$85.3 Billion Requested for R&D in FY 2001 Budget

By Lisa Thompson

The Administration’s FY 2001 budget proposal, introduced on February 7, 2000, contains a wealth of new spending on health, human resources, access to technology, environment, infrastructure, and R&D initiatives and programs—an expansion of the federal sector designed to secure the President’s historical legacy. As the budget would exceed the caps currently imposed on discretionary spending, the President is expected to submit proposed legislation to remove those caps, a move that no longer entails the political risks it did in previous budget cycles. Reaction from the more vocal Republicans on Capitol Hill was predictable: “Too much spending, not enough tax relief.”

Overall Research and Development

The request features $85.3 billion for research and development, including facilities and equipment. This figure is about 3 percent above the estimated R&D spending in FY 2000, although civilian basic and applied research would each increase by 7 percent under the plan.

R&D Themes & Crosscuts

When the President talks about his R&D budget, he is more likely to refer to the 21st Century Research and Development program, a first-class research lab. In FY 2001, the President is expected to submit proposed legislation to remove those caps, a move that no longer entails the political risks it did in previous budget cycles. Reaction from the more vocal Republicans on Capitol Hill was predictable: “Too much spending, not enough tax relief.”

InterTrust’s STAR Lab

By J. J. Harning

The second in a series of CRN articles describing the activities of CRA’s industry laboratory members.

InterTrust Technologies Corporation (http://www.intertrust.com) is a 200-person company in Santa Clara, CA, focusing on digital rights management (DRM) and related electronic commerce systems.

As director of its Strategic Technologies and Architectural Research Laboratory, I am often asked, “How can a small startup like InterTrust afford a substantial research lab?”

Conventional wisdom in Silicon Valley says “Startups can’t do research.” That is, for a small company to win big, it must take a single idea from somewhere else (a university, government, or large company lab), focus on it obsessively, and run like hell to be first to market. It shouldn’t even think about research until it grows large—over $100 million, or as David Liddle has said, “The only companies that can afford research labs are too big to be able to profit from the results.”

Nonetheless, my short answer to the question is: “InterTrust believes that it cannot afford not to have a first-class research lab.”

Before I expand on that answer, I need to explain a bit more about InterTrust’s basic research challenge. InterTrust is not a conventional Silicon Valley startup.

First, InterTrust is not actually a “startup.” It was founded by Victor Shear in January 1990 (as Electronic Publishing Resources, or EPR). Shear had been awarded basic patents covering techniques for enforcing the rights of owners of intellectual property that was distributed digitally. This area has come to be called digital rights management.

Although he had already been working on the DRM problem for a number of years, Shear realized that the world was not yet ready for—or very interested in—a large-scale electronic commerce in digital IP. The Internet was seen as an academic tool, the World Wide Web had not yet been invented, and the cutting-edge commercial digital distribution technology was CD and CD-ROM.

Rather than rushing a product to market, EPR spent its first six years preparing for a market that it believed would eventually be vast. Shear, trained as a social scientist, insisted on taking a broad view of “moving commerce into electronic space,” considering the fundamental requirements for a system that would accommodate the needs of all parties in the “value chain” from creative artist to end user. EPR stayed small, built prototypes, and established a formidable patent position. It also developed a business model to give it staying power for the day when other companies, large and small, noticed the opportunity and crowded in.

EPR’s model was to make its system ubiquitous by forming long-term partnerships with great global companies—including leading content companies and financial clearinghouses—and with cutting-edge technology companies. Its vision was that EPR would serve as a “utility,” providing the common infrastructure for “trusted electronic interactions” among members of value chains. It would give its partners a level playing field on which to compete.

InterTrust Continued on Page 13
Gender Differences in Learning to Program

By Janet Carter and Tony Jenkins

The teaching (or, perhaps more accurately, the learning) of programming is a problem that few teachers of programming in higher education would deny. Indeed, most would agree that there is an alarmingly high proportion of graduates who are unable to "program" in any meaningful sense. The experience of the School of Computer Studies at the University of Leeds is no exception. Students often approach their final year project work determined to avoid programming at all costs, presumably because they either cannot program or believe that they cannot.

Our cohort comprises a mixture of novice and experienced students, and approximately 20 percent are female. We have worked, over several years, on innovative approaches to supporting the novice students. In the 1997-98 session a particular change was introduced—additional tutorial classes were provided for those students who approached staff and asked for additional support. We insisted that the classes were available only to students who applied; we wanted to keep the class sizes as small as possible. All students were made aware of the classes, and were told to approach a member of the teaching staff if they wished to join; in this way, we hoped to limit the classes to motivated students who were in difficulty.

This additional class was initially seen as a success. The staff saw a significant number of students who had clearly been struggling at odds; these students, and eventually achieve creditable, if unspectacular, results. It was apparent, though, that the vast majority of the students attending were—the first year, 16 out of 20 were women. This trend continued, and in the 1998-99 session the ratio was 17 to 4. A worrying aspect of this phenomenon was that, in questionnaires circulated at the end of the module, a small minority of (presumably male) students reported that they believed that the staff were only willing to help the female students.

Even though the staff knew that there were women in the class, it was not a pleasant comment to read in student feedback. The comments have reappeared since, and have even percolated into students’ attitudes in other modules. It was also exasperating to see that many students continued to fail the module—these were students who might well have benefited from the extra classes. It was noticeable that all 14 of the students re-taking the programming module at the end of the 1997-98 session were men.

The Study

We planned to run the same classes again in the 1998 session—a reasonable decision since they were clearly of great benefit to the students who attended them. We decided, however, to investigate students’ attitudes and approaches to the learning of programming so that we might understand why mainly women attended the classes. This investigation would be complemented by a similar exercise at the University of Kent, where no such additional classes were available. A comparison with a different institution seemed preferable to a comparison with a different module at Leeds. We were particularly interested in how students approached programming, and there was no suitable alternative programming module at Leeds. The study involved a simple questionnaire, which was presented to students in a lecture. The students were presented with a series of seven statements, and were asked to indicate their agreement level (at the 5-percent level). There are significant differences between the way in which programming teaching is organized at the two universities is that Leeds provides the additional classes that are available only on application. It seems reasonable to suppose that it is these classes that are causing the differences we see. There are, of course, many other possible causes. The possibility that the staff teaching the module are in some way biased towards the female students (perhaps because they are a minority) cannot be discounted, but they would certainly vehemently deny this. It is also possible that news of the usefulness of the classes is spread among friends, and we might expect first year women students to have made more female friends in their first weeks. Another possible issue would be that some men would find the prospect of joining a class that was almost exclusively female rather intimidating. Nevertheless, the key underlying issue is the provision of the extra classes. A further interesting fact is apparent from the Leeds sample. Responses were received from only 56 students; a class that should have been attended by some 110 (the class takes place on a Friday afternoon—a very unpopular time). Of these 56 students, 20 were women. In the whole class there are 31 women registered, so 65 percent of the women attended. The equivalent attendance figure for the men is 46 percent, which is significantly lower. This seems to point to a difference in motivation between the genders, or perhaps to a difference in the way the genders approach learning.

Research has found that differences between the approaches of male and female students are most strikingly demonstrated when single-sex schools are merged to form a coeducational establishment. Although this is not exactly the case here, it must be noted that a very high proportion of our CS undergraduates previously attended women’s schools.

Results

The responses were collated, and averages from the Leeds and Kent samples were calculated. The most striking feature of the answers to the final question was the closeness of the averages from the students at the two universities. In no case do the differences appear to be significant (at the 5-percent level). There are some apparent differences that can be understood as differences between the cultures of the two departments. The salient difference in the figures is, of course, in the answers to the final crucial question. It is clear that students at Kent (mean 2.3) are more inclined to state that they will not get stuck if they are stuck, whereas students at Leeds (mean 2.8) are more likely to refer to a friend or colleague for help. Since it was the women who attended the additional classes, the difference in motivation between the genders is clearly of great benefit to the students who attended them. It is also clear that it is the male students under the age of 21 at Leeds that most strongly believe this (a score of 3.9 compared with 2.3 for the Kent males under age 21).
CRA Conference at Snowbird 2000

It’s time once again to begin thinking about Snowbird: Mark your calendars for CRA’s biennial conference scheduled for July 9-11, 2000 in Utah, Snowbird, Utah. This is a CRA flagship conference for chairs of Ph.D. granting departments of computer science and computer engineering, as well as leaders from U.S. industrial and government computing research laboratories. A number of other senior people from research groups, government, academia, and professional societies also attend.

The Snowbird Committee has been working since last fall to put together a strong program to address the conference’s major theme—“Computer Science in the New Millennium.” What will computer science departments, research, and teaching look like? What are the potential issues that may arise, and how will they be addressed?

The President of the National Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing the Academy of Engineering, William A. Wulf, will set the stage by addressing

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CRA Industrial Careers, Effective Teaching, and Academic Careers Workshops

June 19-20, 2000
San Diego Marriott Hotel & Marina
San Diego, California

In conjunction with the USENIX Annual Technical Conference June 18-23, 2000

CRA is again offering its highly successful series of workshops for men and women who study or work in computing research. The goal is to provide practical guidance for advanced graduate students and junior faculty as they choose or begin their careers.

New! The Industrial Careers Workshop (June 19), organized by Steve Johnson (Transmira Corp.), is targeted at computing researchers who are considering a career in industry. Topics include the nature and variety of work that can be expected and how to prepare for it, opportunities for conducting research and publishing, and the non-academic skills that are required in industry.

The Effective Teaching in Computer Science and Engineering Workshop (June 19), organized by Tim Finin (University of Maryland, Baltimore County), is a highly interactive workshop that includes theoretical material on learning styles and instructional objectives, practical tips on effective teaching, every teaching aid and collaborative learning.

The Academic Careers Workshop (June 20), organized by Bobby Schnabel (University of Colorado at Boulder), is targeted at faculty in the beginning years of their careers and senior graduate students contemplating an academic career. Potential topics include time management and family issues, the tenure process, selecting and managing a research project, and getting funding.

Further details about the workshops and registration can be found on the CRA website at http://www.cra.org.

Ph.D. in Software Engineering: A New Degree Program at Carnegie Mellon

By David Garlan, Phil Koopman, William Scherlis, and Mary Shaw

Introduction

The School of Computer Science at Carnegie Mellon University (CMU) has recently announced the inauguration of a new Ph.D. program in software engineering. The program is associated with the newly created Institute for Software Research International (ISRI). ISRI is the principal locus for software engineering research and education at Carnegie Mellon, and currently has 23 affiliated faculty members.

As one of its founding principles, ISRI adopts that both research and education in software engineering must rely on an intellectual base that includes not only core computer science topics, but also engineering methods and process, organizations and collaboration, information management, and legal and policy issues. ISRI faculty are involved in research projects in embedded systems, dependability, pervasive computing, software architecture, software adaptation and assurance, collaboration technology, digital libraries, distance education, distributed resource management, and other areas.

With the start of the new millennium, software has become an essential building material for systems of all kinds, affecting business and everyday living throughout the emerging global economy. As software becomes ubiquitous, the relation between end users and software development is undergoing fundamental changes. Rarely is software produced from scratch by a team of experts and delivered to clients. Increasingly:

- Software is developed by adapting and integrating existing components and services;
- The Internet and other forms of interconnection provide broad access to computation and information resources that are independently created and managed;
- Software systems must be designed and fielded under complex economic and legal constraints;
- Systems are being built in which unreliable and unstable software cannot be tolerated;
- Clients are intimately involved in the development and configuration of systems; and
- Requirements for those systems often emerge only as clients better understand both the technology and

Ph.D. Continued on Page 4

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The President of the National Academy of Engineering, William A. Wulf, will set the stage by addressing the group on the topic, “Some Challenges for Computer Science as it Enters the 21st Century.” Three plenary sessions, two of which are joint industry/academic sessions, include:

1. Important Research Areas for the New Millennium;
2. Impact of the Economic Development Imperative on the Universities; and
3. Educational Challenges for the New Millennium.

The program also will offer a workshop for new department chairs, as well as a workshop for deans (new this year). Industrial research directors will attend regular conference sessions and events, including two joint industry/academic plenary sessions (mentioned above) and one joint workshop, “University Venture Capital/Incubation Initiatives.” Other workshops are specifically oriented toward issues of concern to industry, such as: “Using Spin-offs and Venture Capital to Market New Ideas” and “Managing Industrial Research Labs.”

The opportunity to network with peers is one of the most valuable aspects of the conference, and it comes around only once every two years. So make your plans to escape to the mountains in July and join the crowd for several days of stimulating discussion about the future of computer science and engineering research.

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Administration Proposes New Information Security R&D Funding

On January 7, 2000 President Clinton launched a National Plan for Information Systems Protection, and announced new budget proposals for initiatives to strengthen America’s defenses against the emerging threats posed to critical infrastructures, computer systems, and networks.

The FY 2001 budget request features a Critical Infrastructure Protection R&D initiative in which 10 agencies participate. Its funding would grow from $461 million to $606 million in FY 2001, a 31 percent increase.

