COMPUTING RESEARCH NEWS

A Publication of the Computing Research Association

May 2004 Vol. 16/No. 3

An Overview of Past and Projected Employment Changes in the Professional IT Occupations

By John Sargent

U.S. Department of Commerce

Professional information technology (IT) occupations have experienced both rapid growth and, most recently, higher-than-average job losses.

Professional IT occupations provided the lion's share of science and engineering job growth during the period 1991-2001. Computer system analysts and scientists and computer programmers together accounted for 79.4 percent of job growth in the science and engineering occupations during this period; if one also adds electrical/electronic engineers (many of whom are IT professionals), the total rises to 93.1 percent.[1]

Given the substantial role that professional IT occupations have played in high-wage job creation—directly and indirectly—and their importance to U.S. competitiveness, economic growth, and innovation, policymakers have focused attention on understanding this key labor market and the challenges associated with both rapid job growth and recent job losses in these occupations.

Accordingly, since the mid-1990s the U.S. Department of Commerce's Office of Technology Policy (OTP) has conducted extensive analysis of the characteristics of the IT workforce, the dynamics of the IT labor market, the IT education and training landscape, and potential policy implications.[2] This article presents an overview of OTP's analysis of IT occupational employment changes between 1990 and 2002, as well as OTP's analysis of the Department of Labor's Bureau of Labor Statistics' (BLS) projections for IT occupational growth through 2012. IT occupational growth/loss analyses for the 1990 to 2002 period discussed in this article are based on data from two sources: 1) the Current Population Survey (CPS), a product of the U.S. Department of Commerce's Census Bureau and BLS, and 2) the Occupational Employment Statistics (OES) survey, a BLS product.

These surveys used separate and distinct occupational classifications. In addition, the survey methodologies differ significantly; for example, CPS data are acquired through a survey of households, while OES data are derived from a survey of companies. As a result, the CPS and OES surveys arrive at different aggregate numbers for the IT workforce and thus are not directly comparable. Still, both surveys provide insight into the dynamics of the labor market for professional IT workers.

A Decade of Strong Employment Growth

Rapid advances in digital technologies and their widespread deployment throughout the economy fueled explosive growth in the demand for workers skilled in the development and use of information technology. Between 1990 and 2000, CPS data show that the number of jobs in professional-level IT occupations doubled, expanding from 1.2 million to 2.5 million. This translates into an annual growth rate[3] of 7.2 percent for these IT occupations, compared with 1.3 percent for all occupations during the same period.

Recent Losses in IT Occupational Employment

The IT occupational employment picture has been quite different since 2000. Between 2000 and 2002, OES data show that employment in the professional IT occupations fell 5.0 percent, significantly higher than total U.S. employment which fell only 1.7 percent. A variety of factors

Employment Changes Continued on Page 21

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CRA Announces 2004 Service Award Winners

CRA is pleased to announce the winners of its 2004 service awards, which will be presented at CRA's Conference at Snowbird, Utah, on July 12, 2004.

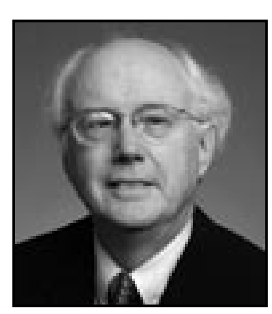
Distinguished Service Awards will be made this year to **David Clark**, Senior Research Staff, MIT Computer Science and Artificial Intelligence Laboratory, and to **Barbara Simons**, ACM Past-President and USACM Co-Chair.

Maria Klawe, Dean of Engineering and Applied Science at Princeton University, and **Nancy Leveson**, Professor, Department of Aeronautics and Astronautics at MIT, will jointly receive the A. Nico Habermann Award for their role as founding co-chairs of the highly successful CRA-W Committee.

CRA presents these awards, usually annually, to individuals for outstanding service to the computing research community. The Distinguished Service Award recognizes service in the areas of government affairs, professional societies, publications, or conferences, and leadership that has a major impact on computing research. The A. Nico Habermann Award honors the late A. Nico Habermann, former head of NSF's Computer and Information Science and Engineering Directorate. This award is given to an individual who has played a leadership role in aiding members of underrepresented groups within the computing research community. It recognizes work in areas of government affairs, educational programs, professional societies, and public awareness.

CRA Distinguished Service Awards

David Clark has deployed his technical expertise and scientific work in networking to serve the CS community in three arenas: 1) through Internet leadership and policy work, 2) through education, and 3) in service on the National Research Council's Computer Science and Telecommunications Board.



David Clark

Clark's Internet leadership reaches back to the 1970s and includes: Head, Internet Configuration Control Board, subsequently the Internet Activities Board and Internet Architecture Board; leadership of the Internet Research Steering Group, including involvement with the Internet Engineering Task Force; one of the framers of end-to-end arguments; and nurturance of nation-wide collaborations among network researchers, through SIGCOMM and less formally.

Clark's service on CSTB, which dates back to 1987, has been extensive. He has chaired CSTB since 1996, helping to grow the Board's

Service Award Winners Continued on Page 22

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Expanding the Pipeline

CRA-W's Graduate Cohort Workshop

By Ishwinder Kaur, Julie Weber, Jan Cuny, Lori Pollock, and Mary Lou Soffa

Across all academic fields, the percentage of women who earn doctorates is gradually approaching parity with the percentage of men who earn doctorates. If the rates of increase continue as in the past 10 years, women will reach parity with men with respect to earned doctorates across all fields by 2007-08, and across science and engineering by 2012-13. However, *women will not achieve parity with men in Computer Science until 2088!*[1] CRA-W's newest program, the Graduate Cohort Program, aims to address this under-representation by building cohorts of graduate students and mentoring them through their graduate years. The kickoff event for the program was a workshop sponsored by Microsoft, with additional support from the National Science Foundation and the ACM SIGS.

Participants in CRA-W's Grad Cohort Workshop held recently in Seattle, Washington, network with Mary Lou Soffa (r), one of the workshop coordinators.

> *"Sponsoring this workshop allowed us to take a proactive role regarding the issue of retaining women in CS graduate programs. We are thrilled to have been a part of making this happen, and hope that its success spurs interest for industry support of future efforts."* [Kevin Schofield, General Manager, Strategy and Communications, Microsoft]

In this article, we describe the goals and structure of the Graduate Cohort Program, and include student responses to the first Cohort workshop held on February 6 and 7, 2004.

Excited by the "incredibly cool" prospect of joining the first cohort, 102 women from 63 academic institutions across North America attended the Grad Cohort Workshop in Seattle, Washington. The attendees were all in their first year of graduate school in either computer science or computer engineering programs. Two participants commented:

> *"I graduated from Wellesley College last spring, but of the dozens of computer science students who graduated with me, I was the only one who chose to enroll in a CS Ph.D. program. I came to the workshop intrigued by the idea of a convention room filled solely with women whose interests truly matched my own! I was excited about how much there would be to learn from one another."* [Julie Weber]

> *"I came to the workshop to meet women in Computer Science. Having studied with just two other women in a class of 40 for all of my undergrad years, I was intensely curious to know other women doing the same stuff I was doing. I looked forward to the prospect of forming a nationwide cohort, getting and sharing help and support, and finding a forum for expression. It was a treat."* [Ishwinder Kaur]

The goals of the workshop were to provide the students with access to information, a variety of female role models, networking skills and experience, and a peer support community.

Many departments do not have standardized means of relaying information to students, but instead rely on informal social networks. For various reasons, women may be less likely to participate in these networks; their male adviser may be more comfortable engaging in outside social activities with students of the same gender, for example, or the student may be reticent to join groups and activities they perceive as male-dominated. The Cohort Workshop included a number of formal presentations covering topics such as how to: 1) get through the first years of grad school, 2) build a research project, 3) finish a thesis, 4) become established in a research community, and 5) get involved in the professional communities beyond your department. Attendees commented:

> *"The formal presentations were a great way to learn good strategies for making things work, inside and outside of the office. I especially enjoyed listening to accomplished professors give us the details about how they made it to where they are and how they personally managed their time when to me it seems impossible. And the advice was plentiful!"* [Weber]

> *"In fact, the formal presentations were hardly formal, and the stage was set for extreme interaction right from the first talk. Students queued up at the microphone in huge numbers, waiting for their turn to ask questions. This exemplifies our immense, unfulfilled curiosity and urge to know stuff about grad school and grad life. It's hard to find an avenue to turn to for these types of questions."* [Kaur]

> *"I had expected a serious and formal affair. But I was pleasantly surprised with the really frank, honest, ask-anything, no-holds-barred attitude. I was excited to meet big names in industry and academia, but you know what—they were equally, if not more so, eager to meet the students."* [Kaur]

Graduate students need to see a variety of female role models with a range of attitudes and approaches to life. They need to know successful women who have been able to balance the demands of career and family life, and they need to be exposed to the many rewards of a research career. Eighteen senior women from academics and industry provided these role models. Students commented:

> *"We got to meet some amazing and impressive women, each unique, but each an example, an inspiration, a role model in her own right."* [Kaur]

> *"Listening to all these success stories was great. I especially like the fact that all these women had lunch/dinner with us and shared more stories. The speakers were AWESOME!"* [Anonymous]

> *"These amazing women professors in CS are actually cool. They are not only smart but they have families and personalities."* [Anonymous]

Networking is clearly important. It gives students a chance to meet others with similar interests and concerns, find role models, build a trusted group of advisers, experience a wider range of research, make technical contacts, and become known. The workshop included a session on Networking Skills and a number of social events (breaks, lunch, and a reception with additional guests from Microsoft and the University of

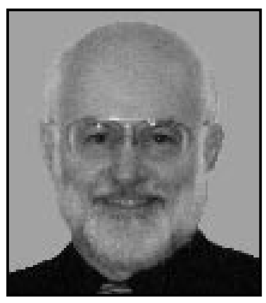
Graduate Cohort Workshop
Continued on Page 23

CRA Elects New Board Members

CRA recently elected four new members to its board of directors. **Robert Constable** (Cornell University), **Mary Jean Harrold** (Georgia Institute of Technology), **Robert Kahn** (Corporation for National Research Initiatives), and **David Tennenhouse** (Intel) will begin three-year terms beginning July 1, 2004.

Three current board members, **Philip Bernstein** (Microsoft), **Leah Jamieson** (Purdue University), and **Moshe Vardi** (Rice University) were re-elected to three-year terms. **Oscar Garcia** was appointed a IEEE-CS representative on the CRA board in February 2004.

Newly Elected



Robert Constable is Professor and Dean of the Faculty of Computing and Information Science, Cornell University. He is an ACM Fellow and a Guggenheim Fellow. Professor Constable was a CS department chair for six years and a director of the Marktoberdorf NATO summer school in Computer Science. His research interests lie in system verification, automated reasoning, and computing theory. Professor Constable received a Ph.D. in Mathematics from the University of Wisconsin.

Mary Jean Harrold is a Professor in the College of Computing at the Georgia Institute of Technology. She is an ACM Fellow and an NSF ADVANCE Professor of Computing at Georgia Tech since 2001. Professor Harrold has been a member of CRA-W since 1998 and currently serves as co-chair. She was director of CRA-W's Distributed Mentor Project, and participated in CRA-W's Grad Cohort for Women Project and CRA-W Distinguished Professor for the Cohort of Associate Professors Project. Her research interests include program analysis and testing, regression testing, empirical studies, and software visualization. Professor Harrold received a Ph.D. in Computer Science from the University of Pittsburgh.

Robert Kahn is President and CEO of the Corporation for National Research Initiatives (CNRI), an organization he created and has led for 18 years. He has been awarded the National Medal of Technology, NAE Draper Prize, Marconi Award, Prince of Asturias Award, IEEE Alexander Graham Bell Medal, and numerous honorary degrees and other honors. Dr. Kahn is a Member of the National Academy of Engineering. He began the Internet project at DARPA and formulated and led the Strategic Computing Program during its initiation. Prior to joining DARPA, he was responsible for the system design of the ARPANET at BBN. Dr. Kahn received a Ph.D. in Electrical Engineering from Princeton University

David Tennenhouse is Vice President of the Corporate Technology Group and Director of Research at Intel Corp. Prior to joining Intel, he was Director of IT at DARPA, and before that was a Research Scientist and Faculty Member at MIT. In 2003 he was elected an IEEE Fellow. His research interests include networking, computer architecture, distributed systems, software radio, and nanoscale electronics. Dr. Tennenhouse was awarded a Ph.D. from the Computer Laboratory at the University of Cambridge.

Board Appointment

Oscar Garcia was appointed to represent the IEEE-CS on the CRA board, effective February 23, 2004. He is the Founding Dean of Engineering at the University of North Texas, and previously was NCR Endowed Distinguished Professor and Chair, Department of Computer Science and Engineering, Wright State University. Dr. Garcia is a past president of IEEE-CS and has served on the IEEE Board of Directors. He is currently Secretary of the Computer Society, Chairman of its Awards Committee, and a Member of its Board of Governors. Dr. Garcia received his Ph.D. in Electrical Engineering from the University of Maryland. ■

Initial Signs Not Encouraging for Science Funding in FY 05

Congress Begins Work on Election-Year Budget by Flat-Funding Science Programs

By Peter Harsha

In a sign that this year promises to be difficult for advocates of increased federal funding for research and development, separate fiscal year 2005 budget resolutions passed by both the House and the Senate in late March call for freezing funding for basic scientific research and development at current levels.

While funding for research and development at the Department of Defense (DOD) and the Department of Homeland Security (DHS) received increases in the resolutions, neither the House nor Senate provided any significant increase to the "General Science, Space and Technology" account—a $23 billion account that includes funding for the National Science Foundation (NSF), basic science at the Department of Energy (DOE), National Aeronautics and Space Administration (NASA), and National Institute of Standards and Technology (NIST).

Budget committee members in both chambers argued that economic realities forced them to make difficult choices within the resolution.

"Even before the end of last year, the 'must do' list for writing this year's budget was already becoming clear," House Budget Committee Chair Jim Nussle (R-IA) said. "This budget had to get our spending under control, and had to get to work reducing the deficit."

But even some of the resolution's supporters had significant concerns about the lack of support for basic scientific R&D. "As a nation, we cannot afford to starve basic science research and education," said Rep. Vern Ehlers (R-MI), who voted for the measure. "Continued underfunding of scientific research and education will erode America's technical and scientific preeminence, diminish our ability to compete economically, and undermine our children's economic prosperity and national security." Ehlers indicated he would work throughout the appropriations process to ensure adequate funding for NSF, NIST, NASA, and DOE.

On the Senate side, former Senate Budget Chair Pete Domenici (R-NM), now chair of the Senate Energy and Natural Resources Committee, noted that Congress had not given the same priority to basic research in the physical sciences as they had given in past years to the life sciences funded through the National Institutes of Health (NIH). During the Senate budget debate, Domenici compared the aggressive approach the Senate took towards funding NIH during its recently completed five-year budget doubling (from $13.7 billion to $27.1 billion in FY 2003). "I am concerned," Domenici said, "that we have collectively failed to be as aggressive when it comes to funding basic scientific research in other agencies."

"Basic research is the engine that makes our national defense, homeland security, and economic superiority possible."

The Congressional Budget Resolution—the compromise legislation that will result after the Senate and House work out the differences in their respective bills (which had yet to happen at press time)—is the first step of the legislative branch in the year-long process that will ultimately produce the 13 appropriations bills that comprise all annual federal discretionary spending. Although the House and Senate Appropriations Committees ultimately have final discretion over how federal dollars get spent on an agency-by-agency and program-by-program basis, the budget resolution establishes the overall spending number with which the appropriators will work. The bill does have symbolic value, however, in that it represents at a "macro" level what the Budget committees, and ultimately the Congress, feel should have priority in funding.

Even as the House and Senate budget committee members met to work out a compromise resolution, appropriations committees in both chambers had already begun holding

Science Funding in FY 05
Continued on Page 24

NSF/CISE: Looking Back, Looking Forward

By Peter A. Freeman

I began my service as AD/CISE in May 2002. This column is my "report" to the community on some of the highlights of the past two years, and some indications of where I hope we will head in the next two years. As such, I hope that you will read it as a personal report, not an official NSF pronouncement!

As I look back over the past two years, four things of importance to the community stand out in my mind:

1. Intellectual Leadership

We are now capitalizing on some of the new directions emerging from ITR, from national needs, and from direct inputs from the community to establish focused and strategic directions such as cyber trust and science of design. In the area of homeland security, we are helping to provide direct and effective leadership across the government. At the same time, we are moving to strengthen and invigorate support for core areas of research. In the area of cyber-infrastructure (CI) we are leading efforts, nationally and within NSF, to exploit the convergence of technological growth, application prototyping, and policy directions.

2. Organizational Excellence

The CISE reorganization has brought our structure into better alignment with intellectual directions in the field, especially the interactions between areas (such as networking and operating systems), and is now permitting us to address a number of internal management issues that impinge on our ability to serve you effectively and efficiently. The flexibility that this new structure permits is already helping us internally, and I am confident that going forward you will see the benefits to you directly.

3. Budget Growth and Direction

CISE continues to do at least as well as the rest of NSF overall, which is pretty good, given the competing demands on the Federal budget. Program directors and senior management at NSF in all areas increasingly understand the importance of our field to the nation and to the conduct of S&E research and education broadly. The concerns I heard from you in my first few months at NSF about what would happen when the ITR priority area ended in FY04 have turned into useful discussions of how to best use that money to continue to strengthen our field.

4. Communication

I have taken a number of steps to ensure better communication between you and NSF. This column, which appears regularly in every issue of *CRN*, is one. I have made changes in how the CISE Advisory Committee is constituted and works that have greatly increased its impact on what we are doing. I have encouraged Division Directors and others to visit with you on your campus whenever possible, and I have done a good bit of that myself. A number of steps have been taken internally as well to improve communication within CISE and between us and other parts of NSF.

There is a fifth thing that stands out in my mind that is much more personal–I am enjoying the opportunity to serve you, the field, and the nation immensely. More about that below.

As I have noted in various ways in a number of public forums, after listening carefully to you and to a number of other sources, I have set four overarching objectives for CISE. We have been operating along these lines for over a year, and I expect that they will continue to characterize what we do during my next two years as AD/CISE.

Strengthen Core CS Research

CISE supports work in a number of fields and we will do as much as we can to build all of them, but computer science is the broadest and deepest of all of the computing-related fields and the one from which the largest number of fundamental new ideas spring. It is essential that computer science continues to grow in its intellectual depth and impact on the entire computer field. We are already doing a number of things to advance on this objective: Migrating ITR funds over the next several years into core program areas, crosscutting themes, emergent areas, and new modalities such as center-scale activities; working hard to balance disciplinary research with integrative activities; and developing strategic new areas such as cyber trust and science of design.

Lead in Cyberinfrastructure

Many of you have heard me say that if we didn't have this as an application driver for fundamental CS research that we would have to invent it. I view the fact that CISE has the responsibility within NSF for providing for shared CI as a great opportunity, not as a problem. CI is revolutionizing the conduct of essentially all of S&E research and education, which in turn will have a profound impact on our society for generations to come. Who wouldn't want to be in the vanguard of that? But, even taking a narrow, CS research viewpoint, the opportunities in CI are immense. Look at what is happening (or could be soon) in CI with sensor networks, algorithm design, computational science and engineering, distributed systems, language and compiler design, human interfaces, information integration, manipulation of data, software engineering, and on and on.

