COMPUTING RESEARCH NEWS

A Publication of the Computing Research Association

September 2003 Vol. 15/No. 4

Guest Column

Title IX and Women in Academics

By Senator Ron Wyden

This fall the athletic fields of America's elementary and secondary schools, colleges and universities will resound with the voices of girls and young women who choose to include sports as part and parcel of their educational experience. Those girls and young women will not only be taking physical exercise; they'll be exercising their rights to equal opportunity under a law known as Title IX.

Title IX states a simple principle. The entire statute reads: "No person in the United States shall on the basis of sex, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any educational program or activity receiving Federal financial assistance."

Many Americans know the enforcement of that common-sense rule has brought women much closer to parity in high school and college sports opportunities. But in my view, what Title IX has achieved on the playing field remains undone in the classroom, where the promise of this law was originally directed. Particularly, I believe that Title IX has yet to be applied stringently enough in traditionally male-dominated fields such as the hard sciences, math and engineering—disciplines where our nation needs competent workers now more than ever before.

We can all agree that fairness implores us to create and enforce equal opportunity for women in math, science and technology. That is a compelling argument in itself, but it is not the only argument. A report from the Hart-Rudman Commission on National Security to 2025 warned that America's failure to invest in science and to reform math and science education was the second biggest threat to our national security, greater than that from any conceivable conventional war.

America will not remain the power it is in the world today, nor will our people be as healthy, as educated, or as prosperous as they should be, if we do not lead the world in scientific research and engineering development. To make our country better, to improve our national security and quality of life, we need to encourage people to go into these disciplines. Women represent a largely untapped resource in achieving this vital goal. Encouragement through Title IX is more than the right thing to do; it is the smart thing to do.

The numbers reveal a striking inequity when it comes to gender representation in the math, science and technology fields. A National Science Foundation study found that women accounted for only 23 percent of physical scientists and 10 percent of engineers. The percentages of women on faculties in these areas are even lower, with 14 percent of science faculty members being women and a mere 6 percent in engineering departments. Moreover, the numbers are getting worse in some areas. The percentage of recipients of computer and information sciences bachelor's degrees who were women, which peaked at 37 percent in 1984, had decreased to just 28 percent in 1999. That is a movement in the opposite direction from athletics, where Title IX has been adequately enforced. Before Title IX, one in 17 girls in school played sports. Now it is one in 2.5. This country needs that kind of progress in math, science, and technology. But it will not happen as long as subtle and not-so-subtle discriminations persist in our educational institutions.

Studies show that women often have trouble advancing in math, science and technology due to a lack of equal access to financial aid and a lack of access to child care in graduate school. Additionally, evidence indicates discrimination toward not only aspiring students, but toward members of university faculties as well. Women in science and math often find themselves pushed into traditional female roles, such as teaching, while their male counterparts receive almost all the research fellowships that pay more completely for graduate school. Without a research background, women are less likely to obtain tenure-track faculty positions, which carry higher pay and prestige.

Just as America's schools were sent a clear message that they would lose Federal funding unless women were given parity in sports, it's time for our institutions to understand that there will be consequences if Title IX does not become a guiding

Title IX
Continued on Page 8

Senator Ron Wyden

Inside CRN

IT Responsible For Most Productivity Gains

By John L. King

The "productivity paradox" of missing organizational payoffs from investments in information technology has finally been put to rest. Recent research has demonstrated a major surge in U.S. productivity between 1995 and 2000 due almost entirely to IT. While investment in IT is essential to this improvement, the key to achieving payoffs from IT investments lies in changing the nature of work processes to exploit what IT offers.

The productivity paradox began in early 1986 when economist Stephen Roach demonstrated that the huge increase in organizational expenditures on IT (computers, peripheral devices, software, and related services) between 1975 and 1985 was accompanied by virtually no gains in organizational productivity. Within weeks, *Fortune* magazine's cover story was about "The Puny Payoff" from computers, and the rest of the business trade press soon followed. Nobel Prize winning economist Robert Solow quipped, "We see computers everywhere except in the productivity statistics."

This news did not make sense to people in the IT fields. Computers could do many things far faster and far better than people could. Their application had dramatically improved performance in all kinds of tasks, from payroll processing to air traffic control. It did not seem possible that such task-level performance would fail to show up in the productivity statistics. Yet the analyses were grounded in the best data available at that time, and the story of the productivity paradox was established as fact.

Several objections to the story arose immediately. Most were aimed at the problems with the data used in Roach's analysis. As good as they were, Roach's data came from the National Income and Product Accounts (NIPA) data maintained by the U.S. Bureau of Economic Analysis. The NIPA system was installed in the 1930s, long before the era of modern IT application. It was not clear whether the NIPA data measured the right things. In addition, the NIPA data measured effects at the level of whole industries, not at the level of individual firms where the vaunted task-level performance of computers would appear. The NIPA data could not be used to account for differences in the quality of IT implementation efforts among the organizations measured. The successes and the failures might balance each other out, with zero productivity gain as a result.

A different objection was raised by economic historians. They pointed out that flat or even declining productivity was a common feature during transitions from old to new regimes for doing complicated things. Paul David of Stanford University compared the replacement of steam engines by electric power in U.S. factories in the late 19th and early 20th centuries to the replacement of older information management practices by IT during the late 20th century. Productivity remained flat for several decades as electricity replaced steam, but then

Productivity Gains
Continued on Page 6

NONPROFIT ORG.
U.S. POSTAGE
PAID
WASHINGTON, DC
PERMIT NO. 993

CRA
1100 Seventeenth Street, NW
Suite 507
Washington, DC 20036-4632

Visionaries Needed for CRA Conference

Grand Research Challenges in Information Security & Assurance

Airlie House, Warrenton, Virginia
November 16-19, 2003

In 2002, CRA sponsored its first "Grand Research Challenges in Computer Science and Engineering." This was the first in a series of highly non-traditional conferences where the goal is to define important questions rather than expose current research. Grand Challenges meetings seek "out-of-the-box" thinking to expose some of the exciting, deep challenges yet to be met in computing research. Because of its clear importance and pressing needs, CRA's second "Grand Research Challenges Conference" will be devoted to defining technical and social challenges in information security and assurance. We are seeking scientists, educators, business people, futurists, and others who have some vision and understanding of the big challenges (and accompanying advances) that should shape the research agenda in this field over the next few decades. These meetings are not structured as traditional conferences with scheduled presentations, but rather as highly participatory sessions exposing important themes and ideas. As such, this is not a conference for security specialists alone: We seek to convene a diverse group from a variety of fields and at all career stages—we seek insight and vision wherever it may reside.

The organizing committee is chaired by Eugene Spafford, Purdue University, and co-chaired by Richard DeMillo, Georgia Institute of Technology. Attendance is limited to 50 people and is by invitation only. Individuals invited must commit to attending for the entire three-day conference (beginning Sunday at 6 pm, ending after lunch on Wednesday.) If you are interested in attending, please submit a two-page (or less) statement of two or three examples of a "grand research challenge" problem in the IS/IA area. The deadline for submission is **September 17, 2003.**

For additional details, including instructions for submitting statements and a list of the organizing committee members, see **http://www.cra.org/** ∎

CRA Outstanding Undergraduate Awards Deadline October 20

The Computing Research Association is pleased to announce the 10th annual CRA Outstanding Undergraduate Awards Program, recognizing undergraduate students who show outstanding research potential in an area of computing research.

Nominees must attend a university or college located in the United States or Canada, and must be nominated by the department chair or a faculty member.

A cash prize of $1,000 will be awarded to each of two undergraduate student winners, one female and one male, who are majoring in computer science, computer engineering, or an equivalent program. A number of other outstanding candidates will be recognized with Honorable Mention. The awards will be presented at one of the major computing research conferences sponsored by CRA, ACM, the IEEE Computer Society, SIAM, AAAI, or USENIX. The two first-prize winners will receive financial assistance toward their travel to the conference. CRA encourages home departments to provide similar assistance to other students who are recognized.

CRA gratefully acknowledges the support of Microsoft Research and Mitsubishi Electric Research Labs who sponsor the Outstanding Undergraduate Awards Program in alternate years. Mitsubishi Electric Research Labs is this year's sponsor.

Additional information about the nomination procedure and criteria for selection are available on the CRA website: http://www.cra.org. All nominations must reach CRA by **October 20, 2003.** ∎

Change in Taulbee Survey Reporting

The CRA Board of Directors has recently approved a change in CRA's procedures for disseminating the results of the annual Taulbee Survey.

One reason for the change is to reward departments that submit the survey on time by disseminating the preliminary salary data to them in December rather than in the January *CRN*. Another is to provide final survey results to CRA members, as a benefit of their membership, before they are made publicly available.

Previously, the Taulbee preliminary faculty salary results have been published in the January issue of *Computing Research News*, followed by the complete survey results in the March edition of *CRN*.

Beginning with the 2002-03 survey, which will be circulated to chairs of Ph.D.-granting departments in mid-September 2003, only departments that have submitted their surveys by the November deadline will receive the preliminary salary results. These results will be provided to those departments by mid-December; *they will no longer be published in the January CRN* or made public at that time.

In mid-February, final Taulbee Survey results will be provided to departments that participated in the survey and to all CRA members. Once again, this is earlier than in the past. *Final results will no longer appear in the March CRN*, nor will they be publicly available at that time. Instead, they will be published in the May issue, and will be posted on the CRA website at that time. ∎

Richard Tapia Celebration of Diversity in Computing Conference 2003

Co-Sponsored by ACM and CRA
October 15-18, 2003 in Atlanta, Georgia

http://www.ncsa.uiuc.edu/Conferences/Tapia2003/

Note to Department Chairs

Taulbee Survey 2002-03 Coming Soon

Special Report

Computing Research Association

Best Practices Memo

University-Industry Sponsored Research Agreements

Universities and businesses have considerable incentive to cooperate in the development of intellectual property (IP). Businesses recognize universities for their rich talent pool and enthusiastic graduate students, while universities recognize businesses as a source of real-world problems, technical know-how, and funding. There are numerous examples of successful research collaborations in computer science, computer engineering, and electrical engineering. Mindful that some IP such as gene splicing and human growth hormone have produced "IP goldmines," many university administrators (and some students and faculty) are eager to establish strong safeguards to protect their rights to intellectual property.

While such safeguards are perhaps essential in biomedical, pharmaceutical, and agricultural research, they are not appropriate in Information Technology (IT). They can be difficult and time-consuming to negotiate, and because considerations such as time-to-market are so important in IT, the delay can frustrate beneficial cooperation. Moreover, patent safeguards are unnecessary because of the role of IP in IT products and the complications involved in deploying IT IP. Formulating university-industry cooperative agreements must be sensitive to these issues. This document describes the best practices for university-industry agreements in IT, particularly the IP aspects of such agreements.

Context and Setting

Research and development in IT-related university departments is funded largely by two mechanisms: federal grants and university-industry sponsored research agreements (SRAs). Commercializing intellectual property derived from federal grants is (when appropriate) required by the Bayh-Dole Act. The law specifies the conditions of ownership and defines "standard practice" for grant-receiving institutions. Practices surrounding university-industry SRAs, however, vary widely, being governed mostly by the needs of the agreeing parties. These agreements can take a variety of forms, as explained in the next section.

Research universities typically have two offices, variously named, that are concerned with funding and intellectual property. The Office of Sponsored Projects (OSP) is generally responsible for negotiating funding agreements with granting agencies, foundations, and companies. The Office of Technology Transfer (OTT) is generally responsible for patenting and licensing technology created at the university. In rough terms, the OSP is largely involved before the intellectual property is created, and the OTT is involved afterwards. (As another generalization, the OSP is typically less familiar with industry's needs than is the OTT.) For all research covered by the Bayh-Dole Act, the university is stipulated as the (initial) owner of the intellectual property. For SRAs, ownership and rights to the intellectual property resulting from research are the subjects of negotiations prior to funding.

The motivation for establishing best practices guidelines is the potential for the conflicting interests of universities and industry to impede their negotiations. An important "best practice" is for the OSP and the OTT to cooperate in establishing the practices described below.