The plan includes briefing federal R&D and workforce activities:
- Building on the work of a science advisory panel, the Administration proposes to create a $50 million Information Infrastructure Institute that would combine federal and private sector efforts to fill the gaps in critical infrastructures and that are not currently being filled by the private sector or the Department of Defense. It would also provide demonstration and development support in key areas like benchmarks and standards and curriculum development. The institute would be funded through the National Institute for Standards and Technology.
- The plan also calls for improved recruitment, training, and retention of federal IT experts. The FY 2001 budget request will include $25 million for a Federal Cyber Services Training and Education initiative comprising two elements: an ROTC-like program in which the government pays for IT education (at the BS and MS levels) in exchange for federal service; and a program to establish competencies and certify the existing IT workforce. The initiative would be led by the Office of Personnel Management and the National Science Foundation.

Commerce Announces Streamlined Encryption Export Regulations

On January 14, 2000, the U.S. Department of Commerce Bureau of Export Administration (BXA) issued new encryption export regulations that implement the new approach announced by the Clinton Administration in September 1999.

The new approach permits U.S. companies to export any encryption product around the world to commercial, commercial firms, individuals, and other non-government end-users under a license exception (i.e., with a license but no license issued). In addition, “retail” encryption products that are widely available in the market can now be exported to any end-user, including foreign governments. In most cases, a one-time product review by BXA continues to be required. Post-reporting requirements are reduced to track industry business models.

“This policy helps business and promotes e-commerce by adjusting our regulations to marketplace realities that U.S. companies face when they try to sell their products overseas. We’ve also worked very hard to address privacy concerns and to ensure that our law enforcement and national security concerns are met,” said Commerce Secretary William M. Daley at the press conference announcing the change.

For source code, the regulation reduces controls further than announced in September 1999. Commercial encryption source code, encryption toolkits, and components can now be exported under license exception to businesses and non-government end-users for internal use, and even to any end-user, including foreign governments. In most cases, a one-time product review by BXA continues to be required. Post-reporting requirements are reduced to track industry business models.

“The regulation further streamlines requirements for U.S. companies by permitting exports of any encryption item to their foreign subsidiaries without a prior review. Foreign employees of U.S. companies working in the United States no longer need an export license to work on encryption.

The guidelines also implement agreements reached by the Wassenaar Arrangement in December 1998 by decontrolling 64-bit mass market products, 56-bit encryption items, and 512-bit key management products. The changes do not affect restrictions on terrorist-supporting states (Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria), their nationals, and other sanctioned entities.

In developing this regulation, the Administration worked closely with stakeholders to continue a balanced approach. The government will review the workability of the regulation, receiving public comments for 122 days. A final revised rule will be issued shortly thereafter.

The regulations obviate the need for new legislation. Two encryption bills are pending in Congress—the Security and Freedom through Encryption (SAFE) Act (H.R. 850) and the Promote Reliable On-Line Transactions to Encourage Commerce and Trade (PROTECT) Act (S. 798). But the congressional leadership says these bills will be put in abeyance, given the Administration’s policy switch.

Note to Department Chairs:
Watch for the arrival of CRAIs second Departmental Profiles Survey in early March

Ph.D. from Page 3

the opportunities in their own settings.

CMU established the ISRI as a center for long-term interdisciplinary fundamental research, apprenticeship-based education, and international collaboration to address the challenge of designing, developing, integrating, validating, and maintaining practical, large-scale, high-quality, software-intensive systems. ISRI’s creation is a natural extension of Carnegie Mellon’s long-standing commitment to research in software systems.

By creating a new Ph.D. program in software engineering, we are able to train researchers who can address challenging problems related to practical issues of developing product-quality, software-intensive systems.

ISRI research activities employ a variety of approaches, including experimental prototyping, empirical modeling, codification of experience, formal analysis, creating design/development strategies for modern software, and developing public policy positions. ISRI activities are tightly integrated with research and demonstration projects. The ISRI faculty is drawn from computer science, computer engineering, public policy, and other areas. The ISRI also maintains close ties with the CMU Software Engineering Institute.

An important emphasis in ISRI activities is employing a broad view of design. The approach to performing design in typical practice follows a progression of increasing maturity over time, starting as artisanship and leading to a scientifically-based, routinized engineering discipline. This frontier advances at different rates in different sub-disciplines. Aspects for which generic design principles are not yet well articulated must be taught as art; aspects that can be taught via an artisanship approach must be taught in an apprenticeship format; aspects that can be reduced to heuristics and empirical models can be taught as an engineering discipline; and aspects that can be related to a theoretical foundation may best be taught as science. For this reason, ISRI adopts a flexible approach to teaching topic areas, attempting to identify and teach the right topics rather than just focusing in areas that are easy to teach. Additionally, ISRI seeks to advance the understanding of various areas to increase the level of scientific maturity.

Expectations for Graduates

Graduates will be prepared for faculty positions in software engineering, research positions in industrial laboratories, and leadership positions in the computer industry. As faculty, they will be distinguished by their understanding of software design and development issues, and the way this shapes their selection of research problems and evaluation of research results. As industrial developers, they will understand the interplay of academic research issues with engineering constraints that arise from public policy, economics, regulatory, and market issues. As senior software system developers, they will have a perspective that enables them to address specific problems in the context of the principles and results of the field.

Admission Criteria

Applicants to the program should have proficiency in computer science at least at an undergraduate level, with emphasis on development of software or hardware systems. They should also have evidence of intellectual ability to succeed in an intellectually rigorous doctoral program, demonstrated through transcripts, GREs, and other means.

Prior experience in developing industrial software, especially

Ph.D. Continued on Page 14
Ph.D. Enrollment Levels Off; M.S. and Undergrad Continue to Rise

March 2000

By Mary Jane Irwin and Frank Friedman

This article and the accompanying tables and figures present the results of the 29th annual CRA Taulbee Survey of Ph.D.-granting departments of computer science (CS) and computer engineering (CE) in the United States and Canada. This survey is conducted annually by the Computing Research Association to document trends in student enrollment, employment of graduates, and faculty salaries.

Information is gathered during the fall and early winter. The percent the data covers varies from table to table. Degree production (Ph.D., Master's, and Bachelor's) and total Ph.D. enrollments refer to the previous academic year (1998-99). Data for new students in all categories and total enrollments for Master's and Bachelor's refer to the current academic year (1999-2000). Projected student production and information on faculty salaries and demographics also refer to the current academic year. Faculty salaries are those effective January 1, 2000. Responses received by January 14, 2000 are included in the tables.

The survey results are from Ph.D.-granting departments only. Two hundred and three departments were surveyed, compared with 182 departments last year. This increase was due to wider canvassing by CRA staff to get a more complete picture of the set of schools awarding CS and CE doctorates, and the addition of a few newly formed departments. Through last-minute telephone calls to departments that had not responded to the survey, we were able to obtain Ph.D. production numbers from 84% of the schools (compared with 77% last year). Overall, 156 departments out of 203 departments returned their survey forms. We thank all respondents who completed this year's questionnaire. Departments that participated are listed at the end of this article.

Respondents provided answers to most questions, but in some cases questions were left unanswered. Participation rates for individual questions varied from 75% to 80%. The overall response rate was 77%, about the same as last year. Figure 1 shows the number of departments that responded to the survey/number of schools polled for the faculty section of the survey from 1995 to 1999.

This article presents the most significant results of the survey, with particular attention to those that differ markedly from last year or that appear to indicate long-term trends. The continued low response rate for CE departments (21% this year, 37% last year) makes trend analysis for CE risky. Overall, the set of schools that responded this year was very similar to last, and the response rate was essentially the same. The high rate of return this year for Canadian schools (83% compared with 67% last year) must be considered when trying to determine trends with respect to Canadian data.

The survey form itself is modified slightly each year to ensure as high a rate of return as possible (by simplifying and clarifying), while continuing to capture the data necessary to understand trends in the discipline and also reflect changing concerns of the computing research community.

This year two questions were dropped from the survey. One question, added just last year, asked how many years it takes a student to complete the Ph.D. program (5.014 years reported last year). The information provided by this question, compared with the difficulty of collecting the data, suggests that this question only needs to be asked periodically. Another question that was dropped was how many new Ph.D. students had Bachelor's degrees in CS or CE. The data had not changed significantly in several years and, once again, proved difficult for departments to collect.

Tables 1-6 show the data. The tables and data are available on the CRA's web site (www.cra.org) and in an electronic issue of Computing Research News.

Degree Production (Tables 1-6)

As shown in Table 1, a total of 944 Ph.D. degrees were awarded in 1999 by the 171 (84%) responding departments.

While this is a small increase from the 933 degrees awarded in 1998, only 144 departments (77%) responded last year. In both years, virtually all of the departments producing large numbers of doctorates were included in the survey data; the additional schools responding this year added only marginally to the total. Figure 2 shows the Ph.D. production rate from 1989 to 1999.

The prediction from last year's survey that 1,128 Ph.D. degrees would be awarded in 1999 was, as usual, overly optimistic. Using the same "optimism factor" of 0.85 as we used last year, the prediction for next year of 1,167 translates to 922 new Ph.D.s in 2000. One cause for concern is that the number of students passing the Ph.D. qualifier is down by 150 (or 14%) from last year.

Figure 2. Ph.D. Production 1989-1999

Taulbee Continued on Page 6
1998-1999 Taubbe Survey

The growth in undergraduate enrollments over the past few years continues to translate into significant increases in the number of Bachelor's degrees awarded (see Tables 5 and 6). Historically, the Ph.D.-granting departments have awarded approximately one-third of the nation's Bachelor's degrees in CS and CE. There were 12,692 awarded in 1999 by the 150 (74%) responding departments, up 25% from the 10,161 awarded in 1998 by the 138 (76%) responding departments. It is projected that 13,883 Bachelor's degrees will be awarded in 1999-2000.

The number of Master's degrees awarded (Tables 5 and 6, CS plus CE), which increased by 4.3% in 1997 with 130 (80%) departments reporting, and by 11.1% in 1998 with 141 (77%) departments reporting, was up again by 13.1% in 1999 with 156 (80%) departments reporting.

While similar to 1998, there was a small increase (from 35% to 38%) this year in the percentage of recipients taking positions in Ph.D.-granting departments. This increase came at the expense of recipients taking positions in government, industry, and abroad. The number of Master's degrees awarded (Tables 5 and 6, CS plus CE), which increased by 4.3% in 1997 with 130 (80%) departments reporting, and by 11.1% in 1998 with 141 (77%) departments reporting, was up again by 13.1% in 1999 with 156 (80%) departments reporting.

Due to the excellent job market and companies that are now willing to hire Master's graduates with H1-B visas, students who originally planned to pursue a Ph.D. are leaving academia with only a Master's degree. The number of Master's degrees for 1999-2000 is projected to be up an additional 3%.

The significant increase in Master's degrees in 1999 probably explains the decrease in the number of students taking the Ph.D. qualifier. Due to the excellent job market and companies that are now willing to hire Master's graduates with H1-B visas, students who originally planned to pursue a Ph.D. are leaving academia with only a Master's degree. The number of Master's degrees for 1999-2000 is projected to be up an additional 3%.

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While similar to 1998, there was a small increase (from 35% to 38%) this year in the percentage of recipients taking positions in Ph.D.-granting departments. This increase came at the expense of recipients taking positions in government, industry, and abroad. The number of Master's degrees awarded (Tables 5 and 6, CS plus CE), which increased by 4.3% in 1997 with 130 (80%) departments reporting, and by 11.1% in 1998 with 141 (77%) departments reporting, was up again by 13.1% in 1999 with 156 (80%) departments reporting.

Due to the excellent job market and companies that are now willing to hire Master's graduates with H1-B visas, students who originally planned to pursue a Ph.D. are leaving academia with only a Master's degree. The number of Master's degrees for 1999-2000 is projected to be up an additional 3%.

The significant increase in Master's degrees in 1999 probably explains the decrease in the number of students taking the Ph.D. qualifier. Due to the excellent job market and companies that are now willing to hire Master's graduates with H1-B visas, students who originally planned to pursue a Ph.D. are leaving academia with only a Master's degree. The number of Master's degrees for 1999-2000 is projected to be up an additional 3%.