Broaden Participation

All of us know of the unacceptably low rates of participation in computing by women and minorities. Today we are also faced with declining numbers of new Ph.D.s and undergraduate enrollments, even though all the predictions for the mid- and long-term are for increasing demand for IT people at all levels. Additionally, the challenges our country is facing demand an increase in the number of U.S. citizens in our fields, not to the exclusion of foreign citizens who have made such great contributions to our country, but in addition to them. CISE has supported a good bit of research that informs us as to the reasons for some of these situations, and it is now time to focus more on intervention to do something about broadening participation.

Make CISE the Best - Managed Unit at NSF

Obviously, this is an internal objective. Why should you care? Very simply, because if we are not effective and efficient in our operations, then we cannot serve you as well as we should. We will continue to refine our new structure and the programs within it, improve our review of proposals, try to do a better job of

NSF/CISE
Continued on Page 23

Outsourcing: Threat or Opportunity?

By Jim Foley

The answer is simple: outsourcing is both a threat and an opportunity.

Outsourcing is a threat in the short term because people's lives are disrupted when jobs are lost—and the current wave of outsourcing is happening more quickly than in the past, thanks to the very technologies of digital computers and communications that our research community has invented! Fortunately, we don't have any neo-Luddites laying siege to our research labs. There are also some short-term threats to our graduate programs (more on that later).

Outsourcing is an opportunity in that it challenges our academic institutions to do what we do very well—think and act creatively, out-of-the-box, and innovatively. Let me suggest some ways of thinking about how we can innovate in our graduate research and education:

- Continue, and even accelerate, the emphasis on connecting computing and applications, both in our research and in our education. When CS undergrads attend grad school, have them learn about something in addition to computer science. Jobs—whether at the BS, MS, or Ph.D. levels—that involve understanding computing + X are less susceptible to offshoring than are jobs that are heads-down programming and development—if for no other reason than the skill set of computing + X is not likely to be as well developed in some of the offshoring destinations, at least not yet.
- Research that focuses on Human-Centered Computing—usability in its many forms—helps people work smarter and learn better. We have already enjoyed a lot of IT-driven productivity. There is no reason to believe that we have reached a plateau. Indeed, every time I have a glitch with my desktop computer, I know we have not reached a plateau!
- More research is needed on tools and languages and methods that speed up the software development process. The goal is to further reduce the need for traditional programmers (which is the hardest-hit US IT job category, according to the Bureau of Labor Statistics) and increase the ability for analysts, designers, and end-users to directly translate user needs into system designs and implementations. This means end-user development tools, rapid prototyping tools, development environments, and so on.

Remember the stories from the early days of telephony about how the increase in phone usage would require exponentially more switchboard operators so that everyone would ultimately be an operator? Fortunately, technological progress led to automatic exchanges and the cost of making phone calls went down. The telecom industry prospered and jobs developed that were much more interesting than

Outsourcing
Continued on Page 22

2002-2003 Taulbee Survey

Undergraduate Enrollments Drop; Department Growth Expectations Moderate

By Stuart Zweben and William Aspray

This article and the accompanying figures and tables present the results of the 33rd annual CRA Taulbee Survey[1] 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 was gathered during the fall of 2003. Responses received by December 10, 2003 are included in the analysis. The periods the data cover vary from table to table. Degree production (Ph.D., Master's, and Bachelor's) and total Ph.D. enrollments refer to the previous academic year (2002-2003). Data for new students in all categories and total enrollments for Master's and Bachelor's degrees refer to the current academic year (2003-2004). Projected student production and information on faculty salaries and demographics also refer to the current academic year. Faculty salaries are those effective January 1, 2004.

The data were collected from Ph.D.-granting departments only. A total of 225 departments were surveyed, the same number as last year. As shown in Figure 1, 177 departments returned their survey forms, for a response rate of 79 percent (compared to 80 percent last year). The return rate of 7 out of 29 (24%) for Computer Engineering (CE) programs is very low, as has been the case for several years (see below). We attribute this low response to two factors: 1) many CE programs are part of an ECE department, and they do not keep separate statistics for CE vs. EE; and 2) many of these departments are not aware of the Taulbee Survey or its importance. The response rate for US CS departments (151 of 169, or 89%) was very good, while the 70% response rate for Canadian programs was moderately good although not as good as in the past several years.

The set of departments responding varies slightly from year to year, even when the total numbers are about the same; thus, we must approach any trend analysis with caution. We must be especially cautious in using the data about CE departments because of the low response rate. However, we have reported CE departments separately because there are some significant differences between CS and CE departments.

The survey form itself is modified slightly each year to ensure a high rate of return (e.g., 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, preliminary survey results about faculty salaries were reported in December 2003 only to respondents. The CRA Board views this, and the release of this final report to respondents in early March 2004, as benefits of participation in the survey. We intend to continue this practice in future years.

This year we also included several new questions from the former Departmental Profiles Survey (see the section entitled "Additional Departmental Profiles Analysis"). We are especially pleased that the increased size of this year's survey did not have a detrimental effect on the response rate. We thank all respondents who completed this year's questionnaire. Departments that participated are listed at the end of this article.

Ph.D. Degree Production and Enrollments *(Tables 1-8)*

As shown in Table 1, a total of 877 Ph.D. degrees were awarded in 2003 by the 177 responding departments. This is an increase of 3% over last year, but still represents, as Figure 2 indicates, the second lowest total national Ph.D. production since 1989. Most likely this number is still reflecting the high-tech boom of the late 1990s when start-up companies presented an extremely attractive employment option for computer scientists.

The prediction from last year's survey that 1,224 Ph.D. degrees would be awarded in 2003 was, as usual, overly optimistic, with an "optimism" ratio, defined as the actual over the predicted, being 0.72. Given next year's prediction of 1,350 graduates (Table 1), we believe the actual number will be between 900 and 1,000.

Most of the other numbers indicate that doctoral students are staying in school and progressing towards the degree. The number entering Ph.D. programs (Table 5) decreased from 3,286 to 3,131 (5%), with this decrease entirely attributable to Canadian and CE respondents. The US CS numbers are flat. However, the number who passed qualifiers (Table 1) increased from 1,375 to 1,545 (12%). On a per-department basis, the number passing qualifiers has risen from 6.5 to 8.7 (33%) in three years. The number who passed thesis proposal exams (Table 1) stayed almost flat, changing from 884 to 881. Total Ph.D. enrollment (Table 6) increased from 10,021 to 12,007 (20%). It seems that the slow turn-around of the economy, and of the dot-com economy in particular, has attracted more people to graduate school in recent years, and more of them appear to be moving past at least the qualifier stage of the Ph.D. program.

Taulbee Continued on Page 6

Figure 1. Number of Respondents to the Taulbee Survey

Year	US CS Depts.	US CE Depts.	Canadian	Total
1995	110/133 (83%)	9/13 (69%)	11/16 (69%)	130/162 (80%)
1996	98/131 (75%)	8/13 (62%)	9/16 (56%)	115/160 (72%)
1997	111/133 (83%)	6/13 (46%)	13/17 (76%)	130/163 (80%)
1998	122/145 (84%)	7/19 (37%)	12/18 (67%)	141/182 (77%)
1999	132/156 (85%)	5/24 (21%)	19/23 (83%)	156/203 (77%)
2000	148/163 (91%)	6/28 (21%)	19/23 (83%)	173/214 (81%)
2001	142/164 (87%)	8/28 (29%)	23/23 (100%)	173/215 (80%)
2002	150/170 (88%)	10/28 (36%)	22/27 (82%)	182/225 (80%)
2003	151/169 (89%)	7/29 (24%)	19/27 (70%)	177/225 (79%)

Figure 2. PhD Production

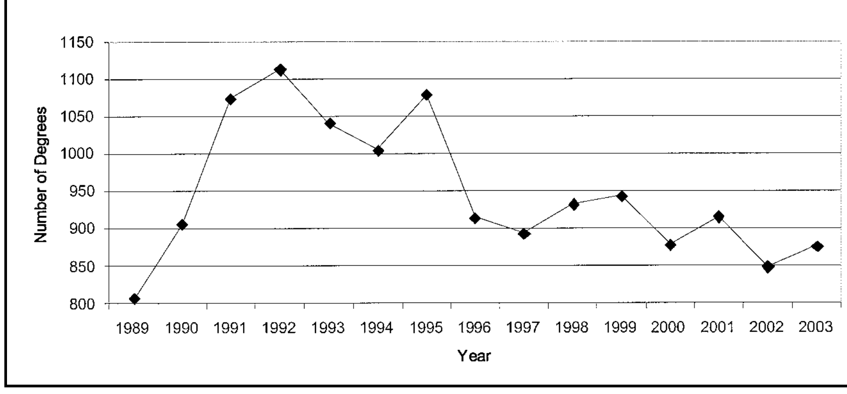


Figure 3. PhD Pipeline Corrected for Year of Entry

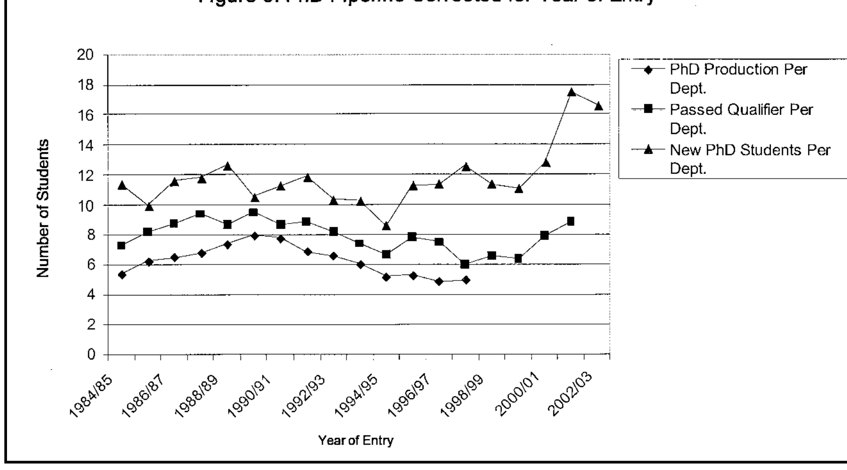


Table 1. Ph.D. Production by Type of Department and Rank

Department, Rank	Ph.D.s Produced	Avg. per Dept.	Ph.D.s Next Year	Avg. per Dept.	Passed Qualifier	Avg. per Dept.	Passed Thesis Exam	Avg. per Dept.
US CS 1-12	167	13.9	217	18.1	261	21.8	238	19.8
US CS 13-24	128	10.7	159	13.3	190	15.8	104	8.7
US CS 25-36	93	7.8	163	13.6	197	16.4	82	6.8
US CS Other	388	3.4	578	5.0	722	6.3	368	3.2
Canadian	72	3.8	126	6.6	133	7.0	79	4.2
US CE	29	4.1	107	15.3	42	6.0	10	1.4
Total	**877**	**5.0**	**1,350**	**7.6**	**1,545**	**8.7**	**881**	**5.0**

2002-2003 Taulbee Survey

Taulbee from Page 5

Figure 3 shows a longer-term trend of the number of CS Ph.D. graduates, normalized by the number of departments responding to the Taulbee Survey. This graph also shows the number of new students entering Ph.D. programs and the number of students who passed qualifiers. These also are normalized for the number of departments reporting. The graph offsets the qualifier data by one year from the data for new students, and offsets the graduation data by five years from the data for new students, to approximate the lag between student entrance into the pipeline, and the qualifier and exit time frame for the same cohort. The figure suggests that, unless a larger fraction of those passing qualifiers do not complete the program, significant increases in Ph.D. production are only a few years away.

Table 4 shows employment for new Ph.D. recipients. Of those who reported employment domestically, 63% took academic employment (compared to 53% last year and 43% the year before). Most of these academic positions were in Ph.D.-granting departments, but 31 were in other CS/CE departments. This represents a considerable increase from the 9 reported last year as having gone to non-Ph.D.-granting CS/CE departments, but still likely falls considerably short of meeting the needs of those departments. There has also been a slight increase (from 83 to 89) in the number of postdoctoral positions (up from 56 two years ago). Figure 4 shows the trend of employment of new Ph.D.s to academia and industry, and the proportion of those going to academia who took positions other than in Ph.D-granting CS/CE departments. After many years of a decided preference for industry jobs over academic jobs, the trend during the most recent two years is striking, and indicative of economic conditions in industry. This has been good for Ph.D-granting CS/CE departments.

Table 4 also indicates increases in the proportion of new CS/CE Ph.D.s in the programming languages/compilers, OS/networks, software engineering, and graphics/HCI areas, while the AI/robotics, theory/algorithms, and database/information systems areas experienced a decreased proportion of Ph.D.s. Multi-year trends are less clear, though there appears to have been an increased production in the graphics/HCI and the numerical/scientific computing areas during the past five years.

Most statistics on gender and ethnicity for Ph.D. students (Tables 2, 3, 7, 8) show little change from last year or, indeed, the last several years. White and nonresident-alien men continue to account for a very large fraction of our Ph.D. production and enrollments. Women represented 20% of enrollments, 17% of graduates. All other underrepresented groups make up a very small minority. As Figure 5 illustrates, we see a second year of slight decrease in the proportion of enrolled Ph.D. students who are nonresident aliens. The cause of this trend is unclear. It could be an increased interest in Ph.D.

Table 2. Gender of Ph.D. Recipients by Type of Degree

	CS		CE		CS&CE	
Male	660	83.2%	57	86.4%	717	83.5%
Female	133	16.8%	9	13.6%	142	16.5%
Total have Gender Data for	**793**		**66**		**859**	
Unknown	18		0		18	
Total	**811**		**66**		**877**	

Table 3. Ethnicity of Ph.D. Recipients by Type of Degree

	CS		CE		CS&CE	
Nonresident Alien	314	41.9%	33	52.4%	347	42.7%
African-American, Non-Hispanic	10	1.3%	1	1.6%	11	1.4%
Native American/ Alaskan Native	1	0.1%	1	1.6%	2	0.2%
Asian/Pacific Islander	105	14.0%	9	14.3%	114	14.0%
Hispanic	16	2.1%	1	1.6%	17	2.1%
White, Non-Hispanic	281	37.5%	16	25.4%	297	36.5%
Other/Not Listed	23	3.1%	2	3.2%	25	3.1%
Total have Ethnicity Data for	**750**		**63**		**813**	
Ethnicity/Residency Unknown	61		3		64	
Total	**811**		**66**		**877**	

Figure 4. Employment of New PhDs in the US and Canada

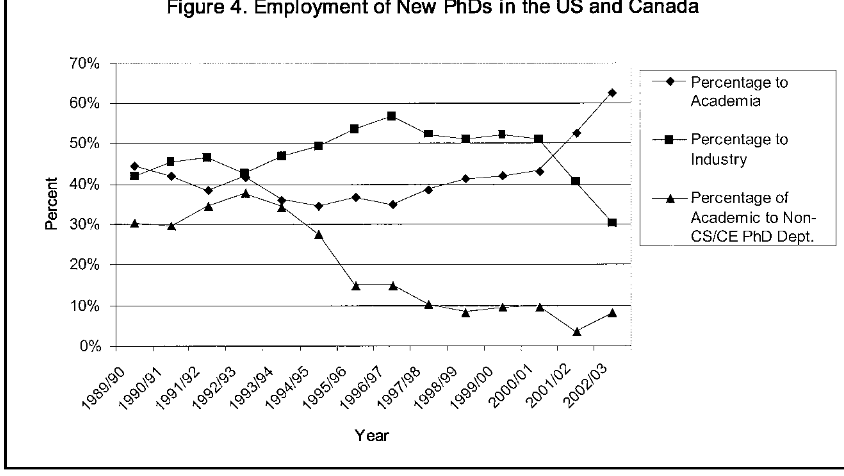


Table 4. Employment of New Ph.D. Recipients by Specialty

	Artificial Intelligence/ Robotics	Hardware/ Architecture	Numerical Analysis/ Scientific Computing	Programming Languages/ Compilers	OS/Networks	Software Engineering	Theory/ Algorithms	Graphics/ Human Interfaces	Databases/ Information Systems	Other/ Unknown	Total		
New Ph.D.s in Ph.D.-Granting Depts.													
Tenure-track	29	32	9	17	48	18	33	22	29	20	**257**	34.2%	
Researcher	17	2	4	1	15	3	4	8	3	4	**61**	8.1%	
Postdoc	23	2	6	7	12	4	12	11	6	6	**89**	11.9%	
Teaching Faculty	2	0	1	5	4	1	1	1	3	9	**27**	3.6%	
												57.8%	**Total**
New Ph.D.s, Other Categories													
Other CS/CE Dept.	5	1	4	1	2	3	4	8	2	1	**31**	4.1%	
Non-CS/CE Dept.	1	0	0	0	0	2	1	1	0	2	**7**	0.9%	
Industry	37	17	10	17	40	14	10	25	13	33	**216**	28.8%	
Government	2	0	4	2	3	0	0	1	1	2	**15**	2.0%	
Self-Employed	1	0	0	0	1	2	0	1	2	2	**9**	1.2%	
Employed Abroad	3	6	1	2	3	7	0	6	2	1	**31**	4.1%	
Unemployed	3	0	0	0	0	0	0	3	1	1	**8**	1.1%	
												42.2%	**Total**
Total have Employment Data for	**123**	**60**	**39**	**52**	**128**	**54**	**65**	**87**	**62**	**81**	**751**	**100.0%**	
Unknown	10	5	2	4	5	7	3	7	7	76	**126**		
Total	**133**	**65**	**41**	**56**	**133**	**61**	**68**	**94**	**69**	**157**	**877**		

2002-2003 Taulbee Survey

programs by domestic students, difficulties with visas for foreign students, or a perceived hostile environment that makes the United States seem less attractive to foreign students. Even with this two-year decline, the current proportion of non-resident aliens is the third highest in the past ten years. However, in 2003, the Educational Testing Service reports significant decreases in the number of students taking the GRE exam from countries that historically have been large feeders of North American graduate programs in CS/CE (especially China and India). The effect of this phenomenon on next year's Taulbee data bears watching.

Master's and Bachelor's Degree Production and Enrollments *(Tables 9-16)*

The statistics on Master's and Bachelor's degrees awarded show mixed trends. Master's degrees were awarded to 9,141 students, an increase of 15% (following a decrease of 4 percent the year before). This may be a byproduct of the increased enrollment trends in Ph.D. programs, since in many schools students obtain the M.S. on the way to the Ph.D. Actual Master's degrees awarded exceeded last year's projections by 17%. This year's expected Master's production (Table 12) exceeds the projection from last year's survey by 4 percent, but if met this still would represent a decrease of more than a 10% from last year's actual production. Bachelor's degrees numbered 19,990, a decrease of 3% (following an increase of 21 percent the year before). Most of this decrease came from CE programs; CS production was down less than 2%, perhaps reflecting the residuals of the high growth in undergraduate program enrollment of the late 1990s. Actual Bachelor's production was only about 1% less than projected last year. Projected Bachelor's production for this year shows a decrease from last year's projections of 7 percent (see Figure 6).

