

Policy 01: Science Policy and the Communities

By Fred W. Wasingen

Introduction

My current role with CRA as Director of Public Policy is drawing to an end. This is a good opportunity to look back over eight years of representing computing research as part of the broader science policy arena, and assess the course of two or three articles in general where the field now stands in the science policy debate. In doing so, I’m not going to spend a lot of time in the past. Opportunity always lies in the other direction, toward the future, and I think that computing research will be faced with enormous opportunities over the next few years. In these articles, I’m going to briefly describe both.

In this piece, I’m going to describe briefly the nature and structure of the science policy debate; in January’s issue, I will discuss the decision-making process and how to influence it. In a final piece in March, I’ll explore what the computing research community, itself, should consider doing, especially in light of recent developments, particularly the opportunities presented by the Interim Report of the President’s Information Technology Advisory Commission (PITAC) and CRA’s Interim Report: Expeditions of an Interim Report: Expeditions of an Interim Report (each of which raises a far more

Computing Research at the Table

At the Snowbird ski resort in Utah in the summer of 1988, computer science and computer engineering department chairs decided at their biennial meeting to reconstitute what was then known as the Computer Science Board as a formal organization. The organization was to be called the Computing Research Association and its offices were to be located in Washington, D.C. The choice of a Washington address was deliberate. The principal purpose of this organizational change, as some explained later, was to give computing research “a seat at the table.” The Snowbird group felt that, for too long, decisions regarding the nature and evolution of their field were being made by people who were, at best, ignorant of its particular needs or, at worst, hostile to its interests.

Coming into existence only in the early 1960’s, the fields of computer science and computer engineering are the juncture of two of the traditional fields of research in the natural sciences, whose origins date back several centuries or even millennia. In the preceding decades, computing researchers had seen federal research policy and funding priorities set predominantly by researchers from these other fields, most of whom were too old to have been exposed to computing or computer science in their graduate training or research.

It is commonly said that the heavy representation of physicists in post-war science policy circles was a reward for the important contributions they made during the war. My guess is that their willingness to engage in politics came about because they realized, first, that the well-being of basic research in physics was inextricably linked with federal government support — if for no other reason, because of the rapidly escalating price for experimental facilities. Second, some of these scientists, confronting the awful (and awesome) results of their work, felt that an enormous sense of social and political responsibility had been laid on their shoulders.

But now, computing and digital communications, technologies that had their origins in that same war and that grew in the post-war environment, are assuming major social and economic significance. At that 1988 Snowbird meeting, attendees declared that computing research had come of age, and it was time for the field to assert a voice in the policy debate. CRA in its current form was created to carry out that mission.

Having Something to Say

A huge question to do so? Is there anything to have a seat at the table. One simply buys a chair and hires someone to sit in it. That was me. It is quite another to have something useful to say and to influence the debate. While I have rarely been accused of lacking something to say, and I did the best I could, it has taken the field some time to develop a coherent message that everyone could agree on. Looking back, it seems symbolic to me that shortly after I arrived at CRA, the field erupted in a fight over the RC report, Computing the Future, a broader A Genda for Computing Science and Engineering, 1992.

The specifics of that fight are not important, but it illustrated the difficulty computing research faced in getting its story together and, even more importantly, in getting it commonly agreed upon within the community.

We are being asked with great urgency by political leaders to participate in policy making. It is no longer necessary for us to convince political leaders that computing research is important to the nation; that is broadly accepted as a proposition in all the right places. But in politics, good will does not translate automatically into good policy, or even tangible support.

Now, we have to answer a broad range of questions from policy makers and politicians whose bottom line is: “What should we do about it?” A nd, of course, if computing researchers don’t provide a convincing answer, others are standing by, ready to do so for us.

A nswering that question is not easy. Science policy is a complex set of issues, and a fifty-year history of debate and many established precedents -- customary ways of thinking -- underlie the present system. It is not easy to say something new, even if we do have a sense that the present system is not serving computing research as well as it might and that something new is needed to be done.

So, the computing research community has two tasks to prepare itself to assert an effective voice on science policy: develop its message, and organize to deliver it. The organization I will leave for the next few articles in this series. Here, I want to concentrate on the structure of policy itself.

The Bottom Line of Science Policy

It is often said (even by me) that the bottom line of science policy is the dollar sign, since the principal focus is on government funding of research. But, in fact, the underlying structure of science policy is much more complex. Federal funds come by way of intricate, political decision-making — a careful dance among science agencies, the administration, Congress, and the research community. It is these processes, and the political pressures that any decision to spend federal money on R&D, even for fundamental research, comes with strings attached.

Some of those strings:

Purpose: Why we have a surplus or deficit of funds, and why any more hands are out than there are funds available. Appropriations have to be justified, and tied, in some way, to a public purpose. Pure philanthropy is not a particularly rational (those of you in shock may close your eyes while reading this paragraph). Even straightforward funding for basic science is often attached with odd and intrusive little strings. Fundings will be earmarked for various purposes or institutions, restrictions will be placed on the expenditures or on use of federal funds. Thankfully, much of this stuff goes away, but a lot of time is spent on it each year by the Washington science policy community, and sometimes it doesn’t go away.

Science policy has these two interlocking and mutually dependent aspects.

• The overall purpose, which is to keep the federal science programs well funded.

• In the case of the corollary but critically important considerations raised above (each of which raises a far more complicated and richer set of questions than the previous paragraph). So, the issue is not set to or not set priorities; the issue is whether the science community will participate in the political process. Many more people still argue against setting priorities, saying that science needs to be supported across the board, and that we need a broad spectrum of healthy research activity. Both ideas seem correct to me, not contradictory, but, then, I’ve been in W ashington too long.

Processes: Here comes the bureaucracy! But, the fact is, to spend billions of dollars requires organization and process, and organization and processes can make a big difference on the priorities. There is a wide range of models already within the government, from NSF’s model of peer-reviewed individual investigator grants to massive federal contract labs like Los Alamos. Suppose one were to argue for doubling funding for basic computing research. Who should be the lead agency? How should it be spent? Who will decide what to spend on and how and when that decision be made? These decisions are sometimes made in a bureaucratic process that resembles trench warfare and that often takes place below the threshold of attention for the affected community. But, the choices do have consequences, sometimes enormous ones. A gain, since decisions on process will be made one way or the other, shouldn’t the computing community be part of the debate?

Proscriptions (Strings): Finally, we need to keep in mind that political decisions are not always rational (those of you in shock may close your eyes while reading this paragraph). Even straightforward funding for basic science is often attached with odd and intrusive little strings. Fundings will be earmarked for various purposes or institutions, restrictions will be placed on the expenditures or on use of federal funds. Thankfully, much of this stuff goes away, but a lot of time is spent on it each year by the W ashington science policy community, and sometimes it doesn’t go away.

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Next month, I’ll discuss the political environment in which these policy decisions are made. Who are the players and what games do they play?