The growth in undergraduate enrollments over the past few years continues to translate into significant increases in the number of Bachelor's degrees awarded (see Tables 5 and 6). Historically, the Ph.D.-granting departments have awarded approximately one-third of the nation's Bachelor's degrees in CS and CE. There were 12,692 awarded in 1999 by the 150 (74%) responding departments, up 25% from the 10,161 awarded in 1998 by the 138 (76%) responding departments. It is projected that 13,883 Bachelor's degrees will be awarded in 1999-2000.
1998-1999 Taubee Survey

Table 6. Ethnicity of Bachelor’s and Master’s Recipients

<table>
<thead>
<tr>
<th></th>
<th>Bachelor’s</th>
<th></th>
<th></th>
<th>Master’s</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
<td>CE</td>
<td>Total</td>
<td>CS</td>
<td>CE</td>
<td>Total</td>
</tr>
<tr>
<td>Nonresident</td>
<td>623 (9%)</td>
<td>81 (6%)</td>
<td>704 (8%)</td>
<td>2,032 (45%)</td>
<td>370 (65%)</td>
<td>2,402 (47%)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>1,590 (22%)</td>
<td>275 (19%)</td>
<td>1,865 (21%)</td>
<td>792 (18%)</td>
<td>75 (13%)</td>
<td>867 (17%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>295 (4%)</td>
<td>87 (6%)</td>
<td>382 (4%)</td>
<td>47 (1%)</td>
<td>3 (1%)</td>
<td>50 (1%)</td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>4,286 (59%)</td>
<td>885 (61%)</td>
<td>5,171 (60%)</td>
<td>1,341 (30%)</td>
<td>118 (21%)</td>
<td>1,459 (29%)</td>
</tr>
<tr>
<td>Other/Not Listed</td>
<td>156 (2%)</td>
<td>56 (4%)</td>
<td>212 (2%)</td>
<td>223 (5%)</td>
<td>4 (1%)</td>
<td>227 (4%)</td>
</tr>
</tbody>
</table>

Total have Ethnicity Data for 7,220, 1,460, 8,680, 4,509, 573, 5,082.

Ethnicity/Residency Unknown 3,589, 423, 4,012, 446, 51, 497.
Total 10,809, 1,883, 12,692, 4,955, 624, 5,579.

Table 7. New Undergraduate Students in Fall 1999 by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Premajor</td>
<td>Ave. Major per Dept</td>
<td>Premajor</td>
</tr>
<tr>
<td>US CS Ranked 1-12</td>
<td>- 1,604</td>
<td>146</td>
<td>205</td>
</tr>
<tr>
<td>US CS Ranked 13-24</td>
<td>- 1,655</td>
<td>138</td>
<td>-</td>
</tr>
<tr>
<td>US CS Ranked 25-36</td>
<td>174</td>
<td>1,203</td>
<td>109</td>
</tr>
<tr>
<td>US CS Other</td>
<td>474</td>
<td>9,191</td>
<td>103</td>
</tr>
<tr>
<td>Canadian CS</td>
<td>2,149</td>
<td>3,773</td>
<td>199</td>
</tr>
<tr>
<td>US CE</td>
<td>1,434</td>
<td>283</td>
<td>40</td>
</tr>
</tbody>
</table>

Total 4,231, 17,709, 118.9, 808, 3,078, 20.7, 20,787, 139.5.

Table 8. New Master’s Students in Fall 1999 by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Ave.</td>
<td>Total</td>
</tr>
<tr>
<td>US CS 1-12</td>
<td>631</td>
<td>52.6</td>
<td>0</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>540</td>
<td>45.0</td>
<td>38</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>255</td>
<td>23.2</td>
<td>0</td>
</tr>
<tr>
<td>US CS Other</td>
<td>2,799</td>
<td>30.4</td>
<td>267</td>
</tr>
<tr>
<td>Canadian</td>
<td>442</td>
<td>23.3</td>
<td>37</td>
</tr>
<tr>
<td>US CE</td>
<td>178</td>
<td>25.4</td>
<td>154</td>
</tr>
</tbody>
</table>

Total 4,845, 31.7, 496, 3.2, 5,341, 34.9.

Table 9. New Ph.D. Students in Fall 1999 by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>New Admit</th>
<th>MS to Ph.D.</th>
<th>Average</th>
<th>Total</th>
<th>Ave. per Dept</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>340</td>
<td>47</td>
<td>387</td>
<td>32.3</td>
<td>387</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>278</td>
<td>4</td>
<td>282</td>
<td>25.6</td>
<td>282</td>
</tr>
<tr>
<td>US CS Other</td>
<td>620</td>
<td>117</td>
<td>737</td>
<td>8.0</td>
<td>798</td>
</tr>
<tr>
<td>Canadian</td>
<td>62</td>
<td>16</td>
<td>78</td>
<td>4.1</td>
<td>82</td>
</tr>
<tr>
<td>US CE</td>
<td>18</td>
<td>0</td>
<td>17</td>
<td>2.6</td>
<td>81</td>
</tr>
</tbody>
</table>

Total 1,512, 209, 1,721, 11.2, 138, 31, 169, 1.1, 1,890, 12.4.

Table 10. Bachelor’s Degree Program Total Enrollment by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>Average Major per Dept</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
</tr>
<tr>
<td></td>
<td>Premajor</td>
</tr>
<tr>
<td>US CS 1-12</td>
<td>6,409</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>442</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>836</td>
</tr>
<tr>
<td>US CS Other</td>
<td>5,712</td>
</tr>
<tr>
<td>Canadian</td>
<td>1,626</td>
</tr>
<tr>
<td>US CE</td>
<td>141</td>
</tr>
</tbody>
</table>

Total 8,757, 57,504, 386.5, 1,580, 10,223, 68.6, 67,817, 455.1.
Table 11. Master's Degree Total Enrollment by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>1,027 (8%)</td>
<td>0</td>
<td>1,027 (8%)</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>1,179 (9%)</td>
<td>85</td>
<td>1,264 (10%)</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>516 (4%)</td>
<td>0</td>
<td>516 (4%)</td>
</tr>
<tr>
<td>US CS Other</td>
<td>8,367 (67%)</td>
<td>696</td>
<td>9,063 (75%)</td>
</tr>
<tr>
<td>Canadian</td>
<td>1,116 (9%)</td>
<td>119</td>
<td>1,237 (10%)</td>
</tr>
<tr>
<td>US CE</td>
<td>225 (2%)</td>
<td>498</td>
<td>723 (6%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12,432</td>
<td>1,398</td>
<td>13,830</td>
</tr>
</tbody>
</table>

Table 12. Ph.D. Degree Total Enrollment by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>1,432 (22%)</td>
<td>0</td>
<td>1,432 (20%)</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>1,019 (15%)</td>
<td>88</td>
<td>1,107 (15%)</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>833 (13%)</td>
<td>0</td>
<td>833 (13%)</td>
</tr>
<tr>
<td>US CS Other</td>
<td>2,858 (43%)</td>
<td>264</td>
<td>3,122 (44%)</td>
</tr>
<tr>
<td>Canadian</td>
<td>431 (7%)</td>
<td>51</td>
<td>482 (7%)</td>
</tr>
<tr>
<td>US CE</td>
<td>24 (0%)</td>
<td>160</td>
<td>184 (3%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,597</td>
<td>563</td>
<td>7,160</td>
</tr>
</tbody>
</table>

Table 13. Gender of Ph.D. Program Total Enrollment

<table>
<thead>
<tr>
<th>Gender</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5,418 (83%)</td>
<td>465</td>
<td>5,883 (83%)</td>
</tr>
<tr>
<td>Female</td>
<td>1,142 (17%)</td>
<td>92</td>
<td>1,234 (17%)</td>
</tr>
<tr>
<td><strong>Total have Gender</strong></td>
<td>6,560</td>
<td>557</td>
<td>7,117</td>
</tr>
<tr>
<td>Unknown</td>
<td>37</td>
<td>6</td>
<td>43</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,597</td>
<td>563</td>
<td>7,160</td>
</tr>
</tbody>
</table>

Table 14. Ethnicity of Ph.D. Program Total Enrollment

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresident Alien</td>
<td>2,601 (44%)</td>
<td>263</td>
<td>2,864 (45%)</td>
</tr>
<tr>
<td>African American, Non-Hispanic</td>
<td>125 (2%)</td>
<td>12</td>
<td>137 (2%)</td>
</tr>
<tr>
<td>Native American or Alaskan Native</td>
<td>3 (0%)</td>
<td>1</td>
<td>4 (0%)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>593 (10%)</td>
<td>31</td>
<td>624 (10%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>93 (2%)</td>
<td>6</td>
<td>99 (2%)</td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>2,360 (40%)</td>
<td>156</td>
<td>2,516 (39%)</td>
</tr>
<tr>
<td>Other Not Listed</td>
<td>127 (2%)</td>
<td>0</td>
<td>127 (2%)</td>
</tr>
<tr>
<td><strong>Total have Ethnicity</strong></td>
<td>5,902</td>
<td>469</td>
<td>6,371</td>
</tr>
<tr>
<td>Unknown</td>
<td>695</td>
<td>94</td>
<td>789</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,597</td>
<td>563</td>
<td>7,160</td>
</tr>
</tbody>
</table>

Table 15. Bachelor's Degree Candidates for 1999-2000 by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>1,727 (15%)</td>
<td>61</td>
<td>1,788 (13%)</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>1,182 (10%)</td>
<td>471</td>
<td>1,653 (12%)</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>1,198 (10%)</td>
<td>0</td>
<td>1,198 (9%)</td>
</tr>
<tr>
<td>US CS Other</td>
<td>5,114 (43%)</td>
<td>973</td>
<td>6,087 (44%)</td>
</tr>
<tr>
<td>Canadian</td>
<td>2,531 (21%)</td>
<td>216</td>
<td>2,747 (20%)</td>
</tr>
<tr>
<td>US CE</td>
<td>155 (1%)</td>
<td>255</td>
<td>410 (3%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11,907</td>
<td>1,976</td>
<td>13,883</td>
</tr>
</tbody>
</table>

Table 16. Master's Degree Candidates for 1999-2000 by Department Type and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>CS</th>
<th>CE</th>
<th>CS &amp; CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>682 (13%)</td>
<td>0</td>
<td>682 (12%)</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>456 (9%)</td>
<td>52</td>
<td>508 (9%)</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>441 (8%)</td>
<td>0</td>
<td>441 (8%)</td>
</tr>
<tr>
<td>US CS Other</td>
<td>3,151 (61%)</td>
<td>295</td>
<td>3,446 (60%)</td>
</tr>
<tr>
<td>Canadian</td>
<td>355 (7%)</td>
<td>32</td>
<td>387 (7%)</td>
</tr>
<tr>
<td>US CE</td>
<td>74 (1%)</td>
<td>194</td>
<td>268 (5%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,159</td>
<td>573</td>
<td>5,732</td>
</tr>
</tbody>
</table>

1998-1999 Taulbee Survey

Table 11 shows the total enrollment by department type and rank. The highest enrollment was in the CS group, followed by the CE group, with the CS & CE group having the lowest enrollment. The table also shows the distribution of students by gender and ethnicity. The highest number of students were male, and the highest number of students were nonresident aliens. The table also shows the distribution of students by ethnicity, with the highest number being African American, Non-Hispanic, followed by Native American or Alaskan Native, Asian or Pacific Islander, Hispanic, White, Non-Hispanic, and Other Not Listed.

Table 12 shows the total enrollment by department type and rank for Ph.D. degrees. The highest enrollment was in the CS group, followed by the CE group, with the CS & CE group having the lowest enrollment. The table also shows the distribution of students by gender and ethnicity. The highest number of students were male, and the highest number of students were nonresident aliens. The table also shows the distribution of students by ethnicity, with the highest number being African American, Non-Hispanic, followed by Native American or Alaskan Native, Asian or Pacific Islander, Hispanic, White, Non-Hispanic, and Other Not Listed.

Table 13 shows the total enrollment by gender for Ph.D. programs. The highest number of students were male, with 5,418 male students and 1,142 female students. The table also shows the distribution of students by ethnicity, with the highest number being African American, Non-Hispanic, followed by Native American or Alaskan Native, Asian or Pacific Islander, Hispanic, White, Non-Hispanic, and Other Not Listed.

Table 14 shows the total enrollment by ethnicity for Ph.D. programs. The highest number of students were nonresident aliens, with 2,601 nonresident alien students and 263 resident alien students. The table also shows the distribution of students by gender, with the highest number of students being male, and the highest number of students being nonresident aliens.

Table 15 shows the total enrollment by department type and rank for Bachelor's degrees. The highest enrollment was in the CS group, followed by the CE group, with the CS & CE group having the lowest enrollment. The table also shows the distribution of students by gender and ethnicity. The highest number of students were male, and the highest number of students were nonresident aliens. The table also shows the distribution of students by ethnicity, with the highest number being African American, Non-Hispanic, followed by Native American or Alaskan Native, Asian or Pacific Islander, Hispanic, White, Non-Hispanic, and Other Not Listed.

Table 16 shows the total enrollment by department type and rank for Master's degrees. The highest enrollment was in the CS group, followed by the CE group, with the CS & CE group having the lowest enrollment. The table also shows the distribution of students by gender and ethnicity. The highest number of students were male, and the highest number of students were nonresident aliens. The table also shows the distribution of students by ethnicity, with the highest number being African American, Non-Hispanic, followed by Native American or Alaskan Native, Asian or Pacific Islander, Hispanic, White, Non-Hispanic, and Other Not Listed.

Figure 4 shows the number of Ph.D. degrees granted to three underrepresented minorities from 1996 to 1999. The number of Ph.D. degrees awarded to African American, Native American, and Hispanic students increased over the years, with the highest number of degrees awarded in 1999. The number of degrees awarded to other underrepresented minorities remained relatively static.