As shown in Figure 7, the number of new undergraduate majors dropped significantly from 23,033 to 17,706 (23%). For the previous three years, the number of new undergraduate students was approximately constant, whereas during the five years before that the number of new undergraduate students more than doubled. One major reason for this striking new trend is that the decline in the technology industry and the moving of jobs offshore are making computer science and engineering less alluring to new undergraduates. In addition, some programs have restricted admission to a subset of those desiring the computer science and engineering major, either by setting numerical limits or increasing the standards for admission. The selectivity of these programs has an impact on the number of students who want to compete for positions in these programs. Lastly, the introduction of new undergraduate programs in the IT field has created alternatives to the traditional CS and CE majors, possibly siphoning students who previously would have selected CS/CE programs. In any case, it is quite clear that the period of explosive growth in enrollments in Bachelor's programs is over.

In all other numbers, we again see mixed trends in both Bachelor's and Master's programs. New Master's students (Table 13) decreased by 8% after having decreased by 3% the previous year. This is further evidence of the effect of the dot-com crash, as fewer students seek degree programs designed mainly to prepare them for industry employment. Total enrollments in Bachelor's programs (Table 16) dropped by 19% (having increased in US CS departments by 4% to 5% and overall by 11% the previous year) and enrollments in Master's programs (Table 15) dropped by 4% (having increased by 21% the previous year).

Most demographics regarding gender and ethnicity for Bachelor's and Master's students show stability when compared with last year's results. The proportion of Master's degree recipients who are nonresident aliens (55.8%) is about the same as the previous year (Table 10).

Faculty Demographics *(Tables 17-23)*

Over the past year, the total number of faculty increased by 6 percent to a total of 5,831. Increases were shown in every category: tenure-track, researcher, postdoc, and teaching faculty.

Ph.D. production shows only 434 graduates taking faculty positions at CS/CE Ph.D-granting departments (Table 4). Tables 19 and 20 indicate that a total of 607 persons were hired during the past year. Thus, more than 70% of the faculty hires appear to have been new Ph.D.s, with the rest a combination of faculty who changed academic position, persons joining academia from government and industry, new Ph.D.s from disciplines outside of CS/CE, and non-Ph.D. holders (e.g., taking a teaching faculty appointment).

This year's observed faculty growth to 5,831 was very close to the prediction of 5,881 from last year's survey. Planned growth for this year is only 2% and only 5% for the following year. Departmental expectations appear to be much more modest and realistic than in previous years. This may reflect more firm numbers of open positions than in the days when several departments were reported to have an open-ended number of positions, and also may reflect an increased supply of candidates.

Table 23 on faculty "losses" shows that the same number of people (89, which is less than 2% of all faculty) actually left academia through death, retirement, or taking nonacademic positions this year and last year. However, this year, the amount of "churn," the number of professors moving from one academic position to another, decreased from 108 to 74. Thus we have further evidence that the faculty "retention problem" that was so much discussed over the past few years seems to have solved itself.

Taulbee Continued on Page 8

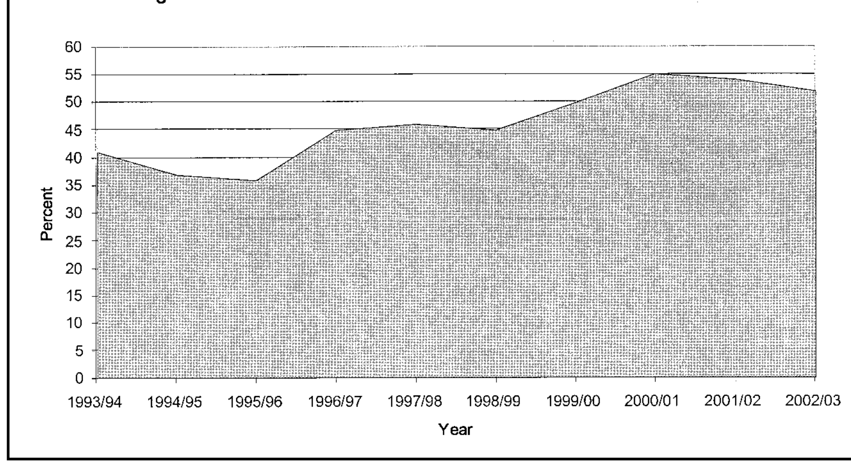


Figure 5. Nonresident Aliens as a Fraction of PhD Enrollments

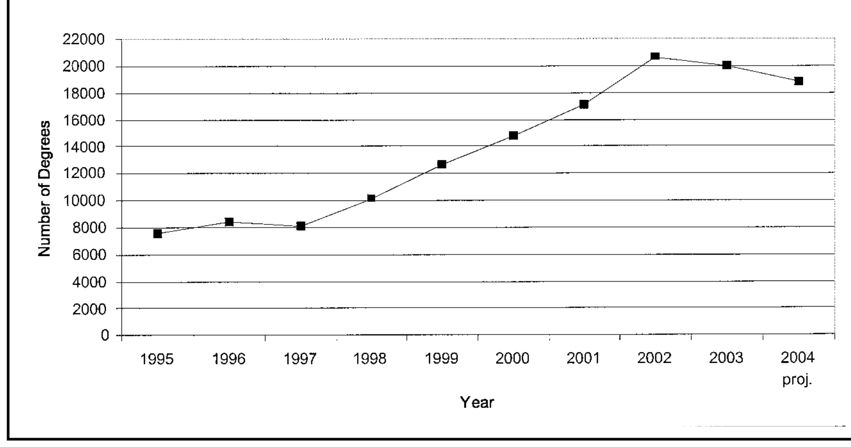


Figure 6. BS Production

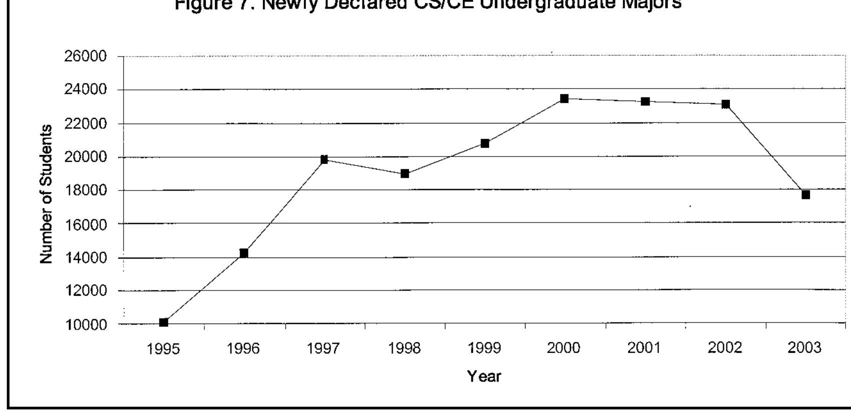


Figure 7. Newly Declared CS/CE Undergraduate Majors

Table 5. New Ph.D. Students in Fall 2003 by Department Type and Rank

	CS				CE				CS&CE	
Department, Rank	**New Admit**	**MS to Ph.D.**	**Total**	**Avg. per Dept.**	**New Admit**	**MS to Ph.D.**	**Total**	**Avg. per Dept.**	**Total**	**Avg. per Dept.**
US CS 1-12	437	28	465	38.8	0	0	0	0.0	465	38.8
US CS 13-24	321	43	364	30.3	6	0	6	0.5	370	30.8
US CS 25-36	274	29	303	25.3	0	0	0	0.0	303	25.3
US CS Other	1,161	347	1,508	13.1	139	27	166	1.4	1,674	14.6
Canadian	169	24	193	10.2	0	0	0	0.0	193	10.2
US CE	0	0	0	0.0	126	0	126	18.0	126	18.0
Total	**2,362**	**471**	**2,833**	**16.0**	**271**	**27**	**298**	**1.7**	**3,131**	**17.7**

2002-2003 Taulbee Survey

Table 6. Ph.D. Degree Total Enrollment by Department Type and Rank

Department, Rank	CS		CE		CS&CE	
US CS 1-12	1,972	18.4%	0	0.0%	1,972	16.4%
US CS 13-24	1,544	14.4%	14	1.1%	1,558	13.0%
US CS 25-36	1,348	12.6%	0	0.0%	1,348	11.2%
US CS Other	5,160	48.1%	502	39.0%	5,662	47.2%
Canadian	694	6.5%	0	0.0%	694	5.8%
US CE	1	0.0%	772	59.9%	773	6.4%
Total	**10,719**		**1,288**		**12,007**	

Table 7. Ph.D. Program Total Enrollment by Gender

	CS		CE		CS&CE	
Male	8,362	79.5%	1,087	84.8%	9,449	80.1%
Female	2,155	20.5%	195	15.2%	2,350	19.9%
Total have Gender Data for	**10,517**		**1,282**		**11,799**	
Unknown	202		6		208	
Total	**10,719**		**1,288**		**12,007**	

Table 8. Ph.D. Program Total Enrollment by Ethnicity

	CS		CE		CS&CE	
Nonresident Alien	5,294	54.0%	481	38.5%	5,775	52.2%
African-American, Non-Hispanic	152	1.5%	35	2.8%	187	1.7%
Native American/ Alaskan Native	19	0.2%	2	0.2%	21	0.2%
Asian/Pacific Islander	1,061	10.8%	413	33.1%	1,474	13.3%
Hispanic	112	1.1%	22	1.8%	134	1.2%
White, Non-Hispanic	2,959	30.2%	292	23.4%	3,251	29.4%
Other/Not Listed	213	2.2%	4	0.3%	217	2.0%
Total have Ethnicity Data for	**9,810**		**1,249**		**11,059**	
Ethnicity/Residency Unknown	909		39		948	
Total	**10,719**		**1,288**		**12,007**	

Taulbee from Page 7

The demographic data for faculty (Tables 19-22) show very small changes. Overall, the percentage of newly hired women faculty increased from 18% to 19%. The gender split of new faculty (81% male, 19% female) remains close to the split for new Ph.D. recipients (Table 2). While there are more newly hired men in tenure-track (82%) and research (86%) positions, these categories are slightly less male-dominated than they were the year before. The percentage of newly hired teaching faculty who are women dropped from 26% to 22%. These changes had no marked effect on the percentages of current faculty of each gender.

It is interesting to compare the ethnicity data for new faculty (Table 20) with that of Ph.D. recipients (Table 3). Forty-nine percent of the newly hired tenure-track faculty in Ph.D.-granting departments and 72% of the newly hired teaching faculty are white, non-Hispanic, even though only 37 percent of the Ph.D. recipients are in this category. By contrast, only 23 percent of the new faculty are nonresident aliens, whereas 43 percent of the degree recipients are in that category. Some new faculty could have become residents after receiving their Ph.D. degrees, but it seems clear that proportionately fewer foreign students take positions, especially teaching positions, at universities in North America.

Research Expenditures and Graduate Student Support *(Tables 24-26)*

Table 24 shows the department's total expenditure (including indirect costs or "overhead" as stated on project budgets) from external sources of support. As was true last year, the higher the ranking, the more external funding per capita, where capitation is computed relative to the number of tenured and tenure-track faculty members. Canadian levels are shown in Canadian dollars. The median per capita amount of support for schools in the 1-36 bands compared to the median reported in last year's survey grew in the 5% to 10% range, while in the lower ranks, the median actually dropped by 3%. Canadian departments show a lower level of expenditures from external sources than every US ranking band; this stems, no doubt, from differences in the way that research is funded in Canada. It is difficult to draw meaning for the numbers for computer engineering because of the small number of departments reporting.

Table 25 shows the number of graduate students supported as full-time students as of fall 2003, further categorized as teaching assistants, research assistants, fellows, or computer systems supporters, and split between those on institutional vs. external funds. The higher the ranking of the department, the greater the proportion of graduate students who are supported on external funds (typically as research assistants and fully supported, externally funded fellows). Canadian departments are more likely than US departments to

Table 9. Gender of Bachelor's and Master's Recipients

	Bachelor's						Master's					
	CS		CE		CS&CE		CS		CE		CS&CE	
Male	12,606	80.6%	2,892	88.6%	15,498	82.0%	5,912	73.6%	800	80.6%	6,712	74.4%
Female	3,041	19.4%	372	11.4%	3,413	18.0%	2,119	26.4%	193	19.4%	2,312	25.6%
Total have Gender Data for	**15,647**		**3,264**		**18,911**		**8,031**		**993**		**9,024**	
Unknown	986		93		1,079		117		0		117	
Total	**16,633**		**3,357**		**19,990**		**8,148**		**993**		**9,141**	

Table 10. Ethnicity of Bachelor's and Master's Recipients

	Bachelor's						Master's					
	CS		CE		CS&CE		CS		CE		CS&CE	
Nonresident Aliens	1,218	9.8%	199	6.3%	1,417	9.1%	4,096	57.2%	413	45.1%	4,509	55.8%
African-American, Non-Hispanic	399	3.2%	194	6.1%	593	3.8%	95	1.3%	40	4.4%	135	1.7%
Native American/ Alaskan Native	41	0.3%	13	0.4%	54	0.3%	13	0.2%	1	0.1%	14	0.2%
Asian/Pacific Islander	3,053	24.5%	747	23.5%	3,800	24.3%	1,072	15.0%	168	18.4%	1,240	15.4%
Hispanic	456	3.7%	136	4.3%	592	3.8%	86	1.2%	10	1.1%	96	1.2%
White, Non-Hispanic	6,934	55.6%	1,759	55.4%	8,693	55.6%	1,678	23.4%	277	30.3%	1,955	24.2%
Other/Not Listed	362	2.9%	127	4.0%	489	3.1%	123	1.7%	6	0.7%	129	1.6%
Total have Ethnicity Data for	**12,463**		**3,175**		**15,638**		**7,163**		**915**		**8,078**	
Ethnicity/ Residency Unknown	4,170		182		4,352		985		78		1,063	
Total	**16,633**		**3,357**		**19,990**		**8,148**		**993**		**9,141**	

2002-2003 Taulbee Survey

Table 11. Bachelor's Degree Candidates for 2003-2004 by Department Type and Rank

Department, Rank	CS		CE		CS&CE	
US CS 1-12	1,889	11.6%	218	8.4%	2,107	11.2%
US CS 13-24	1,461	9.0%	376	14.5%	1,837	9.7%
US CS 25-36	1,775	10.9%	83	3.2%	1,858	9.9%
US CS Other	7,889	48.5%	1,444	55.6%	9,333	50.2%
Canadian	3,246	20.0%	5	0.2%	3,251	17.2%
US CE	0	0.0%	470	18.1%	470	1.8%
Total	**16,260**		**2,596**		**18,856**	

Table 12. Master's Degree Candidates for 2003-2004 by Department Type and Rank

Department, Rank	CS		CE		CS&CE	
US CS 1-12	821	11.2%	65	7.7%	886	10.9%
US CS 13-24	781	10.7%	0	0.0%	781	9.6%
US CS 25-36	488	6.7%	0	0.0%	488	6.0%
US CS Other	4,728	64.7%	409	48.6%	5,137	63.1%
Canadian	488	6.7%	2	0.2%	490	6.0%
US CE	0	0.0%	366	43.5%	366	4.5%
Total	**7,306**		**842**		**8,148**	

Table 13. New Master's Students in Fall 2003 by Department Type and Rank

	CS		CE		CS&CE	
Department, Rank	Total	Avg. per Dept.	Total	Avg. per Dept.	Total	Avg. per Dept.
US CS 1-12	597	49.8	50	4.2	647	53.9
US CS 13-24	772	64.3	5	0.4	777	64.8
US CS 25-36	342	28.5	0	0.0	342	28.5
US CS Other	3,929	34.2	289	2.5	4,218	36.7
Canadian	736	38.7	31	1.6	767	40.4
US CE	0	0.0	206	29.4	206	29.4
Total	**6,376**		**581**		**6,957**	

support their graduate students through teaching assistantships rather than research assistantships.

Respondents were asked to "provide the net amount (as of fall 2003) of an academic-year stipend for a graduate student (not including tuition or fees)." The results are shown in Table 26. Canadian stipends are shown in Canadian dollars. The higher the ranking band, the higher the median level of support for teaching assistants. Median amounts of support for research assistants at the top 24 schools also are much higher than those for the lower-ranked bands.

Faculty Salaries *(Tables 27-34)*

Each department was asked to report the minimum, median, mean, and maximum salaries for each rank (full, associate, and assistant professors and non-tenure-track teaching faculty) and the number of persons at each rank. The salaries are those in effect on January 1, 2004. For US departments, nine-month salaries are reported in US dollars. For Canadian departments, twelve-month salaries are reported in Canadian dollars. Respondents were asked to include salary supplements such as salary monies from endowed positions.

The minimum and maximum of the reported salary minima (and maxima) are self-explanatory. The range of salaries in a given rank among departments that reported data for that rank is the interval ["minimum of the minima," "maximum of the maxima"]. The mean of the reported salary minima (maxima) in a given rank is computed by summing the departmental reported minimum (maximum) and dividing by the number of departments reporting data at that rank.

The median salary at each rank is the middle of the list if you order its members' mean salaries at that rank from lowest to highest, or the average of the middle two numbers if there is an even number of items in the set. The average salary at each rank is computed by summing the individual means reported at each rank and dividing by the number of departments reporting at that rank. We recognize that these means and medians are only approximations to the true means and medians for their rank.

U.S. average salaries increased between 1.9% and 2.5%, depending on tenure-track rank, and 1.4% for non-tenure teaching faculty. These increases are less than the 3% levels experienced last year. Canadian salaries (shown as 12-month salaries in Canadian dollars) decreased by 0.8% to 2.0%, depending on rank. This compares unfavorably to last year's increase of 3.8% to 5.2% for different tenure-track categories; it may also reflect differences in the specific departments reporting, which has a more profound effect on Canadian results than on US results.

Median salaries for new Ph.D.s (those who received their Ph.D. last year and then joined departments as tenure-track faculty) were unchanged from those reported in last year's survey (Table 34). This may help ease the salary compression and inversion experienced during the dot-com boom.

Additional Departmental Profiles Analysis

Every three years, CRA collects additional information about various aspects of departmental activities that are not expected to change much over a one-year period. These data used to be collected via a separate survey, called the Departmental Profiles Survey. The most recent data from this survey were published in the November 2000 issue of *Computing Research News*. Effective this year, the data from this survey will be collected as part of the Taulbee data collection cycle during those years when these data are due to be collected (next in fall of 2006). The data include teaching loads, sources of external funding, methods of recruiting graduate students, departmental support staff, and space. Where possible, we will compare this year's results with the previous Profiles report. However, there is a much higher response rate from US CS departments to this year's survey, particularly among higher-ranked departments, so comparisons with the previous survey should be interpreted with this in mind.