Taubilee Survey

Due: November 13

Remember to submit the survey online at www.cra.org/Survey/ FillOut

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COMPUTING RESEARCH NEWS November 1998
Policy News

CRA Appoints New Director Of Government Affairs

CRA has recently made a major new commitment to its government affairs program, appointing its first full-time Director of Government Affairs while retaining the services of Fred W. “Rick” Weingarten, our former Executive Director and Director of Public Policy, as a consultant. We believe these changes will enable CRA to be even more effective in the coming years as we work on policy issues related to computing research funding, underrepresented groups in the profession, and other policy issues of concern to the computing research community.

We are pleased to announce the appointment of Lisa Thompson as CRA’s new Director of Government Affairs. Lisa received a Bachelor’s degree in Physics from the University of Southern California and studied science policy at George Washington University. She worked briefly for the National Academy of Sciences, President’s Council of Scientific Society Presidents on policy issues before joining the Joint Policy Board for Mathematics. There, for the past eight years, she has worked on government affairs programs, focusing on both research and educational issues for the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics (an affiliate society of CRA).

Lisa is thoroughly familiar with the legislative process and players in the science and technology area, and she knows how to communicate effectively with lawmakers and their staffs. She has developed a highly regarded electronic bulletin to appraise researchers in the field of activities in Washington. She has also compiled useful information kits for mathematicians that provide them basic talking points on mathematics policy to use with lawmakers and offers practical advice on topics such as the Next Generation Internet. Lisa has also been an active member in the Coalition for National Science Funding (CNSF), which works to obtain funding from all areas of science, and she is well known in the Washington science policy community.

CRA’s new Director of Government Affairs, Lisa Thompson, has joined the House in passing the STATEMENT BY THE PRESIDENT to sign this bill into law. 1998 the President affirms his resolve statement from the Office of the Press signature is soon to follow. In a statement from the Office of the Press, the President said, “The Internet Tax Freedom Act (ITFA), which was introduced by Senators Bennett (R-NM) and Lott (R-MS) and passed by the Senate on December 17, 1998, is an important step toward a fair and equitable tax system for electronic commerce.”

Lisa’s appointment is as follows: “I have known and worked with Lisa for many years on science policy issues that affected both CRA and the mathematics community. I know that CRA’s community will find her to be an incredibly talented and knowledgeable representative for computing research. She will do a great job.” Rick will continue to serve the community by spending about a day a week as a consultant on policy issues to CRA. Rick joined CRA in 1990, serving at the first full-time Executive Director and simultaneously holding the position of Director of Public Policy. He led an extraordinary job at establishing CRA as an important presence in the science policy community in Washington and has been an excellent proponent for computing research. He built up CRA membership, as well as a staff and programs to serve them. With the growth of the organization, it became time in 1995 to separate the senior and administrative post from the government affairs directorship. Rick stayed on at CRA half-time, serving as the Director of Public Policy, while holding a similar half-time position at the National Library of Medicine (NLM). After three satisfying years in these dual half-time positions, Rick decided it was time for him to throw himself full-time into new efforts. He has accepted a one-year position to recreate LA’s information technology and management issue, Rick plans to move on to another policy or educational position. It is CRA’s good fortune to be able to draw on the knowledge and ability of both Lisa and Rick. CRA is looking forward to continuing its tradition of serving the computing research community with this partnership.

Internet Tax Freedom Act

Both the House and the Senate have passed S. 442, the Internet Tax Freedom Act. This bill creates a three-year moratorium on the collection of taxes by local and state agents from electronic commerce conducted on the Internet. At the time CGN goes to press, it is uncertain whether the signature is soon to follow. In a statement from the Office of the Press, Secretary released on October 8, 1998 the President affirmed his resolve to sign this bill into law.

STATEMENT BY THE PRESIDENT

“I am pleased that the Senate has joined the House in passing the Internet Tax Freedom Act. This bill will create a short-term moratorium on new and discriminatory taxes that would slow down the growth of the Internet, and launch a search for long-term solutions to the tax issues raised by electronic commerce. As I said earlier this year in my speech on Internet taxation, given our global economy, it would be shortsightedstrom just not allow 30,000 state and local tax jurisdictions to tax the Internet, nor can we allow the erosion of the revenue that state and local governments need to fight crime and invest in education. I look forward to signing this legislation into law so that America can continue to lead in the Information Age.”

CRA Seeks Applications for Executive Fellowship Program

(Exceptional, highly motivated, mid-career and senior computer and information scientists from the nation’s universities are invited to apply for a one-year Fellowship in a federal agency in Washington, DC.)

Applicants should have extensive technical expertise in information technology. They should also have a strong interest in broad applications of information technology to government and society. A dual experience in applying technology to societal problems is highly desirable.

From two to four fellowships will be awarded this year. Fellow selected will begin September 1, 1999.

Applications are due by January 15, 1999.

Applications and applications information can be found on the CRA website http://www.cra.org/Policies/execfell.html

这两个法案对电子商业的税收问题进行了有效控制，避免了对电子商业的过早征税。

CRA Executive Fellowship Program, 1310 L Street NW, Suite 505, Washington, DC 20005-4632; or Fax: 202-667-1066.

CRA is thoroughly committed to promoting the growth and development of electronic commerce and to ensuring that the Internet remains a free and open platform for innovation and communication.

CRA is pleased to announce the appointment of Lisa Thompson as CRA’s new Director of Government Affairs. Lisa received a Bachelor’s degree in Physics from the University of Southern California and studied science policy at George Washington University. She worked briefly for the National Academy of Sciences, President’s Council of Scientific Society Presidents on policy issues before joining the Joint Policy Board for Mathematics. There, for the past eight years, she has worked on government affairs programs, focusing on both research and educational issues for the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics (an affiliate society of CRA).

Lisa is thoroughly familiar with the legislative process and players in the science and technology area, and she knows how to communicate effectively with lawmakers and their staffs. She has developed a highly regarded electronic bulletin to appraise researchers in the field of activities in Washington. She has also compiled useful information kits for mathematicians that provide them basic talking points on mathematics policy to use with lawmakers and offers practical advice on topics such as the Next Generation Internet. Lisa has also been an active member in the Coalition for National Science Funding (CNSF), which works to obtain funding from all areas of science, and she is well known in the Washington science policy community.

CRA’s new Director of Government Affairs, Lisa Thompson, has joined the House in passing the STATEMENT BY THE PRESIDENT to sign this bill into law. 1998 the President affirms his resolve statement from the Office of the Press signature is soon to follow. In a statement from the Office of the Press, the President said, “The Internet Tax Freedom Act (ITFA), which was introduced by Senators Bennett (R-NM) and Lott (R-MS) and passed by the Senate on December 17, 1998, is an important step toward a fair and equitable tax system for electronic commerce.”

Lisa’s appointment is as follows: “I have known and worked with Lisa for many years on science policy issues that affected both CRA and the mathematics community. I know that CRA’s community will find her to be an incredibly talented and knowledgeable representative for computing research. She will do a great job.” Rick will continue to serve the community by spending about a day a week as a consultant on policy issues to CRA. Rick joined CRA in 1990, serving at the first full-time Executive Director and simultaneously holding the position of Director of Public Policy. He led an extraordinary job at establishing CRA as an important presence in the science policy community in Washington and has been an excellent proponent for computing research. He built up CRA membership, as well as a staff and programs to serve them. With the growth of the organization, it became time in 1995 to separate the senior and administrative post from the government affairs directorship. Rick stayed on at CRA half-time, serving as the Director of Public Policy, while holding a similar half-time position at the National Library of Medicine (NLM). After three satisfying years in these dual half-time positions, Rick decided it was time for him to throw himself full-time into new efforts. He has accepted a one-year position to recreate LA’s information technology and management issue, Rick plans to move on to another policy or educational position. It is CRA’s good fortune to be able to draw on the knowledge and ability of both Lisa and Rick. CRA is looking forward to continuing its tradition of serving the computing research community with this partnership.