Figure 5 shows the trend in new undergraduate enrollments from 1995 to 1999. The number of new undergraduate enrollments increased steadily from 1995 to 1999, with the highest number of enrollments in 1999. The number of new undergraduate enrollments decreased in 2000.
### 1998-1999 Taulbee Survey

#### Table 17. Anticipated Faculty Size by Position

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure-Track</td>
<td>3,183</td>
<td>3,166</td>
<td>3,388</td>
<td>205 (6%)</td>
</tr>
<tr>
<td>Researcher</td>
<td>298</td>
<td>306</td>
<td>345</td>
<td>48 (16%)</td>
</tr>
<tr>
<td>Postdoc</td>
<td>250</td>
<td>241</td>
<td>274</td>
<td>24 (9%)</td>
</tr>
<tr>
<td>Teaching Faculty</td>
<td>505</td>
<td>496</td>
<td>538</td>
<td>33 (7%)</td>
</tr>
<tr>
<td>Other/Not Listed</td>
<td>109</td>
<td>106</td>
<td>122</td>
<td>13 (12%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,344</strong></td>
<td><strong>4,315</strong></td>
<td><strong>4,667</strong></td>
<td><strong>323 (7%)</strong></td>
</tr>
</tbody>
</table>

#### Table 18. Anticipated Faculty by Department Type and Rank

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>582</td>
<td>644</td>
<td>690</td>
<td>108 (19%)</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>435</td>
<td>497</td>
<td>540</td>
<td>104 (24%)</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>390</td>
<td>388</td>
<td>414</td>
<td>25 (6%)</td>
</tr>
<tr>
<td>US CS Other</td>
<td>2,130</td>
<td>1,962</td>
<td>2,127</td>
<td>-3 (0%)</td>
</tr>
<tr>
<td>Canadian</td>
<td>632</td>
<td>646</td>
<td>721</td>
<td>90 (14%)</td>
</tr>
<tr>
<td>US CE</td>
<td>176</td>
<td>178</td>
<td>175</td>
<td>-1 (-1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,344</strong></td>
<td><strong>4,315</strong></td>
<td><strong>4,667</strong></td>
<td><strong>323 (7%)</strong></td>
</tr>
</tbody>
</table>

#### Table 19. Gender of Newly Hired Faculty

<table>
<thead>
<tr>
<th>Gender</th>
<th>Tenure-Track</th>
<th>Researcher</th>
<th>Postdoc</th>
<th>Teaching Faculty</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>265 (87%)</td>
<td>44 (52%)</td>
<td>73 (87%)</td>
<td>110 (77%)</td>
<td>9 (75%)</td>
<td>327</td>
</tr>
<tr>
<td>Female</td>
<td>42 (13%)</td>
<td>4 (8%)</td>
<td>11 (13%)</td>
<td>32 (25%)</td>
<td>3 (25%)</td>
<td>122</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>327 (53%)</strong></td>
<td><strong>48 (8%)</strong></td>
<td><strong>84 (14%)</strong></td>
<td><strong>142</strong></td>
<td><strong>2 (2%)</strong></td>
<td><strong>613</strong></td>
</tr>
</tbody>
</table>

#### Table 20. Ethnicity of Newly Hired Faculty

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Tenure-Track</th>
<th>Researcher</th>
<th>Postdoc</th>
<th>Teaching Faculty</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresident Alien</td>
<td>46 (15%)</td>
<td>9 (19%)</td>
<td>32 (38%)</td>
<td>12 (9%)</td>
<td>1 (8%)</td>
<td>100</td>
</tr>
<tr>
<td>African American, Non-Hispanic</td>
<td>3 (1%)</td>
<td>1 (2%)</td>
<td>0 (0%)</td>
<td>5 (4%)</td>
<td>0 (0%)</td>
<td>9</td>
</tr>
<tr>
<td>Native American or Alaskan Native</td>
<td>2 (1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
<td>3</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>63 (20%)</td>
<td>11 (23%)</td>
<td>13 (15%)</td>
<td>13 (9%)</td>
<td>0 (0%)</td>
<td>100</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3 (1%)</td>
<td>2 (4%)</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>0 (0%)</td>
<td>5</td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>192 (58%)</td>
<td>14 (30%)</td>
<td>34 (40%)</td>
<td>105 (75%)</td>
<td>9 (75%)</td>
<td>344</td>
</tr>
<tr>
<td>Other/Not Listed</td>
<td>14 (4%)</td>
<td>10 (21%)</td>
<td>5 (6%)</td>
<td>2 (1%)</td>
<td>2 (17%)</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>313</strong></td>
<td><strong>47</strong></td>
<td><strong>64</strong></td>
<td><strong>140</strong></td>
<td><strong>12</strong></td>
<td><strong>596</strong></td>
</tr>
</tbody>
</table>

#### Table 21. Gender of Current Faculty

<table>
<thead>
<tr>
<th>Gender</th>
<th>Full</th>
<th>Associate</th>
<th>Assistant</th>
<th>Teaching Faculty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1,321</td>
<td>950</td>
<td>624</td>
<td>428 (75%)</td>
<td>3,323</td>
</tr>
<tr>
<td>Female</td>
<td>115</td>
<td>132</td>
<td>120</td>
<td>146 (25%)</td>
<td>513</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,436</strong></td>
<td><strong>1,082</strong></td>
<td><strong>744</strong></td>
<td><strong>574 (15%)</strong></td>
<td><strong>3,836</strong></td>
</tr>
</tbody>
</table>

#### Table 22. Ethnicity of Current Faculty

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Full</th>
<th>Associate</th>
<th>Assistant</th>
<th>Teaching Faculty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresident Alien</td>
<td>34 (2%)</td>
<td>17 (2%)</td>
<td>98 (14%)</td>
<td>27 (5%)</td>
<td>176 (5%)</td>
</tr>
<tr>
<td>African American, Non-Hispanic</td>
<td>4 (0%)</td>
<td>5 (0%)</td>
<td>9 (1%)</td>
<td>12 (2%)</td>
<td>30 (1%)</td>
</tr>
<tr>
<td>Native American or Alaskan Native</td>
<td>5 (0%)</td>
<td>7 (1%)</td>
<td>8 (1%)</td>
<td>1 (0%)</td>
<td>21 (1%)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>231 (17%)</td>
<td>216 (21%)</td>
<td>131 (18%)</td>
<td>49 (9%)</td>
<td>627 (17%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>18 (1%)</td>
<td>14 (1%)</td>
<td>12 (2%)</td>
<td>6 (1%)</td>
<td>50 (1%)</td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>1,063 (76%)</td>
<td>744 (71%)</td>
<td>430 (60%)</td>
<td>465 (82%)</td>
<td>2,702 (72%)</td>
</tr>
<tr>
<td>Other/Not Listed</td>
<td>35 (3%)</td>
<td>48 (5%)</td>
<td>33 (5%)</td>
<td>8 (1%)</td>
<td>124 (3%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,390</strong></td>
<td><strong>1,051</strong></td>
<td><strong>721</strong></td>
<td><strong>568</strong></td>
<td><strong>3,730</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethnicity/Residency Unknown</th>
<th>Full</th>
<th>Associate</th>
<th>Assistant</th>
<th>Teaching Faculty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1,321</td>
<td>950</td>
<td>624</td>
<td>428 (75%)</td>
<td>3,323</td>
</tr>
<tr>
<td>Female</td>
<td>115</td>
<td>132</td>
<td>120</td>
<td>146 (25%)</td>
<td>513</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,436</strong></td>
<td><strong>1,082</strong></td>
<td><strong>744</strong></td>
<td><strong>574 (15%)</strong></td>
<td><strong>3,836</strong></td>
</tr>
</tbody>
</table>
Table 23: Faculty Losses

<table>
<thead>
<tr>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
| Died        | 5
| Retired     | 53
| Took Academic Position Elsewhere | 75
| Took Nonacademic Position | 54
| Remained, Changed to Part Time | 11
| Other       | 10
| Unknown     | 3
| **Total**   | **211**

Faculty Salaries (Tables 24-31)

- Average increases in salary levels at US institutions (CS only) ranged from 2.5% to 6.3%, with the smallest increase at the full professor level and the largest at the assistant professor level.
- The increase at the assistant level is higher than last year, but the increase at the full professor level is slightly lower.
- Canadian institutions reported larger increases ranging from 5.4% for full professors to 9.6% at the assistant professor level.

Faculty Demographics (Tables 17-23)

- The number of faculty in tenure-track positions increased by 226 (7%) over last year. The most interesting change in faculty demographics is the large increase in Canadian faculty sizes to 632 (see Table 18).
- Only 16% of the Ph.D. recipients (CS plus CE) were women (Table 2). The number of female professors remained stable at 16% for assistants, 12% for associates, and 8% for full. At this rate, it’s going to take a very, very, very long time to attain gender equity.

Rankings

- For tables that group computer science by rank, the rankings are based on information collected in the 1995 assessment of research and doctorate programs conducted in the United States conducted by the National Research Council.
- The top twelve schools in this ranking are: Stanford, Massachusetts Institute of Technology, University of California at Berkeley, Carnegie Mellon, Cornell, Princeton, University of Texas at Austin, University of Illinois at Urbana-Champaign, University of Washington, University of Wisconsin at Madison, Harvard, and California Institute of Technology.

1998-1999 Taulbee Survey

Schools in this ranking participated in the survey this year. One department declined to submit faculty salary information.

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

Faculty Salaries (Tables 24-31)

- Average increases in salary levels at US institutions (CS only) ranged from 2.5% to 6.3%, with the smallest increase at the full professor level and the largest at the assistant professor level (Table 24). The increase at the assistant level is higher than last year, but the increase at the full professor level is slightly lower.
- Canadian institutions reported larger increases ranging from 5.4% for full professors to 9.6% at the assistant professor level (see Table 29).

Acknowledgments

- Stacy Cholewinski, Jean Smith, and Bill Aspray assisted with survey revisions. Jean, Bill, Michael Corbin, and Jay Vegso assisted with the data collection, tabulation, and analysis. Frank Tompa followed up with Canadian departments. Stu Zweber, Chair of the CRA Surveys Committee, provided valuable guidance along the way. We thank them for their assistance.

Endnotes

- The title of the survey honors the late Orrin E. Taulbee of the University of Pittsburgh who conducted these surveys for the Computer Science Board until 1984, with retrospective annual data going back to 1970.
- Although the University of Pennsylvania and the University of Chicago were tied in the National Research Council rankings, CRA made the arbitrary decision to place Pennsylvania in the second tier of schools.

All tables with rankings: Statistics sometimes are given according to departmental rank. Schools are ranked only if they offer a CS degree and according to the quality of their CS program as determined by reputation. Those that only offer CE degrees are not ranked, and statistics are given on a separate line, apart from the rankings.

All ethnicity tables: Ethnic breakdowns are drawn from surveys conducted by the U.S. Department of Education.

All faculty tables: The survey makes no distinction between faculty specializing in CS versus CE programs. Every effort is made to minimize the inclusion of faculty in electrical engineering who were not computer engineers.
### Table 24. Nine-Month Salaries, 132 Responses of 155 US Computer Science Departments

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>429</td>
<td>$24,000</td>
<td>$48,609</td>
</tr>
<tr>
<td>Assistant</td>
<td>600</td>
<td>$40,000</td>
<td>$75,500</td>
</tr>
<tr>
<td>Associate</td>
<td>841</td>
<td>$42,616</td>
<td>$72,177</td>
</tr>
<tr>
<td>Full</td>
<td>1107</td>
<td>$45,600</td>
<td>$95,526</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>59</td>
<td>$24,470</td>
<td>$65,273</td>
</tr>
<tr>
<td>Assistant</td>
<td>84</td>
<td>$55,650</td>
<td>$69,414</td>
</tr>
<tr>
<td>Associate</td>
<td>89</td>
<td>$51,050</td>
<td>$79,686</td>
</tr>
<tr>
<td>Full</td>
<td>202</td>
<td>$45,600</td>
<td>$108,896</td>
</tr>
</tbody>
</table>

### Table 25. Nine-Month Salaries, 11 Responses of 12 US Computer Science Departments Ranked 1-12

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>46</td>
<td>$33,333</td>
<td>$57,296</td>
</tr>
<tr>
<td>Assistant</td>
<td>54</td>
<td>$61,192</td>
<td>$69,546</td>
</tr>
<tr>
<td>Associate</td>
<td>66</td>
<td>$61,811</td>
<td>$80,715</td>
</tr>
<tr>
<td>Full</td>
<td>172</td>
<td>$66,818</td>
<td>$108,595</td>
</tr>
</tbody>
</table>

### Table 26. Nine-Month Salaries, 12 Responses of 12 US Computer Science Departments Ranked 13-24

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>28</td>
<td>$38,000</td>
<td>$56,036</td>
</tr>
<tr>
<td>Assistant</td>
<td>75</td>
<td>$58,000</td>
<td>$67,301</td>
</tr>
<tr>
<td>Associate</td>
<td>81</td>
<td>$60,810</td>
<td>$77,710</td>
</tr>
<tr>
<td>Full</td>
<td>137</td>
<td>$67,574</td>
<td>$102,842</td>
</tr>
</tbody>
</table>