Teaching Loads *(Tables 35-38)*

Tables 35-38 discuss teaching loads in semester-length courses per year. The US departments ranked 1-12 have the lowest teaching loads, both officially and actually, with departments ranked 13-36 having slightly higher loads and other CS departments and CE departments having the highest loads. The Canadian departments have official loads that are similar to those of the US departments ranked in the top 36, but they seem to have less load

Taulbee Continued on Page 11

Table 14. New Undergraduate Students in Fall 2003 by Department Type and Rank

	CS			CE			CS&CE Majors	
Department, Rank	Pre-Major	Major	Avg. Major per Dept.	Pre-Major	Major	Avg. Major per Dept.	Major	Avg. Major per Dept.
US CS 1-12	237	760	63.3	5	187	15.6	947	78.9
US CS 13-24	9	1,001	83.4	0	316	26.3	1,317	109.8
US CS 25-36	426	1,635	136.3	0	21	1.8	1,656	138.0
US CS Other	3,761	8,079	70.3	1,172	1,639	14.3	9,718	84.5
Canadian	823	3,423	180.2	0	59	3.1	3,482	183.3
US CE	0	0	0.0	38	586	97.7	586	97.7
Total	**5,256**	**14,898**	**84.6**	**1,215**	**2,808**	**16.0**	**17,706**	**100.6**

Table 15. Master's Degree Total Enrollment by Department Type and Rank

Department, Rank	CS		CE		CS&CE	
US CS 1-12	1,371	7.0%	70	3.7%	1,441	6.7%
US CS 13-24	1,718	8.8%	94	4.9%	1,812	8.4%
US CS 25-36	832	4.3%	0	0.0%	832	3.9%
US CS Other	13,649	69.7%	1,040	54.7%	14,689	68.4%
Canadian	2,001	10.2%	30	1.6%	2,031	9.5%
US CE	0	0.0%	668	35.1%	668	3.1%
Total	**19,571**		**1,902**		**21,473**	

CRA Welcomes New Members

Academic

City University of New York, Graduate Center (CS)
University of Michigan, Dearborn (CIS)
University of Nebraska at Omaha (IST)

Labs/Centers

McAfee Research, Network Associates, Inc.

2002-2003 Taulbee Survey

Table 16. Bachelor's Degree Program Total Enrollment by Department Type and Rank

	CS			CE			CS&CE Majors	
Department, Rank	Pre-Major	Major	Avg. Major per Dept.	Pre-Major	Major	Avg. Major per Dept.	Total	Avg. Major per Dept.
US CS 1-12	584	5,170	430.8	0	368	30.7	5,538	461.5
US CS 13-24	286	5,185	432.1	0	1,598	133.2	6,783	565.3
US CS 25-36	1,230	6,423	535.3	0	286	23.8	6,709	559.1
US CS Other	7,418	36,657	318.8	1,978	6,443	56.0	43,100	374.8
Canadian	1,516	13,006	684.5	0	101	5.3	13,107	689.8
US CE	0	0	0.0	132	1,607	267.8	1,607	267.8
Total	**11,034**	**66,441**	**377.5**	**2,110**	**10,403**	**59.1**	**76,844**	**436.6**

Table 17. Actual and Anticipated Faculty Size by Position

	Actual	Projected		Expected Two-Year Growth	
	2003-2004	2004-2005	2005-2006		
Tenure-Track	4,208	4,302	4,499	291	6.9%
Researcher	468	485	539	71	15.2%
Postdoc	312	342	390	78	25.0%
Teaching Faculty	703	665	679	-24	-3.4%
Other/Not Listed	140	134	141	1	0.7%
Total	**5,831**	**5,928**	**6,248**	**417**	**7.2%**

Table 18. Actual and Anticipated Faculty Size by Department Type and Rank

	Actual	Projected		Expected Two-Year Growth	
	2003-2004	2004-2005	2005-2006		
US CS 1-12	704	695	685	-19	-2.7%
US CS 13-24	592	557	588	-4	-0.7%
US CS 25-36	516	563	609	93	18.0%
US CS Other	2,948	3,006	3,214	266	9.0%
Canadian	747	781	815	68	9.1%
US CE	324	326	337	13	4.0%
Total	**5,831**	**5,928**	**6,248**	**417**	**7.2%**

Table 19. Gender of Newly Hired Faculty

	Tenure-track		Researcher		Postdoc		Teaching Faculty		Other		Total	
Male	239	81.6%	73	85.9%	90	78.9%	73	78.5%	18	81.8%	493	81.2%
Female	54	18.4%	12	14.1%	24	21.1%	20	21.5%	4	18.2%	114	18.8%
Total	**293**		**85**		**114**		**93**		**22**		**607**	

Table 20. Ethnicity of Newly Hired Faculty

	Tenure-track		Researcher		Postdoc		Teaching Faculty		Other		Total
Nonresident Alien	62	22.8%	12	14.6%	34	32.7%	14	15.7%	6	30.0%	128
African-American, Non-Hispanic	6	2.2%	0	0.0%	0	0.0%	1	1.1%	0	0.0%	7
Native American/ Alaskan Native	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1
Asian/Pacific Islander	54	19.9%	23	28.0%	24	23.1%	9	10.1%	4	20.0%	114
Hispanic	3	1.1%	1	1.2%	4	3.8%	0	0.0%	0	0.0%	8
White, Non-Hispanic	134	49.3%	45	54.9%	39	37.5%	64	71.9%	10	50.0%	292
Other/Not Listed	12	4.4%	1	1.2%	3	2.9%	1	1.1%	0	0.0%	17
Total have Ethnicity Data for	**272**		**82**		**104**		**89**		**20**		**567**
Ethnicity/ Residency Unknown	21		3		10		4		2		40
Total	**293**		**85**		**114**		**93**		**22**		**607**

Table 21. Gender of Current Faculty

	Full		Associate		Assistant		Teaching Faculty		Total	
Male	1,589	91.4%	1,046	87.7%	1,063	84.2%	612	74.7%	4,310	86.0%
Female	150	8.6%	147	12.3%	200	15.8%	207	25.3%	704	14.0%
Total have Gender Data for	**1,739**		**1,193**		**1,263**		**819**		**5,014**	

2002-2003 Taulbee Survey

Table 22. Ethnicity of Current Faculty

	Full		Associate		Assistant		Teaching Faculty		Total	
Nonresident Alien	10	0.6%	34	3.0%	234	19.9%	38	4.8%	316	6.7%
African-American, Non-Hispanic	6	0.4%	10	0.9%	16	1.4%	12	1.5%	44	0.9%
Native American/ Alaskan Native	2	0.1%	1	0.1%	3	0.3%	3	0.4%	9	0.2%
Asian/Pacific Islander	307	19.2%	246	21.9%	219	18.7%	65	8.2%	837	17.9%
Hispanic	20	1.2%	17	1.5%	26	2.2%	15	1.9%	78	1.7%
White, Non-Hispanic	1,227	76.6%	780	69.5%	647	55.2%	649	82.4%	3,303	70.5%
Other/Not Listed	29	1.8%	34	3.0%	28	2.4%	6	0.8%	97	2.1%
Total have Ethnicity Data for	**1,601**		**1,122**		**1,173**		**788**		**4,684**	
Ethnicity/ Residency Unknown	138		71		90		31		330	
Total	**1,739**		**1,193**		**1,263**		**819**		**5,014**	

Table 23. Faculty Losses

	Total
Died	8
Retired	59
Took Academic Position Elsewhere	74
Took Nonacademic Position	22
Remained, but Changed to Part-Time	13
Other	30
Unknown	3
Total	**209**

Taulbee from Page 9

reduction than the US departments so that their official and actual loads are about the same. Mean actual teaching loads in US CS departments ranked above 12 are slightly higher than those in the previous Profiles survey conducted in 2000, while official loads and median actual loads for these departments are about the same as they were in 2000. The actual and official load in the top 12 departments appears to be slightly lower now than in 2000.

Virtually all departments offer some possibility for load reduction, and the majority offer the possibility of load increase. Load reductions are widely available as parts of special packages for new faculty and for administrative duties (and universal among the CE departments that responded). About one-third of the departments offer reduction for type or size of class taught. Buy-out policies vary widely, with the US 1-12 ranked and the Canadian departments least willing to offer buy-outs. The Canadian schools and the lower-ranked US departments are much more willing to give teaching load reduction for strong research involvement than the US schools ranked in the top 36. Increases in teaching load are mainly for faculty who are shifting their primary responsibilities to teaching. The responses from the US CS departments to this year's questions about load reduction and increase are similar to those published in the 2000 Profiles report.

Sources of External Funding *(Tables 39-44)*

Tables 39-45 discuss sources of external funding. In the US CS departments, NSF is the largest funder, consistent with the situation in 2000. Typically, NSF's share now is twice or more as high as the next largest funders, generally DARPA or other defense agencies. Only small percentages of funding are received from NIH, DOE, state agencies, other mission-oriented federal agencies, or private foundations. Defense agencies such as ARO, AFOSR, and ONR provide a larger proportion of current funding for top 12 departments than they did in 2000, while NSF and DARPA provide a smaller proportion. For other US CS departments, NSF's share is larger and DARPA's is smaller than in 2000. Industry provides a larger share of funding in the top 12 departments, but a smaller share in other departments.

Median funding for US CS departments from each major source follow the ranking strata, with highest values for rank 1-12 departments, next highest values for departments ranked 13-24, and so on. Similarly, industrial funding makes up a much higher percentage of the funding in the US CS departments ranked 1-12 than in any other departments. CE departments tend to get slightly more funding from NSF than DARPA, and they receive higher percentages of funding from state agencies and industrial sources than most CS departments. Since only a small number of CE departments responded to the survey, care should be exercised when trying to generalize these observations to other CE departments. NSERC and the provincial agencies provide three-

Taulbee Continued on Page 12

Table 24. Total Expenditure from External Sources for CS/CE Research by Department Rank and Type

Department, Rank	Total Expenditure: Minimum	Total Expenditure: Mean	Total Expenditure: Median	Total Expenditure: Maximum	Per Capita Expenditure: Minimum	Per Capita Expenditure: Mean	Per Capita Expenditure: Median	Per Capita Expenditure: Maximum
US CS 1-12	$4,075,000.00	$19,104,087.00	$11,857,635.00	$72,577,846.00	$181,524.00	$409,596.00	$324,980.00	$1,051,853.00
US CS 13-24	$5,026,662.00	$ 8,566,394.00	$ 7,418,250.00	$14,185,474.00	$114,242.00	$300,087.00	$305,861.00	$ 524,209.00
US CS 25-36	$2,419,083.00	$ 6,109,443.00	$ 5,795,062.00	$16,908,841.00	$115,635.00	$213,113.00	$178,522.00	$ 337,992.00
US CS Other	$ 33,502.00	$ 2,321,627.00	$ 1,414,981.00	$21,270,796.00	$ 2,393.00	$110,460.00	$ 87,603.00	$ 820,949.00
Canadian	$ 65,457.00	$ 2,002,239.00	$ 1,135,837.00	$ 8,725,154.00	$ 2,045.00	$ 55,322.00	$ 35,272.00	$ 189,677.00
US CE	$1,000,000.00	$ 2,659,400.00	$ 2,819,287.00	$ 3,999,027.00	$ 71,795.00	$201,574.00	$117,311.00	$ 499,878.00

Table 25. Graduate Students Supported as Full-Time Students by Department Type and Rank

Department, Rank	Institutional Funds: Teaching Assistants	Institutional Funds: Research Assistants	Institutional Funds: Full-Support Fellows	Institutional Funds: Graduate Assistants for Computer Systems Support	Institutional Funds: Other	External Funds: Teaching Assistants	External Funds: Research Assistants	External Funds: Full-Support Fellows	External Funds: Graduate Assistants for Computer Systems Support	External Funds: Other
US CS 1-12	437 21.0%	266 12.8%	96 4.6%	0 0.0%	0 0.0%	0 0.0%	1,058 50.9%	210 10.1%	1 0.0%	10 0.5%
US CS 13-24	314 20.7%	193 12.7%	111 7.3%	6 0.4%	6 0.4%	3 0.2%	826 54.5%	45 3.0%	0 0.0%	12 0.8%
US CS 25-36	388 29.3%	151 11.4%	56 4.2%	10 0.8%	38 2.9%	0 0.0%	621 46.8%	49 3.7%	0 0.0%	13 1.0%
US CS Other	1,709 36.6%	635 13.6%	162 3.5%	157 3.4%	74 1.6%	40 0.9%	1,697 36.3%	176 3.8%	16 0.3%	9 0.2%
Canadian	358 47.7%	176 23.5%	13 1.7%	4 0.5%	6 0.8%	0 0.0%	158 21.1%	16 2.1%	1 0.1%	18 2.4%
US CE	215 22.8%	70 7.4%	24 2.6%	10 1.1%	1 0.1%	0 0.0%	613 65.1%	8 0.9%	0 0.0%	0 0.0%
Total	**3,421 30.3%**	**1,491 13.2%**	**462 4.1%**	**187 1.7%**	**125 1.1%**	**43 0.4%**	**4,973 44.1%**	**504 4.5%**	**18 0.2%**	**62 0.5%**

2002-2003 Taulbee Survey

Table 26-1. Fall 2003 Academic-Year Graduate Stipends by Department Type and Rank

Department, Rank	Teaching Assistantships				Research Assistantships			
	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	$ 9,225	$17,444	$17,100	$36,552	$13,824	$19,318	$17,100	$39,264
US CS 13-24	$12,540	$17,441	$16,100	$28,290	$14,980	$20,105	$17,888	$43,908
US CS 25-36	$13,000	$15,867	$14,753	$25,299	$13,190	$16,566	$14,925	$31,686
US CS Other	$ 2,194	$12,447	$12,600	$24,300	$ 2,194	$13,472	$13,536	$24,300
Canadian	$ 1,522	$ 9,588	$11,610	$17,060	$ 4,000	$11,967	$12,000	$23,200
US CE	$ 9,500	$14,076	$13,815	$19,464	$13,500	$15,426	$14,370	$19,464

Table 26-2. Fall 2003 Academic-Year Graduate Stipends by Department Type and Rank

Department, Rank	Full-Support Fellows				Assistantships for Computer Systems Support			
	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	$14,400	$18,864	$18,350	$24,600	$13,824	$15,912	$15,912	$18,000
US CS 13-24	$13,750	$18,274	$17,438	$27,000	*	*	*	*
US CS 25-36	$13,000	$19,252	$18,000	$29,940	$14,228	$14,693	$14,850	$15,000
US CS Other	$ 5,600	$15,743	$15,500	$24,000	$ 1,323	$11,213	$12,250	$18,000
Canadian	$11,440	$24,434	$21,250	$40,000	*	*	*	*
US CE	$11,200	$16,276	$16,300	$21,000	*	*	*	*

*Numbers not reported due to low number of respondents

Table 26-3. Fall 2003 Academic-Year Graduate Stipends by Department Type and Rank

Department, Rank	Other Assistantships			
	Minimum	Mean	Median	Maximum
US CS 1-12	*	*	*	*
US CS 13-24	*	*	*	*
US CS 25-36	$3,300	$15,382	$15,925	$26,378
US CS Other	$1,200	$10,037	$12,000	$15,000
Canadian	$1,875	$16,015	$ 9,000	$34,100
US CE	*	*	*	*

*Numbers not reported due to low number of respondents

Taulbee from Page 11

quarters of the Canadian support, with the next highest levels of support coming from industrial sources and other mission-oriented federal agencies. Actual funding amounts were not reported in the *CRN* article associated with the 2000 Profiles Survey.

Graduate Student Recruiting *(Tables 45-47)*

Earlier we presented the current status of graduate student stipends (see Table 26). We update these each year as part of the regular Taulbee Survey. The Profiles Survey asks about factors that affect these stipends, and this information is summarized in Table 45. For most US departments, stipend amounts are most frequently affected by advancement within the graduate program. Differences among the stipend source are important at many US CS departments, with years of service and recruiting enhancements being other factors in about a quarter of the departments. It is noteworthy that recruiting enhancements now are only a factor in about a quarter of the departments rather than about a third in 2000, while the other factors are present in the same proportion of departments as in 2000. In Canada, the most important factor influencing stipend amounts is the source of funds.

Table 46 shows methods used by departments to recruit graduate students, and Table 47 shows the costs associated with these methods. Most of the top 36 ranked departments use multi-year (typically 3 or 4 years) support guarantees as a recruiting tool, whereas less than half of the CE departments and departments ranked above 36 or unranked do so. The vast majority of the top-ranked departments also pay for graduate students to visit campus, which is much less common among the CE and other CS departments. Top-ranked US CS departments are also much more likely to enhance graduate student stipends than the other departments surveyed. Overall, 45% of the US CS departments had stipend enhancements in the 2000 survey, so this appears to be a much less prevalent tool than it was during the dot-com era. The typical enhancement is between $3,000 and $4,000 in the United States (about two-thirds the value for the 2000 survey) and $5,000 Canadian in Canada. The amount spent on paid visits to campus appears comparable to the value in 2000, and the amount of guaranteed summer support appears consistent with the general stipend increases over the three-year period since the last Profiles Survey.