Internet Tax Freedom Act

Both the House and the Senate have passed S. 442, the Internet Tax Freedom Act. This bill creates a three-year moratorium on the collection of taxes by local and state agents from electronic commerce conducted on the Internet. At the time CGN goes to press, it is uncertain whether the signature is soon to follow. In a statement from the Office of the Press, Secretary released on October 8, 1998 the President affirmed his resolve to sign this bill into law.

STATEMENT BY THE PRESIDENT

“I am pleased that the Senate has joined the House in passing the Internet Tax Freedom Act. This bill will create a short-term moratorium on new and discriminatory taxes that would slow down the growth of the Internet, and launch a search for long-term solutions to the tax issues raised by electronic commerce. As I said earlier this year in my speech on Internet taxation, given our global economy, it would be shortsighted to not allow 30,000 state and local tax jurisdictions to tax the Internet, nor can we allow the erosion of the revenue that state and local governments need to fight crime and invest in education. I look forward to signing this legislation into law so that America can continue to lead in the Information Age.”

CRA Seeks Applications for Executive Fellowship Program

(Exceptional, highly motivated, mid-career and senior computer and information scientists from the nation’s universities are invited to apply for a one-year Fellowship in a federal agency in Washington, DC.)

Applicants should have extensive technical expertise in information technology. They should also have a strong interest in broad applications of information technology to government and society. A dual experience in applying technology to societal problems is highly desirable.

From two to four fellowships will be awarded this year. Fellow selected will begin September 1, 1999.

Applications are due by January 15, 1999.

Applications and applications information can be found on the CRA website http://www.cra.org/Policies/execfell.html

DEADLINE: January 15, 1999

Electronic applications are preferred, and may be sent to cra@ execfell(cra)org.

Questions may also be sent to this e-mail address, or telephone to CRA at 202-234-2113.

Send non-electronic information to: CRA Executive Fellowship Program, 1310 L Street NW, Suite 505, Washington, DC 20036-4632; or Fax: 202-667-1066.
Profiles Survey

1997-1998 CRA Departmental Profiles Survey

By Mirek Truszczynski and Stephen Seidman

In spring 1998, the Computing Research Association conducted a survey of U.S. and Canadian Ph.D. granting departments of computer science and engineering to collect data on budget, staff support, space, faculty teaching loads, and graduate student support. The survey asked for the data for the most recent annual period for which the data were available. In most cases this meant the period from July 1, 1996 to June 30, 1997. The results of the survey were reported in a workshop at the 1998 CRA Conference at Snowbird.

The survey was sent to 186 Ph.D. granting programs in computer science and engineering. The response rate for U.S. programs was 52%, with 99 out of 170 programs responding. The response rate for the Canadian programs was 50%, where 8 out of 16 programs responded.

When analyzing the results of the survey, we divided the U.S. programs into four groups according to the most recent N.R.C. ranking: CS departments ranked 1 - 12 (7 responses), CS departments ranked 13 - 24 (9 responses), CS departments ranked 25 - 36 (9 responses), and CS departments ranked 37 or higher (60 responses including 4 not ranked by the N.R.C.). In a different analysis, we divided the U.S. computer science and computer engineering programs into public (65 responses) or private (24 responses) institutions.

Some departments responding to the survey did not provide answers to all the questions. However, the proportion of missing values was small, only sporadically exceeding 10%. We believe that these response rates are sufficiently high for the aggregate results of the survey, presented below, to be meaningful.

Too few (four) computer engineering departments responding to the survey to allow us to report the results for this group separately and maintain the anonymity of the respondents.

Finally, we want to emphasize that this article presents only a statistical summary of the results of the survey. We did not attempt to give a detailed interpretation of the data for two reasons. First, there are significant differences among academic institutions in handling budgets, space, and personnel. We feel that although these differences are important, averaging over many responses decreases their effect and yields meaningful aggregate data. Second, since this was the first survey of its kind in many years, there is no temporal data to substantiate any conjectures about longitudinal trends.

Support staff

Table 1 presents the average ratio of the number of secretaries, computer support staff, and research programmers to the number of full-time equivalent (FTE) faculty for all categories of programs. The results show that for the categories of secretarial staff and research programmers, this ratio is higher for the U.S. programs than for the Canadian ones. The ratio is higher for the Canadian programs for computer support staff. Further, privately funded institutions have generally higher levels of staff support per FTE than institutions supported by public funds. Finally, the ratio of staff support is generally higher in top ranked departments.

Budget

Table 2 presents the average ratio of annual department expenditures for the most recent complete fiscal year (in thousands of U.S. dollars) to the number of FTE faculty. (Please note that all Canadian dollars were converted to U.S. dollars for comparison and analysis.) Total expenditures include the regular departmental budget expenditures (salaries, including TA stipends, equipment purchases, and maintenance, and operating expenses), expenditures of funds from external grants and contracts and from discretionary accounts, and expenditures of overhead funds returned to the department. Total expenditures do not include the value of equipment donations. There are no significant differences between the three groups of top-ranked U.S. programs. However, the average expenditure per FTE in a U.S. program ranked 37 or higher is about 40% lower than the same average for programs ranked 1 - 36. There is also a striking difference between U.S. and Canadian programs, with the average expenditure per FTE in Canadian programs being more than 50% lower than in the United States.

Table 3 summarizes the findings on the rate of external funding per faculty member. Unlike other results of the survey, there is a significant difference here between private and public institutions.

The rate of external funding is also higher in the U.S. than in Canada. It is also higher for top-ranked departments than for departments ranked 37 and higher.

The survey also asked about the structure of the budget. These data are summarized in Table 4. The data show that external funding plays a smaller role in the budgets of the Canadian programs compared with the U.S. Similarly, the portion of the budget that comes from external funds in the U.S. programs ranked 1 - 36 is much higher than in the programs ranked 37 and higher. Table 5 presents the average ratio of annual departmental expenditures for instructional and research laboratories to the number of FTE faculty (in thousands of U.S. dollars). These expenditures include maintenance.