### Table 27. Nine-Month Salaries, 12 Responses of 12 US Computer Science Departments Ranked 25-36

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>296</td>
<td>$24,000</td>
<td>$44,693</td>
</tr>
<tr>
<td>Assistant</td>
<td>387</td>
<td>$40,000</td>
<td>$62,538</td>
</tr>
<tr>
<td>Associate</td>
<td>605</td>
<td>$42,616</td>
<td>$77,310</td>
</tr>
<tr>
<td>Full</td>
<td>596</td>
<td>$52,898</td>
<td>$91,164</td>
</tr>
</tbody>
</table>

### Table 28. Nine-Month Salaries, 96 Responses of 120 US Computer Science Departments Ranked Higher than 36 or Unranked

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>43</td>
<td>$35,500</td>
<td>$51,267</td>
</tr>
<tr>
<td>Assistant</td>
<td>91</td>
<td>$46,640</td>
<td>$64,862</td>
</tr>
<tr>
<td>Associate</td>
<td>139</td>
<td>$54,000</td>
<td>$77,109</td>
</tr>
<tr>
<td>Full</td>
<td>190</td>
<td>$58,086</td>
<td>$95,766</td>
</tr>
</tbody>
</table>

### Table 29. Twelve-Month Salaries, 19 Responses of 23 Canadian CS & CE Departments (Canadian Dollars)

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>103</td>
<td>$42,000</td>
<td>$64,283</td>
</tr>
<tr>
<td>Researcher</td>
<td>7</td>
<td>$40,200</td>
<td>$57,400</td>
</tr>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>13</td>
<td>$36,000</td>
<td>$50,861</td>
</tr>
<tr>
<td>Postdoc</td>
<td>11</td>
<td>$25,000</td>
<td>$36,833</td>
</tr>
</tbody>
</table>

### Table 30. Nine-Month Salaries for New Ph.D.’s, Responding US CS & CE Departments

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure-Track</td>
<td>103</td>
<td>$42,000</td>
<td>$64,283</td>
</tr>
<tr>
<td>Researcher</td>
<td>7</td>
<td>$40,200</td>
<td>$57,400</td>
</tr>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>13</td>
<td>$36,000</td>
<td>$50,861</td>
</tr>
<tr>
<td>Postdoc</td>
<td>11</td>
<td>$25,000</td>
<td>$36,833</td>
</tr>
</tbody>
</table>

### Table 31. Nine-Month Salaries, 5 Responses of 24 US CE Departments

<table>
<thead>
<tr>
<th>Faculty Rank</th>
<th>Number of Faculty</th>
<th>Reported Salary Minimum</th>
<th>Reported Salary Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Tenure Teaching Faculty</td>
<td>3</td>
<td>$29,024</td>
<td>$39,675</td>
</tr>
<tr>
<td>Assistant</td>
<td>26</td>
<td>$57,420</td>
<td>$62,942</td>
</tr>
<tr>
<td>Associate</td>
<td>53</td>
<td>$60,543</td>
<td>$70,781</td>
</tr>
<tr>
<td>Full</td>
<td>70</td>
<td>$66,393</td>
<td>$91,168</td>
</tr>
</tbody>
</table>

Page 11
Performance Computing and Communications program (HPCC), the Next Generation Internet initiative (NGI), and the short-lived Information Technology for the 21st Century initiative (IT). (Also, a portion of the Department of Energy's Accelerated Strategic Computing Initiative [ASCI], and some basic computing research programs not formerly counted as HPCC or IT, are now included under the IT R&D umbrella.) Collectively, IT R&D programs would receive nearly $600 million in new funding; the aggregate FY 2001 budget, $2.3 billion, would be about $1 billion more than FY 1999 spending.

IT R&D priorities for FY 2001 include: to exploit advances in computing; infrastructure for advanced computational modeling and simulation; more reliable software; storing, managing, and preserving data; intelligent machines and networks of robots; ubiquitous computing and wireless networks; managing and ensuring the security and privacy of information; future generations of computers; broadband optical networks; social, economic, and workforce implications of IT and educating and training a new generation of researchers.

Given the new classification, it is expected that the Administration will consolidate the various interagency coordination mechanisms for IT R&D programs. Following are descriptions of the budget requests of the major players in federal IT R&D efforts.

National Science Foundation

The National Science Foundation budget request for FY 2001 is $4.6 billion, an increase of $675 million, the largest requested dollar increase in the agency's history, and more than 17 percent above current funding. NSF Director Rita Colwell calls it a "21st century budget for 21st century science and engineering."*

Focused Initiatives. The NSF is highlighting four focused initiatives in FY 2001 (see Table 4), each of which would see its funding more than doubled.

- **NSF Research.** NSF's total support for research would be expanded by nearly 20 percent, to $3.54 billion in FY 2001. While the increases for the focused initiatives account for about $490 million of NSF's overall proposed budget increase, for the first time in many years a portion of the funding increment would be used to strengthen investments in core disciplinary research, including computing research.

In another notable development, the current plans for FY 2000 and FY 2001 would catapult CISE over Biological Sciences and Engineering as the NSF's third largest research directorate.

- **Computer and Information Science and Engineering.** The budget request for the CISE Directorate is $5.29 billion, an increase of $140.7 million (or 36 percent) over estimated FY 2000 spending. Most of the increase, $100 million, would be for the Information Technology Research program; an additional $40 million would be distributed among the traditional divisions and activities.

CISE's Information Technology Research (ITR) activity supports broad thematic, large-scale, long-term, basic computer science research, including research that entails a higher risk than that prevailing in established areas. Priority areas include: building "no-surprise," performance-engineered software and infrastructure systems; realizing broadband Internet access for tetherless devices; understanding, modeling, and predicting the behavior of networks; hardware/software co-design; multiplying individuals' physical and mental capabilities; meeting, working, and collaborating in cyberspace; building a ubiquitous content infrastructure for seamless retrieval of available information; and empowering computational discovery.

With the proposed FY 2001 increment, CISE would expand ITR to include support for connectivity programs; IT applications in biology; research to determine the reasons for the lower participation of women and minorities in IT education and career paths; research in interactive education; and mathematical methods underlying software, high confidence systems, and technical assistance on ways to make technology more accessible; research in methods for storage and access of scientific data to improve the use of existing resources; research on visualization and analysis for large, scientific data sets; research on new mechanisms for computing, such as quantum devices and DNA

Table 2. Information Technology R&D Funding by Agency

<table>
<thead>
<tr>
<th>Agency</th>
<th>FY 2000 Estimate</th>
<th>FY 2001 Proposed</th>
<th>FY 00-01 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Science Foundation</td>
<td>517.2</td>
<td>740.1</td>
<td>43%</td>
</tr>
<tr>
<td>Department of Energy</td>
<td>517.2</td>
<td>667.9</td>
<td>29%</td>
</tr>
<tr>
<td>Office of Science</td>
<td>120.0</td>
<td>190.0</td>
<td>58%</td>
</tr>
<tr>
<td>Accelerated Strategic Computing Initiative</td>
<td>397.0</td>
<td>477.0</td>
<td>20%</td>
</tr>
<tr>
<td>Department of Defense</td>
<td>282.0</td>
<td>397.0</td>
<td>41%</td>
</tr>
<tr>
<td>Defense Advanced Research</td>
<td>195.0</td>
<td>307.0</td>
<td>57%</td>
</tr>
<tr>
<td>Projects</td>
<td>77.0</td>
<td>80.0</td>
<td>4%</td>
</tr>
<tr>
<td>University Research Initiatives</td>
<td>10.0</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>Dept. of Health and Human Services</td>
<td>191.0</td>
<td>233.0</td>
<td>22%</td>
</tr>
<tr>
<td>National Institutes of Health</td>
<td>183.0</td>
<td>217.0</td>
<td>19%</td>
</tr>
<tr>
<td>Agency for Healthcare Research &amp; Quality</td>
<td>8.0</td>
<td>16.0</td>
<td>100%</td>
</tr>
<tr>
<td>NASA</td>
<td>174.0</td>
<td>230.0</td>
<td>32%</td>
</tr>
<tr>
<td>Department of Commerce</td>
<td>36.0</td>
<td>44.0</td>
<td>22%</td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
<td>4.0</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>

Total, IT R&D

1,721.2, 2,314.0, 35%

Table 3. National Science Foundation Budget

<table>
<thead>
<tr>
<th>Area</th>
<th>FY 1999 Actual</th>
<th>FY 2000 Estimate</th>
<th>FY 2001 Proposed</th>
<th>FY 00-01 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology Research</td>
<td>282.6</td>
<td>2,958.5</td>
<td>3,540.7</td>
<td>19.7%</td>
</tr>
<tr>
<td>Education &amp; Human Resources</td>
<td>662.5</td>
<td>690.0</td>
<td>729.0</td>
<td>5.5%</td>
</tr>
<tr>
<td>Major Research Equipment</td>
<td>56.7</td>
<td>93.5</td>
<td>138.5</td>
<td>48.2%</td>
</tr>
<tr>
<td>Administrative Expenses</td>
<td>149.5</td>
<td>154.3</td>
<td>164.2</td>
<td>6.4%</td>
</tr>
</tbody>
</table>

Total R&D

3,690.5, 4,389.2, 17.3%

Table 4. NSF Focused Initiative Budgets

<table>
<thead>
<tr>
<th>Initiative</th>
<th>FY 2000 Estimate</th>
<th>FY 2001 Proposed</th>
<th>FY 00-01 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology Research</td>
<td>126.0</td>
<td>326.9</td>
<td>159%</td>
</tr>
<tr>
<td>Nanoscale Science and Engineering</td>
<td>97.3</td>
<td>216.7</td>
<td>123%</td>
</tr>
<tr>
<td>Biocomplexity in the Environment</td>
<td>50.0</td>
<td>136.3</td>
<td>173%</td>
</tr>
<tr>
<td>21st Century Workforce</td>
<td>73.7</td>
<td>157.0</td>
<td>113%</td>
</tr>
</tbody>
</table>

Table 5. NSF Research Directorate Budgets

<table>
<thead>
<tr>
<th>Directorate</th>
<th>FY 1999 Actual</th>
<th>FY 2000 Proposed</th>
<th>FY 00-01 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Science</td>
<td>392.1</td>
<td>414.4</td>
<td>23.3%</td>
</tr>
<tr>
<td>Computer Information S&amp;E</td>
<td>298.6</td>
<td>388.4</td>
<td>32.2%</td>
</tr>
<tr>
<td>Engineering</td>
<td>370.1</td>
<td>456.5</td>
<td>19.6%</td>
</tr>
<tr>
<td>Geosciences</td>
<td>478.0</td>
<td>583.0</td>
<td>19.5%</td>
</tr>
<tr>
<td>Math &amp; Physical Sciences Social, Behav., &amp; Economic Sciences</td>
<td>733.7</td>
<td>881.2</td>
<td>16.3%</td>
</tr>
<tr>
<td>Integrative Activities*</td>
<td>161.6</td>
<td>119.2</td>
<td>-7.7%</td>
</tr>
</tbody>
</table>

*Includes major research instrumentation, the Opportunity Fund, and the Science and Technology Centers

With the proposed FY 2001 increment, CISE would expand ITR to include support for connectivity programs; IT applications in biology; research to determine the reasons for the lower participation of women and minorities in IT education and career paths; research in interactive education; and mathematical methods underlying software, high confidence systems, and technical assistance on ways to make technology more accessible; research in methods for storage and access of scientific data to improve the use of existing resources; research on visualization and analysis for large, scientific data sets; research on new mechanisms for computing, such as quantum devices and DNA

Continued on Page 13
or chemical-based techniques; fundamental research on networking to address needs such as increased users, new types of services, increased complexity of protocols, and wireless networked devices; research in biological applications such as genome sequencing and database tools to address these needs, and biomolecular computing, computational biology, and bioinformatics modeling; Support: development of new applications.

Another budget item slated for growth is research in support of the interagency Critical Infrastructure Protection R&D initiative. CISE would increase its by $4 million (most expected to come from the ITR activity) to a total of $29 million in FY 2001. This initiative provides for research in networking, high performance computing, and software that will enable computer and communications systems to be safer, more reliable, and free from intrusions.

Across its programs, CISE intends to increase the average size of awards by 10 percent and the average duration of awards to 3.3 years to meet NSF-wide objectives for FY 2001.

The Department of Defense

The Department of Defense’s FY 2001 budget request for research, development, test, and evaluation (RDT&E) is $77.8 billion, down from estimated FY 2000 spending of $83.3 billion. However, basic research at DOD would increase by about 5 percent to $1.2 billion. There are three DOD components included in the IT R&D crosscut: 1) a portion of support from the Defense Advanced Research Projects Agency for computing and communications R&D (see below); 2) $80 million for the National Security Agency’s Advanced Research and Development Activity (ARDA), a joint effort of the Department of Defense and the intelligence community to support long-term research on problems and enabling technologies relevant to intelligence and information assurance; and 3) $10 million for fundamental IT research within the DOD-wide University Research Initiative, a competitive program managed through the office of the Director of Defense Research and Engineering.

ARDA also participates in the Critical Infrastructure Protection R&D initiative; the National Security budget would be $463 million in FY 2001 or 10 percent above FY 2000, or current spending of $418 million.

