COMPUTING RESEARCH NEWS

CRA Information Technology Worker Study Released

By Peter Freeman and William Aspray

As announced in the November 1998 issue of *Computing Research News*, CRA has undertaken a study to improve the understanding of the supply of and demand for information technology (IT) workers in the United States, as well as the surrounding contextual issues. The report, "The Supply of Information Technology Workers in the United States," was written by Peter Freeman and William Aspray on behalf of the Intersociety Study Group on Information Technology Workers, with financial support from the National Science Foundation. An intensive eight-month effort led to a completed report in April. Individual copies of the report are available upon request from CRA. You can also download a copy from www.cra.org.

There are four *major contributions* in this study:

1. *Evaluation of data.* The report identifies and evaluates all the major sources of statistical information relevant to this subject. The study group found that federal data are by far the most important and reliable, but that they have some serious shortcomings related to untimely reporting, occupational descriptions that are out of date and based on ambiguous job titles, and incompatibilities between supply and demand data collected by different agencies.
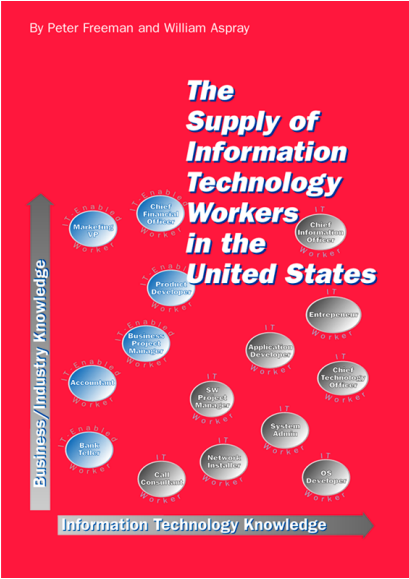
There are other data sources. However, it is questionable whether data from geographically restricted studies can be generalized to the national level; and many of the national studies done by private organizations have methodological weaknesses.

2. *Definition of 'IT Worker.'* This report outlines a way of distinguishing IT workers from a much larger class of workers whose jobs are enabled by information technology. One of the problems with the national debate is that IT workers have been treated as a single, undifferentiated mass. However, the phrase "information technology worker" encompasses many different occupations that require a wide array of skills and knowledge. It would be helpful in future discussions to segment the class of IT workers into classes of occupations that have similar levels of knowledge and skill.

3. *Description of the Supply System.* A detailed description of the supply system is presented, which includes not only majors in twenty different IT-related disciplines at the associate, bachelor's, master's, and doctoral levels, but also many people majoring in science, engineering, business, and even non-technical disciplines who often take some course work in IT subjects. The supply system also includes an increasingly important and rapidly growing continuing education element.

4. *Analysis of shortage claims.* The report evaluates the question of whether there is a shortage of IT workers in the United States. The study group determined that the data are inadequate to ascertain what mismatch there is, if any, between national supply and demand. Therefore the report makes use of a variety of other quantitative and qualitative kinds of evidence. These include: secondary indicators such as wage growth and labor certificates awarded, based on federal data; quantitative studies specific to geography and private studies on the national level as mentioned previously; anecdotal evidence about how employers have acted in their search to recruit or retain workers, or take alternative solutions such as refusing work or replacing workers by machines; and other kinds of qualitative evidence.

The preponderance of evidence suggests that there is a shortage of IT workers, or at least a tight labor market. None of this evidence has the certainty of a direct count of supply and demand, and without this kind of direct count it is impossible to distinguish an actual shortage from a mere tightness in the labor market.

IT² Tops Federal R&D Priorities for 2000

By Lisa Thompson

Since the March 1999 issue of *CRN*, further analysis of the FY 2000 R&D budget request reveals additional agency details about the IT² initiative, as well as its place in the overall budget.

The FY 2000 budget request for R&D, including facilities and equipment, totals $78.2 billion, about 1 percent below estimated R&D spending in FY 1999. Eliminating defense-sector development — which is projected to decrease by 6 percent — from the equation, aggregate spending on the remaining components would increase by 2 percent. Looking only at basic research, civilian basic research would increase by 4 percent, to more than $17 billion, while defense basic research is projected to decrease by 1 percent.

The Administration notes the following highlights in its R&D budget:

◆ *Information Technology for the Twenty First Century (IT²)*: The budget provides a total of $1.8 billion, a 28 percent increase, for IT² and High Performance Computing and Communications. IT² is a new initiative, funded at $366 million in FY 2000, to keep America at the cutting-edge of the Information Revolution by increasing support for fundamental, long-term research, advanced applications, and research on the economic and social implications of information technology.