Expectations

The possibility of producing a much-needed revenue stream by licensing their intellectual property has motivated some administrators, regents, and chancellors to require OSPs to exact strong protection for the university's rights. Patent protection, which is generally required for biomedical, pharmaceutical, and agricultural IP, is very slow to obtain and can be expensive to secure and to defend. Almost all patenting expenditures do not recover their investment. As a general rule, universities that successfully generate revenue from IP do so with a tiny number (< 10) of significant patents. (In 2001, the University of California *system* generated 77 percent of all revenue from 25 licenses, and none was IT.) There are no known "goldmine" IT licenses.

Managing IT IP using the traditional patent/licensing mechanism is inappropriate for the following reasons. First, patent protection is rarely the best form of IT IP protection. Copyright is usually better, since it can be used to control an embodiment of the ideas, such as a software implementation. Second, time-to-market is often a significant consideration in making a product a success, so both the university and industry are best served by rapid action. Third, products like software often contain many "key" ideas (e.g., algorithms), and it is difficult to assess how any specific idea contributes to the overall worth of the product, say for the purpose of assessing royalties. Fourth, unlike patents, which are published in enough detail that someone can reproduce the art, effective transfer of IT IP such as software often requires participation by the creators. Finally, many IT ideas can be implemented by "those schooled in the art" once they have seen the technology in operation. Thus, companies have a risk of using IP inadvertently, increasing the value of mechanisms that lower that risk.

The implications of these considerations are: a) universities can introduce significant barriers to cooperation by forcing IT into a standard patent-centric form, and b) agreement principles customized to IT will focus on rapid action.

Consulting and Internships

The most valuable part of intellectual property is the intellect that produced it. Accordingly, IT businesses understand that working with faculty and graduate students is at least as valuable as licensing the IP that they produce. Because IT requires only modest facilities, and to avoid complex negotiations with universities about who owns the resulting IP, many firms have opened labs near universities as a venue for faculty consulting and student internships. Performed on their premises with their equipment and staff, the companies own all of the IP. It is an efficient scheme for the businesses, and it can provide professionally valuable experience for both faculty and students. But it cuts out the university.

A Model for Sponsored Research

Confronted with the aforementioned facts, several universities have adopted approaches that reflect the best practice. In these cases, an industrial partner funds research with the understanding that it will receive a non-exclusive, non-transferable, worldwide, royalty-free license to any IP created by the organization. In one model the partner funds (annually) a specific team with a specific research direction, and the arrangement is seen as ongoing. In another model (e.g., Stanford's EPIC program) industry partners join a consortium for a modest annual fee, and then have "pay-per-view" privileges for any specific IP at a specified rate for a non-exclusive, royalty-free license. The university retains ownership of the IP, and the option to negotiate an exclusive license is available. Standardized terms and conditions regularize the process for rapid and predictable execution.

Although it is assumed that industry wants and needs exclusive licenses, in general this seems not to be the case. Since companies in IT do their own development, licenses protect them from being sued for infringing on others' IP. For that purpose a non-exclusive license suffices.

In this model, industry supports the effort with its funds "up front," with the assurance that there will be a license "if anything useful comes out of the research." Not charging royalties has the advantage that the uses of the IP do not have to be accounted for. There is risk on both sides: It is possible the university might do better by negotiating more favorable terms for a specific promising technology, and industry is gambling that the investigators' discoveries get to them early enough for rapid deployment. However, this model has the value of promoting and accelerating cooperation. There is generally an understanding among the participants that if the IP turns out to be a "home run," then the company will return later to the question of what it owes the university for the IP, typically in the form of generous donations or longer-term research contracts.

End Notes

The assertions in this memo are documented in "Model Language for Patent and Licensing Agreements for Industrially Sponsored University Research In Information Technology," by J Strother Moore, University of Texas, Austin. See: http://www.cra.org/reports/ip/. Additional information and sample wording for agreements are also provided.

Approved by the
Computing Research Association
Board of Directors
July 2003

Prepared by:
J Strother Moore (University of Texas, Austin)
Lawrence Snyder (University of Washington)
Philip A. Bernstein (Microsoft Research)

The Northern Report: Computer Science News from Canada

By Gord McCalla

Now that the Canadian Association of Computer Science/ Association informatique canadienne (CACS/AIC) is officially an affiliated society of the Computing Research Association, it seems reasonable to provide an annual report on important issues within the Canadian computer science community that may also be of interest to CRA members and its other affiliated societies. This year I would like to briefly focus on several issues: research initiatives, current enrollment trends, accreditation of programs, and the software engineering dispute in Canada.

Research Initiatives

The research climate for Canadian computer science (and other science and engineering disciplines) continues to improve. For several years the Canadian federal government has been increasing its investments in research and development as it tries to position Canada to succeed in the emerging knowledge economy. At the same time, many provincial governments have invested heavily in computer science and computer engineering, stimulating considerable growth in many computer science departments in the country.

The result of these investments is a huge growth in demand from computer scientists for research funding. In fact, for each of the past 4 years, the number of new computer science applicants for "discovery grants" from Canada's Natural Sciences and Engineering Research Council (the grants that fund professors' curiosity-driven research programs) has led all NSERC disciplines. In 2003 alone some 114 of 900 new applicants were computer scientists (with many more computer engineers applying to engineering committees).

Fortunately, NSERC has continued to get increased funding to handle this influx of "news," with some $12.5 million (Canadian) in new funds having recently been allocated for first-time applicants over the next 3 years. The next challenge will be to make sure that even more money enters the system to fund these new applicants as they progress through the system, seeking increased renewal grants down the road. And a modest start has been made: in a recent NSERC re-allocations exercise the base budget for funding computer science was increased in recognition of the importance of the field and its incredible growth.

NSERC has also added considerably more money to its Canada Graduate Scholarships program, creating some 600 new scholarships paying $17.5K (Can) for one year to M.Sc. students and $35K (Can) for 3 years to Ph.D. students, while the existing program of postgraduate scholarships continues. In addition, NSERC has created several new programs, including a networks program to encourage "distributed centers of critical mass" of scientists at different institutions interacting with one another on cutting-edge research, and a special opportunities program for high-risk (but potentially high-payoff) research.

Beyond NSERC, over the past few years the Canadian government has announced funding of some 2,000 Canada Research Chairs positions (across all academic disciplines) at universities across the country. It also continues its Canadian Foundation for Innovation (CFI) program that has begun to rebuild university

The Northern Report
Continued on Page 9

CISE FY2004 Update

By Sean Jackson, National Science Foundation

This column will serve as an update on some of the changes in CISE as we start a new fiscal and academic year.

Changes in CISE

The CISE Directorate is approaching the end of its second decade as a major organizational unit within NSF. CISE is unique among NSF directorates in its dual responsibility for the health of the CISE research communities and for the support of a national computation and communication infrastructure for all of NSF's research and educational disciplines. The past few years have seen unprecedented growth in the CISE budget, a continuing diversification of CISE research, education and infrastructure programs, and an attendant, dramatic increase in proposal pressure and staff workload. Today, CISE is a primary source for the funding of fundamental academic research in computing, communication, and information, and of research at the interface of information technology and other disciplines. Since the last CISE reorganization in 1997, the directorate's budget has grown by 113 percent (60% for NSF) and the number of proposals received has grown by more than 125 percent (16% for NSF).

While the opportunities for our community have increased with the introduction of NSF-wide priority areas, such as the CISE-led Information Technology Research program and a growing number of program announcements and solicitations for traditional programs and areas of special emphasis, success rates have diminished dramatically. We believe investigators have responded to these opportunities and the falling success rates by submitting more proposals. This is counterproductive, as it raises the workload in CISE and in the research community. We want the community involved in research and teaching, not proposal-writing, and we want a CISE staff with the time and resources to effectively manage grant selection and oversight.

The proposed new CISE will have four divisions, working as highly integrated units, coordinating to manage the broad research portfolio for which CISE is responsible. The four divisions are: Computing & Communication Foundations (CCF); Computer and Network Systems (CNS); Information and Intelligent Systems (IIS); and Deployed Infrastructure (DDI). The slides from the announcement of the reorganization provide a good introduction and can be found at: http://www.cise.nsf.gov/news/cise_all_hands_meeting_files/frame.htm

The new divisional structure will be more closely aligned with the demands of the science. CCF, CNS, and IIS are principally "research" divisions, which represent a natural progression from core foundations through systems to basic and focused research in the context of complex information and intelligent systems. We believe this organization reflects a common grouping of the research communities served by CISE, and that individual investigators will easily find a "home" for their research interests. We also recognize the high degree of interactivity across these delineations and will work to ensure a strong, collaborative environment.

DDI represents the next logical step in the progression with management responsibility for national cyberinfrastructure activities. This division merges the national infrastructure programs currently managed by Advanced Computational Infrastructure and Research (ACIR) and Advanced Networking Infrastructure and Research (ANIR), and expands the scope of CISE cyberinfrastructure to include computation, communication, information, distributed sensing, instrumentation, and middleware. DDI will also be responsible for the education, outreach, and training (EOT) activities related to the national cyberinfrastructure. In choosing to put all of the planning, design, construction, operation, and upgrading of centers and facilities into one division, we are recognizing the highly integrated and diverse resources in modern cyberinfrastructure, the need for coordinating these activities with all NSF directorates, and the unique management challenges associated with large and distributed facilities. In addition, each of the other three CISE divisions will support fundamental and focused research that will enable future generations of cyberinfrastructure.

Within each division there will be a small number of *clusters* of technical and administrative staff, each responsible for a single program or a small group of programs. Individual program managers may be designated as the point of contact for specific sub-disciplines within a cluster, but each manager will be part of a team. This will add breadth to the narrow confines of current programs, and allow investigators to seek support alone or as collaborators for research with a broader scope.

CISE will introduce a series of *themes* in order to address national priorities and broadly applied CS&E research priorities. Individuals from each of the divisions will develop, manage, and integrate the portfolio of projects that address these multi-disciplinary topics. Initial themes are expected to include cyber trust, science of design, information integration, and education and workforce. Information Technology Research (ITR) funds for FY2004 will include CISE investments in these thematic areas.

Cyber Trust

Cybersecurity is a clear example of a national priority to which the CISE themes are designed to respond. Congress expects NSF leadership on cybersecurity research and education. Fiscal year 2003 research activities in cybersecurity were handled through four different program announcements. In 2004, these four programs will be handled by the four program managers working as a team under one program solicitation called "Cyber Trust." The title reflects our understanding that the public not only wants their information systems to be secure, they want to *trust* them in all kinds of situations. As a simple example, they need to be able to trust that data will be kept private.

By centralizing the research in cyber trust around a key theme, CISE will ensure that the area of cybersecurity receives increased, concerted attention that builds on the significant work that has already been devoted to it. In addition to restructuring the program, we expect to allocate more funds to research and education in this area, which is

NSF Update
Continued on Page 10

Past is Prologue: View from the Chair

By Jim Foley

What can you, our members, expect from CRA? Well, because past is indeed prologue, I encourage you to read our 2003 Annual Report, enclosed with this issue of *CRN*.

CRA's biennial Conference at Snowbird 2004 for department chairs and directors of labs and centers is already being planned by co-chairs Moshe Vardi and Dick Waters and an able committee. The dates are July 11-13, 2004. Plenary sessions will cover such topics as CSE education apres le crash; the vast and persuasive impact of IT on the U.S. economy; and issues affecting women and minorities in CSE.

The ever-popular Academic Careers Workshop for new faculty and nearly finished Ph.D. students, organized by Lori Clark, is scheduled for February 23-24, 2004 in Washington, DC. Space fills up very quickly for this workshop, so advise potential attendees (graduate students and junior faculty choosing or beginning their careers) of the dates now. Information will be posted at http://www.cra.org. Encourage new faculty to use start-up funds to attend; scholarships will be available for grad students.

The second CRA Grand Research Challenges Conference, on Information Security and Assurance, will be held November 16-19, 2003. The organizing committee, chaired by Gene Spafford and co-chaired by Rich DeMillo, will issue invitations based on papers submitted by September 17, 2003 (see http://www.cra.org for details). This is *your* opportunity to help shape the field. We are also seeking ideas for a topic for Grand Research Challenges III, currently planned for 2005.

Growth in our academic membership slowed to just two net new members last year. Facing uncertain membership growth for this year and without the surplus generated by a Snowbird conference, the CRA board adopted a very conservative 2003-04 budget at our February meeting. After learning of our situation, two industry members recently stepped up to the plate and increased their membership levels—Microsoft became a Sustaining Member and Sun a Supporting Member. Other industrial members are planning increases as well. These acts of corporate good citizenship, along with tight cost controls at CRA, have allowed us to continue all of our programmatic efforts.