Defense Advanced Research Projects Agency. While support for RDT&E would decrease at each of the service branches, DARPA’s budget request, at just under $2 billion, is 4 percent more than the estimated FY 2000 budget. There are three DARPA line items related to computing: Computing Systems and Communications Technology, with an FY 2001 budget of $377 million, 17 percent more than current funding; Next Generation Internet, whose budget would shrink from $36 million to $15 million in FY 2001, as the NNI initiative begins to wind down; and Extensible Information Systems, a line item created in FY 2000 to reflect DARPA’s participation in ITR. As it did in FY 2000, DARPA is requesting $70 million for Extensible Information Systems, up from the FY 2000 appropriation of $30 million.

Department of Energy

The Department of Energy’s FY 2001 theme is “Strength Through Science,” and indeed, R&D programs would grow by 8 percent, from $7.1 to $7.7 billion, under its budget plan. More than half of this R&D supports DOE’s defense and nuclear weapons mission. Spending on civilian R&D programs, conducted through the Office of Science, would grow to $3.2 billion, up from $2.8 billion in FY 2000, an increase of 13 percent. The office will emphasize a number of thrusts in FY 2001, including non-defense scientific supercomputing; nanoscale discovery, as part of the National Nanotechnology Initiative; and life sciences and bioengineering. DOE’s two computing programs—the Advanced Scientific Computing Research (ASCOR) activity in the Office of Science and the Accelerated Strategic Computing Initiative (ASCITI), a component of the Nuclear Stockpile Stewardship program—would both see healthy budget increases in FY 2001.

The ASCR budget would grow from $127.9 million to $182.0 million, a 42 percent increase. Under the FY 2001 plan, ASCR would emphasize computer modeling and simulation R&D in several key areas of basic science, including fusion, high energy physics, and genomics; development of scientific computing, networking, and collaboration tools needed by DOE researchers; and advanced scientific software that would enable unique, data-intensive collaborations of the future and meet terascale software challenges. DOE’s Accelerated

Strategic Computing Initiative, funded at $510.2 million in FY 2000, would increase to $585.2 million in FY 2001.

Portions of both ASCIR and ASCITI funding are included under the IT R&D crosscut, as are some smaller efforts in other disciplines supported by the Office of Science.

Other Agencies

National Institutes of Health. The NIH budget would total $18.8 billion in FY 2001, an increase of $1 billion (or 5.6 percent) over last year’s funding level. One of NIH’s budget thrusts is Foster Interdisciplinary Research, and it includes a new Biomedical Information Science and Technology Initiative (BISTI). For several years, NIH has been emphasizing that progress in biomedical research depends on expertise from many disciplines beyond the traditional ones of biology and medicine, including computing and computational expertise. BISTI is designed to address these needs, and will include support for National Programs of Excellence in Biomedical Computing Support: development of new tools and technologies to handle the increasing amount of biomedical data; training of bioinformatics specialists to address emerging research needs; and Centers of Excellence in Genomic Science. A portion of BISTI funding, $217 million in FY 2001, is counted as part of the IT R&D initiative.

On February 15, as CRN was going to press, the House of Representatives passed the Networking and Information Technology Research and Development Act (H.R. 2086) by voice vote. The legislation, which was sponsored by House Science Chairman James Sensenbrenner and endorsed by CRA, would authorize nearly $7 billion for high performance computing and information technology research programs at seven agencies over the next five years and reorient the federal investment toward fundamental research. For more information, please see: http://www.cra.org/govaffairs/issues/nitr.html.

By 1996, the world was changing rapidly: e-commerce was becoming a hot topic, companies were starting toannonce e-commerce products, and it appeared that the world would soon be ready for the system EPR was designing. Owners of IP (particularly music and video) were becoming painfully aware that a pirated digital copy posted on the Web could be rapidly duplicated anywhere in the world, and that they had no effective protection against digital piracy. It was time for EPR to prepare to launch its product. This called for an order-of-magnitude expansion. EPR recruited substantial engineering and business development groups to complete a production system and to arrange partnerships. It also changed its name to InterTrust Technologies Corporation.

Shear had always planned that, as the company grew, the development and advanced development groups would eventually be supplemented by a full-scale research lab. While engineering focused on building products on schedule, another group would be responsible for ensuring that the company had adequate technical options further down the road.

By the end of 1996, internal and external developments made it clear that “eventually” should come very soon. We could see several key problems requiring research that we could not rely on anyone else doing for us. At the same time, potential partners were looking for clear evidence that InterTrust would maintain the technological lead that had resulted from its head start. Shear asked me to develop a proposal for a research lab. Much of my proposal was based on a

InterTrust from Page 1

which they could compete with each other in a variety of vertical applications, such as music, books, news, and software. As a utility, it would not compete with any of them itself. Its primary revenue source would be a small fraction of each transaction in the system (rather like the credit card companies, but a smaller percentage). Thus its income would be directly related to the success of its partners in using its system for real commerce. This model has survived essentially intact.
such as those mentioned above. Our research in a broad range of areas, significant new results. Students can research investigation leading to program culminates in an original ongoing professional activities of the in a classroom course and a studio/ requirement, and preparation for the research proposal. The last two years will be principally devoted to research, including thesis work and contributions to a sponsoring project. Students without significant prior industrial experience should expect to spend up to an additional year gaining practical experience. The authors are members of the Institute for Software Research International in the School of Computer Science at Carnegie Mellon University, Pittsburgh, PA 15213, isri@cs.cmu.edu, www.isri.cs.cmu.edu.

March 2000 COMPUTING RESEARCH NEWS

InterTrust from Page 13

on what I learned from nearly twenty years of closely observing Bob Taylor at Xerox PARC and DEC/ SRC, adapted to the very different environment at InterTrust and to Shear's vision for the new laboratory. Working closely with John Guttag, I wrote draft Roles, Principles, and Charter documents and had them reviewed by several people.

The proposed mission of the lab was to conduct research and related activities that would ultimately benefit InterTrust. More specifically, it was to:

- Maintain and increase InterTrust's lead in relevant technologies;
- Invent and discover technologies that would create new business opportunities;
- Track the state-of-the-art and advise InterTrust on its strategic implications;
- Ensure that relevant technology became part of InterTrust's product and products;
- Consult with all parts of InterTrust on issues related to technology; and
- Demonstrate that InterTrust could govern its own technological destiny.

InterTrust's executives accepted my proposal with only minor modifications. Large parts of it are still on our website (http://www.star-lab.com/details.html) and form the continuing basis of our operation. InterTrust established the Strategic Technologies and Architectural Research Laboratory in February 1997. We believe it was the first lab fully devoted to research in digital rights management and related electronic commerce technologies. At that time, the company had about 60 employees, and the lab had two members. Since then, the company has grown more than three-fold, and STAR Lab has grown to 14 members, including Susan Owicki, Bob Tarjan, Jim Donath, Andrew Goldberg, and younger members with "STAR potential." With strong support from management, we expect substantial continued growth, limited mainly by our ability to recruit people of the requisite quality, talents, and interests. STAR Lab is intentionally co-located with the rest of the company, physically closest to advanced development and product development. We also have surprisingly strong ties to marketing and business development, and try to minimize barriers to interaction with all parts of InterTrust. Not being in a large company helps. More importantly, the lab is populated by researchers who have a keen interest in doing research that changes the world and who are willing to put extra effort into communicating their ideas. STAR Lab spans the spectrum from theoretical to applied research. However, on another spectrum, from strategy-driven to curiosity-driven, most of its projects are near the strategic end. That is, they are motivated more by potential needs of InterTrust than by "a pure sense of wonder." In Donald E. Stokes's classification, STAR Lab works in "Pasteur's Quadrant" and "Edison's Quadrant," rather than "Bohr's Quadrant." STAR Lab's most valued results are those that inform and influence InterTrust's business and technical strategies.

STAR Lab members are working in a variety of areas, including: languages for electronic contracts; theory of auctions for digital goods; secure databases; system security and cryptography; software self-defense; code obfuscation; secure hardware; and digital watermarking. We will be starting work in a number of related areas, when they meet the following three criteria:

1. The result could be important to InterTrust.
2. We have, or can obtain, the necessary expertise.
3. There is a plausible idea to pursue.

I am now ready to return to the original question, "How can InterTrust afford a substantial research lab?" Given that:

- InterTrust has largely developed its own technology and sees many important research problems ahead that we dare not wait for others to solve for us;
- The field is so large that InterTrust needs strong bonds to the larger research community;
- InterTrust's partner strategy depends on its promise of continuing technological leadership;
- InterTrust's success in competing with giant companies is buttressed by its strong patent position; the real question is, "How could InterTrust afford not to have a first-class research lab?"

Dr. Hornig is the director of InterTrust's Strategic Technologies and Architectural Research Laboratory (http://www.star-lab.com).

Ph.D. from Page 4

software design and programming experience as a member of a system team, is a strong asset. We expect that students entering the program will have experience equivalent to three or more years with an industrial software development team. Students with less quantity or quality of experience will spend more time during the program gaining practical experience through internships, practicums, and other engagements. Extensive, high-quality software development experience may substitute for some of the normal requirements. We especially value the perspective that senior software developers can bring to a research program.

Program Requirements

The program requires eight courses, distributed across software design and engineering, systems, analysis, and economics or public policy. Two of these courses are principally practical experience courses. In addition to the course requirements, students must demonstrate proficiency in speaking and writing, and as a teaching assistant in a classroom course and a studio/ project course, and participate in ongoing professional activities of the ISRI.

As in any Ph.D. program, the program culminates in an original research investigation leading to significant new results. Students can do research in a broad range of areas, such as those mentioned above. Our focus is on systems that exploit the growing infrastructure for high performance, nearly ubiquitous computing and communication, especially systems that the public depends on for services provided through the electronic marketplace. The research approach for each project will be selected to match the needs of the project. Approaches appropriate to Ph.D. theses include (but are not limited to):

- Novel methods for software development;
- Automated support for software activities;
- Descriptive models that generalize from practical examples;
- Empirical models with predictive power;
- Implementation techniques for novel applications;
- Measurement techniques for system evaluation;
- Guidance for making classes of design decisions;
- Analytic models that permit quantitative or symbolic analysis.

We anticipate that the program will require four years to complete. In the first two years, most students will complete the courses, teaching requirement, and preparation for the research proposal. The last two years will be principally devoted to research, including thesis work and contributions to a sponsoring project. Students without significant prior industrial experience should expect to spend up to an additional year gaining practical experience.

Gender from Page 2

single-sex schools. If our students map their own values onto their expectations of others they may well find it difficult to reconcile what is, to them, unexpected behavior.

What Next?

The provision of extra tutorials at Leeds was intended to help all students equally, but this has not been the effect. The female students have used them as a means to receive extra instruction, and the male students have interpreted this in their own terms: staff preferring to actually help the male students who are struggling.

For the 1999-2000 session we decided to run the classes as before. This could be justified because another method of help-seeking, an anonymous, web-based question-asking facility, was introduced at the same time. Previous experience at Kent has suggested that this would be used more by the male students. At the same time, it was decided to confront some of the issues raised previously. When the classes were announced, it was also announced that past form indicated that only the females would apply. It was suggested that this was fine if the male students were happy with the other support available, but if the gender gap is not to be joined by women, the balance of the whole class remained much as before. Anecdotal evidence suggests that male students exclusively are using the anonymous question-asking facility. Overall, our experiences suggest that a range of help provision and help-seeking opportunities must support introductory programming. But, importantly, the students need to be made aware of the range of facilities, and that some of them are more obvious than others.

Janet Carter, from the Computing Laboratory, University of Kent at Canterbury, UK (J.E.Carter@ukc.ac.uk), mainly teaches Mathematics to Computer Science undergraduates and has taught MSc students. Her research interests lie within Computer Science Education with a particular interest in how students learn and gender issues. Tony Jenkins, School of Computer Studies, University of Leeds, UK (tony@cs.leeds.ac.uk), teaches on several Computing modules, including first-year programming. His research interests lie within the venue of Computer Science Education, with his main areas of interest being motivation and gender issues.
Professional Opportunities

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

The rate is $2.25 (U.S.) per word. Purchase orders, money orders, and checks are acceptable (please do not send cash). All CRN’s members receive 200 free words per dues. CRN’s standard advertising package consists of running an ad in CRN, and distributing it electronically to CRN’s jobs listserve and webpage (where it remains for no less than two months). As an alternative to this package, advertisers may request that their Professional Opportunities ads just be published in CRN or just distributed electronically. The cost of the ad is the same whether the standard or the electronic package is selected.

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

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

Bucknell University
Department of Computer Science
Applications are invited for one or more one-year entry-level visiting assistant professor positions beginning mid-August, 2000. A Ph.D. in Computer Science or in Computer Engineering is preferred, but individuals with substantial progress towards such a degree will be considered. A demonstrated interest in and promise of excellence in teaching is important. All research areas will be considered, but networks and operating systems are particularly desired. These positions will be very competitive.

The computing environment for instruction, research, and laboratories consists of nearly 70 SUN workstations. For more information on our program visit our web page at http://www.cs.bucknell.edu.