◆ *Strong Support for Basic Research*: A 7 percent increase in the National Science Foundation research budget, a 5 percent increase in the Department of Energy's science budget, and a 4 percent increase for NASA's space science research.

◆ *Research and Experimentation Tax Credit*: The budget proposes extending this credit for one year through June 30, 2000, at a cost of $2.4 billion over five years.

Most of the other emphases in the R&D budget are programs continuing from previous years, meaning that IT² is the only major new initiative for FY 2000.

Following are descriptions of the FY 2000 budget requests of the key agencies involved in computing research, including their overall budget numbers and their planned computing activities, with emphasis on their roles in IT².

National Science Foundation (NSF):

The National Science Foundation budget request for FY 2000 is

According to the NSF budget documents, the IT² activities "build upon NSF's previous substantial investments within the Computer and Information Science and Engineering activity, as well as investments under its theme of Knowledge and Distributed Intelligence and other information technology-related projects, which amount to almost $700 million in FY 1999."

Expanding the Pipeline

The Coalition to Diversify Computing

By Andrew Bernat and Sandra Johnson Baylor, Co-Chairs

The continuing low percentage of minorities in computer science and engineering at all stages of the educational pipeline is an untenable situation. CRA has joined with the Association for Computing Machinery, IEEE Computer Society and ADMI (the Association of Computer Science and Engineering Departments at Minority Institutions) to create the Coalition to Diversify Computing (CDC) to develop programs to directly increase this too-low percentage. CDC has as its charge to take positive action to increase the numbers of minority computing students and professionals at all levels. It is particularly noteworthy that all of the major computing organizations are working together to solve a pervasive and persistent societal problem.

How Bad is the Underrepresentation of Minorities?

According to the most recent CRA Taulbee Survey, 1 percent of graduating Ph.D.s in Computer Science and Engineering in the last year were African-American, 3 percent were Hispanic, and 0.5 percent were Native American. These figures have remained static since CRA started compiling minority graduation figures. At the same time, the percentage of minorities in the general population is growing –– in Texas, for example, the average high school senior class is now more than 50 percent minority.

Why should these figures and this situation matter to you?

Consider the wealth of ideas that students of varying cultures and backgrounds could have generated to further your research or to develop new products. Consider that there are far fewer faculty, staff, or students to choose from when you have open positions. And consider the tremendous impact on our society if significant portions of the population are left out in this technology-driven economy –– the development of a permanent economic underclass?

Solving the underrepresentation problem is not possible without concerted efforts by many stakeholders throughout our society –– to think that CDC can do it alone is foolish. But it is equally foolish to use the enormous scale of the problem to countenance inaction.

In this article, we present an overview of CDC's activities. Initial funding for these activities has been provided by EOT-PACI, which is a joint national educational program led by the National Computational Science Alliance (Alliance) and the National Partnership for Advanced Computational Infrastructure (NPACI). We particularly solicit additional participation and ideas; please feel free to contact either of the co-chairs or project lead members. Further details may be found on the CDC webpage: www.npaci.edu/Outreach/CDC.

Global Activities

◆ Develop a CDC website to serve as a repository of information on programs of value to minority researchers. It will also serve as a focal point for CDC activities, and allow the sharing of relevant ideas and resources.
Lead member: Charles Isbell

◆ Host a "Workshop on Best Practices in Minority Student Recruiting and Retention" in computing research careers. Bring together individuals who have demonstrated successful programs and distill what is known to work in a form that is accessible and valuable to the entire community.
Lead member: Andrew Bernat

◆ Conduct a study of why minorities are not going into research careers and/or academia. Is it as simple as the fact that the money in industry is so much better? For example, according to the Taulbee Survey there were forty-one new African-American Ph.D.s in CS between 1991 and 1996, but only one went into academia. As well, conduct a study of tenure decisions for those minorities who did go into academic CS/CE positions.
Lead member: Bryant York

Activities for High School Students

Similar to the successful CRA-W "Women in Computer Science" brochure, the CDC "Faces of Computer Science" brochure will feature the successes of from twelve to twenty minority scientists who have insightful, interesting personal histories –– histories that serve to inspire high school students as they are considering their future careers. This brochure will be available in print and on the Web, and widely advertised and distributed.
Lead member: Jesse Bemley