Departmental Support Staff *(Tables 48-50)*

Tables 48-50 show various kinds of staff support provided to the department. Table 48 shows that the higher the ranking, the more full-time secretarial and administrative support the department has. Schools ranked 1-12 have more than four times as much support as the lower-ranked CS departments and 1.5 times as much support as a CE department. It may be more useful to normalize these data by the size of the department's tenure-track faculty. If this is done, the top 12 departments and the CE departments have about 0.4 administrative support staff per faculty, departments ranked 13-36 about 0.3, and those ranked

Taulbee Continued on Page 14

Table 27. Nine-month Salaries, 147 Responses of 169 US Computer Science Departments

Faculty Rank	Number of Faculty	Reported Salary Minimum			Overall Mean	Overall Median	Reported Salary Maximum		
		Minimum	Mean	Maximum			Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	608	$16,000	$48,182	$ 88,303	$ 55,833	$ 55,526	$34,000	$ 65,234	$135,100
Assistant Professor	1,000	$48,269	$72,091	$ 87,000	$ 76,531	$ 76,392	$61,316	$ 81,297	$124,542
Associate Professor	922	$42,158	$77,029	$108,000	$ 85,555	$ 85,437	$64,744	$ 94,932	$165,000
Full Professor	1,335	$52,200	$89,300	$122,540	$111,354	$107,670	$83,500	$147,671	$280,786

Table 28. Nine-month Salaries, 11 Responses of 12 US Computer Science Departments Ranked 1-12

Faculty Rank	Number of Faculty	Reported Salary Minimum			Overall Mean	Overall Median	Reported Salary Maximum		
		Minimum	Mean	Maximum			Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	60	$32,205	$45,792	$ 70,000	$ 66,802	$ 67,919	$ 67,700	$ 85,589	$110,838
Assistant Professor	113	$51,748	$77,281	$ 87,000	$ 83,477	$ 82,794	$ 85,000	$ 92,775	$115,000
Associate Professor	90	$66,732	$86,228	$108,000	$ 95,252	$ 94,662	$ 79,300	$107,859	$130,000
Full Professor	230	$73,874	$94,943	$113,000	$124,510	$121,887	$125,737	$176,277	$ 225,000

2002-2003 Taulbee Survey

Table 29. Nine-month Salaries, 12 Responses of 12 US Computer Science Departments Ranked 13-24

		Reported Salary Minimum					Reported Salary Maximum		
Faculty Rank	Number of Faculty	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	46	$48,000	$59,944	$ 74,000	$ 68,413	$ 66,829	$ 62,220	$ 79,761	$100,000
Assistant Professor	89	$75,000	$79,525	$ 85,000	$ 84,913	$ 83,572	$ 82,500	$ 91,169	$117,000
Associate Professor	70	$67,915	$87,669	$ 98,900	$ 95,435	$ 94,297	$ 85,900	$101,882	$127,000
Full Professor	192	$76,000	$94,554	$110,500	$129,861	$121,421	$153,422	$189,246	$280,786

Table 30. Nine-month Salaries, 12 Responses of 12 US Computer Science Departments Ranked 25-36

		Reported Salary Minimum					Reported Salary Maximum		
Faculty Rank	Number of Faculty	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	51	$40,823	$52,945	$ 75,408	$ 62,830	$ 61,209	$ 60,705	$ 78,617	$135,100
Assistant Professor	106	$68,000	$75,101	$ 81,600	$ 78,682	$ 78,396	$ 78,000	$ 83,261	$ 88,134
Associate Professor	98	$64,307	$80,238	$ 96,750	$ 91,144	$ 92,706	$ 87,725	$105,200	$165,000
Full Professor	158	$68,199	$93,131	$120,756	$121,309	$119,633	$110,650	$166,450	$252,000

Table 31. Nine-month Salaries, 112 Responses of 133 US Computer Science Departments Ranked Higher than 36 or Unranked

		Reported Salary Minimum					Reported Salary Maximum		
Faculty Rank	Number of Faculty	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	451	$16,000	$46,650	$ 88,303	$ 53,037	$ 52,903	$34,000	$ 60,884	$110,000
Assistant Professor	692	$48,269	$70,463	$ 85,698	$ 74,720	$ 74,779	$61,316	$ 78,901	$124,542
Associate Professor	664	$42,158	$74,723	$106,500	$ 83,032	$ 82,885	$64,744	$ 91,933	$160,000
Full Professor	756	$52,200	$87,744	$122,540	$106,934	$103,443	$83,500	$138,227	$220,773

Table 32. Nine-month Salaries, 7 Responses of 29 US Computer Engineering Departments

		Reported Salary Minimum					Reported Salary Maximum		
Faculty Rank	Number of Faculty	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	13	$44,112	$64,287	$ 83,150	$ 70,549	$ 70,437	$ 54,468	$ 77,539	$ 95,000
Assistant Professor	64	$65,000	$74,760	$ 88,800	$ 78,419	$ 78,093	$ 71,108	$ 82,861	$ 89,300
Associate Professor	42	$63,700	$79,865	$109,200	$ 86,404	$ 85,865	$ 77,563	$ 93,051	$109,200
Full Professor	111	$76,360	$92,674	$109,000	$110,966	$101,747	$108,749	$156,693	$200,000

Table 33. Twelve-month Salaries, 19 Responses of 27 Canadian Computer Science Departments (Canadian Dollars)

		Reported Salary Minimum					Reported Salary Maximum		
Faculty Rank	Number of Faculty	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Non-Tenure Teaching Faculty	69	$37,963	$57,174	$ 75,000	$ 62,720	$ 62,852	$49,551	$ 70,216	$105,327
Assistant Professor	182	$45,606	$70,799	$ 90,000	$ 77,371	$ 77,207	$65,268	$ 85,724	$105,342
Associate Professor	190	$50,000	$78,544	$ 97,277	$ 88,637	$ 88,011	$69,582	$ 99,221	$130,212
FullProfessor	244	$60,659	$91,774	$112,485	$110,008	$107,883	$85,017	$138,125	$193,814

Table 34. Nine-month Salaries for New PhDs, Responding US CS and CE Departments

		Reported Salary Minimum					Reported Salary Maximum		
Employment Position	Number	Minimum	Mean	Maximum	Overall Mean	Overall Median	Minimum	Mean	Maximum
Tenure-Track Faculty	117	$61,128	$75,493	$87,679	$76,379	$76,308	$61,128	$77,363	$120,000
Researcher	9	$36,900	$55,556	$72,000	$55,556	$55,556	$36,900	$55,556	$72,000
Postdoc	24	$30,000	$44,737	$61,000	$45,970	$45,970	$35,000	$47,204	$61,000
Non-Tenure Teaching Faculty	9	$40,000	$55,726	$72,000	$55,793	$55,793	$40,000	$55,860	$72,000

2002-2003 Taulbee Survey

Table 35. Official and Actual Teaching Loads of Tenured and Tenure-track Faculty

	Official Teaching Load				Actual Teaching Load			
Department, Rank	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	2	2.3	2.0	3	2	2.2	2.0	3
US CS 13-24	2	2.7	2.5	4	2	2.4	2.0	4
US CS 25-36	2	2.6	2.5	4	2	2.4	2.0	4
US CS Other	2	3.8	4.0	9	2	3.3	3.0	9
Canadian	2	2.3	3.0	4	2	3.0	3.0	4
US CE	2	3.6	4.0	5	2	2.9	3.0	4
Total	**2**	**3.5**	**3.0**	**9**	**2**	**3.0**	**3.0**	**9**

Taulbee from Page 12

above 36 or unranked and the Canadian departments have about 0.2. For the US CS departments, these normalized values are less than they were in 2000. About 80% of funding for administrative support staff comes from institutional funds in the top 24 departments, and 90% or more comes from institutional funds in other departments.

The number of computer-support personnel employed by a CS department (Table 49) varies from a low of about 0.1 per tenure-track faculty for CE departments and US CS departments ranked above 36 or unranked, to slightly more than 0.2 per tenure-track faculty for US departments ranked 1-12 and for Canadian departments. Top-ranked departments are much more likely to support such positions with external funds (almost half of computer support personnel in the top 12 departments are paid from external funds, while only 10% to 20% of these personnel in Canadian departments, CE departments, and US departments ranked above 24 are supported by external funds).

Table 50 shows full-time research employees. US CE and Canadian CSE departments typically employ with internal funds five or six times as many full-time researchers as do US CS departments. US CS departments ranked in the top 24 have many more such positions than do the other departments, both in raw numbers and on a per FTE tenure-track faculty basis; they are mainly supported with external funds. Except for the top 12 departments, the ratios of research employees per FTE tenure-track faculty in US CS departments have declined since 2000.

Departmental Space *(Tables 51-62)*

Tables 51-62 illustrate a variety of space details. Table 51 lists total current departmental space. The amount of space held by a department varies widely, by a factor of almost 200 from smallest to largest space. Within the US CS departments, the average department ranked 1-12 has 1.5 times as much space per tenure-track faculty as the typical other CS department. Average values per tenure-track faculty in all US CS categories are below their corresponding values in the 2000 Profiles Survey, although in each stratum, actual average space has grown at least 10%. The actual amount of additional space per department increased about 5,000 sq. ft. from 2000 to 2003. In 2000, departments estimated that they would receive over 30,000 sq. ft. of new space by 2003. These differences may be explained by a combination of optimism on the part of the departments, and the fact that much of the new space ends up replacing existing space rather than adding to it. Canadian departments average about 10% to 20% below typical US CS departments. CE departments have the highest amount of space per FTE faculty (about 56% above the level for rank 1-12 US CS departments).

Tables 52-55 break down current space by category of space. The pattern in Table 51 for total department space is similar in Table 52 (space for faculty, staff, and student offices) and Table 53 (space for conference and seminar rooms). Table 54 shows that the CS departments ranked in the top 24 have substantially more research laboratory space than the other CS departments. On a per tenure-track faculty basis, the differences are not as great among the US CS departments, but Canadian departments appear to have only three-quarters the space per tenure-track faculty. CE departments have about three times as much research lab space per tenure-track faculty as do CS departments. Instructional lab space, shown in Table 55, is much greater for the top 12 ranked US CS departments and the Canadian departments than for other departments responding. However, several departments apparently do not have instructional lab space. Probably in those departments that space is owned by their college or central campus offices, and in fact it is likely that many of the other departments have at least some of their instructional space provided by a more central university unit.

It is interesting to note that research lab space now is 27.7% of the total space, whereas in 2000 it was only 21.0%. All other categories of space are a somewhat smaller portion of total space to compensate for this.

Tables 56-62 show space growth expectations. Table 56 indicates that only about half of the departments responding actually have definite plans for new space. This contrasts with an 81% figure in the 2000 survey. Table 57 shows when the space is expected to be added, Table 58 shows the total space expected, and Tables 59-62 break down these expected additions by category of space. Expected growth in office space accounts for the largest proportion (41.5%) of the total expected space growth, but this is a smaller proportion of office space than exists currently (50.9%). Each other category of space accounts for about a 3% higher proportion of the total planned space than it does as a proportion of current space.

Concluding Observations

This year, we see more conclusive data supporting reductions in undergraduate enrollments. This effect is observed in both the United States and Canada. While the reductions are significant, they should be interpreted in view of the staggering increases experienced in the late 1990s. Present enrollment levels are still considerably higher than before the surge during the dot-com era.

An upturn in the number of Ph.D.s produced appears to be on the horizon, absent exogenous forces. The multi-year increase in the number of students who passed qualifiers should soon have an effect on the number of graduates from Ph.D. programs. It will be interesting to see if this trend continues as economic conditions improve.

Faculty churn appears to be over, at least for the time being. Far fewer faculty moved from one academic position to another. Estimates of faculty growth are considerably more modest, and more accurate, than in previous years. Faculty salaries showed rather small increases compared with the recent past. These observations all are consistent with the economic downturn.

Some data from the former Departmental Profiles Survey showed differences, but much of it did not. This validates CRA's decision to conduct the Profiles analysis only every 3 years (next in fall 2006). Of

Table 36. Faculty Load Reductions and Increases

	Faculty Load Reduction Possible		Faculty Load Increase Possible	
Department, Rank	Yes	No	Yes	No
US CS 1-12	91.7%	8.3%	77.8%	22.2%
US CS 13-24	83.3%	16.7%	80.0%	20.0%
US CS 25-36	83.3%	16.7%	80.0%	20.0%
US CS Other	98.2%	1.8%	77.0%	23.0%
Canadian	100.0%	0.0%	81.3%	18.8%
US CE	100.0%	0.0%	66.7%	33.3%
Total	**96.0%**	**4.0%**	**77.5%**	**22.5%**

Table 37. Type of Load Reductions Possible in Departments Offering Reductions

Department, Rank	Special Package for New Faculty	Administrative Duties	Type or Size of Class Taught	Buyout Policy	Strong Research Involvement	Other
US CS 1-12	75.0%	75.0%	33.3%	33.3%	33.3%	25.0%
US CS 13-24	58.3%	83.3%	25.0%	66.7%	33.3%	25.0%
US CS 25-36	75.0%	75.0%	16.7%	58.3%	33.3%	16.7%
US CS Other	88.6%	83.3%	29.8%	83.3%	52.6%	7.9%
Canadian	89.5%	94.7%	21.1%	21.1%	68.4%	42.1%
US CE	100.0%	100.0%	57.1%	85.7%	42.9%	14.3%
Total	**85.2%**	**84.1%**	**29.0%**	**70.5%**	**50.0%**	**14.8%**

2002-2003 Taulbee Survey

Table 38. Reasons for Increase in Teaching Load

Department, Rank	Shifting Primary Responsibilities to Teaching	Other
US CS 1-12	77.8%	22.2%
US CS 13-24	80.0%	20.0%
US CS 25-36	80.0%	20.0%
US CS Other	74.4%	25.6%
Canadian	81.3%	18.8%
US CE	50.0%	50.0%
Total	**70.3%**	**29.7%**

particular note is that high space growth is no longer forecast, consistent with the softening of faculty growth. Also, fewer departments appear to be offering special stipend enhancements as a means to recruit new graduate students.

Rankings

For tables that group computer science departments by rank, the rankings are based on information collected in the 1995 assessment of research and doctorate programs in the United States conducted by the National Research Council [see http://www.cra.org/statistics/nrc-study2/home.html].

The top twelve CS departments in this ranking are: *Stanford, Massachusetts Institute of Technology, University of California (Berkeley), Carnegie Mellon, Cornell, Princeton, University of Texas (Austin), University of Illinois (Urbana-Champaign), University of Washington, University of Wisconsin (Madison), Harvard, and California Institute of Technology.* All schools in this ranking participated in the survey this year.

CS departments ranked 13-24 are: *Brown, Yale, University of California (Los Angeles), University of Maryland (College Park), New York University, University of Massachusetts (Amherst), Rice, University of Southern California, University of Michigan, University of California (San Diego), Columbia, and University of Pennsylvania.*[2] All schools in this ranking participated in the survey this year.

CS departments ranked 25-36 are: *University of Chicago, Purdue, Rutgers, Duke, University of North Carolina (Chapel Hill), University of Rochester, State University of New York (Stony Brook), Georgia Institute of Technology, University of Arizona, University of California (Irvine), University of Virginia, and Indiana.* All schools in this ranking participated in the survey this year.

CS departments that are ranked above 36 or that are unranked that responded to the survey include: *Arizona State University, Auburn, Boston, Brandeis, Case Western Reserve, City University of New York Graduate Center, Clemson, College of William and Mary, Colorado School of Mines, Colorado State, Dartmouth, DePaul, Drexel, Florida Institute of Technology, Florida International, Florida State, George Mason, George Washington, Georgia State, Illinois Institute of Technology, Iowa State, Johns Hopkins, Kansas State, Kent State, Lehigh, Louisiana State, Michigan State, Michigan Technological, Mississippi State, Montana State, New Jersey Institute of*

Taulbee Continued on Page 17

Table 39. Sources of External Funding, US CS Ranked 1-12

	Mean	Median	Total	% of Total External Funding
NSF	$6,366,220	$4,952,790	$57,295,983	30.0%
DARPA	$5,453,909	$2,236,118	$27,269,545	14.3%
NIH	$ 345,590	$ 183,000	$ 1,727,950	0.9%
DOE	$ 814,417	$ 400,000	$ 4,072,087	2.1%
State agencies	$ 773,488	$1,150,681	$ 2,320,465	1.2%
Industrial sources	$3,437,715	$ 580,656	$30,939,433	16.2%
Other defense agencies- e.g., ARO, AFOSR, ONR	$4,639,002	$2,679,563	$37,112,013	19.4%
Other mission-oriented federal agencies	$2,007,744	$1,676,260	$12,046,461	6.3%
Private foundation	$ 225,414	$ 85,321	$ 1,803,313	0.9%
Other	$2,350,517	$ 514,161	$16,453,616	8.6%

Table 40. Sources of External Funding, US CS Ranked 13-24

	Mean	Median	Total	% of Total External Funding
NSF	$3,317,498	$3,509,750	$36,492,481	38.5%
DARPA	$1,795,567	$1,189,851	$14,364,532	15.2%
NIH	$ 366,867	$ 312,865	$ 2,934,936	3.1%
DOE	$ 400,345	$ 192,227	$ 2,402,071	2.5%
State agencies	$ 700,109	$ 433,446	$ 4,900,764	5.2%
Industrial sources	$ 507,896	$ 357,274	$ 5,078,957	5.4%
Other defense agencies- e.g., ARO, AFOSR, ONR	$1,902,168	$1,201,700	$19,021,681	20.1%
Other mission-oriented federal agencies	$ 556,761	$ 505,765	$ 4,454,090	4.7%
Private foundation	$ 249,418	$ 76,803	$ 2,244,760	2.4%
Other	$ 483,744	$ 210,579	$ 2,902,461	3.1%

Total external funding does not equal total in Table 24 due to one department not reporting breakdowns

Table 41. Sources of External Funding, US CS Ranked 25-36

	Mean	Median	Total	% of Total External Funding
NSF	$3,233,047	$2,847,444	$38,796,567	52.9%
DARPA	$ 992,573	$ 660,749	$ 6,948,014	9.5%
NIH	$ 310,895	$ 113,820	$ 1,554,477	2.1%
DOE	$ 306,480	$ 273,845	$ 2,145,357	2.9%
State agencies	$ 285,500	$ 159,681	$ 1,998,498	2.7%
Industrial sources	$ 404,481	$ 349,472	$ 4,044,807	5.5%
Other defense agencies - e.g., ARO, AFOSR, ONR	$ 877,101	$ 898,438	$ 7,893,911	10.8%
Other mission-oriented federal agencies	$ 502,320	$ 351,262	$ 3,013,920	4.1%
Private foundation	$ 553,838	$ 58,494	$ 3,876,868	5.3%
Other	$ 434,414	$ 83,285	$ 3,040,901	4.1%

2002-2003 Taulbee Survey

Table 42. Sources of External Funding, US CS Ranked Higher than 36 or Unranked

	Mean	Median	Total	% of Total External Funding
NSF	$1,054,709	$502,646	$97,033,219	42.6%
DARPA	$ 377,842	$285,161	$14,735,837	6.5%
NIH	$ 412,931	$225,346	$ 9,497,404	4.2%
DOE	$ 347,239	$ 77,357	$10,764,409	4.7%
State agencies	$ 247,246	$118,676	$13,104,054	5.8%
Industrial sources	$ 181,055	$ 77,945	$11,587,501	5.1%
Other defense agencies - e.g., ARO, AFOSR, ONR	$ 533,171	$323,180	$36,788,786	16.2%
Other mission-oriented federal agencies	$ 341,826	$160,449	$14,014,854	6.2%
Private foundation	$ 84,330	$ 26,176	$ 2,698,547	1.2%
Other	$ 375,975	$136,957	$17,294,863	7.6%

Table 43. Sources of External Funding, US CE

	Mean	Median	Total	% of Total External Funding
NSF	$913,026	$876,053	$3,652,105	34.3%
DARPA	$758,024	$700,000	$3,032,096	28.5%
NIH	*	*	$ 150,000	1.4%
DOE	$-	$-	$ -	0.0%
State agencies	*	*	$1,171,074	14.9%
Industrial sources	$375,500	$417,458	$1,126,501	10.6%
Other defense agencies - e.g., ARO, AFOSR, ONR	*	*	$ 530,525	5.0%
Other mission-oriented federal agencies	$-	$-	$ -	0.0%
Private foundation	*	*	$ 82,297	0.8%
Other	*	*	$ 893,002	8.4%

* Numbers not reported due to low number of respondents

Table 44. Sources of External Funding, Canadian CS/CE

	Mean	Median	Total	% of Total External Funding
NSERC	$ 837,728	$592,319	$12,565,925	41.8%
Provincial agencies	$1,160,106	$463,432	$10,440,950	34.8%
Industrial sources	$ 289,239	$ 96,033	$ 2,892,393	9.6%
Defense agencies	*	*	$ 239,242	0.8%
Other mission-oriented federal agencies	$ 439,554	$455,322	$ 2,197,771	7.3%
Private foundation	*	*	$ 246,643	0.8%
Other	$ 207,237	$165,411	$ 1,450,661	4.8%

* Numbers not reported due to low number of respondents

Table 45. Factors Affecting the Amount of a Graduate Student's Stipend

Department, Rank	Advancement to Next Stage of Program	Years of Service	GPA	Recruitment Enhancements	Differences Among Various Stipend Sources	Other
US CS 1-12	66.7%	16.7%	0.0%	41.7%	41.7%	25.0%
US CS 13-24	33.3%	25.0%	8.3%	8.3%	16.7%	58.3%
US CS 25-36	58.3%	25.0%	8.3%	25.0%	25.0%	33.3%
US CS Other	65.5%	22.1%	15.9%	23.0%	48.7%	19.5%
Canadian	29.4%	23.5%	23.5%	35.3%	64.7%	29.4%
US CE	66.7%	33.3%	16.7%	16.7%	16.7%	33.3%
Total	**59.3%**	**22.7%**	**14.5%**	**24.4%**	**44.8%**	**25.0%**

Table 46. Departments Using Selected Graduate Student Recruitment Incentives

Department, Rank	Upfront One-Time Signing Bonus	Stipend Enhancements	Guaranteed Multi-Year Support	Guaranteed Summer Support	Paid Visits to Campus	Other Recruitment Incentives
US CS 1-12	25.0%	41.7%	75.0%	8.3%	83.3%	41.7%
US CS 13-24	8.3%	33.3%	100.0%	50.0%	83.3%	33.3%
US CS 25-36	16.7%	41.7%	75.0%	41.7%	83.3%	25.0%
US CS Other	6.2%	15.0%	38.1%	21.2%	25.7%	23.0%
Canadian	17.6%	17.6%	64.7%	11.8%	23.5%	23.5%
US CE	0.0%	16.7%	33.3%	50.0%	50.0%	16.7%
Total	**9.3%**	**20.3%**	**50.0%**	**23.8%**	**38.4%**	**25.0%**

2002-2003 Taulbee Survey

Taulbee from Page 15

Technology, New Mexico State, North Carolina State, North Dakota State, Northeastern, Northwestern, Oakland, Ohio, Ohio State, Oklahoma State, Old Dominion, Oregon Health & Science, Oregon State, Pennsylvania State, Polytechnic, Portland State, Rensselaer Polytechnic, Southern Methodist, State University of New York (Albany), Syracuse, Texas A&M, Texas Tech, Tufts, Utah State, Vanderbilt, Virginia Commonwealth, Virginia Polytechnic, Washington State, Washington (St. Louis), Wayne State, Western Michigan, Worcester Polytechnic, and Wright State.