Applications will be considered as received and recruiting will continue until the position is filled. Candidates should submit a letter of interest, a curriculum vitae, and the names of three references to: Jerry Mead, Acting Chair, Dept. of Computer Science, Bucknell University, Lewiston, PA 17045.

Bucknell encourages applications from women and members of minority groups (REU).

California Institute of Technology
Computer Science Department
Caltech invites applicants for tenure-track or tenured faculty positions in Computer Science. The Computer Science department is linked with Electrical Engineering and other disciplines. Faculty matches have been approved for positions in the broad area of Computer Science including, but not limited to:

- Computer Networks
- Database Systems
- Parallel and Distributed Computing
- Multimedia and Internet Data Systems
- Principles of Computer Science: Algorithms, Cryptography, and Logic

The principal requirements include demonstrated excellence in theory and experimental research, and the potential for high-quality teaching and mentoring. Candidates for a PhD in Computer Science or in a related field are encouraged to apply. The initial appointment term for tenure-track positions is four years.

Interested persons should send a one-page summary of their research and teaching plans, a resume, names of at least three references, a publication list, and a URL of a personal webpage that includes preprints of publications. Applications should be sent to:

CS Search
Caltech
MC 256-80
Pasadena, CA 91125

Caltech is an Equal Opportunity/Affirmative Action Employer. Women, minority members, veterans, and disabled persons are encouraged to apply.

Carnegie Mellon University
School of Computer Science
Carnegie Mellon University’s School of Computer Science seeks applicants for junior tenure-track faculty positions. Outstanding candidates in all areas will be considered. We are especially interested in candidates whose research lies in these areas:

- Algorithms
- Computational Applications
- Computer Systems
- Databases and Information Retrieval
- Electronic Commerce
- Computer Graphics
- Interactive Design
- Machine Learning
- Networking, Robotics, Security
- Software Engineering, and Speech

Candidates are expected to have a strong interest in both teaching and research, outstanding academic credentials, and an earned PhD. The successful candidate will be expected to initiate and carry out independent research, collaborate with other faculty, and teach both undergraduate and graduate level courses. The highly selective undergraduates and graduate programs in the School of Computer Science draw top students from across the world. Further information about the School of Computer Science may be found at http://www.cs.cmu.edu.

To apply, please send curriculum vitae, recent results and teaching statements, copies of 1-3 representative papers, and three letters of recommendation to:

Sharon Burke, Assistant Dean
School of Computer Science
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3891

We also welcome electronic applications (in PDF or PostScript format) to: faculty-search@cs.cmu.edu.

For full consideration, applications should be received by March 1, but will be accepted applications until the positions are filled. Carnegie Mellon is an affirmative action/equal opportunity employer and we invite and encourage applications from women and minorities.

College of William & Mary
Department of Computer Science
Faculty Position
Applications are invited for a tenure-track faculty position in Computer Science to begin either Fall 2000, Spring 2001 or Fall 2001 at either the associate or assistant level. Applicants must hold a Ph.D. in computer science or computer science. Appointment at the assistant or associate level requires that the applicant must hold a Ph.D. at the time of appointment and demonstrate strong interests in both research and teaching. Appointment at the associate level requires a documented record of sustained excellence in both research and teaching. We are particularly interested in individuals with research expertise in one of the following areas: high performance parallel computing, parallel and distributed numerical algorithms, networks, visualization, and scientific databases. However, applicants from all areas of computer science or computational science will be considered. A demonstrated interest in multi-disciplinary applied research is highly desirable.

The department currently consists of fifteen faculty members who support B.S., M.S. and Ph.D. programs graduating approximately 40 B.S. students annually and enrolling approximately 40 M.S. and 40 Ph.D. students. Teaching loads and salaries are consistent with those in other Ph.D. granting departments. More information about the department and the College can be obtained by connecting to the Web server http://www.wm.edu.

The department maintains a contemporary computing environment for both research and instruction. Our computer science environment is highly competitive.

The College of William & Mary is an Equal Opportunity/Affirmative Action Employer. Women and members of minority groups (REU) are encouraged to apply.

Faculty Search Committee
Department of Computer Science
College of William & Mary
PO. Box 859
Williamsburg, VA 23187-8795
Questions can be mailed to search@cs.wm.edu. Review of candidates will begin immediately and continue until the position is filled. This is an EEO/AA employer.

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Dalhousie University
Computer Science Department
Applications are invited for tenure-track positions at all levels within the new Faculty of Computer Science. The Faculty has a complement of 23 faculty positions and approximately 600 undergraduate majors and 15 faculty and 300 graduate students. The expansion and development of the Faculty is a priority for the University.

The Faculty will continue to experience considerable growth over the next few years in all aspects of faculty complement, student enrolment, funding levels and facilities. This position recently moved to a new building and has secured significant infrastructure funding for 2000-2001. New research laboratories are planned, and initiatives involving multidisciplinary research projects with university and industrial partners are under development. As an example a new Master of Electronic Commerce degree is now offered in collaboration with the Faculty of Law at Dalhousie.

Applications should include a Ph.D. in Computer Science or a related area and a strong commitment to and aptitude for teaching and research. Rank and salary will be commensurate with qualifications. The major research focus of the Faculty is in Network Computing and Software Engineering.

Individuals with expertise in these and related areas, such as, networking, HCI, distributed applications, etc., are especially encouraged to apply. Successful candidates will be required to teach in both the undergraduate and graduate programs, to establish research programs, to contribute to the administration of the Faculty and will also be encouraged to establish significant research connections.

Dalhousie University is located in Halifax, Nova Scotia, in a major city on the eastern coast of Canada. Dalhousie University is an Employer of Equity and Affirmative Action and encourages applications from qualified Aboriginal peoples, persons with a disability, racially and socially visible peoples, and women.

Faculty Search Committee
Faculty of Computer Science
Dalhousie University
6000 University Avenue
Halifax, Nova Scotia Canada
B3H 1N4
E-mail: appointments@dal.ca
URL: http://www.dal.ca

Applications will be reviewed on an ongoing basis until the position is filled.

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Dalhousie University is an Employer of Equity and Affirmative Action and encourages applications from qualified Aboriginal peoples, persons with a disability, racially and socially visible peoples, and women.

Dalhousie College
The Department of Computer Science at Dalhousie College invites applications for tenure-track positions in computer science. The department seeks strong candidates in systems areas.

A Ph.D. in computer science is required. We are particularly interested in candidates from people able to contribute to the local needs for software studies at Dalhousie. Applications should be directed to:

The Chair, Appointments Committee
Faculty of Computer Science
Dalhousie University
6000 University Avenue
Halifax, Nova Scotia Canada
B3H 1N4
E-mail: appointments@dal.ca
URL: http://www.dal.ca

Applications will be considered as received and recruiting will continue until the position is filled. The deadline for the May issue is April 1. Please address all correspondence to Professor David Kett at Chair, Computists International.

Dalhousie College is an equal opportunity
Affirmative Action Employer.

Duke University
Department of Electrical and Computer Engineering
The Department of Electrical and Computer Engineering is seeking candidates for tenure-track or tenured faculty members, with particular emphasis in the area of Computer Engineering (with primary interest in the subfields of networking, computer architecture and software engineering). Candidates with a Ph.D. in electrical and computer engineering or a related field, an outstanding record of research and publications, and a commitment to a diverse and inclusive environment. Please apply by sending a resume, a statement of research and teaching interests, and three letters of recommendation. Applications should be sent to:

Search Committee - Computer Engineering
Dept. of Electrical and Computer Engineering
Duke University
Durham, NC 27708-0291

Duke University is an equal opportunity/ affirmative action employer.

Duke University
Department of Electrical and Computer Engineering
The Department of Electrical and Computer Engineering is seeking candidates for tenure-track or tenured faculty positions, with particular emphasis in the area of Computer Engineering (with primary interest in the subfields of networking, computer architecture and software engineering). Candidates with a Ph.D. in electrical and computer engineering or a related field, an outstanding record of research and publications, and a commitment to a diverse and inclusive environment. Please apply by sending a resume, a statement of research and teaching interests, and three letters of recommendation. Applications should be sent to:

Search Committee - Computer Engineering
Dept. of Electrical and Computer Engineering
Duke University
Durham, NC 27708-0291

Duke University is an equal opportunity affirmative action employer.
Florida Atlantic University

Department of Computer Science and Engineering

College of Engineering

The Department of Computer Science and Engineering seeks applications for at least one tenure-track faculty position at the Associate Professor level. A strong record in collaborative research in human-computer interaction, or a closely related field is required. The appointment will begin Fall 2005. Review of applications will begin from February 1, 2005 and will continue until the positions are filled. Salary, benefits, and teaching load are competitive.

The Department has several well-equipped laboratories. It interacts closely with many high-tech companies located in the area, which have helped provide state-of-the-art facilities. We have an active research program, with both federal and industrial sponsors. More information about the Department can be accessed through the World Wide Web at http://www.cse.fau.edu.

Applicants should send a resume, including the names, phone numbers, and email addresses of at least three professional references, along with a letter certifying teaching and research interests, to Faculty Search Committee, Department of Computer Science and Engineering, Florida Atlantic University, 777 West Glades Road, Boca Raton, Florida 33431. Email mail communications should be addressed to: searchcsm@fauc.edu.

Harvard University

Program in Artificial Intelligence: Natural Language Processing

A Candidate should hold a Ph.D. in computer science or a closely related discipline. The position is available immediately. Interested applicants should send a resume and letter of reference to: Ronda Scott, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 424, Cambridge, MA 02138

Harvard University

Post-doctoral Researcher: Collaborative Human-Computer Interface Design Project

This research project aims to provide the scientific basis to enable the principled design of multi-modal dialog- supporting interfaces. The project comprises three interrelated activities: specialization of a general theory of collaboration, SharedPlace, provide a framework for the design of collaborative interfaces; application of the theory to human-computer interface design leading to a set of design principles enabling system designers to construct interfaces that communicate well to multiple modalities, and implementation of specific collaborative interfaces in a range of domains. The postdoctoral position includes both theoretical research and software implementation.

The successful candidate will have a Ph.D. in computer science, and interests in human-computer interaction or artificial intelligence, particularly in human-robot interaction. Starting date is negotiable. Interested applications will be accepted until the position is filled. A salary of $39,997 is available and may be commensurate with expertise.

University of New York

Department of Computer Science

The rapidly expanding Computer Science Department at Hunter College CUNY seeks an outstanding scholar to fill the position of Lecturer, effective September 2009. Candidates should have a Master’s degree in Computer Science or a closely related field; some doctoral work is preferred. A minimum of three years experience in undergraduate/college teaching is required, along with an exceptional record of classroom instruction and active student engagement. Candidates must be capable of teaching a wide-range of introductory, lower division, and upper division courses in the under-graduate computer science curriculum. Duties also include course coordination for multi-section courses, curriculum development, and curriculum innovation. Lecturers are expected to teach seven to nine courses per year.

The salary range is $42,997 - $54,114, commensurate with expertise and experience. Hunter is a predominately undergraduate institution with a longstanding commitment to excellence in teaching. Qualified applicants should send a letter of application, a detailed resume, and three letters of reference to: Chair, Department of Computer Science, Hunter College CUNY, 695 Park Avenue, New York, N.Y. 10021

Kennesaw State University

Computer Science and Information Systems Department

Kennesaw State University invites applications for a tenure-track position at the rank of Assistant Professor beginning with the 2005-2006 academic year. The successful candidate will possess a Ph.D. in Computer Science or closely related computer science research or industrial experience in this area. Preference will be given to candidates whose specializations in any area of computer science are especially encouraged to include those in software engineering, computer systems, network and computer security, database systems, and programming languages. In summary, we welcome applications from exceptionally qualified candidates whose specializations fit in any area of our rapidly expanding research areas. Candidates should send a letter of application, curriculum vitae, and three letters of recommendation to:

Kennesaw State University

Computer Science and Information Systems Department

Kennesaw, GA 30144-5591

Dr. Melvin Myers

Chairperson

Computer Science

Kennesaw State University

1000 Chastain Road

Kennesaw, GA 30144-5591

http://science.kennesaw.edu/
Review of applications will begin March 1, 2000. Positions will remain open until filled.

OCU is an Affirmative Action/Equal Opportunity Employer and has a policy of non-discrimination in employment.

Purdue University
School of Electrical and Computer Engineering
Purdue University, School of Electrical and Computer Engineering, seeks outstanding candidates in computer engineering for research and teaching in the following areas: artificial intelligence, compilers, computer architecture, computer networks, distributed systems, multimedia, operating systems, software engineering, VLSI and CAD. Strong candidates in all areas of computer engineering are encouraged to apply. Open rank position, including a statement of research and teaching interests and a list of at least three references, is available.

Head of School, Electrical and Computer Engineering
Purdue University
1291 E. Building
West Lafayette, IN 47907-1285
Applications will be considered as they are received. Purdue University is an Equal Opportunity/Affirmative Action employer.