Activities for Undergraduate Students

Develop materials for encouraging minority students to continue with graduate education and assemble a team of four to five members to visit schools with large populations of Native Americans, Hispanics, and African-Americans.
Lead members: Forbes Lewis and Ramon Vasquez Espinoza

Activities for Undergraduate and Graduate Students

Provide regular support for minority students and faculty to participate in the annual ADMI and biennial CRA Conference at Snowbird. The participants will be selected based on their achievements, and will be encouraged to take full advantage of the conferences, including making contacts, learning about research and funding opportunities, and possibly presenting the results of their work.
Lead member: Ramon Vasquez Espinoza

Activities for Graduate Students and Faculty

◆ Develop a database of minority graduate students and faculty to be used as a resource for the dissemination of information about CDC activities and NPACI and Alliance programs and activities. The database will serve as an excellent resource to increase the participation of minorities in the various NPACI and Alliance Programs.

◆ Develop a database of contacts who have an interest in helping minorities pursue careers in computing, in addition to information on minorities themselves. This will help build an information infrastructure to be used by CDC to initiate projects, inform people about CDC activities, and build a network of individuals with common goals. The database will be incorporated into the CDC Website, and will help those supportive of CDC's goals to stay informed.
Lead member: Valerie Taylor

   Important websites:
   CDC: www.npaci.edu/Outreach/CDC
   EOT-PACI: www.eot.org
   Alliance: www.ncsa.edu
   NPACI: www.npaci.edu
   For further information, feel free to contact Sandra Johnson Baylor, E-mail: sandrajb@us.ibm.com, IBM T.J. Watson Research Center and Andrew Bernat, E-mail: abernat@cs.utep.edu, University of Texas at El Paso ∎

Association Corner: (Be sure to check out our website www.cra.org for more CRA information)

CRA extends congratulations and best wishes to NEC Research Institute on its 10th Anniversary

Membership packets are in the mail for U.S. academic departments for the 1999-2000 membership year

CRA has a new look!

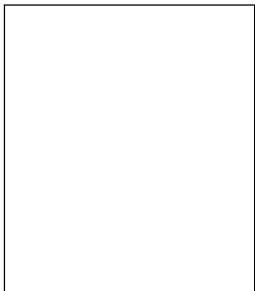• CRA •

Community Highlights

Service Award Winners

CRA presents two awards, usually annually, to individuals for outstanding service to the computing research community. The first, the Distinguished Service Award, recognizes service in the areas of government affairs, professional societies, publications, or conferences, and leadership that has a major impact on computing research.

The second award honors the late A. Nico Habermann, who headed NSF's Computer and Information Science and Engineering Directorate until his death. Dr. Habermann was deeply committed to increasing the participation of women and underrepresented minorities in computing research. This award is given to an individual who has played a leadership role in aiding members of underrepresented groups within the computing research community. It recognizes work in areas of government affairs, educational programs, professional societies, and public awareness.

CRA Distinguished Service Award

Bill Joy, Sun Microsystems, Inc., and Ken Kennedy, Rice University, have been selected as co-recipients of the 1999 CRA Distinguished Service Award for their vision of computing in the new millennium and

Bill Joy

for mapping out the government's role in fulfilling that vision. Joy and Kennedy chaired the President's Information Technology Advisory Committee (PITAC). They led PITAC through a series of public meetings in which they studied numerous issues, including: high-end computing, scalable infrastructure,

software, funding modes, research management, and socioeconomic and workforce issues.

PITAC's final report, issued on February 24, 1999, concluded that information technology will be one of the key factors driving progress in the 21st century, and that a vigorous information technology research and development effort is essential for achieving America's aspirations for the new century. At the same time, federal support for research in information technology is seriously inadequate. To address this problem, the report recommended that the federal government increase its support for information technology research by $1.37 billion by FY 2004.

The administration has already responded to the report by proposing a dramatic $366 million increase in next year's computing research budget. The computing research community owes an enormous debt to Bill Joy and Ken Kennedy for making a compelling case regarding the crucial importance of information technology research to the future of this country.
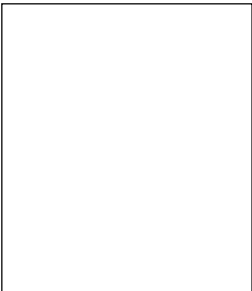
Bill Joy, Chief Scientist at Sun Microsystems Inc., co-founded the company in 1982. At the University of California, Berkeley 1975-1982, he was the principal designer of Berkeley UNIX, for which he received a Grace Murray Hopper Award from the Association for Computing Machinery. In 1993, the USENIX Association awarded him its Lifetime Achievement Award for his service to the UNIX community. Bill Joy is also a Member of the National Academy of Engineering.