Survey Continued on Page 7

Table 1. Support Staff per Faculty Member

<table>
<thead>
<tr>
<th>Secretarial Staff</th>
<th>Computer Staff</th>
<th>Research Programmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>.48</td>
<td>.24</td>
</tr>
<tr>
<td>Public</td>
<td>.32</td>
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<tr>
<td>US CS Ranked 1-12</td>
<td>.87</td>
<td>.34</td>
</tr>
<tr>
<td>US CS Ranked 13-24</td>
<td>.40</td>
<td>.25</td>
</tr>
<tr>
<td>US CS Ranked 25-36</td>
<td>.56</td>
<td>.40</td>
</tr>
<tr>
<td>US CS Other</td>
<td>.28</td>
<td>.15</td>
</tr>
<tr>
<td>US</td>
<td>.37</td>
<td>.20</td>
</tr>
<tr>
<td>Canadian</td>
<td>.27</td>
<td>.14</td>
</tr>
</tbody>
</table>

Table 2. Annual Budget per Faculty Member (thousands of U.S. dollars)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>$286</td>
<td>224</td>
<td>337</td>
<td>358</td>
<td>337</td>
<td>202</td>
<td>240</td>
<td>109</td>
</tr>
</tbody>
</table>

Table 3. External Funding per Faculty Member (thousands of U.S. dollars)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>$166</td>
<td>92</td>
<td>206</td>
<td>205</td>
<td>157</td>
<td>81</td>
<td>110</td>
<td>53</td>
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</table>

Table 4. Budget Composition

<table>
<thead>
<tr>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>3.5%</td>
<td>2%</td>
<td>2%</td>
<td>7%</td>
</tr>
<tr>
<td>Discretionary</td>
<td>4%</td>
<td>2%</td>
<td>4%</td>
<td>5%</td>
<td>3.5%</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>External</td>
<td>40%</td>
<td>36%</td>
<td>44%</td>
<td>52%</td>
<td>46%</td>
<td>32%</td>
<td>37</td>
<td>19%</td>
</tr>
<tr>
<td>Regular Budget</td>
<td>54%</td>
<td>60%</td>
<td>51%</td>
<td>42%</td>
<td>47%</td>
<td>64%</td>
<td>59</td>
<td>74%</td>
</tr>
</tbody>
</table>

Table 5. Annual Lab Expenditures (per Faculty Member)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Instructional</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$11,000</td>
<td>$5,000</td>
<td>$17,000</td>
<td>$28,000</td>
<td>$9,000</td>
<td>$12,000</td>
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<tr>
<td>Research</td>
<td>20,000</td>
<td>18,000</td>
<td>28,000</td>
<td>24,000</td>
<td>47,000</td>
<td>12,000</td>
<td>15,000</td>
<td>11,000</td>
</tr>
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</table>

Table 6. Instructional Lab Expenditure Structure

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>15%</td>
<td>12%</td>
<td>15%</td>
<td>17%</td>
<td>7%</td>
<td>12%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>Equipment Purchases</td>
<td>49</td>
<td>43</td>
<td>31</td>
<td>40</td>
<td>49</td>
<td>45</td>
<td>45</td>
<td>33</td>
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<tr>
<td>Staff</td>
<td>36%</td>
<td>45%</td>
<td>53</td>
<td>43</td>
<td>44</td>
<td>43</td>
<td>42</td>
<td>60</td>
</tr>
</tbody>
</table>
Profiles Survey

Table 7. Research Lab Expenditure Structure

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>11%</td>
<td>10%</td>
<td>26%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Purchases</td>
<td>57</td>
<td>57</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Staff</td>
<td>32</td>
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<td>52</td>
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</table>

Table 8. Equipment Donations

<table>
<thead>
<tr>
<th></th>
<th>top 25%</th>
<th>median</th>
<th>bottom 25%</th>
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<tbody>
<tr>
<td>Instructional Lab</td>
<td>$400,000 or more</td>
<td>$180,000 or more</td>
<td>$17,000 or less</td>
</tr>
<tr>
<td>Research Lab</td>
<td>$500,000 or more</td>
<td>$123,000 or more</td>
<td>$45,000 or less</td>
</tr>
</tbody>
</table>

Table 9. Space—Sources of Funding

<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Renovated</th>
<th>Planned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional</td>
<td>88%</td>
<td>72%</td>
<td>70%</td>
</tr>
<tr>
<td>State</td>
<td>32</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>Federal</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Industrial</td>
<td>0</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Private</td>
<td>6</td>
<td>4</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 10. Total Space per Faculty Member in sq. ft.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching</td>
<td>1,212</td>
<td>1,154</td>
<td>1,801</td>
<td>1,425</td>
<td>1,411</td>
<td>946</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 11. Teaching Load per Faculty Member (Official)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching</td>
<td>2.8</td>
<td>3.5</td>
<td>2.2</td>
<td>2.5</td>
<td>2.6</td>
<td>3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12. Graduate Stipends (median)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Assistant</td>
<td>$9,500</td>
<td>$10,500</td>
<td>$11,425</td>
<td>$11,316</td>
<td>$11,000</td>
<td>$9,970</td>
<td>$10,500</td>
<td>$6,172</td>
</tr>
<tr>
<td>Research Assistant</td>
<td>11,050</td>
<td>10,919</td>
<td>11,893</td>
<td>12,500</td>
<td>11,163</td>
<td>10,500</td>
<td></td>
<td>10,959</td>
</tr>
<tr>
<td>Fellowship</td>
<td>12,000</td>
<td>12,673</td>
<td>13,000</td>
<td>14,000</td>
<td>13,630</td>
<td>12,000</td>
<td>12,586</td>
<td>10,540</td>
</tr>
</tbody>
</table>

Table 13. Graduate Student Support

<table>
<thead>
<tr>
<th></th>
<th>Offices</th>
<th>Research Labs</th>
<th>Instructional Labs</th>
<th>Conference Rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>.70</td>
<td>.65</td>
<td>.66</td>
<td>.75</td>
</tr>
<tr>
<td>Public</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US CS Ranked 1-12</td>
<td>.86</td>
<td>.77</td>
<td>.77</td>
<td></td>
</tr>
<tr>
<td>US CS Ranked 13-24</td>
<td>.77</td>
<td>.62</td>
<td>.66</td>
<td></td>
</tr>
<tr>
<td>US CS Ranked 25-36</td>
<td>.77</td>
<td>.66</td>
<td>.66</td>
<td></td>
</tr>
<tr>
<td>US CS Other</td>
<td>.66</td>
<td>.66</td>
<td>.66</td>
<td></td>
</tr>
<tr>
<td>Canadian</td>
<td>.75</td>
<td>.75</td>
<td>.75</td>
<td></td>
</tr>
</tbody>
</table>

Survey from Page 6

nance costs, equipment purchases, and personnel costs. The value of donated equipment is not included. It is noteworthy that the ratio for instructional laboratories is higher in Canada than in the U.S., but that the ratio for research laboratories is lower in Canada. Further, the per-FTE level of support for research laboratories in the U.S. departments ranked 1 – 36 is two to four times higher than for the remaining U.S. programs.

The survey also gathered data on the structure of expenditures for instructional and research laboratories. These data are presented in Tables 6 and 7. As might be expected, staff and equipment purchases predominated.

Equipment donation to instructional and research labs provide substantial support to many computer science programs. Thirty-four U.S. computer science programs reported donations of instructional equipment. The same number of U.S. computer science programs reported research equipment donations. The first quartile, median, and the third quartile of the estimated value of these donations are given in Table 8. Five Canadian programs (out of 8 responding to the survey) reported donations of instructional equipment with an estimated value ranging from $5,000 to $255,000. Three Canadian programs reported donations of research computing equipment.

Space

The survey asked about use of space in the departments. We found no clear trends as a function of type (public vs. private), ranking, or country. We thus report the average space use over all responses. The results are shown in Figure 1 below.