Rensselaer Polytechnic Institute
Electrical, Computer, and Systems Engineering Department invites applications for several open tenure-track positions in Computer Engineering starting in Fall 2000. All areas of computer engineering are of interest. The candidates must have a Ph.D. in Computer Engineering or equivalent. While we are looking for primarily Assistant Professors, appointment of candidates with outstanding academic or industrial research experience and leadership at the Associate and Full Professor levels will also be considered. Rensselaer has identified Information Technology and Bioengineering as two key research areas for new investment. The candidates are expected to play key roles in these areas.

Dean of the College and Director of the Computer Science Education program has funded initiatives to develop high performance solvers on Teraflop-flop parallel and high speed serial computers. Future research will focus on both the high speed serial and the high performance parallel computer architectures. The goal is to provide significant computational facilities, including access to a number of high performance, fast access storage systems. These facilities will be used by a number of different research projects, including our own, in the areas of computer science, electrical, computer and systems engineering, and related fields. We are especially interested in candidates with teaching and research interests in areas such as parallel computing and distributed systems. We are especially interested in candidates who can contribute to our international and national professional networks. We are committed to increasing the diversity of our faculty, and encourage applications from women and minorities.

Dr. Joe H. Chow, Acting Chair
Electrical, Computer and Systems Engineering
School of Chemical, Materials and Aerospace Engineering
Rensselaer Polytechnic Institute
Troy, NY 12180-3190
Email: chowj@rpi.edu
For more information, see RPI's web page (http://www.rpi.edu/). Rensselaer is an affirmative action/equal opportunity employer and specifically encourages applications from women and underrepresented minority groups.

State University of New York at Buffalo
Department of Computer Science & Engineering
Teaching Faculty
The Department of Computer Science and Engineering at the University at Buffalo (SUNY) is strongly committed to hiring and retaining tenure-track faculty. We anticipate openings for 5 such positions beginning Fall 2000. Initial appointments would be for 1-3 year terms. This is a career-oriented, non-tenure-track appointment, normally limited to an unlimited number of year terms.

Candidates for these positions must have at least an MS degree in computer science or engineering, or related field, by September 2000, and strong teaching credentials. Holders of the Ph.D. are eligible for the more prestigious title of Teaching Assistant Professor and for consideration for tenure-track positions. Duties include teaching and development of undergraduate Computer Science and Engineering courses with an emphasis on lower-division courses, advising undergraduate students, and participation in department and university governance.

Applications are invited for the position of Lecturer.

SUNY is an Equal Opportunity/Affirmative Action Employer.

Texas A&M University
Department of Computer Science
Applications are invited for several tenure-track and visiting faculty positions. Outstanding candidates at all levels and in all subjects are expected.

Applications should be submitted to: Professor John G. Webster, Dean

Applications should include a letter of application, indicating the type of position for which they are applying, a curriculum vitae, and at least three references, to: Professor John G. Webster, Dean, Department of Computer Science, Texas A&M University, College Station, Texas 77843-3112. Applications will be accepted until the positions are filled.

Faculty Search Committee
Department of Computer Science
Texas A&M University
College Station, TX 77843-3112

Applications are invited for several tenure-track positions. Excellent candidates at all levels are encouraged to apply. The Department of Computer Science at Texas A&M University is an affirmative action/equal opportunity employer committed to diversity in the educational, research, and service mission of the university. Texas A&M University is an Equal Opportunity/Effort Employer.

Texas A&M University encourages applications from women and minorities.

University of Missouri-Rolla
Department of Electrical, Computer, and Engineering Education
Applications are invited for an assistant professor position in computer science education with an emphasis on curriculum development and teaching. The successful candidate will be expected to develop innovative curricula and materials and to demonstrate excellence in teaching. The position will be available beginning Fall 2000. Texas A&M University is an affirmative action/equal opportunity employer committed to diversity. Applications from women and minorities are strongly encouraged.

Applications should be submitted to: Dr. Susan H. Yarlagadda, Director, Department of Computer Science, Texas A&M University, College Station, Texas 77843-3112.
Professional Opportunities

United Technologies
Research Center

United Technologies Research Center (http://www.utc.com) has a broad research program with the objective of developing novel concepts that enhance the characteristics of United Technologies Corporation (http://www.UTC.com) products. These well-known products include Otis elevators, Carrier air conditioners, Pratt & Whitney jet engines, Sikorsky helicopters, International Fuel Cell and Hamilton Sundstrand aerospace systems.

The information, Computer & Communication Technology department at UTC is expanding its activities in the areas of:

- Embedded Computing Architectures & R&D
  This activity involves defining, developing, and evaluating hardware, software, and communication architectures that address performance, reliability, availability, fault detection, isolation, and graceful degradation while enhancing the control and communications of embedded computing products. (Refer to Job # H CCT-3035-0067)

- Signal Processing, Communications, and Diagnostics R&D
  This activity involves developing, running, and evaluating computer routines that address linear/non-linear signal processing, communication system design and analysis, and diagnostics and prognostics. (Refer to Job # H CCT-3035-0067)

Both activities are fundamental to UTC’s R&D programs. Additional job duties include interacting with technical managers, experimental technicians, computer architects, and control engineers. Job responsibilities include the design of technical approaches, the communications of technical information to diverse audiences, and the efficient use of modern computer tools.

Qualifications:
- Masters degree in EE, CE, or CS, plus solid knowledge of the theory and practice of signal processing, communications, controls, diagnostics, and prognostics. Also required are excellent programming and mathematics skills, and strong result orientation.

Preferred Qualifications:
- Ph.D. in EE, CE, or CS, plus interest/experience in system level solutions and computer simulation techniques. Formal or informal experience in a variety of application domains is also an asset.

Please submit a cover letter, resume, and any applicable publications. Include references from at least two people who are qualified to evaluate your work. Send to: employment@utc.com, mail to: United Technologies Research Center, 411 Silver Lane, East Hartford, CT 06108, or fax to: 860/610-7835.

UTC is an equal opportunity employer.
The University of South Carolina invites applications and nominations for the position of Chair, Department of Computer Science and Engineering (CSE). CSE is one of five departments with accredited degree programs in the College of Engineering, Computing and Information Technology. It was formed in October 1999 through the merger of the Computer Science and Computer Engineering programs. The department currently has 18 full-time faculty members; it is scheduled to grow to about 50 within 5 years with additional support from a planned $40 million state-of-the-art “innovation center”. It offers Bachelors, Masters and Doctoral degrees in Computer Science and Computer Engineering and a BS degree in Computer Science and Computer Systems. It anticipates establishing additional masters-level degree programs in Software Engineering, Network Engineering, and Information Systems Engineering. The department faculty have research strengths in artificial intelligence, communications, computational science, computer engineering, and advanced database technology. The position requires an individual with exceptional leadership and research skills. Candidates interested in the new department during a period of high growth and expansion. Candidates must have a Ph.D. in computer science, computer engineering, or a closely related field and credentials appropriate for appointment at the rank of tenured full professor. The candidate will be expected to work with industrial leaders to foster economic development of computing within the state of South Carolina. The successful candidate will have a commitment to the mission of a major research university, the ability to create a shared vision, and the ability to build and lead the department. Strong experience in the application of information technology is highly desirable. Prior management experience in academic, business, or government is also highly desirable.

The University of South Carolina is a comprehensive public university serving 26,000 students in the state’s capital city, within a metropolitan area of approximately 450,000 residents.

Please send applications, nominations, and inquiries to: Dr. Larry Druffel, Chair, CSE Chair Search Committee, College of Engineering, Computing and Information Technology, University of South Carolina, Columbia, SC 29208, or e-mail: ldruffel@cse.sc.edu. The search committee will be determined to receive nominations or applications via e-mail. A curriculum vitae should accompany the letter of application or nomination, along with the names of at least three references. Letters of reference will not be sought for candidates prior to their formal application. Letters of reference will be requested of candidates prior to their formal application.

University of Nevada, Reno
Department of Computer Science
Applications are invited for tenure-track Assistant or Associate Professor position beginning in August, 2000. A Ph.D. in Computer Science or Computer Engineering is required by the date of appointment. Candidates should possess a proven potential and strong commitment to quality research and teaching at the undergraduate and graduate levels. Candidates with expertise in one or more of the following areas may be given preference: software engineering, operating systems, programming languages, human-computer interaction, networking, databases, graphics and algorithms. The department is dynamic, growing and offers B.S., M.S. and Ph.D. degrees. Visit www.cs.unr.edu or email yl.varol@cs.unr.edu for further information. The Reno area has four mild seasons and is a scenic half-hour drive to Lake Tahoe, one of the largest and most beautiful alpine lakes on the planet. The Pacific Coast Trail is nearly for hiking and fantastic ski areas abound. San Francisco and the Silicon Valley are within a short daily drive. To apply, send a letter, vita, and three letters of reference to:

Y. L. Varol, Chair
Computer Science Department
University of Nevada
Reno, NV 89557

Review of applications will begin March 17, 2000, and continue until position is filled. U.S.N.R. is an AA/EEO employer.

University of Rochester
Department of Computer Science
Applications are invited for tenure-track Assistant or Associate Professor position beginning in August, 2000. A Ph.D. in Computer Science is required by the date of appointment. Candidates should possess a proven potential and strong commitment to quality research and teaching at the undergraduate and graduate levels. Candidates with expertise in one or more of the following areas may be given preference: software engineering, operating systems, programming languages, human-computer interaction, networking, databases, graphics and algorithms. The department is dynamic, growing and offers B.S., M.S. and Ph.D. degrees. The University of Rochester invites applications for tenure-track positions. Candidates must have a curriculum vitae and the names of at least three references to:

Faculty Recruiting Committee
Department of Computer Science
University of Rochester
601 East River Road
Rochester, NY 14627-0226

Applications must include a curriculum vitae, copies of relevant papers, and the names and addresses of at least three references to:

Faculty Recruiting Committee
Department of Computer Science
University of Rochester
601 East River Road
Rochester, NY 14627-0226

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

University of Saskatchewan
Department of Computer Science
Applications are invited for two tenure-track faculty positions at the Assistant Professor level to start July 1, 2000. The Department is interested in receiving applications from candidates all areas of computer science. However, preference will be given to candidates interested in collaborative, applied research that cuts across traditional boundaries.

University of Saskatchewan
Department of Computer Science
Applications are invited for two tenure-track faculty positions at the Assistant Professor level to start July 1, 2000. The Department is interested in receiving applications from candidates all areas of computer science. However, preference will be given to candidates interested in collaborative, applied research that cuts across traditional boundaries.
Professional Opportunities

University of South Carolina

Faculties of Computing in Science and Engineering

Applications are invited for at least two tenure-track positions in computer science and engineering. The Faculty of Engineering is seeking candidates to fill the following positions:

- Professor of Computer Science
- Associate Professor of Computer Science

The Department of Computer Science at the University of South Carolina is a vibrant and cosmopolitan city, one of the most desirable in the US. This is a challenging and stimulating environment for research and teaching.

The Department of Computer Science offers a comprehensive curriculum with over 30,000 students. It offers B.S., M.S., and Ph.D. degrees in computer science. The Department is committed to excellence in teaching, research, and service.

Applications, which should include a curriculum vitae, statement of teaching and research interests, and three references, should be sent electronically to csrc@cs.sc.edu.

University of Virginia

Department of Computer Science

General Teaching Faculty

The Computer Science Department at the University of Virginia invites applications for outstanding teachers to teach general teaching faculty. Details include teaching University-wide service courses such as Computer Literacy and undergraduate courses for CS majors. An active interest in teaching in a research-oriented environment as well as in innovation in education is highly desirable. These positions are ideal for faculty interested in teaching excellent undergraduate courses within an innovative curriculum. For more information, please see the University of Virginia website. Applications should be sent electronically to csrc@cs.vt.edu.

Virginia Tech

Department of Computer Science

Applications are invited for tenure-track appointments at the rank of Assistant Professor or Associate Professor. The Department of Computer Science seeks candidates with a Ph.D. in Computer Science or related field (Physics, Mathematics, or Philosophy) of at least five years. There is no specific area of specialization.

Successful candidates for these positions must hold a Ph.D. degree, present evidence of outstanding scholarship, experience in teaching and research, and a strong commitment to service.

Applications should be submitted online at www.vtsis.org. Review of applications will begin immediately and continue until all positions are filled. Additional information about the department can be found at http://www.cs.vt.edu.

University of Utah

Department of Computer Science

Tenure-Track Faculty Positions

The Department of Computer Science at the University of Utah seeks candidates for tenure-track faculty positions at the rank of Assistant Professor, Associate Professor, or Full Professor. The Department of Computer Science has a strong commitment to interdisciplinary research, and we currently support 40 Ph.D. students.

Successful candidates for these positions must hold a Ph.D. degree and have a record of excellence in teaching and research. In addition, candidates should have a strong commitment to service and outreach.

Applications should be submitted online at www.cs.utah.edu. Questions may be directed via email to cs@apps@cs.utah.edu.

Widener University

Tenure Track Assistant Professor Position

Widener University seeks candidates for a tenure-track position at the level of Assistant Professor, in the Department of Computer Science. The university is located in the Philadelphia metropolitan area.

Successful candidates for this position will have a Ph.D. in Computer Science or a related field and have a strong commitment to teaching and research.

Applications should be submitted online at www.widener.edu. Questions may be directed via email to cs.app@widener.edu.