Bill Joy is the inventor/co-inventor of many of Sun's technologies (including Sun's Network File System, Sparc Microprocessor Architecture, Java, and Jini technologies) and business strategies (open systems, "The Network is the Computer," Java licensing strategy, and Community Source licensing (for Jini).

Bill Joy's current research involves new uses of distributed

computing enabled by using Java and Jini, new methods of human-computer interaction, new microprocessor and system architectures, and the uses in computing of scientific advances in areas such as complex adaptive systems, quantum computing, and the cognitive sciences.

Ken Kennedy is the Ann and John Doerr Professor in Computational Engineering at Rice University. He founded the Department of Computer Science at Rice in 1984 and served as Chair until 1988. Throughout his career, he has conducted

Ken Kennedy

research on the optimization of code compiled from high-level languages, especially Fortran. He has been an active researcher on vectorization and parallelization. Kennedy was one of the proposers of the Center for Research on Parallel Computation, which he has directed since its inception in 1989.
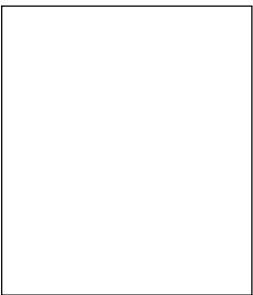
Professor Kennedy has chaired and served as a member of a number of National Research Council/National Academy of Engineering bodies. He has also been appointed to advisory committees for the White House, Congress, the National Science Foundation, and DARPA. He has taken a leadership role in conferences and workshops, and serves on several editorial boards.

Ken Kennedy is a member of the National Academy of Engineering, and a Fellow of the American Association for the Advancement of Science, the Institute of Electrical and Electronics Engineers, and the Association for Computing Machinery.

CRA A. Nico Habermann Award

Sheila Humphreys has been selected to receive the 1999 A. Nico Habermann Award. Dr. Humphreys is currently the Academic Coordinator

for Student Matters, Department of Electrical Engineering and Computer Sciences at UC Berkeley. For the past twenty years, she has worked as a mentor and advocate for students from underrepresented groups in computer science and

Sheila Humphreys

engineering at the University of California, Berkeley.

Sheila Humphreys founded and subsequently coordinated the Berkeley Computer Science Reentry Program in 1983, which became a model for programs to prepare women with non-traditional backgrounds for graduate study in Computer Science. In 1985, she initiated and organized the Excellence and Diversity Program in the Berkeley ECE Department to recruit and mentor graduate students, with an emphasis on underrepresented groups. Since 1990 she has worked with ECE graduate students to initiate and direct the Summer Undergraduate Program in Engineering Research (SUPERB) at Berkeley, an undergraduate research and mentoring program targeting underrepresented students which has been used as a model by other departments.

Sheila Humphreys is currently initiating a local science fair and an Internet-based information system to help local high school students prepare for admission to UC Berkeley under new Proposition 209 guidelines.

CRA's overall Awards Committee is chaired by Dan Reed (University of Illinois, Urbana-Champaign). He also chairs the Distinguished Service Award committee with members Fran Berman (University of California, San Diego) and Richard Muntz (University of California, Los Angeles). Corky Cartwright (Rice University) is chair of the Habermann Award Committee, with members Richard Tapia (Rice University) and Valerie Taylor (Northwestern University). ∎

Computing Leadership Summit

CRA convened its fourth annual Computing Leadership Summit in Washington, DC, on March 10. The presidents, executive directors, and other senior leadership of CRA and its five affiliate societies — AAAI, ACM, IEEE-CS, SIAM, and USENIX — gathered to discuss issues of common concern. The primary focus of this year's event was the proposed Information Technology for the 21st Century Initiative (IT2), which would increase support for computing and communications research by $366 million (see article, page 1).

Three of the principals involved in coordinating the multiagency

initiative spoke with the group about their agencies' plans: David Tennenhouse, Director of the Information Technology Office at DARPA; Ruzena Bajcsy, Assistant Director for the Computer and Information Sciences and Engineering Directorate at the National Science Foundation; and Martha Krebs, Director of the Office of Science at the Department of Energy.