Funding for the National Science Foundation this year will probably increase by about 6 percent—nowhere near what is needed for the budget-doubling approved last year by Congress. Improving on this for the following fiscal year will be a challenge. This is particularly critical to continuing progress, given the decreasing base of industrial research. We will need all of our members to help carry this message to Washington.

How can you help CRA achieve our four goals of community building, human resources development, information dissemination, and influencing policy? Very simply: suggest additional ways that CRA can achieve our goals—and volunteer to make it happen! Become one of the 55 non-board members of CRA committees (see list) who help make CRA work. You can be one of them! Contact me at foley@cc.gatech.edu to volunteer.

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

The computing research community thanks the following non-board members who served on CRA committees from July 2002 through June 2003.

Al Aho, Columbia University
Richard Alo, University of Houston
Nancy Amato, Texas A&M
Sandra Johnson Baylor, IBM
Ron Brachman, AT&T (now at DARPA)
Eric Brittain, MIT
Carla Brodley, Purdue University
Sheila Castaneda, Clarke College
Theresa Chatman, Rice University
Allison Clark, NCSA
Joanne Cohoon, University of Virginia
Anne Condon, University of British Columbia
Carla Ellis, Duke University
(board member eff. July 1, 2003)
Gerald Engel, University of Connecticut
Faith Fich, University of Toronto
Joan Francioni, Winona State University
Oscar Garcia, Wright State University
C.W. Gear, NEC Research Institute
Barbara Gutek, University of Michigan
Mary Jane Harrold, Georgia Institute of Technology
Juris Hartmanis, Cornell University
Tom Henderson, University of Utah
Raquell Holmes, Boston University
Andrew Hume, AT&T Labs - Reseasrch
John Hurley, Clark Atlanta University
Charles Isbell, Georgia Institute of Technology
Jolene Jesse, AAAS
Sid Karin, UC San Diego
Randy Katz, UC Berkeley
John King, University of Michigan
(board member eff. July 1, 2003)
Willis King, University of Houston
Charlotte Kuh, National Research Council
Cynthia Lanius, Rice University
Andrea Lawrence, Spelman College
Phoebe Lenear, NCSA
Clayton Lewis, University of Colorado, Boulder
Ran Libeskind-Hadas, Harvey Mudd College
Monica Martinez-Canales, Sandia National Lab
J Strother Moore, University of Texas, Austin
James Morris, Carnegie Mellon University
David Novick, University of Texas, El Paso
Christos Papadimitriou, UC Berkeley
Lori Pollock, University of Delaware
Ann Redelfs, NPACI/SDSC
Eric Roberts, Stanford University
Gabby Silberman, IBM
Barbara Simons, ACM
Robert Sproull, Sun
Valerie Taylor, Texas A&M
Patricia Teller, University of Texas, El Paso
Henry Walker, Grinnell College
Roger Webb, Georgia Institute of Technology
Pamela Williams, Sandia National Lab
Ellen Yoffa, IBM
Wei Zhao, Texas A&M University

SNOWBIRD 2004 ALERT - Department Chairs and Directors of Labs/Centers

Mark your calendars now for CRA's Conference at Snowbird 2004!

This biennial event is a "must" for department chairs and directors of labs and centers. The planning committee is putting together a stimulating program, including the always-popular workshop for new chairs. The dates are **July 11, 12, and 13, 2004** in Snowbird, Utah. Refer to future issues of *CRN* and the CRA website (http://www.cra.org) for updates, including program details and registration/accommodation instructions as they become available.

If you would like to suggest a topic for the program, please contact either of the program co-chairs:

Academic Co-Chair: Moshe Y. Vardi, Rice University (vardi@cs.rice.edu)
Labs/Centers Co-Chair: Dick Waters, Mitsubishi Electric Research Labs (dick@merl.com)

Committee Members:
James Aylor (University of Virginia)
Lori Clarke (UMass, Amherst)
Scot Drysdale (Dartmouth College)
John King (University of Michigan)
Dan Reed (University of Illinois, UC)
Mary Lou Soffa (University of Pittsburgh)
Alfred Spector (IBM Corp.)
Valerie Taylor (Texas A&M)
Frank Tompa (University of Waterloo)

CRA awarded its 2003 Outstanding Undergraduate Awards at the ACM awards banquet in San Diego in June. Pictured above are: Front row (l-r) Omar Khan (Cornell University), Outstanding Male Award; Julie Thornton (Kansas State University), Female Runner-Up; Bistra Dilkina (Simon Fraser University), Outstanding Female Award; Noah Snavely (University of Arizona), Male Runner-Up; Chand John (University of Texas at Austin), Finalist. Back row (l-r) Jim Foley, CRA's board chair; Anton Morozov (Hunter College), Honorary Mention; Vijay Reddi (Santa Clara University), Honorary Mention; Phillipe Loher (North Carolina State University), Honorary Mention; Mahdi Mekic (Lamar University), Honorary Mention; Yuli Ye (University of Waterloo), Finalist; and Andy Bernat, CRA's executive director.

Productivity Gains from Page 1

accelerated rapidly in the late 1920s as the last of the steam factories closed and the full benefit of electric power took hold. Electricity proved to be far superior to steam, but the transition took a long time. The IT revolution would play out in a similar way, David argued, with productivity rising as the full effect of IT use was felt.

More than fifteen years have passed since Roach's work appeared. IT application never slowed down. In fact, the mid and late 1990s brought the dot-com era, an extraordinary boom in IT application that coincided with one of the longest periods of economic expansion in U.S. history. If productivity were to change, the late 1990s was the time to see it. In addition, and partly in response to the productivity paradox, economic researchers were developing new measures focusing on the firm level and incorporating an improved suite of productivity measures. The results of new research on the late 1990s are coming out, and they tell a remarkable story.

Productivity grew from 1.33 percent to 2.07 percent between the periods 1975-1993 and 1995-2000, according to Dale Jorgensen of Harvard University, Mun Ho of Resources for the Future, and Kevin Stiroh of the Federal Reserve Bank of New York. This is the largest gain in many years. The gain was due mainly to "capital deepening," which means providing more effective capital investment to leverage the efforts of workers. When IT-capital deepening was separated from other capital deepening, the results are even more impressive. IT capital deepening jumped from 0.37 percent to 0.87 percent, while other capital deepening actually dropped from 0.43 percent to 0.37 percent in the 1995-2000 period. In other words, IT capital input accelerated while other capital input decelerated.

Capital deepening is not the only factor that can affect productivity: the quality of the work force also plays a major role. During these two time periods, labor quality actually declined due to the heated economy and the easy availability of jobs as the less productive workers entered the work force. Thus, the major productivity increase occurred in spite of a decline in labor quality during that period. When productivity gains are separated into IT-related productivity and other-related productivity, the conclusions become obvious. IT-related productivity rose from 0.21 percent to 0.45 percent, while other-related productivity over the same periods grew from only 0.05 percent to 0.17 percent. In short, there was a doubling of U.S. productivity in the period 1995-2000, which effectively means that the wealth of the country was building twice as quickly. Nearly all of that improvement was due to IT.

The dot-com crash and the sluggish economy following 2000 put a damper on the celebration. But this slowdown also provided a needed respite to step back from the "irrational exuberance" of that era to reflect on the changes underway. This is particularly important when articles with titles like "IT Doesn't Matter" appear in *Harvard Business Review,* and academic leaders cast nervous glances at noticeable declines in applications and enrollments in undergraduate computer science and graduate information systems programs. Paul David's hopeful story suggests that IT will continue to bring major improvements in productivity over the coming years, especially given the continued pace of improvement in the underlying technology itself. The challenge now lies in better understanding the ways in which IT affects organizational performance for the better.

The effort to demonstrate IT's role in productivity has been matched by research into the "hidden assets" that complement IT investments in the quest for productivity improvement. Erik Brynjolffson of MIT and Lorin Hitt of the University of Pennsylvania define hidden assets as those that are not counted by standard economic measurement systems. Many of these hidden assets have grown up around IT implementation, including specialized software and utilities, revised work practices, new control systems, and improved analytical capacity to aid in management decision making. The ratio of hidden assets is highest in the most productive firms, reaching as much as 10:1. The value created by IT assets and hidden assets working together goes beyond standard economic measurements, affecting things such as customer convenience and service quality. Previous research not only missed the productivity impacts of IT, but failed to recognize the complexity of the mechanisms involved in improving productivity.

The story of IT and productivity has been odd. The productivity payoffs of IT have been elusive for years, yet organizations kept spending on IT in spite of this news, and dramatically accelerated IT investments in the 1990s. When econometricians finally teased out the payoffs of IT, the dot-com boom collapsed and the economy turned down. It seems ironic that it was impossible to see the evidence of productivity when the economy was roaring, but it is easy now that things have slowed down. In fact, this is to be expected because understanding almost always lags the things to be understood. It takes time to understand change of this magnitude.

The revolution launched by IT is far too large and complex to play out in just a few decades. The revolution involves economic, political, social and cultural systems that often change slowly and in subtle and sometimes ambiguous ways. The advances in IT that gave the revolution its power were accomplished by expertise in narrow areas of specialization in computer engineering, computer science, and information systems. An important role for such specialization remains, but it is increasingly important to look across and not just within these specializations, and to join with economists, psychologists, operations management specialists, library and information specialists, and others to grasp the full magnitude of the changes underway. Without this broad effort, many of those who helped to launch the revolution will see it default to those with far less sense of how it all happened, and only a distant notion of what is at stake.

Dr. John L. King (jlking@si.umich.edu) is Dean and Professor in the School of Information at the University of Michigan. He was recently elected to a three-year term on the CRA Board of Directors. ∎

CRA Welcomes New Members

Academic Departments

Loyola University Chicago (CS)
University of Montana (CS)
University of South Florida (CSE)

Special Insert

CRA Workshop on Research Related to National Security: Report and Recommendations

By Kathleen McKeown, Lori Clarke, and John Stankovic (Organizers)

Introduction

The Computing Research Association (CRA) hosted a workshop in September 2002 to develop recommendations that will strengthen the research infrastructure in areas of critical importance to national security. It was funded by the National Science Foundation.

The workshop focused on three general topics:

1. how to facilitate technology transfer from research to practice;
2. how to foster research and infrastructure support for best practices in security and information fusion; and
3. strategies for funding research in this area.

Participants were invited from the areas of computer security, real-time systems, and information fusion, and included representatives from academia, industry, and government. Twenty people attended (see list at the end). The workshop was co-located with two workshops on Information Technology Research for Critical Infrastructure—hosted by UC Berkeley, Vanderbilt University, and the University of Virginia—in order to facilitate attendance at all events and to cross-pollinate ideas from different groups of people.

The aims of this workshop on research related to national security are directly relevant to CRA's mission. CRA seeks to strengthen research and advanced education in computing and allied fields. It does this by working to influence policy that impacts computing research, encouraging the development of human resources, contributing to the cohesiveness of the professional community, and collecting and disseminating information about the importance and the state of computing research. Each plays an important role in achieving the organizational objectives for the benefit of the country.

In the following sections, we discuss the recommendations that the workshop produced for each of the topic areas.

Research Areas

The workshop focused on three research areas—security, information fusion, and critical infrastructure—based on recommendations made by a National Research Council Committee on Science and Technology for Countering Terrorism. That committee called for research in information and network security, new information technology for emergency response, and new information technology for the detection, remediation, and attribution of attacks (information fusion).

Security includes authentication, availability, containment, detection and identification, privacy, recovery, and new security models.

Information technology for emergency response includes a variety of problems—most notably problems for critical infrastructure.

Information fusion includes research in data and text mining, data integration, language technologies, image and video processing, and evidence combination. Rather than consider again the question of which research areas are important for national security, the CRA Workshop took the results of the NRC committee's report as a starting point.

To provide common grounds for discussion, the workshop began with presentations by experts, who outlined the current state of the art and active research topics in each of these three areas.

Recommendations on How to Facilitate Interaction between Research and Practice in Security and Information Fusion

Top priority should be given to methods for facilitating interaction between research and practice. It is especially important that researchers have the ability to base their work on real problems with connections to real data. Because of concerns about national security and privacy, this can be particularly problematic. Nonetheless it is important that researchers and technologists have access to scenarios and data that are recognized as realistic and as representative of the challenges being faced by practitioners. If this is not the case, research results face the risk of being dismissed as irrelevant or immature.