The survey indicates significant activity with respect to added or forthcoming space allocated to U.S. computer science departments. Out of 89 U.S. departments, 21 reported acquiring new space in the past year. The amount of new space ranged widely (minimum 41 sq. ft., median 1,600 sq. ft., maximum 8,690 sq. ft.). Five departments reported loss of space.

Twenty-five U.S. departments reported renovation of existing space. The scope of renovation differed substantially among programs (minimum 260 sq. ft., median 1,912 sq. ft., maximum 10,000 sq. ft.). The survey asked respondents to indicate funding sources for the newly acquired or renovated space. The results are shown in Table 9. Institutional and state funding were listed most often by far, with federal, industrial, and private funding being mentioned only sporadically.

A minority of U.S. departments expect new space to become available to them by 2005. Of these, 26 (79%) expect new space by the end of 2005. The departments are rather optimistic about timely delivery of the new space. Over 60% expect it to be available on time or expect it is likely to be available on time. Once again, institutional and state sources are the two most commonly listed (Table 10).

Table 10 presents the ratio of the total departmental space available to the number of FT E faculty. The total departmental space consists of faculty, staff, and graduate student offices, conference and seminar rooms, and research and instructional laboratories operated by the department. There is little difference between the U.S. and Canada, and little difference between U.S. private and public institutions. However, there are significant differences between top-ranked U.S. departments and those ranked 37 and higher. The departments ranked 1 – 12 report almost twice as much space per FT E (1,801 sq. ft.) as those departments ranked 37 and up (946 sq. ft.).

The planned space is similar to the use of the space currently available to the programs. However, there appears to be a greater emphasis on laboratory space, with half of the planned space allocated to research and instructional labs (Figure 2 below).

Too few responses were received from the Canadian departments about recently acquired, renovated, or planned space to report aggregate statistics. Of the 8 Canadian departments responding, two reported a gain of new space and one reported a loss of space. Two Canadian departments reported renovation of some of the existing space during the reporting period. Finally, three Canadian departments expect new space by the end of 2005.

Teaching loads

Data submitted from departments using the quarter system were converted to semesters, using the following conversion: 1 quarter = 1 3/4 semesters.

Survey Continued on Page 8

Table 12. Graduate Stipends (median)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td>12,500</td>
<td>11,163</td>
<td>10,500</td>
<td></td>
<td>10,959</td>
</tr>
<tr>
<td>Fellowship</td>
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<td>12,586</td>
<td>10,540</td>
</tr>
</tbody>
</table>

Table 13. Graduate Student Support

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<th>Instructional Labs</th>
<th>Conference Rooms</th>
</tr>
</thead>
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</table>
Survey from Page 7

course = 0.67 semester courses. A n official teaching load of 3 semester courses per year was reported by 33% of the respondents, and an additional 31% reported an official teaching load of 4 semester courses per year. The minimum reported was 0.67 and the maximum reported was 8.

Table 11 on page 7 presents the average official teaching loads. Teaching loads are correlated with the rank. In particular, official teaching loads in departments ranked 1 - 16 are about 50% lower than those reported by departments at public institutions. A dual teaching loads reported are generally lower than official loads. However, due to technical problems with the survey form, the data on actual teaching loads are not reliable and will not be reported. N in-every-five percent of the departments that responded to the survey allow for teaching load reductions. Of these, 86% allow for reduction as part of startup packages for new faculty members. Other commonly cited reasons for load reductions are administrative duties, course buyout, and strong research program, cited respectively by 83%, 76%, and 44% of the departments that permit load reductions. The average reported buyout was 19% of annual salary. One-quarter of the departments also listed type and size of class as reasons for load reduction.

Graduate student support

One of the goals of the survey was to determine typical work requirements for teaching and research assistants. We found that for 78% of the U.S. programs, the standard work requirement for a TA is 20 hr/week, with the mean being close to 20 hr/week for all classes of programs. In contrast, the Canadian respondents report a mean standard work requirement for a TA of only 12 hr/week. The case of research assistants, 80% of the U.S. programs report 20 hr/week as the standard work requirement. The mean standard work requirement for an RA reported by the Canadian programs was 17.6 hr/week.

The survey asked for the net value of stipends (stipend for a nine-month assignment minus institution and fees for teaching assistant, research assistant, and fellowship holders. Since there was significant variability in the reported stipends, we decided to report the median stipend value, which is less affected by outliers in the data. The median net stipend is shown in Table 12. The results show that there are no significant differences in net stipend among different categories of programs. However, teaching and research assistantship stipends reported by the Canadian programs are substantially lower (by about 40%) than those reported by the U.S. institutions. The results in Table 12 also show that teaching assistantship stipends are slightly lower for graduate assistants and these, in turn, are lower than for fellows.

A cademic progress was the factor given most frequently (63%) in determining stipend amounts. Other commonly reported included: passes (60%), differences in the source of funding (48%), recruitment enhancements (26%), and GPA (15%).

In the survey, we also gathered information on the number of supported graduate students. Table 13 presents the ratio of the number of graduate students to the number of full-time graduate students for various categories of programs. The survey provided interesting insights into the student incentives used to attract new graduate students. Forty-one percent of U.S. programs and 65% of Canadian programs reported first-year stipend enhancement. Guaranteed multi-year support was reported by 51% of programs, with 44% guaranteeing support for 2 years and 16% of them guaranteeing support for 3 years. Paid visits to campus were reported as an incentive for 44% of programs, with a median amount per visit of $500 and a maximum of $1,000. Finally, guaranteed summer support was reported by 28% of the programs. The median amount of summer support was $3,600 for a U.S. program and $3,332 and for a Canadian program.

Conclusions

The initial feedback from the Snowbird workshop where the results of the survey were presented indicated that such data are of great interest to computer science and computer engineering departments. It was a common sentiment that the survey needs to be conducted regularly every two or three years so as to provide meaningful data for the temporal analysis of changes in resources available to computer science and engineering programs. At the same time, discussions at the workshop and e-mail correspondence indicated that many programs indicated several shortcomings in the survey design and in the implementation of web-based survey forms. The survey currently under review by the CRA Board with the goal of making it more precise, streamlining it, and making it easier to complete. It is expected that the survey will be repeated in two years.

Acknowledgments

We would like to thank Larry Finkelstein, Chip M artin, and M od Vardi for their help in developing the survey. C o regen Adress, help, and encouragement throughout the whole project is greatly appreciated. We would also like to acknowledge the assistance obtained from the CRA sta, especially from E. A. S. A. B. T. M. and S. C. H. L. finally, we would like to thank Lena T. S. T. for her help in analyzing the results of the survey.

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Research Priorities

The bulk of the report concentrates on four research priorities: software, scalability, high-end computing, and socio-economic and workforce impacts (notably, many of PITAC’s suggestions are similar to those made at CRA’s May 1997 workshop, “Research Challenges for the Next Generation Internet”). Software – Declaring software “the new physical infrastructure of the information age,” PITAC recommends additional funding for software in computer science, engineering, and applications. Historically, reports PITAC, federal programs have underesti-eated the amount of money needed for software development and testing. Today, demand for software outpaces U.S. ability to supply it and companies still depend on users to identify bugs.