University of: *Alabama (Birmingham, Huntsville, and Tuscaloosa), Buffalo, California (at Davis, Riverside, Santa Barbara, and Santa Cruz), Cincinnati, Colorado (at Boulder, Colorado Springs, and Denver), Connecticut, Delaware, Denver, Florida, Georgia, Hawaii, Houston, Idaho, Illinois (Chicago), Iowa, Kansas, Kentucky, Louisiana (Lafayette), Louisville, Maine, Maryland (Baltimore Co.), Massachusetts (at Boston and Lowell), Minnesota, Missouri (at Kansas City and Rolla), Nebraska (Lincoln), Nevada (Las Vegas), New Hampshire, New Mexico, North Texas, Notre Dame, Oklahoma, Oregon, Pittsburgh, South Carolina, South Florida, Tennessee (Knoxville), Texas (at Arlington, Dallas, El Paso, and San Antonio), Tulsa, Utah, and Wyoming.*

Computer Engineering departments participating in the survey this year include: *Georgia Institute of Technology, Northwestern, Princeton, Rensselaer Polytechnic, Santa Clara University, the University of Tennessee (Knoxville), and the University of California (Santa Cruz).*

Canadian departments participating in the survey include: *Concordia, Dalhousie, McGill, Memorial, Queen's, Simon Fraser, and York universities.* **University of:** *Alberta, British Columbia, Calgary, Manitoba, Montreal, New Brunswick, Quebec (Montreal), Regina, Saskatchewan, Victoria, Waterloo, and Western Ontario.*

Acknowledgments

Jean Smith and Drew Sutter assisted with data collection, tabulation, and analysis for this survey. Andy Bernat and Jay Vegso assisted with the preparation of the final report. We thank them for their assistance.

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Endnotes

[1]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.

[2]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 guidelines set forth by the U.S. Department of Education.

All faculty tables: The survey makes no distinction between faculty specializing in CS vs. CE programs. Every effort is made to minimize the inclusion of faculty in electrical engineering who are not computer engineers. ∎

Table 47. Mean Amounts and Years of Selected Graduate Student Recruitment Incentives

Department, Rank	Upfront One-Time Signing Bonus	Stipend Enhancements	Guaranteed Years of Support	Guaranteed Summer Support	Paid Visits to Campus
US CS 1-12	$4,000	$2,960	3.6	*	$598
US CS 13-24	*	$4,000	3.7	$5,870	$570
US CS 25-36	$3,500	$3,640	3.4	$5,374	$511
US CS Other	$2,857	$2,866	3.1	$3,739	$559
Canadian	$4,667	$5,000	3.0	$3,800	$563
US CE	NA	*	4.5	$6,400	$267
Total	**$3,625**	**$3,238**	**3.3**	**$4,601**	**$546**

*Numbers not reported due to low number of respondents

Table 48. Full-time Secretarial/Administrative Employees by Type of Support

	Institutional Support				External Support				Total			
Department, Rank	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	5.0	19.3	12.0	80.0	-	6.1	2.5	37.0	5.0	25.4	18.5	85.0
US CS 13-24	7.0	11.2	10.0	18.0	-	2.8	2.0	10.0	8.0	14.0	13.5	22.0
US CS 25-36	5.0	12.6	9.0	38.0	-	1.0	1.0	4.0	5.0	13.6	9.0	42.0
US CS Other	1.0	4.6	3.0	33.0	-	0.5	-	8.0	1.0	5.1	4.0	33.0
Canadian	3.0	8.3	7.0	22.0	-	0.4	-	3.0	3.0	8.7	7.0	25.0
US CE	-	16.1	7.0	79.0	-	1.0	-	4.0	-	17.1	11.0	120.0
Total	**-**	**7.4**	**5.0**	**80.0**	**-**	**1.1**	**-**	**37.0**	**-**	**8.5**	**6.0**	**85.0**

Table 49. Full-time Computer Support Employees by Type of Support

	Institutional Support				External Support				Total			
Department, Rank	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	-	6.2	4.0	20.0	-	5.8	4.0	30.0	3.0	11.9	8.0	50.0
US CS 13-24	-	5.3	4.0	13.0	-	2.1	0.5	9.0	-	7.4	5.5	22.0
US CS 25-36	-	7.1	7.0	15.0	-	0.8	1.0	2.0	-	7.8	7.0	16.0
US CS Other	-	2.5	2.0	12.0	-	0.5	-	8.0	-	3.0	2.0	12.0
Canadian	4.0	8.5	6.0	22.0	-	0.2	-	2.0	4.0	8.7	6.5	22.0
US CE	-	3.0	1.0	15.0	-	0.3	-	2.0	-	3.3	2.0	15.0
Total	**-**	**3.9**	**3.0**	**22.0**	**-**	**0.9**	**-**	**30.0**	**-**	**4.8**	**3.0**	**50.0**

Table 50. Full-time Research Employees by Type of Support

	Institutional Support				External Support				Total			
Department, Rank	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
US CS 1-12	-	0.9	-	10.0	-	21.3	6.0	160.0	-	22.2	6.0	170.0
US CS 13-24	-	1.4	-	11.0	-	13.9	7.0	42.0	1.0	15.3	9.0	42.0
US CS 25-36	-	0.8	-	9.0	-	2.2	0.5	11.0	-	2.9	0.5	11.0
US CS Other	-	0.3	-	9.0	-	1.6	-	26.0	-	1.9	-	28.0
Canadian	-	1.8	-	30.0	-	3.3	0.5	15.0	-	5.2	1.5	30.0
US CE	-	8.3	-	56.0	-	1.9	-	11.0	-	10.1	-	56.0
Total	**-**	**0.9**	**-**	**56.0**	**-**	**4.1**	**-**	**160.0**	**-**	**5.0**	**-**	**170.0**

2002-2003 Taulbee Survey

Table 51. Total Departmental Space (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	14,410	65,147	53,357	201,580	781,765
US CS 13-24	13,344	36,669	36,206	58,162	440,032
US CS 25-36	15,383	37,675	27,943	109,941	452,102
US CS Other	1,500	20,255	16,924	57,743	2,106,551
Canadian	4,912	26,990	24,542	63,520	404,845
US CE	10,509	80,386	41,000	291,000	401,933

Table 52. Departmental Space for Faculty, Staff, and Student Offices (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	6,270	33,904	30,297	104,295	406,848
US CS 13-24	10,632	23,062	21,889	37,618	276,749
US CS 25-36	7,735	22,161	18,233	52,027	265,936
US CS Other	763	9,656	7,744	32,997	1,004,200
Canadian	1,959	11,275	8,653	32,301	169,132
US CE	4,118	42,632	8,000	181,225	213,164

Table 53. Departmental Space for Conference and Seminar Rooms (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	1,939	6,597	5,371	16,754	79,168
US CS 13-24	-	2,663	2,383	5,287	31,950
US CS 25-36	836	2,801	2,509	7,246	33,613
US CS Other	-	1,048	700	5,000	108,998
Canadian	-	1,582	1,226	7,376	23,731
US CE	-	776	242	2,500	3,884

Table 54. Departmental Space for Research Labs (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	4,500	14,763	8,568	74,131	177,156
US CS 13-24	2,228	8,405	8,678	15,841	100,862
US CS 25-36	-	9,586	4,762	51,675	115,027
US CS Other	-	5,891	4,705	40,168	612,617
Canadian	687	7,121	6,380	15,477	106,816
US CE	3,145	31,674	23,000	100,000	158,368

Table 55. Departmental Space for Instructional Labs (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	1,631	9,883	7,830	28,255	118,593
US CS 13-24	-	2,539	2,625	8,716	30,471
US CS 25-36	700	3,127	2,434	8,073	37,526
US CS Other	-	3,661	2,722	19,875	380,736
Canadian	700	7,011	5,903	16,845	105,166
US CE	1,341	5,303	6,239	10,000	26,517

Table 56. Definite Departmental Plans to Gain New Space

Department, Rank	Yes	No	No Answer
US CS 1-12	41.7%	16.7%	41.7%
US CS 13-24	50.0%	16.7%	33.3%
US CS 25-36	66.7%	0.0%	33.3%
US CS Other	45.6%	31.6%	22.8%
Canadian	66.7%	16.7%	16.7%
US CE	71.4%	14.3%	14.3%
Total	**50.3%**	**19.4%**	**30.3%**

INVITATION FOR PARTICIPATION

CRA-W Distinguished Lecture Series
and Graduate School Recruiting Panels

Applications now being accepted to host recruitment events designed to attract female students to graduate school. Applications from all educational institutions, including minority institutions, are solicited.

See: http://www.cra.org/distinguished.lecture/
Contact Program Coordinators:
Renée J. Miller (miller@cs.toronto.edu)
Joann Ordille (joann@avaya.com)

2002-2003 Taulbee Survey

Table 57. Year Departments Plan to Add Space

2003		2004		2005		2006		2007		2008		2009	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
6	7.1%	48	56.5%	17	20.0%	6	7.1%	2	2.4%	5	5.9%	1	1.2%

Table 58. Total Expected Additional Space of Departments Adding Space (net sq. ft.)

Department, Rank	Minimum	Mean	Median	Maximum	Total
US CS 1-12	700	41,723	3,900	158,390	166,890
US CS 13-24	1,528	21,134	15,068	46,600	126,803
US CS 25-36	500	26,261	19,920	63,000	183,824
US CS Other	100	16,733	12,000	82,048	752,993
Canadian	1,658	13,492	8,000	35,647	148,412
US CE	3,614	18,259	9,710	50,000	73,034

Table 59. Total Expected Additional Office Space* for Faculty, Staff, and Grad Students (net sq. ft.)

Department, Rank	% Adding None**	Minimum	Mean	Median	Maximum	Total
US CS 1-12	25.0%	700	28,367	5,000	79,400	85,100
US CS 13-24	0.0%	764	10,268	4,677	28,000	61,607
US CS 25-36	14.3%	550	8,611	6,578	20,000	51,664
US CS Other	13.3%	100	7,900	4,401	35,589	308,094
Canadian	0.0%	1,231	5,802	3,000	16,645	63,824
US CE	0.0%	2,000	8,164	2,827	25,000	32,654

*Square footage numbers include only those departments adding additional office space
**Percentage is among all departments adding total space

Table 60. Total Expected Additional Conference and Seminar Space (net sq. ft.)**

Department, Rank	% Adding None***	Minimum	Mean	Median	Maximum	Total
US CS 1-12	50.0%	*	9,540	9,540	*	19,080
US CS 13-24	33.3%	625	3,079	2,885	5,923	12,317
US CS 25-36	42.9%	1,600	4,263	4,475	6,500	17,050
US CS Other	40.0%	153	2,506	1,000	10,515	67,658
Canadian	27.3%	800	1,651	1,253	3,420	13,209
US CE	50.0%	*	2,725	2,725	*	5,450

*Numbers not reported due to low number of respondents
**Square footage numbers include only those departments adding additional conference and seminar space
***Percentage is among all departments adding total space

Table 61. Total Expected Additional Research Laboratory Space (net sq. ft.)**

Department, Rank	% Adding None***	Minimum	Mean	Median	Maximum	Total
US CS 1-12	75.0%	*	*	*	*	29,470
US CS 13-24	16.7%	764	8,991	11,000	17,727	44,956
US CS 25-36	28.6%	500	18,246	16,920	32,700	91,230
US CS Other	24.4%	300	6,157	5,621	17,983	209,344
Canadian	27.3%	1,105	6,048	5,701	10,555	48,382
US CE	25.0%	6,930	8,310	8,000	10,000	24,930

*Numbers not reported due to low number of respondents
**Square footage numbers include only those departments adding research laboratory space
***Percentage is among all departments adding total space

Table 62. Total Expected Additional Instructional Laboratory Space (net sq. ft.)**

Department, Rank	% Adding None***	Minimum	Mean	Median	Maximum	Total
US CS 1-12	50.0%	*	16,620	16,620	*	33,240
US CS 13-24	50.0%	1,100	2,641	2,823	4,000	7,923
US CS 25-36	42.9%	650	5,970	6,615	10,000	23,880
US CS Other	44.4%	600	6,716	5,064	27,636	167,897
Canadian	36.4%	350	3,285	2,000	9,944	22,997
US CE	75.0%	*	*	*	*	10,000

*Numbers not reported due to low number of respondents
**Square footage numbers include only those departments adding instructional laboratory space
***Percentage is among all departments adding total space

The Incredibly Shrinking Pipeline Is Not Just for Women Anymore

By James H. Morris and Peter Lee

If you can keep your head while all about are losing theirs and blaming it on you, perhaps you have underestimated the seriousness of the situation.

The tech meltdown and the media stories about offshoring are causing a lot of angst among us all. These temporary phenomena should motivate us to re-examine the real goals of computer science and education. Some of the recent attempts to encourage students to enter computer science have three problems: they are addressing the wrong goals, the wrong career paths, and the wrong audience.

The Wrong Goals

Portraying computer science as a path to getting rich is wrong and contributes to the boom-bust pattern of computer science enrollments. In fact, the vocational nature of computer science reduces its appeal to many students. Contrast this with the promise of biology and other physical sciences. They offer intellectual grandeur and the opportunity for a rewarding career that helps humanity. Since 1990 the number of undergraduate degrees awarded in the biological sciences has increased 70 percent. During the same period, the number of computer science degrees awarded each year has dropped by 10 percent. Since the peak in 1987, computer science degree production has actually fallen by one-third. The numbers are equally bad at the doctoral level. Today, we are producing about 25,000 computer science bachelor's degrees annually. Roughly 1,000 each year reach the Ph.D. level. The life sciences produce six times as many at each level! These figures force us to question whether we are developing adequate critical mass in the scientific community to tackle the challenges of computer science. They also suggest that the breakdown is in recruiting undergraduates.

These numbers alone may be alarming enough. But, in our view, they are merely symptoms of deeper problems in how we educate our students. In a nutshell, our current approaches to computer science education fail to teach the *science* of computing. As a result, they fail to inspire the very best and brightest young minds to enter the field.

As readers of *CRN* know, computer science is faced with scientific challenges that rival any in the history of science, but are relevant to pressing practical problems of today. Computer science involves questions that have the potential to change how we view the world. For example:

- What is the nature of intelligence, and can we reproduce it in a machine? To explore outer space we must create intelligent robots.
- How can we ensure the reliability and security of systems more complex than humans have ever created?
- What is the nature of human cognition, and how can this allow us to design machines that help us make sense out of petabytes of unstructured data?
- What are the consequences of computation on devices operating at molecular scale, exploiting quantum physical effects?

Questions like these seem to be esoteric when placed next to the practical needs. But their answers are likely to have profound social and economic impacts. Indeed, it is this interplay between such fundamental challenges and the human condition that makes computer science so interesting. The results from even the most esoteric computer science research programs often have widespread practical impact. Computer security depends upon the innovations of public key encryption and number theory. Google is powered by state-of-the-art distributed computing systems, algorithms, and artificial intelligence.

Computational methods are transforming an amazingly wide range of scientific, business, and artistic practices. Computer science enables science to be both fundamental *and* practical at the same time. This characteristic of the field is likely to persist for the foreseeable future.

Action item 1: Find charismatic figures to promote computer science the way Albert Einstein promoted physics.

The Wrong Career Path

Writing about this problem in *The New York Times*, Steve Lohr lamented that a computer science major was taking a job on Wall Street. Our majors working outside the computer industry is a *good* thing for computer science. A computer science program could be a great preparation for virtually any career: microbiology, business, law, medicine—any field touched by computing. Just as brilliant liberal arts students major in English before settling into a career, many students should start with computing as the focus of a "liberal science" education.

We're educating more than enough biologists, as anyone with a degree in biology will tell you. A Ph.D. in Biology must run a gauntlet of post-docs before getting an academic position, if she ever does. A biology education is not nearly as versatile. In contrast, Ph.D.s in computer science always find work in their field. Our government has over-funded the life sciences, allegedly because aging congressmen like cures for diseases. Computers increase our intelligence, not our life span. Which would you prefer for congressmen?

To prepare our students for more wide-ranging careers we must broaden what we teach. Naturally, computer science majors should learn the basis of how it all works from the atoms up to the Internet; but that is not enough. They should learn some other things:

How to make something work in the mud. Our modern world is complex and messy. To be effective, a person needs to be her own engineer, knowing how to fiddle with technology under adverse conditions. Students should build robots that work in places like Antarctica.

How to tell what's really going on. The methods of empirical science must be understood. The ability to discern a real phenomenon and distinguish it from myth or opinion is vital. Chemistry labs have been the traditional place for that, but the user testing lab could teach more relevant lessons.

How does computing fit into the world? Computers did not spring just from the minds of Turing and von Neumann, but are the latest development in a process that goes back to the invention of interchangeable parts and beyond. More than a calculator, the computer is becoming the interface between people and their world. Computer scientists must know enough history and social science to chart and predict the impact of computers on the intersecting worlds of work, entertainment, and society. To do this, they must understand the whole modern world and its roots.