In addition to providing access to the problems and the data, programs must be developed that facilitate an understanding of their counterparts by both researchers and practitioners. Researchers need a deeper understanding of the complex processes in which practitioners, such as government analysts, participate. They need to be able to observe practitioners and their processes in action. Practitioners need an understanding of the potential of new technology. Most are not comfortable with new technology, and novel methods for introducing technology must be developed so that people can become familiar with and test new systems—all while continuing to make progress on their real-world tasks.

Given these needs, the workshop recommended that the following actions be taken:

1. ***Create testbeds of open data.*** The workshop recommends establishing a center that will make it easier for both government and industry to provide data. In general, it is hard to generate synthetic data with enough scale; this is a research project worthy of its own funding. Issues include development of new techniques for automatic scrubbing, agreement between researchers and intelligence agencies on what constitutes good, normal operational and attack scenarios, and a long-term focus on establishing and maintaining the testbed. It was suggested that different research groups focus on different aspects of the testbed; one group might focus on generating operational data, while another focuses on generating attacks. Initial models for such a testbed are being explored under the NSF KDD program, a joint program with the National Security Agency. Funding for such models involving these and other agencies should be provided.

2. ***Establish structures that facilitate interactions.*** The workshop recommended a variety of structures that could address the problem of connecting research with practice. Grants focusing solely on the transfer of technology for a short-term period should be established. Funding programs that stress interactions between the intelligence community and industry and research groups are also needed. National laboratories that focus on issues of security and data mining would allow researchers and practitioners to come together for longer periods of time. Such laboratories could provide the ability to generate large-scale simulations in which experiments could be carried out. Organizations such as In-Q-Tel should seek to encourage technologies driven by needs and not by the market, with special effort placed on removing bureaucratic difficulties. Google provides a good model for moving from research to practice that could be used as the basis for new structures.

3. ***Adopt human factors methods for modeling and improving security processes.*** It was recognized that often the security processes that practitioners follow are cumbersome and error-prone. To facilitate understanding of the tasks and the human activities involved, research should consider and incorporate cognitive approaches such as scenario-driven exercises, workflow modeling, cognitive think-aloud protocols, and expert panels. Increasing the automation of many of these security processes, combined with rigorous analysis, would eliminate many opportunities for security breaches.

4. ***Reconsider research paradigms***. Researchers and funders must look to long-term efforts that include the continual development and improvement of realistic testbeds and careful evaluation of technology based on those testbeds. The workshop recommended that multiple cycles of evaluation are needed. In the first cycle, researchers might work with end-users to see how they react to initial tool functionality and design. In later cycles, after responding to initial concerns, more rigorous evaluation could be undertaken. This is a process that may go through many cycles and takes time. Funding agencies and users must recognize that long time periods are needed for this process to work well.

5. ***Create measures of effectiveness***. If practitioners are to understand which technologies are worth being deployed, they need measures of effectiveness that can help them distinguish and choose among options. Such measures should provide qualitative assessments of functionality and usefulness, as well as the more typical quantitative metrics.

Best Practices in Security, Real-Time Systems, and Information Fusion

The workshop addressed the question of best practices primarily through breakout groups that focused on each research area separately. It became clear, however, that there were commonalities across all areas. Unfortunately, it was agreed that there are not very many best practices within individual areas. It was difficult enough to define 'best practice,' let alone the appropriate problems for which best practices should be developed. Furthermore, best practices change so quickly that it would be difficult to create a static list.

Instead, the subgroups looked to mechanisms and processes that could be put in place to dynamically track best practices. We report on recommendations separately for each research area.

Information Fusion

While researchers are very often focused on tools and methods, we agreed that what needs to be disseminated and described to the more general community are the best tools for given tasks. We need a focus on the problem, not the tool. Thus, a summary of what different search engines do is not helpful; instead, practitioners need to know how it behaves in a specific context.

This subgroup recommended the development of a playground for tool evaluation. The playground would define scenarios and data against which tools could be tested. Such a playground might be set up on the Web, allowing researchers to post tools and practitioners to specify problems against which they could evaluate multiple tools. In order for this to work, researchers must agree on an annotation scheme for markup of data and common APIs for tightly coupled or distributed architectures. In addition to tasks, games should also be explored as a motivating mechanism for exploring the best fit of a tool.

In summary, this subgroup did not think it appropriate for any organization to develop a list of best practices; rather, it thought it would be better to define an environment for determining best practice, given a particular task. Best practice depends on context. This environment should be used to capture lessons learned. It should be developed as a glass-box scenario, logging behavior and allowing observation of end-users to see how well tools work, particularly when personal preferences play a role. It is possible that an organization such as the Linguistic Data Consortium at the University of Pennsylvania would be appropriate for setting up and maintaining such an environment, if provided with adequate funding.

Real-Time and Embedded Systems

The few best practices in existence include formal methods used for core algorithms, real-time analysis, and quality of service guarantees. In addition, there are common modeling and analysis tools in use, as well as integrated development environments. However, most of these tools are limited to idealized systems and situations. They also do not adequately address security and information fusion issues. Extensions to these tools and best practices are needed for all of these issues.

The most critical areas for which best practices are needed include methods to deal with the integration of constraints, dynamic real-time aspects of the system, dependable software development for real-time systems, computer security, and more principled development of large-scale distributed systems, which typically are still ad hoc.

This subgroup recommended the development of a set of Critical Infrastructure Protection (CIP) centers that focus on science and provide industry/research consortiums. Such centers could provide diversity on any given problem and will allow for integration of security with real-time issues. Different centers might focus on different problems—emergency response systems; wireless sensor networks for security of infrastructure systems for power, water, and transportation; or cyber security on the Internet—but cooperate with others.

Security

The security subgroup had the least agreement on what constitutes best practice, opting for the term "plausible practice" instead. Even security itself encompasses many possible areas, such as cryptography, network security, computer security, and security administration. The subgroup focused on security administration.

Recommendations include the need for more quantitative research on good security and evaluation. For improvement in security practice, the subgroup pointed out the need for creating novel forms of attacks on existing methods. Best practice is often limited due to the installed operating system and software, which are often decades behind the techniques put forth by the research community. This dichotomy between research and practice in security means that different recommendations must be developed for different situations. Given that all of our systems have vulnerabilities, it is unrealistic to expect that any system can ever be entirely secure. Instead, we need to move toward strategies that provide security components that are self-configurable and, in the case of attacks, self-healing.

Recommendations on Strategies for Funding Research in These Areas

There are a number of programs already in place at the different funding agencies to address issues of national security.*

The workshop recommends that a mix of funded programs targeting issues of national security be established and maintained. In particular, it is important that both short- and long-term efforts be supported; either type of effort alone is not sufficient. Four critical issues were identified as key to development of new technology for national security:

1. ***Improve mechanisms for funding technology transfer***. We need better methods for funding efforts to deploy mature research into applications. Possibilities include 12-month funding augmentation at the end of existing grants or short-term grants focused entirely on technology transfer. Improvement of the Small Business Innovation Research (SBIR) model should also be considered. The conversion rate from Phase I to Phase II SBIR grants in the current model is fairly large, but many small companies are never weaned off of SBIR grants; when these grants end, the company also ends. A more gradual move between phases is needed. In addition to short-term efforts, a study of mechanisms that facilitate tech transfer is needed.

2. ***Establish support for longer-term research on national security***. The problems will not be addressed by deployment of existing research alone. Many of the problems facing the intelligence community are hard ones and existing solutions are not available. Nonetheless, there are research efforts underway that are applicable to these problems that could be focused on this area. Funding programs that allow for the creation of centers and focused research over a long time period are needed. The need for open and realistic testbed data sources, comparable to the data used by the intelligence community, is one example of an area where new research is needed. These testbeds would in turn be used for other research. The NSF KDD and ARDA programs provide good models for this type of funding. Additional programs such as these in more areas are encouraged.

3. ***Create new programs that facilitate interactions between practice and research***. Such programs could include a faculty center where faculty are given clearances, or a scholar-in-residence program where researchers spend a sabbatical or a shorter period of time at one of the intelligence agencies or national laboratories where researchers and practitioners could be brought together. Programs that embody cognitive methods for observing end-user needs and the use of demo and employed systems are particularly important. Flexibility and experimentation with new models for prototyping, testing, and redesigning systems are needed.

4. ***The research community must get involved.*** There is a need for more participation by the research community in funding programs. DARPA has a need for new program managers, and without them new programs will not be initiated. NSF also has a need for rotators who are willing to serve time at NSF to oversee funding programs. Research recommendations from the community are also influential in starting new programs at both DARPA and NSF. For example, in order to establish a cross-institutional workshop on a topic of relevance, NSF needs a White Paper from a university. Similarly, DARPA is open to suggestions from the community on new programs.

**The National Science Foundation (NSF) has created at least one program jointly with the National Security Agency under the Knowledge Discovery and Dissemination (KDD) program, and plans others. The mission of the Advanced Research and Development Activity (ARDA) is to work closely with the intelligence agencies and has several programs (e.g., AQUAINT, NIMD) where researchers and intelligence analysts are teamed to work together on problems and solutions. DARPA has no set-aside to address problems in information security, but initiatives can come through the program managers. That said, there are several ongoing security-related programs within DARPA that bring together research from different sites.*

Workshop Participants

James Allan
University of Massachusetts, Amherst

Kelcy Allwein
Defense Intelligence Agency

Chris Buckley
Sabir Research

Jagdish Chandra
George Washington University

Yvo Desmedt
Florida State University

Helen Gill
National Science Foundation

Virgil Gligor
University of Maryland

Sally Howe
National Coordination Office

Andrew Hume
AT&T

Rob Kolstad
SAGE Executive Producer
USENIX

Jay Lala
DARPA

Carl Landwehr
National Science Foundation

Elizabeth D. Liddy
Syracuse University

Stephen R. Mahaney
National Science Foundation

Kathleen R. McKeown
Columbia University

Bert Miuccio
Center for Benchmark Services

Al Mok
University of Texas at Austin

Salim Roukos
IBM

Shankar Sastry
University of California, Berkeley

Jonathan Smith
University of Pennsylvania

John Stankovic
University of Virginia

Gary Strong
National Science Foundation

Kathleen McKeown (Columbia University), John Stankovic (University of Virginia), and Lori Clarke (University of Massachusetts, Amherst) are all members of CRA's Board of Directors. ■