A nd despite previous failures to establish national software libraries, PITAC believes these endeavors are so important that they should be tried again.

Scalability – Noting how the Internet’s popularity and our depen- dence on it are increasing daily, PITAC warns that “we cannot safely extend what we currently know to more complex systems.” PITAC calls for greater investment in “core software and communications technologies.”

Additionally, the Committee recommends “broadening” the NGI infrastructure testbed to include information, commerce, and other services. It also urges formation of additional industry partnerships to finance projects on a scale large enough to examine design and deployment issues.

High-End Computing – The A dvocacy Committee prefaxes recommendations in this area by briefly recounting the nation’s evolution from high-performance computing to high-end computing. The Committee then calls for more

PITAC Continued on Page 9
What the United States needs, says the type of wide-ranging exploration that characterized Xerox PARC and MIT Project Mac.

As proposed by PITAC, each center could (through competitive bidding) receive as much as $40 million annually for ten years. The focus of such expeditions could be in infrastructure-based (examples include distributed databases, teleimmersion) or discipline-based (bioinformatics, multiscale engineering).

Enabling Technology Centers
To advance the use of next generation IT in various applications (health care, transportation, government services, environment), PITAC proposes Enabling Technology Centers (ETC’s). These centers could be based at either universities or federal research institutions. As many as fifteen centers might operate at once, with each receiving as much as $10 million annually for ten years. Each ETC could enter into a five-year cooperative agreement, with a formal review in the third year for renewal funding. As a model, PITAC suggests NSF’s Science and Technology Centers.

What’s Up Ahead
Since the report’s release, subpanels of PITAC members and non-members have been meeting to review comments on the interim report. Additionally, say Kennedy, committee members have been interacting with the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) “so that things are moving along.”

On Capitol Hill, the House Subcommittee on Basic Research held hearings on the report in early October. Subcommittee reaction to the report was generally favorable. In fact, several committee members tried to get witnesses (among them, CRA Board Chairman Edward Lazowska) for the inevitable budget questions they would face in testifying before Congress next year.

Rep. Eddie Bernice Johnson (D-Texas) asked whether PITAC’s goals could be met if new funds were forthcoming. In other words, could existing R&D funds be reallocated and applied to long-term investments? Neal Lane (in his first appearance before the Subcommittee as Director of the Office of Science Policy) replied that “while there’s always an opportunity for reallocation,” without additional revenue “it would be hard to make much progress in response to the recommendations of the Committee.”

Rep. Gil G. Gutknecht (R-Minnesota), who favored PITAC’s recommendations, cautioned that the Y2K problem might give other members pause in appropriating new funds for IT R&D. “Here we are, a little more than a year away from the millennium,” he said, and the administration is requesting additional funds “for a problem which, frankly, did not sneak up on us.” Gutknecht, who also serves on the House Budget Committee, said “the computer industry has a little bit of a black eye right now.” The Congressmen added, “we need better answers for other folks.”

In his opening statement, Lazowska noted that a common PittAC theme was essentially, “It’s the software, stupid.” Picking up on that paraphrase of the famous campaign slogan, Rep. Vernon Ehlers (R-Michigan) asked witnesses to explain the complexity of the software issue and how they anticipated closing the software gap.

Other concerns raised included NSF as the lead agency for coordinating R&D, teacher training in IT, and the Department of Energy’s Accelerated Strategic Computing Initiative (ASCI) program.

A review of the first report (to be released later in the week) could give the subpanel a chance to review comments on the interim report. In that case, the report is expected next February. Thus, by the time any budget figures are submitted to Congress, the 2000 presidential election will be ramping up. C R N will continue to follow developments and report further on PITAC in future issues.

CRA-W from Page 2

gious awards (such as ACM and IEEE Fellows, ACM Grace Murray Hopper Award, etc.). The goal of the Awards Committee is to publicize and elicit nominations for the awards.

[Lead member: Nancy Leveson, nleveson@mit.edu]

General Activities
The Women’s Department Project supports a database of over 700 Ph.D. level women in CS & E who are working in North America. Ph.D. - level means that the women have a Ph.D. degree in CS or ECE, that they have a Ph.D. degree in a related field but identify themselves as computer scientists or engineers, or that they are currently enrolled in a Ph.D. program in Computer Science or Computer Engineering. The database has been used extensively since 1992 for statistical studies and for diverse recruiting purposes. The database has been queried by appropriately qualified women job candidates, program committee members, editorial board members, and invited speakers for conferences. Women of all career levels are listed in the database and searches can be tailored to career level, technical area, or other parameters. [Lead member: Joann Ordille, joann@ibell-labs.com]

[On and off the subject of further discussion, two RAs have been brought to your attention every issue of C R N. If you would like to submit an article for consideration, please contact Joan Francioni (joanflwind.winona.mns.edu).

CRA-W is supported by the National Science Foundation, which assists in travel to meetings and seed money for the committee’s projects, and by the EOT-PA C1. A dimmerst of the EOT-PA C1 in San Diego, EOT-PA C1 provides general support for CRA-W, including support for new CRA-W programs, maintaining the committee’s webpages and handling publicity for CRA-W. Larger projects, such as the MPEG meeting workshops, have successfully acquired separate funding to support their efforts. The current co-chairs of the CRA-W committee are Horty Cuny, University of Oregon (cury@cs.uoregon.edu), and Leah Jamieson, Purdue University (lht@ecn.purdue.edu).

Joan Francioni is a professor at Winona State University in Minnesota. She is a member of CRA-W and the publication committee of 9%. Her current research focuses on computer technology for persons with disabilities. She can be reached for comments or articles about Joan by joanflwind.winona.mns.edu.

CRA Staff:
William Aspray (study Co-Chair)
Jane Smith
[Stevens Committee Member]
**Computing Research News**

**November 1998**

**Professional Opportunities**

**Arizona State University**  
Computer Science and Engineering Department  
We anticipate that we will have several tenure-track faculty openings at all ranks (assistant, associate, and full) for the year 1999-2000, and are soliciting candidates to apply. Applicants are required to have completed Ph.D.s in computer science, computer engineering, or a closely related field by the appointment date. Applicants at the assistant professor level must demonstrate promise and applicants at the associate professor level and full professor level must demonstrate excellence in research and teaching appropriate to their rank. A record of publications and participation in computing and computer architecture research, computer education, computer security, computer engineering, computer networks, computer systems, computer-aided design, data compression, databases, digital signal processing, distributed systems, engineering education, high-level languages, human factors, intelligent systems, knowledge-based systems, networking, parallel computing, programming languages, software engineering, and VLSI design is desirable. A competitive salary, attractive fringe benefits, and a stimulating and fast-paced environment await recipients of these appointments. For more information about the department, refer to the http://www.cs.arizona.edu/compsci/  

**Brown University**  
Department of Computer Science  
Faculty positions in Computer Science are available, to begin on September 1, 1999. Brown has strengths in areas including algorithms, software engineering, computer architecture, computer-aided design, computer graphics, computer security, distributed computing, and programming languages. Faculty positions are also available in the areas of artificial intelligence, databases, distributed systems, information systems, management information systems, neural networks, and software engineering. The Brown University Computing and Information Technology Institute (CTI) is a young, world-class research and educational environment that focuses on innovation in information technology and by leveraging the expertise of faculty, staff, and students. The CTI currently has over 40 full-time faculty and a student body currently growing at a rate of 30% per year. CTI offers Bachelors, MS and PhD degrees in Computer Science and Engineering and provides a demanding and fast-paced environment for research and teaching with ample opportunities for partnerships with other technology industry leaders and emphasis on quality, leading edge graduate research. For more information about the department, refer to the http://www.cs.brown.edu/cti/.  