Any good undergraduate program includes liberal arts, science, and life skills. The computer-oriented studies should go beyond engineering skills to the things a person should know to prosper in a computing-intensive world: the potential and the limits of computing devices, matching solutions to problems, and the ethics of information use. More generally, we should impart basic skills—how to judge what you know and don't know, how to learn what you need to know, how to understand other professions and cultures, and how to communicate—using computers and networks as tools.

Action item 2: Broaden computer science curriculums, reducing engineering emphasis.

The Wrong Audience

Trying to attract computer science majors after they have arrived at university is too late. High schools and middle schools are the places to encourage computing.

In those schools, computer science is not "cool" and has second-class status compared to biology, physics, and chemistry. Girls in high school find computer science both unwelcoming and intellectually unattractive; more than three-quarters of the students in advanced placement computer science programs are male. In major high school science competitions, such as the Siemens-Westinghouse Science and Technology Competition, the numbers of computer science entrants in regional and national finals are dwindling as projects in biology and physics drown them out. What passes for computer science in the high school curriculum is just training in computer programming. This dooms computer science to second-class status; computer science courses rarely count towards satisfying the science requirements in high school curricula. Worse, high school computing does not teach the visions and grand challenges of computer science.

Ironically, the overflow of physical scientists go into high school teaching where they inspire new generations of students to pursue their overcrowded field. Let's hope some of today's out-of-work computer professionals find their way into teaching.

Action item 3: Run a nationwide program to teach real computer science to high school teachers. Find a way to get more computer scientists into teaching high school.

Action item 4: Reform the advanced placement computer science curriculum by adding tests beyond programming.

Action item 5: Provide research opportunities for high school students that lead to contestants in national science fairs.

Conclusion

It is time to panic—not because of the recent events, but because of a long-term misunderstanding of our field. Are we about a device or about an idea? As programmed digital devices continue to shrink in size and cost, many predict that the computer *per se* will disappear, just as the electric motor disappeared into hundreds of niches in our homes and automobiles. Should we shrink in size and cost along with the computer? If not, we had better get a grip on the intellectual basis of computer science and explain it to the world.

Professor James H. Morris, Carnegie Mellon University, recently completed his term as Dean of the School of Computer Science at Carnegie Mellon University. Peter Lee is Professor and Associate Dean for Undergraduate Programs, Computer Science Department, CMU. ∎

Kay Wins Turing Award

ACM has announced that Alan Kay, a Senior Fellow at HP and President of Viewpoints Research Institute, has won the Turing Award for 2003. It was awarded for leading the team that invented the programming language Smalltalk and for fundamental contributions to personal computing.

The award will be presented at ACM's annual awards banquet on June 5 at the Plaza Hotel in New York.

Earlier this year Kay was also one of four people awarded the Draper Prize by the National Academy of Engineering.

Employment Changes from Page 1

are likely to have contributed to these job losses in the IT occupations, including: the dot-com bust; the end of work on Y2K; the terrorist attacks of September 11, 2001 and their related effect on the U.S. economy; a downturn in corporate IT spending; the brief 2001 recession; productivity increases; and the offshore outsourcing (offshoring) of IT work. The effect each of these factors had on the recent drop in the aggregate number of professional IT workers in the United States remains uncertain.

Also, the decline was not uniform across professional IT occupations during this period. Some IT occupations grew—computer systems analysts (1.0 percent), network systems and data communications analysts (11.9 percent), and computer hardware engineers (5.5 percent). Network and computer systems administrators declined only slightly (0.6 percent). And other IT occupations experienced larger declines—computer programmers (13.8 percent) and computer support specialists (8.4 percent) (see Figure 1).

At the same time, CPS data show that unemployment rates in the IT occupations reached all-time highs in 2002—6.1 percent for computer programmers, and 5.0 percent for computer system analysts and scientists.

Interestingly, during the 2000-2002 period, every professional IT occupation enjoyed positive salary growth ranging from 2.2 percent on the low end (computer programmers) to 6.2 percent on the high end (computer and information systems managers).

Projected Return to IT Employment Growth, But Slower Than in the 1990s

Every two years, BLS develops occupational employment projections covering a ten-year period. In BLS's latest projections—released in February 2003, covering the period 2002-2012—IT employment growth is projected to resume, though at a slower rate than during the 1990-2000 period. Overall, employment in the professional IT occupations[4] is expected to grow from 3.3 million to 4.4 million, adding a total of 1.15 million new jobs. This represents a projected annual growth rate of 3.1 percent, more than twice that of the overall U.S. annual job growth of 1.4 percent. BLS projects a total of 1.6 million job openings[5] for the professional IT occupations during the ten-year period.

As in previous BLS projections, the projected growth rate, new jobs, and total job openings[6] for the professional IT occupations far surpass those projected for the engineering, physical sciences, life sciences, and mathematical occupations (see Table 1).

However, the BLS projections for 2002-2012 represent a decreased expectation for employment growth in the professional IT occupations compared with the agency's 2000-2010 projections. In its 2000-2010 projections, BLS projected 2.15 million new jobs in the professional IT occupations. In contrast, BLS projects that only 1.15 million new IT jobs will be created during the 2002-2012 period, a reduction in projected job growth of nearly one-half (see Figure 2).

Despite these reduced expectations, professional IT occupational growth is still projected to account for the lion's share (70 percent) of science and engineering job openings during the period 2002-2012 (see Figure 3).

Projected growth among the IT occupations varies significantly. On the low end of job growth, computer hardware engineers are expected to grow at an annual rate of 0.5 percent. Computer programmers are expected to grow at an annual rate of 1.4 percent, equal to the overall annual job growth rate of the United States during this period. All other IT occupations are projected to grow at an annual rate of 2.7 percent or higher—nearly twice the national average—led by network systems and data communications analysts, a category that is expected to grow at a rate of 4.6 percent. Three other IT occupations—computer software engineers (applications), computer software engineers (systems software), and database administrators—are expected to grow at an annual rate of 3.8 percent.

Growth in the number of jobs in the professional IT occupations is projected to be led by computer systems analysts (185,000), followed by computer software engineers (applications) (179,000) and computer support specialists (153,000). Computer hardware engineers (4,000) and computer and information systems managers (7,000) are expected to add the fewest jobs.

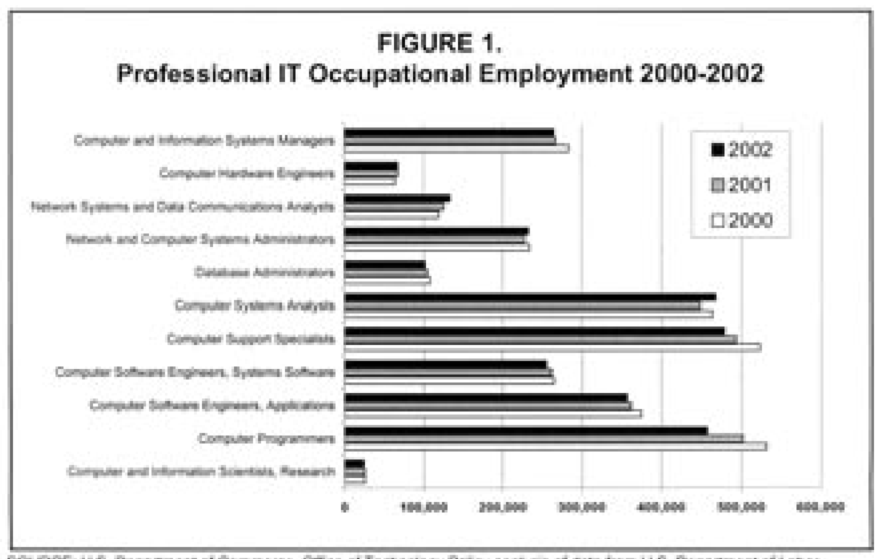
Endnotes:

[1]Current Population Survey.
[2]"The Digital Work Force: Building Infotech Skills at the Speed of Innovation," U.S. Department of Commerce, June 1999; "Education and Training for the Information Technology Workforce: Report to Congress from the Secretary of Commerce," U.S. Department of Commerce, June 2003.
[3]In this article, annual growth rates are actually calculated compounded annual growth rates over the identified period.
[4]The Department of Commerce's Office of Technology Policy defines professional IT occupations as including: computer and information systems managers; computer and information scientists, research; computer hardware engineers; computer programmers; computer software engineers, applications; computer software engineers, systems software; computer support specialists; computer systems analysts; database administrators; network and computer systems administrators; network systems and data communications analysts; and all other computer specialists.
[5]Total job openings refers to the sum of job growth plus net replacement requirements.
[6]Total job openings includes both job growth and net replacements.

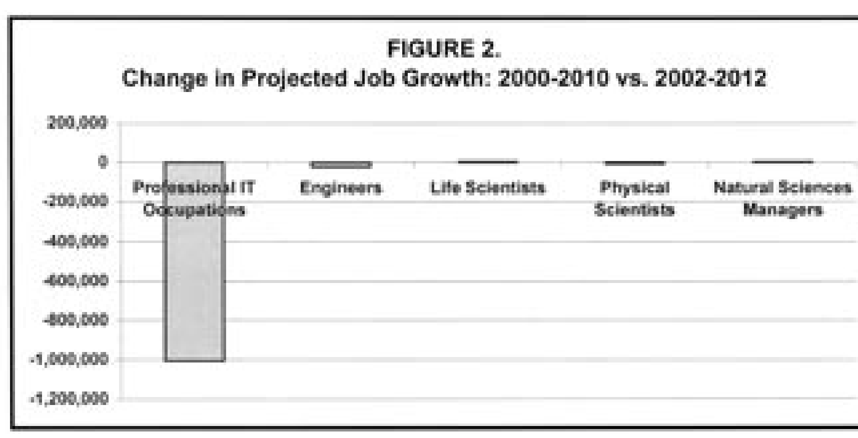
John Sargent is a Senior Policy Analyst in the Office of Technology Policy, U.S. Department of Commerce. ∎

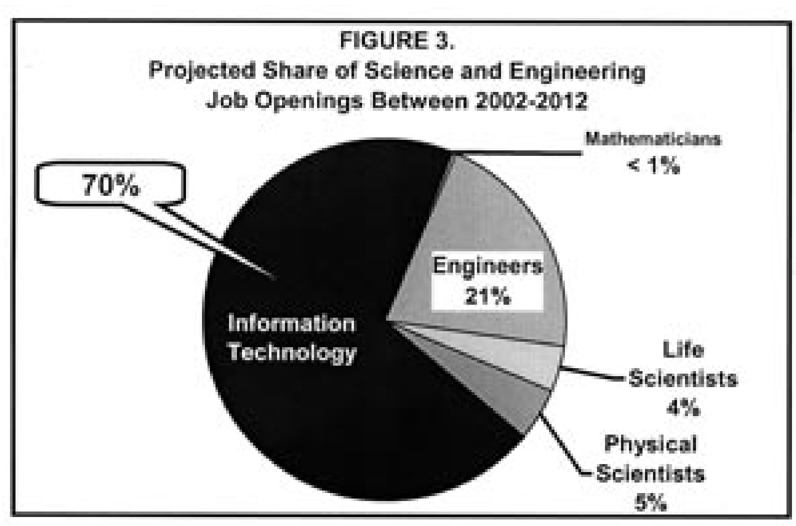
Table 1. BLS Occupational Projections for 2002-2012

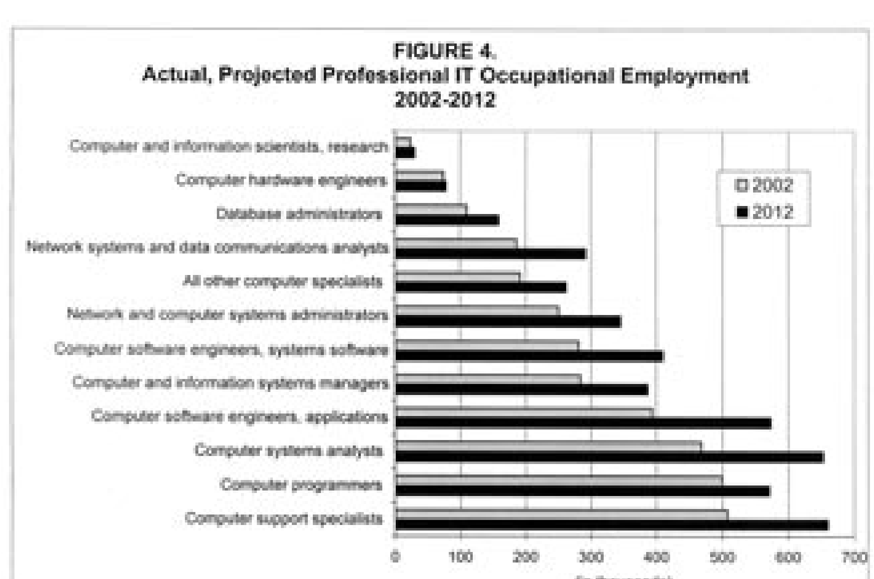
Occupational Classification	New Jobs	Total Job Openings	Annual Growth Rate
Information Technology	1,150,334	1,600,000	3.1 percent
Engineering	123,603	475,000	0.7 percent
Physical Sciences	36,192	99,000	1.4 percent
Life Sciences	38,994	91,000	1.7 percent
Mathematical Occupations	8,000	35,000	0.8 percent



SOURCE: U.S. Department of Commerce, Office of Technology Policy analysis of data from U.S. Department of Labor Occupational Employment Survey, 2000-2002, http://www.bls.gov/oes/oes_dl.htm







Service Award Winners
from Page 1

program and impact. In addition, he: 1) chaired the project that produced the report, *Computers at Risk*;
2) served on all the Internet series committees, which together yielded four reports; and 3) was instrumental in developing the fundamentals of computer science and innovation in information technology projects.

Though a research scientist, Clark has produced many Ph.D.s, and has been responsible for the cultivation and support of several, now well known, women in the field.

The nomination statement ends by saying, "Clark has received a variety of honors and awards for his technical accomplishments. That he has balanced an ongoing program of research, continuously contemplating new approaches to network architecture, with an expanding set of service activities attests to his versatility and his commitment to the field."

Barbara Simons, over the past 20 years, has served not only the computer science community, but also the general public through her advocacy of the responsible use of technology by government and business interests, her efforts in developing and supporting programs to increase the participation of women and minorities in the computing profession, and her work on behalf of scientific freedom and human rights.


Barbara Simons

Simons has served the ACM community extensively, including as President (1998-2000) and Secretary (1990-92), as well as Vice-Chair of SIGACT, Chair of ACM's Scientific Freedom and Human Rights Committee, and Member of ACM's Committee on Central and Eastern Europe. She established the ACM US Public Policy Committee (USACM) in 1993 and currently serves as Co-Chair.

Simons has been a strong advocate for individual rights, especially in the areas of privacy and anonymity, and she has often testified before state and national legislatures and at government-sponsored hearings, bringing a computing expert's perspective to important political decisions. Her nominators note that she "formulated and was often the first person to present to the community many of the issues surrounding computer security, privacy, the Digital Millennium Copyright Act, encryption, E-Voting, and Total Information Awareness."

Simons' work to increase diversity in computing includes: Co-founding the Reentry Program for Women and Minorities in the Computer Science Department at U.C. Berkeley; Membership on the Board of the Coalition to Diversify Computing, a joint CRA/ACM/IEEE-CS committee that works at increasing participation of underrepresented minorities in computer science; and participation in the Richard Tapia Conference to Celebrate Diversity in Computing and the Grace Hopper Celebration of Women in Computing.

One of her nominators notes, "What is most astounding about Barbara's contributions is the fact that she did all of this work outside of her regular job. In some cases, the Distinguished Service Award has gone to individuals for whom service is part of their regular job. Barbara is truly an example of dedication to the computer science community."

CRA A. Nico Habermann Award


Maria Klawe

Although **Maria Klawe** and **Nancy Leveson** have been active in many ways in recruiting and retaining women in CSE, their selection for this joint award recognizes their role as founding co-chairs of the highly successful CRA-W Committee. Klawe and Leveson provided the enthusiasm, shared vision, and commitment that forged CRA-W into the cohesive and productive group that it remains. Since its founding in 1991, CRA-W has led efforts at the national level to increase the representation of women in computing research, running programs that have involved more than 2,000 participants! After founding CRA-W, Klawe and Leveson continued to support its activities, each serving on the Steering Committee for many years. Both of them participated in numerous CRA-W workshops.


Nancy Leveson

In particular, under the direction of Klawe and Leveson as co-chairs and later as members, they:

- Established the CRA-W committee as an action-based committee, a tradition that continues to this day. Each committee member is responsible for a project.
- Initiated brainstorming sessions seeking to craft projects that could positively impact CSE women at the undergraduate, graduate, and faculty levels.
- Led the brainstorming discussions and often initiated the projects and drafted volunteers to lead them.
- Secured NSF funding to support the committee activities, the first of such funding from NSF.

Many of the initial CRA-W projects developed under their leadership continue to thrive today, including:

- Systers-academia (a moderated mailing list for women graduate students and faculty in CSE.
- Career Mentoring Workshop (first held in 1993—brings together graduate students and new PhDs with senior researchers to develop career strategies).
- "Expanding the Pipeline" column in CRN (that reports, through a regular column, on projects and issues relevant to underrepresented groups).
- Distributed Mentoring Project (initiated in 1994 with NSF funding, it brings together CSE undergraduates and professors for a research summer at the mentor's institution). ∎

GRACE HOPPER CELEBRATION OF WOMEN IN COMPUTING

October 6-9, 2004
Chicago, Illinois

http://www.grace.hopper.org/cfp.html

Outsourcing
from Page 4

operating a switchboard. In some sense, today's programmers are yesterday's operators. They *will* be replaced; indeed, many already have been as better and better development tools have come along. Imagine where we would be if all programming were done in assembler, or even in Fortran II or IV! We would have lots of programmers (switchboard operators) and programs (phone calls) would be very expensive indeed.

- Research is becoming internationalized—this has been happening for decades. The opportunity is to prepare our North American graduate students to work in an international environment. Most of our grad students have summer jobs, but how many of them are outside North America? Let's help our students look beyond our shores for internships. And let's encourage them to do a semester abroad with international research colleagues.
- Research innovation is not enough. Transfer into commercialization is what creates jobs. We are good at this, but can be better. As I discussed in the January 2004 CRN, university licensing offices sometimes present barriers to partnering. After that piece ran, I heard a horror story from a CRA industrial member, describing a year of agonizing delays in negotiating a university research partnership. What could have been a win-win became a lose-lose. We can also do better in helping our graduate students and junior faculty colleagues understand industrial research and tech transfer.