2002-03 Computing Research Association Members

Arizona State University - CSE
Auburn University - CSSE
Ball State University - CS
Boston College - CS*
Boston University - CS
Bowdoin College - CS*
Bradley University - CS
Brandeis University - CS
Brigham Young University - CS
Brown University - CS
Bryn Mawr College - MCS
Bucknell University - CS
California Institute of Technology - CS
California Polytechnic State University - CS
California State University, Chico - CS
California State University, Hayward - MCS
Carnegie Mellon University - CS
Carnegie Mellon University - ECE
Case Western Reserve University - EECS
Clemson University - CS
Colgate University - CS*
College of Charleston - CS
College of William & Mary - CS
Colorado School of Mines - MCS
Colorado State University - CS
Columbia University - CS
Cornell University - CS
Cornell University - ECE*
Dalhousie University - CS
Dartmouth College - CS
DePaul University - CS
Drexel University - CS
Duke University - CS
Emory University - MCS*
Florida Atlantic University - CSE
Florida Institute of Technology - CS
Florida International University - CS
Florida State University - CS
Florida State University - IS
George Washington University - CS
Georgia Institute of Technology - CS
Georgia Institute of Technology - ECE
Georgia Southern University - IT
Georgia State University - CIS
Georgia State University - CS
Grinnell College - MCS
Harvard University - CS
Harvey Mudd College - CS
Illinois Institute of Technology - CS
Illinois State University - ACS
Indiana University - CS
Indiana University - I
Indiana University - LIS*
Iowa State University - CS
Johns Hopkins University - CS
Johns Hopkins University - SI*
Juniata College - IT*
Kansas State University - CIS
Kent State University - CS
Lehigh University - CSE
Long Island University - ICS
Louisiana State University - CS
Massachusetts Institute of Technology - AA*
Massachusetts Institute of Technology - EECS
Miami University - CS*
Michigan State University - CS
Michigan Technological University - CS
Mississippi State University - CS
Montana State University - CS
Naval Postgraduate School - CS*
New Jersey Institute of Technology - CCS
New Mexico State University - CS
New York University - CS
North Carolina State University - CS
Northeastern University - CS
Northwestern University - CS
Northwestern University - ECE
Oakland University - CSE
Ohio State University - CIS
Ohio University - EECS
Oklahoma State University - CS
Old Dominion University - CS
Oregon Health & Science University - CSE
Oregon State University - CS
Pace University - CSIS
Pennsylvania State University - CSE
Pennsylvania State University - IST
Polytechnic University - CIS
Portland State University - CS
Princeton University - CS
Purdue University - CS
Purdue University - ECE
Rensselaer Polytechnic Institute - CS
Rice University - CS
Rochester Institute of Technology - CS
Roosevelt University - CS&T*
Rutgers University, Busch Campus - CS
Santa Clara University - CE
Simon Fraser University - CS
Singapore Management University - IS*
Southern Illinois University, Carbondale - CS
Southern Methodist University - CSE
Southern Polytechnic State University - CSE
Stanford University - CS
State University of New York, Albany - CS
State University of New York, Binghamton - CS
State University of New York, Stony Brook - CS
Stevens Institute of Technology - CS
Swarthmore College - CS
Syracuse University - IS
Temple University - CIS
Texas A&M University - CS
Texas Tech University - CS
Trinity College - CS*
Tufts University - CS
University at Buffalo - CSE
University at Buffalo - IS
University of Alabama, Birmingham - CIS
University of Alabama, Tuscaloosa - CS
University of Arizona - CS
University of Arkansas - CSCE
University of Arkansas at Little Rock - I
University of California, Berkeley - EECS
University of California, Berkeley - IMS
University of California, Davis - CS
University of California, Irvine - ICS
University of California, Los Angeles - CS
University of California, San Diego - CSE
University of California, Santa Barbara - CS
University of California, Santa Cruz - CE
University of California, Santa Cruz - CS
University of Central Florida - CS
University of Chicago - CS
University of Cincinnati - ECECS
University of Colorado, Boulder - CS
University of Delaware - CIS
University of Denver - CS
University of Florida - CISE
University of Georgia - CS
University of Hawaii - ICS*
University of Houston - CS
University of Idaho - CS
University of Illinois, Chicago - CS
University of Illinois, Urbana Champaign - CS
University of Iowa - CS
University of Kansas - EECS
University of Kentucky - CS
University of Louisiana at Lafayette - CACS
University of Louisville - CECS
University of Maine - CS
University of Manitoba - CS
University of Maryland - CS
University of Maryland, Baltimore Co - CSEE
University of Massachusetts, Amherst - CS
University of Michigan - EECS
University of Michigan - I
University of Minnesota - CSE
University of Mississippi - CIS
University of Missouri, Rolla - CS
University of Nebraska, Lincoln - CSE
University of Nevada, Las Vegas - CS
University of Nevada, Reno - CS
University of New Brunswick - CS
University of New Hampshire - CS
University of North Carolina at Chapel Hill - CS
University of North Carolina, Charlotte - IT
University of North Dakota - CS
University of North Texas - CS
University of Notre Dame - CSE
University of Oklahoma - CS
University of Oregon - CIS
University of Pennsylvania - CIS
University of Pittsburgh - CS
University of Puget Sound - MCS
University of Redlands - MCS
University of Rochester - CS
University of South Alabama - CIS
University of South Carolina - CSE
University of Southern California - CS
University of Tennessee, Knoxville - CS
University of Texas, Arlington - CSE
University of Texas, Austin - CS
University of Texas, Dallas - CS
University of Texas, El Paso - CS
University of Toledo - EECS
University of Toronto - CS
University of Toronto - ECE
University of Tulsa - MCS
University of Utah - CS
University of Vermont - CS
University of Virginia - CS
University of Washington - CSE
University of Washington - I
University of Washington, Bothell - CS
University of Washington, Tacoma - CSS
University of Waterloo - CS
University of Wisconsin, Madison - CS
University of Wisconsin, Milwaukee - EECS
University of Wyoming - CS
Utah State University - CS
Vanderbilt University - EECS
Virginia Commonwealth University - CS*
Virginia Tech - CS
Wake Forest University - CS
Washington State University - EECS
Washington University in St. Louis - CS
Wayne State University - CS
West Virginia University - CSEE
Western Michigan University - CS
Williams College - CS
Worcester Polytechnic Institute - CS
Wright State University - CSE
Yale University - CS
York University - CS

Labs and Centers Members

Accenture Technology Labs*
AT&T Labs
Avaya
Computer Science Research Institute at Sandia National Labs
Fraunhofer Center for Research in Computer Graphics
Fujitsu Laboratories of America
Hewlett-Packard Co.
Honda R&D Americas
IBM Research
IDA Center for Computing Sciences*
Institute for Human & Machine Cognition
Intel Corp.
Lawrence Berkeley National Laboratory*
Los Alamos National Laboratory*
Lucent Technologies, Bell Labs
Microsoft Corp. (Sustaining Member)
Mitsubishi Electric Research Labs
National Center for Atmospheric Research
National Center for Supercomputing Applications
NEC Laboratories America
Palo Alto Research Center
Panasonic Information & Networking Technologies Lab
Ricoh Innovations, Inc.
San Diego Supercomputer Center
Sun Microsystems, Inc. (Supporting Member)
Telcordia Technologies (Supporting Member)

Affiliate Professional Society Members

American Association for Artificial Intelligence
Association for Computing Machinery
Canadian Association of Computer Science (CACS/AIC)
IEEE Computer Society
Society for Industrial and Applied Mathematics
USENIX Association

*New members 2002-03

Title IX from Page 1

principle in hiring, tenure, scholarships, and the provision of lab space and equipment. It is the law on the books, and schools that are not following it now should be put on notice that Title IX will be enforced as vigorously in the halls of academia as it is on athletic fields.

Applied more comprehensively, Title IX can serve as a valuable tool in not only breaking down formal barriers to entry, but in actually ensuring that more women succeed at math, science and engineering—or any other disciplines they choose.

This will require a sea change in the attitudes of many people at the nation's educational institutions. In my view, the Federal government should move now to bring about that change in a number of ways—particularly by helping to clearly define just how pervasive and how institutionalized discrimination in these fields has become.

Despite a great deal of anecdotal evidence, there are few studies about just how often women are discouraged from studying math, science and engineering, and how regularly women who do enter these fields face discouragement from their supervisors and colleagues. That is why Senator Barbara Boxer (D-CA) and I have asked the General Accounting Office to find out what is being done, if anything, to ensure Title IX enforcement in math, science, and engineering.

I also passed legislation requiring a review of whether the National Science Foundation is meeting its goals to expand opportunities in these disciplines for women, minorities, and people with disabilities, particularly in faculty hiring, promotion, tenure, and allocation of lab space. Another section of my amendment required a study to look at gender differences in the distribution of Federal research and development funds.

Shifting awareness in the government's scientific culture may be just as critical as changes at our educational institutions. As chair of the Science, Technology, and Space Subcommittee in the previous Congress, I held several hearings on the topic of encouraging women to enter math and science fields. I called on NASA Administrator Sean O'Keefe and his agency to use a new education initiative to help triple the number of women graduating with math, science, and engineering degrees by 2012. With clear evidence of inequity, there was no reason a Federal agency launching an education program should not do so with an eye to closing the gender gap.

I am committed to continuing to push government agencies and institutions receiving Federal funds to abide by and actively consider the text and spirit of Title IX. That is why I have signed on as a co-sponsor to two resolutions, one introduced by Senator Joe Biden (D-DE) and the other by Senator Patty Murray (D-WA), both of whom reaffirm our commitment to the principles set forth in the Title IX law.

After I began advocating publicly on this issue, I received an e-mail from a professor on a search committee for a chemistry professor. He was lamenting the fact that out of 80 applicants for the position, only six were women. This frustrated educator suggested that gender inequity had to be attacked much earlier in the process, and I agree—it must be attacked much earlier, and in some cases even outside the scope of Title IX.

In addition to the barriers women face in the educational arena, cultural stereotypes discourage girls from math and science at a young age. Young girls in their formative years too often receive the message that math and science are not meant for them. In fact, one popular talking doll on the market a few years ago actually spouted catch phrases like "math is hard" and "shopping is fun." Inside the classroom, a lack of expectations and a shortage of female role models frequently perpetuate the problem.

The good news is that the stereotypes can be overcome. Nancy Stueber, the president of the Oregon Museum of Science and Industry, has told me stories of young girls who walked into the museum thinking that science and math were for boys. When the girls were asked to draw pictures of a scientist, they all drew an older white man in a lab coat. However, after participating in programs at the museum, those same girls drew pictures of women in lab coats. They had begun to imagine themselves as mathematicians, scientists and engineers.

My goal is to make sure that when those young women choose their careers, this nation's educational institutions are fully compliant with the law that guarantees them equal access. Careers in math and the hard sciences are their right—and it is in our nation's interest to encourage them. The enforcement of Title IX may well be America's best hope to maintain our position at the forefront of key scientific disciplines and our leadership in the world community.

Senator Wyden (D-OR) was elected to the Senate in 1996 and is a former chair of the Senate Commerce Subcommittee on Science, Technology and Space. [The Senator's views do not necessarily represent the views of CRA.]

"Expanding the Pipeline" is a regular feature in CRN, prepared by the CRA Women's Committee (CRA-W). It serves as a vehicle for describing projects and issues related to women in CSE and a source of information for issues faced by underrepresented groups in CSE. ▮

Undergraduate Awards

Pictured above receiving the female CRA Outstanding Undergraduate Award for 2003 is Bistra Dilkina, Simon Fraser University. The award was presented by CRA's executive director, Andy Bernat, at ACM's awards banquet in San Diego in June. Looking on is Julie Thornton, Kansas State University, who received the female runner-up award.

Pictured above receiving the male CRA Outstanding Undergraduate Award for 2003 is Omar Khan, Cornell University. The award was presented by CRA's executive director, Andy Bernat, at ACM's awards banquet in San Diego in June.

COMPUTING RESEARCH NEWS

Vol. 15/No. 4

Computing Research News
(ISSN 1069-384X) is published five times per year, in January, March, May, September, and November.

Subscriptions: Call 202-234-2111, send e-mail to crn@cra.org, or mail subscription inquiries to CRA, 1100 17th Street, NW, Suite 507, Washington, DC 20036-4632. A free subscription is available to qualified subscribers. One-year paid subscriptions are $30 in the United States, $45 (U.S.) in Canada, and $54 (U.S.) elsewhere.

Change of Address: Note that a change of address must include the old and new addresses with ZIP+4. Please include a street address or PO Box number.

Postmaster: Send address changes to: CRA, 1100 17th Street, NW, Suite 507, Washington, DC 20036-4632. Postage paid at Washington, DC.

The Northern Report from Page 4

research infrastructure, often with matching funds from provincial governments and industry. While none of these programs is focused on computer science specifically, computer science departments have certainly taken at least their fair share of these funds. Overall, the general climate in Canada for research seems to be highly positive, with both levels of government actually supporting their innovation agenda with real funding.

Enrollment Trends

A recent survey of Canadian computer science departments has revealed a general leveling off in undergraduate enrollments with some universities experiencing considerable decline, especially in the early years of their programs. It is also increasingly difficult to get internship and co-op placements for students, and the job market generally for computer science graduates is soft. This seems to be at least a North America-wide phenomenon in the wake of the dot-com crash.

On the other hand, graduate enrollments continue to surge, a natural enough result of increased numbers of faculty members and increased research funding. Unless the job market turns around, an obvious crunch point lies ahead, with many freshly-minted Ph.D. graduates and not many new faculty and industrial research positions for them. This is certainly worrisome. One trend that may help to offset this worry is a widespread movement among Canadian computer science departments to forge interdisciplinary programs with a variety of other academic disciplines. New faculty positions may become available to support these interdisciplinary programs, and many new students may well be attracted to such programs, especially those who have not been attracted to traditional notions of computer science.