**Bucknell University**  
College of Engineering  
Rooke Chair in the Historical and Social Context of Engineering  
The Rooke Chair in the Historical and Social Context of Engineering will integrate the essential dimensions of the history and social context of technology for engineering and non-engineering students. The position will focus on fostering a deeper understanding of the social context of engineering and its role in the project level and the broad historical levels. To apply, send curriculum vitae, a statement (include a CV) letter, and the names of at least three references to Prof. Stanley Zdonik, Recruiting Chair, nicol@cs.dartmouth.edu.  

**Brocklyn College**  
Department of Computer Science  
We are seeking applicants for a senior position in computer science at the rank of Associate Professor or Professor level. We are an urban liberal arts college, and the department is involved in approximately 1000 undergraduate majors, over 500 Master's students and over 200 Ph.D. graduate students. Several major research projects are currently underway. Excellent faculty and students SFC/UN and PC network, excellent teaching environment.  
We would prefer to hire one individual in each of the following areas of specialization:  
1. operating systems, distributed systems, and/or parallel and distributed computing  
2. graphics and/or multimedia  
3. database systems and information systems  
4. artificial intelligence, computer architecture, networks, software engineering, and/or computer education  
A successful candidate will teach undergraduate and/or graduate courses in C/S and is expected to develop a research program at the highest level. The successful candidate will have a broad knowledge of computer science and should have good pedagogical skills. For appointment as an Assistant Professor, a candidate should have a Ph.D. in computer science. For appointment as an Associate Professor, a candidate should have a record of participation in research and scholarship in the highest quality research environments.  
Please send a curriculum vitae and three letters of recommendation to Prof. A. Arora, Temple University, Dept. of CS, Brooklyn College, 2000 Bedford Avenue, Brooklyn, NY 11210 (arora@cs.brooklyn.cuny.edu). It is anticipated that the position will be filled in the College of Engineering prior to the beginning of the fall 1999 semester. A successful candidate is expected to establish a relationship with the University's CUNY Graduate Center. Several major research projects are currently underway. Excellent faculty and students SFC/UN and PC network, excellent teaching environment.  

**Bucknell University**  
College of Engineering  
Bucknell University  
Lawrence, PA 17046  
Bucknell encourages applications from women and members of minority groups (EAO)  
**Brooklyn College of The City University of New York (CUNY)**  
Department of Computer and Information Science (CIS)  
We are seeking applicants for a senior position in computer science at the rank of Associate Professor or Professor level. We are an urban liberal arts college, and the department is involved in approximately 1000 undergraduate majors, over 500 Master's students and over 200 Ph.D. graduate students. Several major research projects are currently underway. Excellent faculty and students SFC/UN and PC network, excellent teaching environment.  
We would prefer to hire one individual in each of the following areas of specialization:  
1. operating systems, distributed systems, and/or parallel and distributed computing  
2. graphics and/or multimedia  
3. database systems and information systems  
4. artificial intelligence, computer architecture, networks, software engineering, and/or computer education  
A successful candidate will teach undergraduate and/or graduate courses in C/S and is expected to develop a research program at the highest level. The successful candidate will have a broad knowledge of computer science and should have good pedagogical skills. For appointment as an Assistant Professor, a candidate should have a Ph.D. in computer science. For appointment as an Associate Professor, a candidate should have a record of participation in research and scholarship in the highest quality research environments.  
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**Case Western Reserve University**  
Computer Science Program, Department of Electrical, Systems, and Computer Engineering  
The Department of Electrical, Systems, and Computer Engineering invites applications for multiple tenure-track positions in the Computer Science Program. We anticipate that we will have several tenure-track faculty openings at all ranks (Assistant, Associate, and Full) for the year 1999-2000, and are soliciting candidates to apply. Applicants are required to have completed Ph.D. in computer science, computer engineering, or a closely related field by the appointment date. The applicant must demonstrate evidence of being a stimulating and fast-paced environment for research and teaching. The applicant must also have a doctoral degree in computer science and have demonstrated leadership ability. They must also have a doctoral degree in computer science or closely related areas. Candidates are sought who will meet the teaching and research needs of the department.  
A successful applicant will find at Brown a stimulating environment conducive to productive and responsible research. Brown has strengths in areas including algorithms, software engineering, computer architecture, computer-aided design, computer graphics, computer security, distributed computing, and programming languages. Faculty positions are also available in the areas of artificial intelligence, databases, distributed systems, information systems, management information systems, neural networks, and software engineering. The Brown University Computing and Information Technology Institute (CTI) is a young, world-class research and educational environment that focuses on innovation in information technology and by leveraging the expertise of faculty, staff, and students. The CTI currently has over 40 full-time faculty and a student body currently growing at a rate of 30% per year. CTI offers Bachelors, MS and PhD degrees in Computer Science and Engineering and provides a demanding and fast-paced environment for research and teaching with ample opportunities for partnerships with other technology industry leaders and emphasis on quality, leading edge graduate research. For more information about the department, refer to the http://www.cs.arizona.edu/compsci/  

**Computists International**  
Computsists International  
Computists International is an Equal Opportunity Affirmative Action Employer. Women and minorities are encouraged to apply.  

**DePaul University**  
Computer Science, Information Systems, and Telecommunications  
The School of Computer Science, Telecommunications, and Information Systems (CICS) at DePaul University invites applications for multiple tenure-track positions beginning September 1999. We welcome applications from outstanding candidates in all areas of specialization. DePaul University is a growing school in downtown Chicago, offering BS, MS, and Ph.D. Program in Computer Science. The CICS Department provides comprehensive, computer-based information systems, Software Engineering, Human- Computer Interaction, Telecommunications, and Distributed Systems. CTI currently has over 40 full- time faculty members.  

**Dartmouth College**  
Computer Science  
Nicol, Recruiting Chair, nicol@cs.dartmouth.edu.  

**Dartmouth College**  
Computer Science  
6211 Sudikoff Laboratory, Hanover, New Hampshire 03755-3510.  
Specific questions on the application process should be directed to: G. Ozsoyoglu, 205 Dana Building, Brookville, New York 11210 (tbaum@sci.brooklyn.cuny.edu.) Please send a curriculum vitae and three letters of recommendation to: G. Ozsoyoglu, 205 Dana Building, Brookville, New York 11210 (tbaum@sci.brooklyn.cuny.edu.) Please send a curriculum vitae and three letters of recommendation to: G. Ozsoyoglu, 205 Dana Building, Brookville, New York 11210 (tbaum@sci.brooklyn.cuny.edu.)
McMaster University

Department of Computing and Software
Faculty of Engineering

FACULTY POSITIONS IN COMPUTING AND SOFTWARE

McMaster University is recognized as the most innovative University in Canada. The Faculty of Engineering at McMaster has a new department, Computing and Software, that offers a new program in Software Engineering and an established program in Computer Science. The Department has state-of-the-art facilities and is rapidly expanding. To learn more about our research strengths, check our web site at www.cs.mcmaster.ca.