There are also threats and concerns. Undergraduate CS enrollments are decreasing, due initially to the dot-com bust and currently to the popular image that all the CS jobs are moving overseas. This leads to several potential problems:

- Because money at universities is always tight, decreasing enrollments might lead deans or provosts to cut the budgets of computing units. (At Georgia Tech, our undergrad majors are down, but our undergrad credit hours are actually up as more and more non-majors take our courses.)
- The Bureau of Labor Statistics jobs forecast released in February shows IT as still the fastest-growing field for the next ten years. (See related article by John Sargent on p. 1). More than 1.6 million new workers will be needed. A companion Commerce Department study shows the production of IT workers as being far below this projected demand. Unfilled demand will lead to even more rapid offshoring.
- Historically, the United States and Canada have depended on international students who study here to remain here to fill many computing jobs, especially at the MS and Ph.D. levels. But, increasingly, attractive opportunities in their native countries may take these students back home. This will exacerbate the projected imbalance of supply and demand.
- There could be a backlash against educating international students in the United States—some would say we are educating those who will return home and take jobs away. There have been occasional attempts to limit federal funding of international students. Doing so would create new problems without fixing any of the old ones.
- The perennial problem of too few US students pursuing careers in computing, engineering, and science will become still more dangerous if the above trends are correct. Already, the United States is producing far fewer first degrees in these areas (5%), versus 9% in the UK, 8% in South Korea, and 7% in Canada, Japan, and Taiwan. From whence cometh our future engineers and scientists?

Jim Foley, CRA's board chair, is Professor and Stephen Fleming Chair in Telecommunications at the Georgia Institute of Technology. ∎

Graduate Cohort Workshop from Page 2

Washington) that provided opportunities to practice newly acquired skills.

"During the reception, I had a long discussion about the US socio-economic scenario and US-Indian trade relations with Phil Bernstein from Microsoft Research, something I least expected. I was "networking" and it was turning out to be lots of fun!" [Kaur]

Peer support has a significant impact on persistence in CS&E graduate programs, and perhaps beyond. Women may well have close professional relationships with men in their home departments, but there is a special value to having a critical mass of female colleagues as well. The primary goal of the Cohort Project is to create self-sustaining peer-support groups among the participants. Many participants listed the knowledge that they were "not alone" in their experiences as the most important result of the workshop.

"The best part about the workshop was the opportunity to meet other students. At the workshop hotel, we were put up in double rooms with other women attendees. Starting out as strangers sharing the room, we ended up becoming trusted acquaintances for life. I got to meet and share experiences with other students who were as lost in graduate life as I was, but both of us, suddenly, no longer as lost for having found each other. The biggest benefit was the feeling, "Oh, then I am not the only one!" Be it the uncertainty you have about being right for grad school or about fitting in at your department, there was always someone else who had also gone through it." [Kaur]

"I left the workshop feeling energized to go back to my home institution with more of a drive to succeed. I was convinced that it was our time to rock the system. To me, that group of 100+ women contained so much talent and so much excitement that it is hard to believe that we will not go forward and change the world, a heady feeling indeed." [Kaur]

Over the next few years, the Graduate Cohort Program will provide ongoing mentoring and support to the students who attended the workshop. Plans include both electronic activities (e-mail discussion groups, virtual panels with senior women participating, electronic poster sessions, research overviews by senior women, etc.), and face-to-face, research-related activities (regional meetings, matching mentors with mentees for specific conferences, using bulletin boards to connect cohort members attending the same conferences, etc.). Our goal is to continue the Cohort Program by inviting the 2004 Cohort along with a 2005 Cohort to a second workshop next year. In addition, we would like to expand the program size. This year more than 200 students applied for our 100 openings; ideally we could welcome all interested students. CRA-W is currently looking for additional funding to support the Graduate Cohort Program.

Thanks to this year's speakers and sponsors (Microsoft, NSF, and the ACM SIGS) for making the workshop possible!

Ishwinder Kaur is a graduate student in the CIS Department at the University of Oregon and Julie Weber is a graduate student in the EECS Department at Tufts University. Jan Cuny (University of Oregon, CRA board vice chair), Lori Pollock (University of Delaware), and Mary Lou Soffa (University of Pittsburgh and CRA board member) are coordinators of the Grad Cohort for Women.

Endnote:

[1]Barbara M. Moskal, "A Summary of Results from the Survey of the Earned Doctorate: Women Earning Computer Science Doctorates," *Computing Research News*, pp. 2, 11; May 2002. (See http://www.cra.org/main/cra.pubs.html.) ∎

Transitions and Awards

CRA board member, **Randal E. Bryant**, the Robert Mehrabian Professor of Computer Science and head of the Computer Science Department in Carnegie Mellon University's School of Computer Science (SCS), has been named dean of the School of Computer Science, effective April 1, 2004.

Congratulations to CRA board member, **Guylaine M. Pollock**, Sandia National Labs, who recently received New Mexico's "2004 Woman on the Move Award" for her volunteer efforts. The award "recognizes an outstanding New Mexico woman who has made a positive difference in her profession, in the lives of others, or in her communities."

Debra J. Richardson, professor of informatics at UC Irvine and interim dean of the School of Information and Computer Science since December 2002, has been named dean of the school effective March 2, 2004. She also will hold the Ted and Janice Smith Endowed Dean's Chair.

Jeannette Wing has been appointed head of the Computer Science Department at Carnegie Mellon University, effective April 1, 2004. ∎

NSF/CISE from Page 4

communicating with you, and, above all, work to ensure that the best ideas from you receive sufficient funding.

These objectives are broad enough that there will obviously be a number of specifics within each, only a few of which I have mentioned here. Their breadth will permit us to respond to changing conditions of budget, national need, and community desires. Your continued comments on them and on the details they encapsulate are essential.

Let me close with a few personal comments about service and working with NSF. As most of you understand, NSF is unique in the extent to which the research and education community guides it, both indirectly and directly. Indirectly, your service on panels, Committees of Visitors, and Advisory Committees, and your participation in workshops and other meetings, provide a strong set of inputs that guide the actions of NSF staff at all levels.

When you come to NSF as a rotator, you are able to actively assist in shaping the direction of our programs and policies. In addition, you are then able to take back to your position in the community a greatly enhanced understanding of your field and of the process that NSF follows. That is obviously beneficial to you and to NSF, and we are always looking for those of you interested in a rotator position.

There is another mode of service to NSF that I want to underscore for some of you. As our very young field matures, some of us are also growing older (!) and finding that we may be able to contribute in leadership roles in ways that we might not have been able to or have wanted to contribute at earlier stages of our careers. Serving in a leadership role is a need at NSF that is especially important and full of opportunity for you personally and professionally.

Having done other things myself, I can attest to how rewarding it is both personally and intellectually to be able every day to work on things that are challenging, difficult, and important to a broad group of people in the community and to the Nation. I am thankful for the opportunity to serve as AD/CISE, and look forward to the next two years with relish.

Peter A. Freeman is Assistant Director for Computer and Information Science and Engineering at the National Science Foundation. ∎

Berkeley Computer Science Division Celebrates 30th Anniversary

On February 28, 2004, the Computer Science Division of the Electrical Engineering and Computer Sciences Department at the University of California, Berkeley, celebrated its founding during Academic Year 1973-74 with a day-long symposium and reunion. More than 350 friends, faculty, and former and current graduate students attended. Some came from as far away as New Zealand, Hong Kong, Zurich, Berlin, and Saarbrucken.

In attendance were four alumni Turing Award winners (Jim Gray, Butler Lampson, Ken Thompson, Niklaus Wirth), and three faculty member Turing Award winners (Manuel Blum—back from CMU for the event, Velvel Kahan, and Richard Karp). A highlight was to be able to celebrate the recent award of the Charles Stark Draper Prize—the "Noble Prize in Engineering"—to Butler Lampson and Chuck Thacker (also a Berkeley alumnus at the event).

Participants heard review talks about the scientific achievements of the Division over the past 30 years, followed by a panel of Berkeley's alumni Turing Award winners and alumnus Bill Joy discussing the past, present, and future of the field, while fielding questions from the overflow audience. Richard Karp, in an after-dinner speech, gave a personal view of the past 30 years at Berkeley.

The presentation and event videos are available at: **http://netshow01.eecs.berkeley.edu:8000/cs/**. A 30th Anniversary Brochure has also been developed to coincide with this event, and is available online at: **http://www.cs.berkeley.edu/cs_brochure_final.pdf**. ∎

Photo: Peg Skorpinski

UC Berkeley Celebration
Left to right: Alumni Ken Thompson, Butler Lampson, Jim Gray, and Niklaus Wirth enjoy the 30th anniversary of UC Berkeley's CS Division.

Professional Opportunities

Mathematical Sciences Research Institute (Berkeley, CA)

Postdoctoral Fellowships
January-May, 2005

MSRI has available up to three computation-intensive postdoctoral fellowships for the program in Mathematical, Computational, and Statistical Aspects of Image Analysis, to be held January 3-May 13, 2005.

These awards are intended for computer scientists, statisticians and mathematicians with Ph.D.s awarded in 1999 or later. They provide support for five months at $3,500 per month, including health insurance and an award for round trip-travel.

For further information and on-line application visit: http://www.msri.org/applications/applying/index.html.

Application Deadline: May 14, 2004. Awards will be announced by June 1, 2004.

Stony Brook University (SUNY)

Computer Science Department
Tenure-Track faculty

The Computer Science Department of SUNY Stony Brook has several tenure-track faculty positions for fall 2004. We are particularly interested in receiving applications from junior candidates in experimental computer systems, specifically in wireless/mobile computing, security, graphics, and computer-human interaction.

The Department currently has 41 faculty members and is expected to recruit additional members in the next few years. There are five main active research areas in the department: visual computing, logic programming/database, concurrency/verification, computer systems, and algorithms. Detailed information on the research activities of these groups can be found in the department home page: www.cs.sunysb.edu.

The Department is in a stage of significant expansion, including a new Computer Science building, along with a new New York State Center of Excellence in Wireless and Information Technology. The Department is also associated with the Center for Data-intensive Computing at the neighboring Brookhaven National Laboratory.

Stony Brook enjoys close proximity to both New York City and Long Island's majestic ocean beaches. Its school districts are highly ranked nationally. Opportunities for industrial collaborations abound with many high profiles IT companies close by. Moreover, the Computer Science Department offers a congenial working environment.

Applicants should have a Ph.D. in Computer Science or a related discipline. Please send a detailed resume, the names of at least three references, and three publications to:

Chair of Faculty Recruiting Committee
Computer Science Department
SUNY at Stony Brook
Stony Brook, NY 11794-4400
Telephone: 631-632-8470

and have at least three reference letters sent to the same address. Letters may also be sent to recruit@cs.sunysb.edu. In addition, please e-mail to the same address a URL pointing to your online resume and publications. Review of applications will begin soon and will continue until the positions are filled.

Applications from women and minorities are particularly sought. Stony Brook is an affirmative action/equal opportunity educator and employer.

Toyota Technological Institute at Chicago (http://tti-c.org)

Computer Science at TTI-Chicago
Faculty Positions at All Levels

Toyota Technological Institute (TTI-Japan) is founding a new Department of Computer Science (TTI-Chicago) adjacent to the University of Chicago campus. Applications are invited for tenure-track and tenured faculty positions at all ranks. In addition to traditional faculty positions, TTI-Chicago has a larger number of limited term positions.

TTI-Chicago will have exclusive use of the interest on a fund of $100 Million being set aside by TTI-Japan for this purpose. TTI-Chicago will be dedicated to basic research, education of doctoral students, and a small masters program. Faculty members will receive continuing research grants and will have a teaching load of at most one course per year in a quarter system.

TTI-Chicago will have close ties with the Computer Science Department of the University of Chicago. The Department is projected to grow to a steady-state of thirty faculty (including limited term faculty) by 2007.

Faculty is particularly sought with research programs in:

- Computational geometry Databases and data mining
- Human-computer interaction Large-scale scientific simulation
- Machine learning Networking and distributed computing
- Software and programming systems Theoretical computer science

Applications should be submitted electronically at:
http://tti-c.org/apps/faculty.htm

Toyota Technological Institute at Chicago is an Equal Opportunity Employer.

The University of Texas at Dallas

Erik Jonsson School of Engineering and Computer Science
Telecommunications Engineering
Faculty Positions – Wireless Multimedia, IP Routing Protocol and Software Defined Radio

The Erik Jonsson School of Engineering and Computer Science at the University of Texas at Dallas invites applications for telecommunications engineering tenured faculty positions in the architecture, systems, software and protocols for wireless and wireline very large scale networks of the future, including, but not limited to:

- Wireless Multimedia
- New Routing Protocols
- Software Defined Radio
- Security
- Network Management

and related areas. Positions are at the associate or full professor levels, starting summer or fall 2004. The successful candidate would be appointed a faculty position in either the Department of Electrical Engineering or the Department of Computer Science. Candidates must have a Ph.D. degree in Electrical Engineering, Computer Science, Software Engineering, Computer Engineering or equivalent. Candidates should have a strong record of research, teaching, and external funding. A startup package in seven figures has been budgeted to these positions.

The Erik Jonsson School of Engineering and Computer Science offers an interdisciplinary Ph.D. degree in Telecommunications Engineering; M.S. Degree in Telecommunications Engineering; B.S. degree in Telecommunications Engineering (the first ABET accredited B.S.T.E. in the US). Faculty for the telecommunications engineering program consists of members from Computer Science and Electrical Engineering. Currently the program has a total of 23 TE affiliated tenure-track faculty and 8 TE affiliated senior lecturers. In fall 2002, a new 152,000 sq. ft. building opened for Computer Science and Engineering to supplement the existing 1994, 150,000 sq. ft. engineering and computer science building. The engineering & computer science buildings provide extensive laboratory facilities for research in computer engineering, electrical engineering, telecommunications engineering, software engineering and computer science.

The University is located in the most attractive suburbs of the Dallas metropolitan area. There are over 900 high-tech companies within 5 miles of the campus, including Texas Instruments, Nortel Networks, Alcatel, Ericsson, Hewlett-Packard, Nokia, Fujitsu, MCI, EDS, and Perot Systems. Almost all the country's leading telecommunication's companies have major research and development facilities in our neighborhood. Opportunities for joint university-industry research projects are excellent. The Jonsson School has experienced very rapid growth in recent years and will become a top-ranked engineering school in the next five years. The Jonsson School is strengthening and expanding its programs by recruiting outstanding faculty and Ph.D. students, increasing funded research, and establishing new programs. The Jonsson School will benefit from a $300 million program of funding from public and private sources over the next five years (see www.utdallas.edu/utd-general/news/). For more information, view the Internet webpage at www.te.utdallas.edu or contact Dr. Duncan MacFarlane, Search Chair, at 972-883-4658. The search committee will begin evaluating applications as soon as possible and will continue until the positions are filled.

Applicants should mail their resume with a list of at least five academic or professional references as soon as possible to:

Academic Search #757
The University of Texas at Dallas
P.O. Box 830688, M/S AD 23
Richardson, TX 75083-0688

The University of Texas at Dallas is an Equal Opportunity Affirmative Action employer and strongly encourages applications from candidates who would enhance the diversity of the University's faculty and administration.

VCU

Virginia Commonwealth University

Professor and Chairperson

Department of Computer Science, School of Engineering

Virginia Commonwealth University invites applications for the position of Professor and Chairperson of Computer Science. VCU is a Carnegie Doctoral/Research University offering over 162 baccalaureate, master's, doctoral, professional and certificate degree programs to over 26,000 students.VCU is also home to the VCU Medical Center, which includes the nation's fourth largest university-based medical school and hospital. Computer Science, one of six programs of study offered by the VCU School of Engineering, currently has nine faculty members with research interests in the areas of Software Engineering, Networking, Software Testing, Medical Applications, Database, Neural Networks, Parallel Programming and Programming Languages. The computer science program has strong ties to the Bioinformatics program in Life Sciences, and excellent working relationships with both Information Systems and Computer Engineering.

The Computer Science Program has offered baccalaureate, certificate, and master's degrees for over 20 years. It was the first in the state to become accredited by the Computer Accreditation Committee of ABET in 1988. In Fall of 2001, the program was moved to become part of the School of Engineering. At this time the School of Engineering also initiated a Ph.D. program in Engineering. Computer Science students can now complete a Ph.D. in Engineering by following a computer science track. The faculty in the computer science program are committed to maintaining a standard of excellence in undergraduate teaching while expanding research activities in conjunction with this newly instituted Ph.D. program.

Candidates for this position must be eligible for employment in the United States and indicate their citizenship or visa status. A Ph.D. in Computer Science is required. We seek a chairperson with a strong research record who can support the teaching and research missions of the computer science program. The Chairperson's responsibilities include direction of and contribution to the undergraduate and graduate teaching mission of the program; promoting the continued growth of the faculty's teaching and research efforts; balancing the teaching, research and service commitments of the faculty, and facilitating research opportunities for the faculty. The Chairperson also manages departmental expenditures, and supervises assessment and improvement of the program to maintain ABET accreditation. Applicants should submit a statement of their teaching and research interests, curriculum vitae, and the contact information for at least four references to **Dr. Robert Klenke, Chair of the Search Committee, Virginia Commonwealth University, P.O. Box 843072, Richmond, VA 23284-3072.** Review of applications will continue until the position is filled.

Virginia Commonwealth University is an Equal Employment Opportunity/Affirmative Action Employer. Women, minorities, and persons with disabilities are encouraged to apply.

Science Funding in FY 05 from Page 3

hearings to set the context for the FY 2005 appropriations bills. Because this year is both a congressional and a presidential election year, the legislative environment is a little different than usual. Congress is obligated to pass all 13 appropriations bills before the start of the new fiscal year October 1, 2004, or risk having to pass a "continuing resolution" that keeps government operating by funding it at the current rate until the appropriations bills are agreed upon. However, its track record for achieving that goal is not good. Work on both the FY 2003 and FY 2004 appropriations spilled into January of the following year.

As the election in November edges closer, the political calculations for delaying the appropriations bills get more complicated. Ideally, Members of Congress generally prefer wrapping up the bills as early as possible before the election so they can return to their districts for the home stretch of their respective campaigns. Any delay beyond October 1 will cut into valuable campaign time. Yet the leadership of either side might see political advantage in delaying the appropriations bills until after the elections—especially if the bills contain controversial provisions that might be uncomfortable campaign issues, or if they foresee an election outcome that might make their position stronger post-election.

To head off this possibility, the appropriations committees in both chambers have begun discussing ways of "packaging" the appropriations bills that might expedite their passage. One idea calls for considering all 13 bills individually at the committee level, then bundling them into a single "omnibus" bill for consideration by the whole chamber—effectively limiting the debate on any one of the bills. A less drastic suggestion also being considered is the possibility of bundling three bills at a time into so-called "mini-buses" for consideration. A third option, slightly more extreme but no less seriously considered, is to forgo the appropriations bills altogether and pass a "continuing resolution" that would apply through FY 2005. This would effectively freeze all federal funding (unless otherwise specified in the continuing resolution) at the FY 2004 level and prevent any new program starts. It was not clear at press time which, if any, of these approaches is most likely to be chosen.

For all the latest budget or policy news, check the CRA Government Affairs web page at **http://www.cra.org/govaffairs**. Also be sure to check CRA's new Computing Research Policy Blog—**http://www.cra.org/govaffairs/blog**—where we post news of interest to the computing research community as it happens. ∎