Accreditation

The Computer Science Accreditation Council of Canada (CSAC)—a joint body of the Canadian academic computer science community and the Canadian Information Processing Society (CIPS), the Canadian organization of software professionals—has drafted revised standards for both computer science and software engineering programs. At a recent meeting of computer science department chairs, however, there was some unrest with the conservative nature of these standards, and a wish on the part of many departments to expand the notion of computer science to include much more broadly interdisciplinary perspectives and to have standards for a much wider variety of programs. The new standards and these broader issues are now being discussed by CSAC and CACS/AIC.

Software Engineering

Software engineering professionalism is still a hot issue in Canada. Starting in the mid-90s, the engineering profession in Canada began to assert what it saw as its exclusive right to practice in the area of software engineering, an assertion that has been hotly contested by the Canadian computer science community. There are three interrelated fronts to this dispute.

The first front has (nominally) been an argument about the use of the term "engineering." In 1997, the engineering profession launched legal action against Memorial University of Newfoundland (MUN) for offering a software engineering program within their computer science department in the faculty of science. The basis for this lawsuit was a 1989 trademark filed by the engineering profession on the terms "engineer" and "engineering." Eventually, MUN was joined in its defense by the Association of Universities and Colleges of Canada (AUCC, the organization of Canadian universities, which was concerned about academic freedom); CIPS (which was concerned about its members' right to practice); and CACS/AIC (which was concerned about both). In 1999, the lawsuit was suspended for a period of 5 years to allow both sides to work out a compromise. Despite several early compromise proposals, it now appears that no reconciliation will be achieved, even though the moratorium expires in another year.

The second front is the creation and accreditation of software engineering programs within and outside of engineering. For the past several years, engineering schools across Canada have been creating their own software engineering programs, variations on standard engineering programs and accredited by the Canadian Engineering Accreditation Board (CEAB). Most engineering schools now have such programs, although the software-specific courses are often provided by computer science departments. So far, seven of these programs have been accredited by CEAB. At the same time, a number of computer science departments have created their own software engineering programs, variations on standard science programs, five of which have been accredited by CSAC.

The third front involves the right to practice. Several years ago, engineering associations across Canada began to successfully lobby for changes to their provincial and territorial Engineering Acts (under which the engineering profession is granted exclusive right to practice engineering) to make it easier to claim "emerging areas of engineering practice." These changes tended to replace the existing description of the scope of engineering practice (which heretofore had included a lengthy list of engineering works) with an essentially circular definition of engineering as that discipline that draws on engineering principles. Such a broad definition would certainly make it easier to "claim" software engineering (as well as many other areas not traditionally considered to be engineering). CIPS, CSAC, and CACS/AIC are attempting to see if further revisions can be made to these Engineering Acts to ensure that the right to practice software engineering is clearly protected for the wide variety of people who have the appropriate skills to do so, whether or not they are professional engineers. Negotiations with engineering societies and governments have not yet resulted in such protection.

Given the size and importance of the software industry, and the implications for everything from the training of software professionals to the final certification of software quality, the final reconciliation of the software engineering dispute is of great importance not only to Canadian computer science departments, but to the entire Canadian economy. Unfortunately, at the current time, it appears that it will be up to the courts to make the final decisions about the issues involved in the software engineering dispute, since no appropriate compromise positions seem to be on the horizon.

So, that's it for this year's report. Hopefully I will be able to update you next year with lots of positive news from the far north.

Note: *The word "department" is used generically to refer to department, school, or faculty of computer science.*

Gord McCalla (mccalla@cs.usask.ca) is President of the Canadian Association of Computer Science/Association informatique canadienne (CACS/AIC) http://www.cs.usask.ca/spec_int/cacs, the Canadian organization of university computer science departments/schools/faculties. He is a Professor in the Department of Computer Science at the University of Saskatchewan in Saskatoon. ▮

Pictured above at CRA's Workshop on the Road Map for the Revitalization of High End Computing in June are (left to right): Thomas Sterling, Center for Advanced Computing Research, California Institute of Technology/JPL; Dan Reed, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign (Workshop Chair); and David Nelson, Director, National Coordination Office for Information Technology Research and Development, the workshop's sponsor.

CRA Releases Two New Reports

During the summer CRA released two reports, *Grand Research Challenges in Information Systems*, and *Recruitment and Retention of Faculty in Computer Science and Engineering*.

The first is the report of the Grand Research Challenges Conference CRA held in June 2002. This conference, which focused on information systems, was the first of a series of conferences CRA plans to hold to address the grand research challenges in a variety of areas related to computer science and engineering. The next conference, on information security and assurance, will be held in November 2003 (see announcement elsewhere in this edition of *CRN*).

The second report, *Recruitment and Retention of Faculty in Computer Science and Engineering*, addresses earlier concerns about the effect that departures of faculty to industry (e.g., dot-com companies) might have on the ability of universities to carry out their research and teaching missions. Since this project began, economic conditions have altered the landscape, especially for high-tech firms. However, the empirical data in this report provide a useful tool for understanding the issues surrounding faculty recruiting and retention, both now and in the future.

Both projects were supported by the National Science Foundation. The reports are posted on the CRA website (http://www.cra.org), and copies may be requested by e-mailing info@cra.org. ▮

Service Awards

Ruzena Bajcsy, Director of CITRIS at UC Berkeley, was presented with CRA's 2003 Distinguished Service Award at ACM's awards banquet in San Diego in June. Pictured with Dr. Bajcsy are CRA board chair, Jim Foley (l), and CRA executive director, Andy Bernat (r).

CRA's A. Nico Habermann award for 2003 was presented to Rita Rodriguez, Program Director in the Division of Experimental and Integrative Activities in the CISE directorate at NSF. Dr. Rodriguez is pictured above with Jim Foley, CRA board chair. The award was presented at ACM's awards banquet in San Diego in June.

Transitions and News

Alfred V. Aho, previously Vice President of the Computing Sciences Research Center at Bell Labs, has returned to Columbia University as Professor of Computer Science.

Marjory Blumenthal, Executive Director of the National Academies' Computer Science and Telecommunications Board for the past 16 years, has recently become the Associate Provost (Academics) at Georgetown University.

David Farber has joined the faculty of Carnegie Mellon University as Full Professor of Computer Science and Public Policy in the School of Computer Science, with secondary appointments in the Heinz School and the Engineering and Public Policy faculty. Dr. Farber was previously Alfred S. Fitler Moore Professor of Telecommunication Systems at the University of Pennsylvania.

Yoav Freund and Robert Schapire have been awarded the 2003 Gödel Prize for their paper "A Decision Theoretic Generalization of On-Line Learning and an Application to Boosting," *Journal of Computer and System Sciences* 55 (1997), pp. 119-139. The Gödel Prize for outstanding papers in the area of theoretical computer science is sponsored jointly by the European Association for Theoretical Computer Science (EATCS) and ACM-SIGACT. **Yoav Freund**, formerly of Banter, Inc. and AT&T Research, has recently joined the Columbia University Center for Computational Learning Systems (CLASS) as a Senior Scientist. Robert Schapire is Professor of Computer Science at Princeton University.

Narain Gehani is the new chair of Computer Science at the New Jersey Institute of Technology. Dr. Gehani was formerly Vice-President for Communications Software Research at Bell Laboratories.

CRA board member **Barbara Grosz,** Professor of Engineering & Applied Sciences at Harvard University, has been elected to the American Philosophical Society. Election to the APS, this country's first learned society, honors extraordinary accomplishments in all fields.

The community mourns the death on May 15 of **Rob Kling**, Indiana University's Professor of Information Systems and Information Science at the School of Library and Information Science (SLIS) and Adjunct Professor of Computer Science.

Ralph Merkle, an inventor of the encryption technology that allows secure transactions over the Internet, has been appointed director of the Georgia Tech Information Security Center (GTISC). Merkle will be joining the College of Computing faculty as Professor of Computing.

Congratulations to **Ian Munro**, Professor in the School of Computer Science at Waterloo University, who was recently elected a Fellow of the Royal Society of Canada, the country's most prestigious academic honour.

Congratulations to CRA board member, **Larry Snyder**, Professor of Computer Science at the University of Washington, on the publication of his new book. *Fluency with Information Technology: Skills, Concepts and Capabilities* provides students with the experience, knowledge, and capabilities needed to apply IT effectively throughout their lives. Details at http://www.aw-bc.com/info/snyder/

David Waltz, former President of NEC Research Institute and a CRA board member, has been named Director of the new Center for Computational LeArning SystemS (CLASS) at Columbia University. CLASS will initially emphasize applications to biological and medical databases; natural language, speech and the Web; and computer systems security. ▮

NSF Update from Page 4

such a vital part of national security. Cyber Trust is an example of how the new CISE structure and processes will address important themes, while reducing duplication and staff workload, increasing the opportunities for collaboration and innovative research, and providing the budget flexibility to make available appropriate duration and levels of funding.

Evolution of ITR

The community has long known that fiscal year 2004 would be the final year of the five-year Information Technology Research (ITR) program as a designated "NSF Priority Area," and has expressed a lot of interest in how it will evolve. The success of the previous four years indicates that ITR should remain an important part of CISE activities. Fiscal year 2004 will be a transition year for the ITR program as we begin to make changes that: 1) focus the research in its last year, and 2) move toward the future. The format for the solicitation is still under development.

As mentioned above, ITR funds will include CISE investments in these thematic areas. In addition, it is likely that rather than inviting a broad range of proposals in three (small, medium, and large) size classes, proposals will be solicited by focus areas.

While details of the solicitation were not available at the time this article was written, we can offer some insight into possible focus areas. Since each of the NSF directorates provides ITR funding, one likely area of focus will be research on domain-specific "cybertools" or the front-end software, data-resources, and other tools that domain scientists use, in conjunction with broadly available computational resources, to accomplish their specific research and education activities. All NSF directorates would engage in this activity.

In addition to the cybertools focus, there will be another focus area central to the CISE research mission. In fiscal year 2005 and beyond, Information Technology Research will remain a critical component of the CISE portfolio. A number of modalities for funding are currently being examined; however, our plan is to use CISE ITR funds this year and in coming years to create new initiatives and to strengthen the core research and education missions. An ITR FY 2004 program announcement is anticipated in October with an earliest due date in January.

Cyberinfrastructure

The envisioned cyberinfrastructure presents a series of research challenges for the CS&E community. The column in the May 2003 issue of *Computing Research News* ("Cyberinfrastructure: Challenges for Computer Science and Engineering Research") described the ultimate goal of cyberinfrastructure: "a transparent and seamless computation and resource-sharing execution environment for user-centric applications." The complexity of managing the massive scale of heterogeneous computation, communication, and storage resources needed to achieve this future networked environment will require significant, sustained innovation at the frontier.

Most of the community is aware of the importance that CISE is placing on cyberinfrastructure. Just as supercomputing promised to revolutionize the conduct of science and engineering research several decades ago, an advanced cyberinfrastructure promises to revolutionize the conduct of science and engineering research and education in the 21st century.

Budget

NSF continues to enjoy broad support from both the administration and Congress. CISE received a very generous increase in appropriations from Congress in 2003. The doubling of the NSF budget by 2007 has been authorized, and we will need annual increases in our appropriations to meet that target.

The fiscal/academic year 2004 is shaping up to be a year of change and great opportunity. The CISE staff looks forward to working with its communities of researchers and educators to seize those opportunities.

Sean Jackson (sjackson@nsf.gov) is a Research Specialist in the CISE Directorate of the National Science Foundation. ▮

Professional Opportunities

CRN Advertising Policy

See http://www.cra.org/main/cra.jobshow.html

Case Western Reserve University, Cleveland, Ohio

Department of Electrical Engineering and Computer Science
Division of Computer Science
Faculty Positions in Computer Science

The Division of Computer Science (CS) of the Department of Electrical Engineering and Computer Science (EECS) at Case Western Reserve University (CWRU) invites applications for several faculty positions. Appointments at all ranks, including an endowed professorship, are of interest and will be considered. All applicants must either hold great promise for or have a significant track record of research leadership and grant funding, as well as teaching excellence and service contributions. All applicants must have a Ph.D. in Computer Science or a closely related field. Appointments will be made until the positions are filled, beginning as early as Fall 2003.