We are seeking new colleagues at all levels. We will consider outstanding candidates from all areas of Software Engineering and Computer Science, but we are especially interested in applicants working in: performance measurement, optimization (both discrete and continuous), biomedical computing, computer communication systems, computer security, distributed systems, high-performance computing, real-time control systems, and software interfaces.

We have taken the position that Software Engineering is an branch of engineering and have designed the new program to meet the engineering accreditation criteria of the Canadian Engineering Accreditation Commission. A ability to be registered as a Professional Engineer in the Province of Ontario, or become registered within three years of appointment, will be considered an advantage.

Aplicants should have a Ph.D. in engineering, computer science, mathematics or an allied field. We will consider outstanding candidates from all areas of specialization in computer science, but we are especially interested in applicants working in: performance measurement, optimization (both discrete and continuous), biomedical computing, computer communication systems, computer security, distributed systems, high-performance computing, real-time control systems, and software interfaces.

One of the openings is designated for an Assistant Professor in Electronic Commerce, and will focus on research in areas such as workflow, virtual enterprises, heterogenous and object-oriented databases, machine learning, agent systems, multimedia, distributed computing, networking, and human-computer interfaces. A Ph.D. in computer science, computer engineering or a closely related discipline is required. The position will commence in July 1999. Salary is commensurate with qualifications and experience. Applications from women, members of visible minorities and aboriginal people are encouraged. Review of applications will commence in early November 1998 and will continue until the positions are filled. Please send a curriculum vitae and a brief statement of research interests to: Chair, Electronic Commerce Recruitment Committee, Department of Computer Science and Engineering, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada L8S 4L7.

Applications will be accepted until the positions are filled.

Computing Research News
November 1998
University of California, Irvine
Department of Information and Computer Science (ICS)

Open Faculty Positions in Information and Computer Sciences

The Department of Information and Computer Science at the University of California, Irvine invites applications for tenure-track and tenured faculty positions in the following areas of research emphasis:

- Applications are encouraged in areas related to software engineering and computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Pennsylvania
Department of Computer and Information Science

The Department of Computer and Information Science at the University of Pennsylvania invites applications for tenure-track faculty positions in several areas of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

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

The Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley invites applications for tenure-track positions in electrical engineering and computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of California, Irvine
Department of Computer Science

The Department of Computer Science at the University of California, Irvine invites applications for tenure-track positions in computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of California, Los Angeles
Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science at the University of California, Los Angeles invites applications for tenure-track positions at all levels in the area of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Florida
Department of Computer Science

The Department of Computer Science at the University of Florida invites applications for tenure-track and tenured faculty positions in computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Illinois
Department of Electrical and Computer Engineering

The Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign invites applications for tenure-track positions at all levels in the area of electrical and computer engineering.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Maryland
College Park
College of Computer, Mathematical, and Physical Sciences

The University of Maryland at College Park invites applications for several tenure-track positions in computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Virginia
Department of Computer Science

The Department of Computer Science at the University of Virginia invites applications for tenure-track positions at all levels in the area of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

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Chair
Computer Science Search Committee
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University of California
Irvine, CA 92697-3425

The University of California is an Equal Opportunity/ Affirmative Action employer.

University of Washington
Department of Computer Science

The Department of Computer Science at the University of Washington invites applications for tenure-track positions at all levels in the area of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

Professor Richard R. Muntz
Chair
Computer Science Search Committee
Department of Computer Science
University of California
Irvine, CA 92697-3425

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University of Wisconsin
Department of Computer Science

The Department of Computer Science at the University of Wisconsin invites applications for tenure-track positions at all levels in the area of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
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University of California
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University of Arizona
Department of Computer Science

The Department of Computer Science at the University of Arizona invites applications for tenure-track positions at all levels in the area of computer science.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
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University of California
Irvine, CA 92697-3425

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

The Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley invites applications for Computational Imaging Chair.

A successful candidate will:
- Be expected to teach at both the graduate and undergraduate levels.
- Be expected to engage in active research in areas of interest to the department.
- Be expected to participate in departmental activities.
- Be expected to participate in university and community activities.

Applications should be sent to:

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Computer Science Search Committee
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University of California
Irvine, CA 92697-3425

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Of course I would be happy to help you! Please provide me with the necessary information so I can assist you effectively.
of graduate student research (Ph. D. and M. S.), and opportunities are available for faculty, who should have Ph. D. in Computer Science and demonstrate a commitment to expand the growth and teaching ability.

The department currently has twenty full-time faculty members and provides a stimulating environment for research, teaching, and service in the areas of computer science, information systems, and human-computer interaction. The University prides itself on excellent classroom instruction, providing students with a solid foundation in the major principles of computer science. Faculty members are actively engaged in cutting-edge research in areas such as artificial intelligence, machine learning, computer architecture, software engineering, and human-computer interaction. The department places a strong emphasis on research, teaching, and faculty space. The department offers a full range of graduate and undergraduate programs, and is dedicated to providing a quality education that results in environmental for research and teaching that results in publishable research and teaching that results in impactful contributions to the field.

To ensure a diverse and inclusive environment for research and teaching that results in impactful contributions to the field, the department is committed to creating meaningful investments in minority and women. Faculty members are encouraged to apply. Research groups in search of a successful candidate should send a curriculum vitae and the names of three references to: Dr. Robert Broadheater, Chair, Department of Electrical and Computer Engineering, 2-274, 410-386-5276.

The University of Texas at Austin

Department of Computer Science

The Department of Computer Science at the University of Texas at Austin has openings for tenure-track positions at all levels, particularly at the assistant professor level. Candidates must hold a Ph. D. in Computer Science or related discipline with professional achievements that demonstrate promise for tenure-track faculty appointments. The successful candidates will be selected from nominations and applications from women and underrepresented minorities.

For further information see http://www.cs.utexas.edu. The application review will be completed as they are received. The review of applications and nominations will begin on December 15, 1999. Applicants should send a letter of interest, curriculum vitae, and names of at least four references to: Chair, Department of Computer Science, 1 University Station, C0100, Austin, TX 78712-0100. Women and underrepresented minorities are encouraged to apply. The University of Texas at Austin is an Affirmative Action/Equal Opportunity Employer.

University of Virginia

Department of Computer Science

The Department of Computer Science at the University of Virginia seeks applicants for tenure-track positions at all levels, particularly at the assistant professor level. Candidates must hold a Ph. D. in Computer Science or related discipline with professional achievements that demonstrate promise for tenure-track faculty appointments. The successful candidates will be selected from nominations and applications from women and underrepresented minorities.

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University of Maryland

Graduate School of Computer Science

The Graduate School of Computer Science at the University of Maryland, College Park, invites applications for one assistant professor position at the assistant professor level. The department places a strong emphasis on research, teaching, and faculty space. The department offers a full range of graduate and undergraduate programs, and is dedicated to providing a quality education that results in impactful contributions to the field.

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