The department is pursuing the development of leading academic programs and research thrusts influenced by the Bio-Micro/Nano-Info theme. Bioinformatics, including computational genomics and neurosciences, is a designated growth area of the CS division, with world-class opportunities for impact through collaboration with the School of Medicine at CWRU. Two other designated growth areas are data mining and visualization, and pervasive networks and distributed systems. There are exceptional opportunities for impact in these areas through exciting collaborations with a wide range of initiatives in the department (i.e., the ECE division) and on campus. Accordingly, special attention will be given to candidates with strong background in: computer algorithms; networks and distributed computing; data and knowledge management; software engineering; human-computer interaction; graphics, visualization and multimedia; and computer architecture. Further information about the positions and the department is available at: http://www.eecs.cwru.edu/.

Application packages must include: (i) a current curriculum vitae; (ii) statement of research and teaching interests; and (iii) biographies of the references providing letters of recommendation. Applicants must arrange for at least three letters of recommendation to be submitted directly. All applications and nominations should be sent to:

Faculty Search Committee
Division of Computer Science
Department of Electrical Engineering and Computer Science
Case Western Reserve University
10900 Euclid Avenue
Cleveland, OH 44106-7071

In employment as in education, CWRU is committed to affirmative action and equal opportunity. Women and minorities are encouraged to apply.

Clemson University

Department of Electrical and Computer Engineering

Applications are invited for faculty positions in the Computer Engineering area of the Department of Electrical and Computer Engineering. The Department has strong research programs in wireless communications and signal processing, mechatronics, computational electromagnetics, solid-state device reliability, power systems, cluster-based computing, reconfigurable computing, and machine vision.

Exceptional candidates at all levels and in all research areas related to computer engineering will be considered. However, we intend to fill at least one position in the area of computer communication networks. For the other positions, we are interested in individuals who can contribute to the Department's active research programs or who can serve as conduits for building interdisciplinary research teams in emerging areas at Clemson (e.g., robotics/control, intelligent systems, and computer simulation).

Candidates should hold a Ph.D. degree in Computer Engineering, Electrical Engineering, Computer Science, or a closely related field and should have high potential for establishing a sustained research program and quality teaching. The individual selected will be expected to contribute to both new and ongoing research programs at Clemson and to teach both undergraduate and graduate courses. A detailed description of the department is available at: http://www.ece.clemson.edu. Send resume and names and addresses of five references to:

Chair
Holcombe Department of Electrical and Computer Engineering
105 Riggs Hall, Box 340915
Clemson University
Clemson, SC 29634-0915

Evaluation will begin October 1, 2003, and will continue until the positions are filled. Clemson University is an Equal Opportunity/Affirmative Action Employer.

Columbia University

Center for Computational Learning Systems
Researcher Positions

The new Center for Computational Learning Systems is seeking highly qualified researchers in machine learning and data mining, especially in the areas of bioinformatics; natural language, speech, and text; and systems security. An ideal candidate will have both theoretical strength and experience with applications to one or more of these specific areas, an entrepreneurial spirit, and the proven ability to develop and lead a successful research program. Candidates should have a Ph.D. in Computer Science or engineering discipline related to their research area. Candidates at all levels should have a strong record of publication.

If currently at a university, candidates for Senior Research Scientist positions are expected to have a strong record of attracting research grant support and supervising graduate research. If at an industrial lab, SRS candidates should have management experience, patents and previous success at technology transfer. SRS candidates would typically have received prizes and been elected as a fellow or officer of a professional society.

Research Scientist candidates are expected to have the promise of growing to meet the requirements of a Senior Research Scientist. If from academia, candidates are expected to have a strong record of attracting grant support and supervising graduate research. If from industry, candidates should have a strong record of successful research and technology transfer along with management experience.

For Associate Researcher positions, candidates are expected to have demonstrated innovation and excellence in research, at least some publications in top journals and conferences, and the promise of growing to meet the requirements of a Senior Research Scientist.

Center members will be expected to seek support for their research, and will have considerable autonomy in creating their own research programs. The Center aims to provide support services that will allow researchers to do their best work. Members will supervise Columbia grad students in their projects. Members have the opportunity to teach but teaching is not required. Joint projects with CS as well as interdisciplinary activities with other Columbia University departments are strongly encouraged. Appointments to the Center will be for fixed renewable terms. Hiring is not necessarily synchronized with the academic year.

Qualified applicants should submit a CV and statement of research experience and goals to:

Center for Computational Learning Systems
Columbia University
500 West 120th Street, Room 510
New York, NY 10027

Electronic applications can be sent to: center-jobs@cs.columbia.edu.

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

Dartmouth

Postdoctoral Positions in:
Structural Genomics
Computational Geometers
Computer Scientists
NMR Spectroscopists

We are funded by the National Institutes of Health under the auspices of the National Institute of General Medical Sciences Protein Structure Initiative (http://www.nih.gov/nigms/funding/psi.html) to develop novel computational methods to enable high-throughput structural and functional studies of proteins. A key focus is structural genomics, whose goal is (in the broadest terms) to determine the three-dimensional structures of all proteins in nature, through a combination of direct experiments and theoretical analysis. Proteins are the worker molecules in every living thing. By determining the structures of proteins, we are better able to understand how each protein functions normally and how faulty protein structures can cause disease. Scientists can use the structures of disease-related proteins to help develop new medicines and diagnostic techniques.

For a description of our research and papers, please visit: http://www.cs.dartmouth.edu/~brd/Research/Bio/

Computer scientists, computational geometers, and NMR spectroscopists are encouraged to apply for postdoctoral research positions in our lab. Applicants with a Ph.D. or equivalent experience should submit a C.V. and a brief statement of research accomplishments and interests (not to exceed two pages), and arrange for three letters of recommendation to be sent directly to the Principal Investigator:

Professor Bruce R. Donald
6211 Sudikoff Laboratory
Department of Computer Science
Dartmouth
Hanover, NH 03755-3510
email: brd@cs.dartmouth.edu

Dartmouth has proved an excellent environment for research in Computational Biology and Chemistry, and we have a distinguished record of job placement for Donald Lab alumni. For more information on our laboratory, and details of the application process, please visit: http://www.cs.dartmouth.edu/~brd/Jobs/.

George Mason University

School of Computational Sciences
Tenure-Track Assistant Professorship

The School of Computational Sciences (SCS) invites applications for a tenure-track Assistant Professorship position in Machine Learning and Knowledge Mining. The successful candidates will be expected to have significant external funding support (more than 80%) for the first few years and an active research agenda on such topics as advanced rule learning, inductive databases, user modeling, and evolutionary computation. It is expected that the individual will be active in the Machine Learning and Inference Laboratory, and provide an educational support of the Computational Intelligence and Knowledge Mining (CIKM) concentration area in the Ph.D. degree program in the School of Computational Sciences. The CIKM area addresses a wide range of topics concerned with deriving useful knowledge from any form of data and other knowledge, and related issues of Computational Intelligence. For more detailed information about the CIKM Ph.D. concentration area and the Machine Learning and Inference Laboratory, visit our website at: http://ww.mli.gmu.edu.

Interested individuals should submit CV and letter of intent (including statements of research and teaching interests and accomplishments) to:

Professor James Gentle
School of Computational Sciences
MS 5C3
George Mason University
Fairfax, VA 22030-4444

Individuals should also arrange to have three letters of recommendation sent to the same address. The application period will remain open until the position is filled; however, review of applications will commence on September 5, 2003, with the intent of filling the position as quickly as possible. Salary will be commensurate with experience.

George Mason University is an Affirmative Action/Equal Employment Opportunity Employer. We strongly encourage women and minority candidates to apply.

The Johns Hopkins University

The Whiting School of Engineering
Faculty Position: Language and Speech Processing

The Johns Hopkins University, Whiting School of Engineering, invites applications for a tenure-track appointment in the area of speech processing at a rank dependent on the experience and accomplishments of the candidate. Candidates must have an earned Ph.D. in electrical engineering, computer engineering, computer science, biomedical engineering, or a closely related field; demonstrated research potential appropriate to rank; a commitment to teaching; and at least 5 years of experience in the field. The School is seeking a person who will play a leading role in the Center for Language and Speech Processing, and be in charge of its speech processing computing systems.

The interdepartmental Center for Language and Speech Processing has participation from 6 different university departments. It includes 18 faculty members and approximately 30 graduate students who are studying for the Ph.D. degree. It is envisioned that the appointed candidate would join the faculty of one of the departments: Electrical and Computer Engineering, Computer Science, or Biomedical Engineering.

Additional information on the Center for Language and Speech Processing and the Whiting School can be found at http://www.clsp.jhu.edu/ and at http://www.wse.jhu.edu/, respectively.

Candidates should submit a complete resume, including the names and addresses of at least three references, to:

CLSP Search Committee
c/o Eric D. Young Ph.D.
Johns Hopkins University
720 Rutland Ave.
Baltimore, MD 21205, USA

Applications will be accepted until the position is filled.

The Johns Hopkins University is an EEO/AA employer.

The National Academies

Division on Engineering and Physical Sciences (DEPS)
Computer Science and Telecommunications Board
Washington, DC
Board Director

DEPS, a division of The National Academies, is seeking a director for one of its most vibrant, active, and influential programs, the Computer Science and Telecommunications Board. The position of Board Director is the senior management official responsible for management and oversight of the board's portfolio of independent assessments of technical and public policy issues relating to computing and communications.

For more information, visit our employment website at national-academies.org, Ref. #030103.

The National Academies
National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council
500 Fifth Street, NW
Washington, DC 20001
EOE,M/F/D/V

North Carolina State University

Department of Computer Science
Formal Methods, Software Engineering, Programming Languages and Compilers

The Department of Computer Science at North Carolina State University seeks to fill two tenure-track faculty positions starting August 15, 2004 in the related areas of Formal Methods, Software Engineering, Programming Languages and Compilers. While the department expects to hire faculty predominantly at the Assistant Professor level, candidates with exceptional research record could be considered for senior level positions.

Candidates with strong research backgrounds in all subareas of Software Engineering, Formal Methods, Programming Languages and Compilers are invited to apply, including candidates with research experience in mostly theoretical aspects or mostly practical aspects of these areas. It is expected that the chosen candidates will add to and/or complement our current strengths in Requirements Engineering, Extreme Programming, Software Reliability, Compilers for embedded, scalar and parallel systems, Software model-checking, Concurrency Theory and Security.

Research in the Department of Computer Science at NC State is sponsored by ARO, AFOSFR, DARPA, DOE, NSF, ABB, Cisco, Ericsson, Fujitsu, IBM, MCNC, Nortel, NSA, and the State of North Carolina. The Department is in a period of rapid growth and advancement (more than half of our tenure-track faculty joined us during the last ten years) and aims to build a highly reputable and strong research program in Computer Science.

The University is located in Raleigh, which forms one vertex of the Research Triangle Park. The Research Triangle area was recently recognized as one of the best places to live in the U.S. It also boasts of a high concentration of high technology companies. In addition to the historical campus, the department occupies substantial space on NCSU's new Centennial Campus, an innovative co-location of university and industrial labs that intentionally fosters close collaboration. The State of North Carolina recently passed a major bond initiative that includes $83 million for a new engineering campus on Centennial Campus. A new 90,000 sq. ft. $36 million Computer Science/Electrical and Computer Engineering building is currently in the design stage. Interested candidates should send a cover letter, their CV and names of four references, preferably before January 15, 2004, to:

Faculty Recruitment Committee
Department of Computer Science
North Carolina State University
Raleigh, NC 27695-8206
or by e-mail to:
faculty_search@csc.ncsu.edu.

Candidates can obtain further information about the department and its research programs at the Department's homepage (http://www.csc.ncsu.edu/). Specific information about the advertised positions can be obtained via email (faculty_search@ncsu.edu).

NC State University is an Equal Opportunity and Affirmative Action employer. In addition, NC State welcomes all persons without regard to sexual orientation. Individuals with disabilities desiring accommodations in the application

Professional Opportunities

process should contact the Computer Science Department at NCSU at (919) 515-2858.

The Ohio State University

The Department of Computer and Information Science at The Ohio State University seeks nominations and applications for the position of Department Chair. Applicants should have an established research reputation in Computer Science and Engineering or a closely related discipline, and possess strong leadership skills and research vision.

The Department of Computer and Information Science has a very active research program, with a strong emphasis on multi-disciplinary research. The department maintains and encourages active collaborations with the Ohio Supercomputer Center, Advanced Computing Center for the Arts and Design, Center for Cognitive Science, Department of Electrical Engineering, Department of Biomedical Informatics, and many other units in the university. We are also recruiting to fill several open positions, including two senior chaired professor appointments.

Applicants are requested to send a curriculum vitae, preferably by e-mail to:

Chair-fsearch@cis.ohio-state.edu
or by mail to:
Chair Search Committee
Department of Computer and Information Science
The Ohio State University
2015 Neil Avenue, DL395
Columbus, OH 43210-1277

Review of applications will begin immediately and will continue until the position is filled.

The Ohio State University is an Equal Opportunity/Affirmative Action Employer. Applicants from under-represented groups are especially sought.

Purdue University

Electrical and Computer Engineering

Asst. Prof., Assoc. Prof., Prof.

The School of Electrical and Computer Engineering at Purdue University invites applications for faculty positions across the breadth of computer science and engineering at all levels. The Computer Engineering Area of the school (engineering.purdue.edu/ECE/Research/Areas/CompEngr) has eighteen faculty members who have active research programs in areas including: AI, architecture, CAI, compilers, distributed systems, graphics, haptics, HCI, machine learning, machine vision, multimedia systems, networking, NLP, OS, security, software engineering, and speech processing. We will consider outstanding applicants in these and other areas. Minimal qualifications include a PhD in computer science/engineering or a related field and a significant demonstrated research record commensurate with the level of position applied for.

Applications should consist of a cover letter, a cv, a research statement, names and email addresses of five references, and URLs of three to five papers. Applications, in the form of a single attached PDF file, and inquiries can be sent to compengr@ecn.purdue.edu. Candidates should also arrange for five reference letters to be sent directly to the above email address. Applications will be considered as they are received. For full consideration, applications should arrive by 1 January 2004.

Purdue University is an equal access, equal opportunity, affirmative action employer.

University of Alabama at Birmingham (UAB)

Department of Computer and Information Sciences

Assistant Professor Position
http://www.cis.uab.edu/

The University of Alabama Birmingham (UAB) Department of Computer and Information Sciences is seeking highly qualified candidates for a tenure track position in the area of Grid and distributed scientific computing, at the Assistant Professor level, beginning as early as Fall 2003. Highly qualified candidates with a PhD in Computer Science, Computational Science, Computational Engineering, or a closely related field are encouraged to apply. A strong research background, including advanced knowledge and demonstrated research results in grid computing, scientific and parallel computing, and scalable applications are required. Deep knowledge of both distributed computing (e.g., grid, OGSA, and multi-tier architectures) as well as scientific computing (e.g., computational methods, parallel numerical techniques, scalability, and parallelization) are musts.

Proof of publication and potential for research funding are important. Commitment to excellence in teaching and service, in addition to research, are also highly valued in prospective hires. Interest in multidisciplinary collaboration is also very important.

The UAB Department of Computer and Information Sciences is enhancing its research capabilities in high performance computing, scientific computing, grid and distributed computing, with interest in strong collaborative ties with the biotechnology and medical research programs of the UAB campus.

Send four references, a complete CV, a one-page research plan, and a one-page teaching plan via email to facapp@cis.uab.edu or via regular mail to:

Warren T. Jones, Chair
Department of Computer and Information Sciences
115A Campbell Hall
1300 University Blvd.
Birmingham, AL 35294-1170

Interviewing for the position will begin as soon as qualified candidates are identified, and will continue until the position is filled.

The University of Alabama at Birmingham is an equal opportunity/affirmative action employer.

University of Illinois At Urbana-Champaign

Department of Computer Science

http://www.cs.uiuc.edu

The Department of Computer Science, UIUC, invites applications for full-time, tenure-track, and tenured professors. All areas of computer science research will be considered, including, in particular, bioinformatics, HCI, NLP, operating systems, security and theory.

Tenure-track applicants must have demonstrated excellence in research; tenured applicants must have recognized national and international stature.

Computer Science at Illinois is internationally recognized for its breadth and depth of research and has strong collaborative relations with many other departments on campus and the Beckman Institute for Advanced Science. The department is targeted to grow aggressively to over 60 faculty and will occupy the new Thomas M. Siebel Center for Computer Science in Fall 2003, becoming the anchor of a new IT quadrangle on the UI campus.

Successful candidates must initiate and conduct independent research and perform academic duties associated with our BS, MS, and PhD programs. Qualifications: PhD in Computer Science or a closely related field (or imminent completion of degree), outstanding academic credentials, and the ability to teach effectively at both the graduate and undergraduate levels. Starting date: August 16, 2004 or January 1, 2005. The salary is open, based on qualifications.

To ensure full consideration, applications must be received by January 9, 2004. Early applications are strongly encouraged. Interviews may take place during the application period, but a final decision will not be made until ad closing.

Applicants should submit an application letter, curriculum vitae and statement of career objectives (PDF preferred) to http://www.cs.uiuc.edu/apply.html. Request at least three letters of recommendation to be sent separately to lmelchi@cs.uiuc.edu. If you or your recommenders do not have Internet access, please contact Lori Melchi at lmelchi@cs.uiuc.edu.

The University of Illinois is an Affirmative Action, Equal Opportunity Employer.

University of Kentucky

Department of Computer Science

The Department of Computer Science invites applications for a tenure-track position to begin in January 2004. The new faculty member will play an important role in the new Visualization and Vision Science Facility, a research unit with over 9,000 sq. ft., and over 5M in funding from state and federal agencies. The goal of the Facility is to advance state-of-the-art visualization technologies through basic and applied research programs. To that end, we are particularly interested in candidates with specialization in computer vision, computer graphics, distributed multimedia, scientific computation, or human computer interaction. Applicants with credentials in other fields that will support the goals of the Facility will also be considered.

The Department of Computer Science offers BS, MS, and PhD degrees. Our faculty are actively involved in research in artificial intelligence, computer vision, networking, cryptography, numerical analysis, operating systems and theory. The Department is funded by a number of external grants including DARPA projects, several NSF ITR awards, and an NSF Research Infrastructure award.

The Department is experiencing a period of dynamic growth, particularly in the areas of multimedia, computer networking, and distributed systems. In the previous five years, the Department has hired six new faculty members, three of which are NSF CAREER awardees. New members of the computer science faculty will have access to significant new laboratory space, generous start-up research funds, and will actively participate in the research activities of the Visualization and Vision Science Facility. A new building for the Department and the Facility is in the planning stage.

The University of Kentucky is an equal opportunity employer and especially encourages applications from women and minority candidates.

Completed applications consisting of a curriculum vitae, statements of teaching and research interests, and the names of at least three references should be submitted to:

Chair, CS Search Committee
c/o Ms. Diane Mier
773 Anderson Hall
University of Kentucky
Lexington, KY 40506

Application review will begin on September 1, 2003 and continue until the position is filled.

University of Kentucky

Department of Computer Science
Visualization and Vision Science Facility

Assistant Research Professor of Computer Science

The Department of Computer Science anticipates an opening for an Assistant Research Professor of Computer Science to participate in the research programs of the new Visualization and Vision Science Facility.

This is a non-tenure-track position. Minimum qualifications include a doctorate in computer science or a related discipline and research experience with a focus in the area of visualization. The person appointed will be expected to provide coordination for visualization research projects as assigned by the Director of the Visualization and Vision Science Facility, to direct student researchers involved in the projects, to actively participate in publication and presentation of research results, and to participate in development of proposals for new projects. Continuation of employment is contingent upon satisfactory performance and on the availability of external funding. Existing external funding will support this position for two years.

To apply, please send a letter of application, a curriculum vitae, and at least three letters of reference to:

Dr. Mirek Truszczynski
University of Kentucky
Computer Science Department
773 Anderson Hall
University of Kentucky
Lexington, KY 40506-0046

University of Kentucky

Department of Computer Science
Visualization and Vision Science Facility

Assistant Research Professor of Computer Science

The Department of Computer Science anticipates an opening for an Assistant Research Professor of Computer Science to participate in the medical application research programs of the new Visualization and Vision Science Facility.

This is a non-tenure-track position. Minimum qualifications include a doctorate in computer science or a related discipline and research experience with a focus in the area of visualization. Research experience with medical applications is highly desirable. The person appointed will be expected to provide coordination of research projects as assigned by the faculty member leading the medical applications research, to manage student researchers involved in the projects, to actively participate in publication and presentation of research results, and to participate in development of proposals for new projects. Continuation of employment is contingent upon satisfactory performance and on the availability of external funding. Existing external funding will support this position for two years.

To apply, please send a letter of application, a curriculum vitae, and at least three letters of reference to:

University of Kentucky
Computer Science Department
c/o Ms. Diane Mier
773 Anderson Hall
Lexington, KY 40506-0046

University of Massachusetts, Amherst

Computer Science Department

Robotics Lab Manager

The Laboratory for Perceptual Robotics investigates planning and control methodologies for complex, multi-objective robotic systems, geometric reasoning for automated assembly planning and robot learning. Research platforms include integrated hand/arm systems, mobile robots, legged systems, and articulated stereo heads.

Senior Robotics Lab Manager 2: M.S. degree in Engineering, Computer Science, or Physical Science or related field, or a B.S. plus equivalent combination of education, training, and experience, and 5-7 years of applicable experience, including analog/video/digital electronics; electronic equipment testing; experience in project management and planning; strong interpersonal skills and an ability to work effectively in a team. Hiring Salary Range: $46,200-$59,400 (for exceptional candidates, consideration may be given for a salary up to $72,600). See http://www.cs.umass.edu/csinfo/join_fac_staff/joinstaff.html for details.

Please send a resume with cover letter and three letters of recommendation to:

Search #R17427
Claire Christopherson
Computer Science Building, Room 100
University of Massachusetts
Amherst, MA 01003-9264

Comprehensive benefits package included.

The University of Massachusetts is an Affirmative Action/Equal Opportunity Employer. Women and members of minority groups are encouraged to apply.

University of Nebraska

Lincoln Endowed Chaired Professorship in Software Engineering

Software engineering is a thrust area of the Computer Science and Engineering (CSE) Department at the University of Nebraska-Lincoln (UNL). We are embarking on dynamic growth and seek applications for an Endowed Chaired Professorship in software engineering. We are committed to the development of a top-tier program in software engineering.

UNL is a comprehensive research university with Carnegie I standing and membership in the elite Association of American Universities. The CSE Department offers BS, MS, and PhD degree programs in computer science, computer engineering, and software engineering. Lincoln, the capital of Nebraska, is a prosperous community of over 250K people and ranks high in quality-of-life.

For complete position advertisements, visit http://cse.unl.edu/search, email search@cse.unl.edu, or phone (402) 472-2401.

University of North Texas

Computer Science and Engineering

Lecturer/Advisor

The job consists of both advising BS in Computer Engineering students and teaching 2 undergraduate level courses per semester either in Computer Science or in Computer Engineering. Advising responsibilities include advising students, participating in departmental orientations for new and prospective students, participate in curricular development, maintain student records, certify graduating students to assure that they have met all degree requirements, and help the department in preparing for accreditation.

Qualifications: A MS in Computer Science, Computer Engineering or related field is required. A PhD is desirable. Candidates with some teaching and/or advising experience will be given preference. Patience in dealing with undergraduate students and good interpersonal skills to resolve problems faced by students are essential for the job.

The position is renewed year by year as needed and based on availability of funds. This is not a tenure earning position.

Salary Range. $40K - $45K for 9 months. Additional salary may be earned during summer by teaching courses, based on need and availability of funds.

Submit a CV and have 3 letters of recommendations sent directly to:

Sally Pettyjohn
Department of Computer Science and Engineering
PO Box 311366
225 Avenue B, Suite GAB 320
The University of North Texas
Denton, TX 76203
or electronically to pettyjoh@unt.edu

UNT is an AA/ADA/EOE.

University of Virginia

Department of Computer Science

The University of Virginia's Department of Computer Science invites applications for a senior, tenured faculty position. Truly outstanding candidates at the Full Professor Level in software and experimental areas of Computer Science will be considered. Candidates should have achieved international recognition as a key intellectual leader in their discipline. The candidate should also excel in teaching. Position is open until filled.

Send a resume and the names of three references to:

Professor Jack Stankovic, Chair
Department of Computer Science
151 Engineer's Way
P.O. Box 400740
University of Virginia
Charlottesville, VA 22904

The University of Virginia is an Equal Opportunity/Affirmative Action Employer.