Tennenhouse described ITO's plans to emphasize research on automated systems, embedded systems, and deeply networked

Federal Funding Agencies

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Information Technology

NRC Report Introduces Fluency with Information Technology

By Larry Snyder

In response to a request from the National Science Foundation, the National Research Council's Committee on Information Technology Literacy undertook a study addressing "What Everyone Should Know About Information Technology." The committee's final report, *Being Fluent with Information Technology*, asserts that the knowledge and understanding of information technology (IT) needed by citizens in the Information Age must go well beyond the content of traditional computer literacy instruction.

Fluency, A Higher Standard

Standard computer literacy course content tends to be largely "skills based," though there are exceptions. The focus in such courses is on instruction in the use of a basic set of contemporary computer applications, such as e-mail, web browsing, word processing, and so forth. Though such knowledge is valuable -- enabling students to use IT immediately -- the skills learned do not have the "staying power"

necessary to accommodate the rapid change characteristic of the field. For example, web browsing was not a skill included in computer literacy courses as recently as five years ago, though it is a basic requirement today for effective computer use.

In the presence of rapid change, the best educational strategy is to prepare students to be life-long learners. For that goal, students will require a more fundamental understanding of information technology in addition to the ability to use contemporary IT tools.

The report identifies three kinds of knowledge -- skills, concepts, and capabilities -- as appropriate for preparing students to be life-long learners:

Contemporary skills refer to proficiency with standard IT applications. Imparting knowledge of skills approximates traditional literacy instruction. The appropriate "working set" will change over time.

Foundational concepts are basic ideas underpinning the technology, such as digital representation of information, which might be found

in a typical computer science curriculum. Concepts enable people to understand the "how," "why," and limitations of current IT. They are also the basis of future self-education about IT.

Intellectual capabilities are higher-level thinking abilities, such as logical reasoning or managing complexity, that are essential to effective use of IT. Capabilities are frequently learned through "life experience" and are applicable to other aspects of life. But, the capabilities are so essential to the effective use of IT that they must be explicitly included in the content required for IT proficiency.

These three coequal forms of knowledge serve different roles in IT preparation. Skills support job-readiness and provide the basis for understanding the other content. Concepts explain phenomena. Capabilities support the thoughtful and confident application of IT in personally relevant settings.

This tripartite approach to literacy instruction benefited from a suggestion by Yasmin Kafai, Assistant Professor of Education and

Information studies at the University of California, Los Angeles. She observed that literacy connotes a rudimentary understanding of a topic. Fluency, however, connotes a higher level of understanding, implying the ability to transform one's knowledge, to express oneself effectively, and to control the medium. Embracing this point of view, the committee adopted the phrase "Fluency with Information Technology" as the goal for its tripartite proposal. FIT is the acronym for "fluent with information technology," and FITness is the state of being FIT.

The Top Ten

In formulating the specific skills, concepts, and capabilities that make a person FIT, it is tempting to include 'everything,' resulting in a recommended body of knowledge, which few if any could possibly know. This is especially easy in a committee situation. To avoid this possibility the committee limited itself to the ten items in each of the

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There are also a number of *contextual issues* revealed in the report that need to be considered in order to gain a full understanding of the supply of and demand for IT workers.

5.   *Political context.* The study group evaluated the reports by the Information Technology Association of America (ITAA) and the Department of Commerce, as well as the criticism of these reports by the U.S. General Accounting Office (GAO). We agree with GAO that the low response rates are a serious weakness in the ITAA and Commerce reports, but this speaks against the quality of the evidence, not necessarily against the conclusion that there is a shortage. The ITAA and Commerce reports can also be faulted for their narrow focus on recipients of computer science bachelor's degrees when discussing the supply of IT workers.

The legislation providing a temporary increase in the number of temporary visas permitted annually under the H-1B visa program was also reviewed. CRA and the other professional societies participating in this study did not take a position on the H-1B increase when it was being debated in 1998, and it is not our intention to second-guess the program now.

6.   *Types of demand.* This report differentiates two kinds of demand. There is *episodic demand*, such as this country is experiencing currently as it struggles with the Y2K problem. There is also *long-term demand*, created by fundamental changes in technology and society.

7.   *Limitations on action.* Even when organizations recognize a

mismatch between supply and demand that they would like to overcome, there are sometimes limitations on their ability to act.

A government organization cannot regulate supply and demand; it can only provide incentives, such as fellowships, to encourage students to study for an area of expertise that appears to be in short supply. But it is difficult for a government to stimulate labor supply by just the right amount since the market is constantly changing, knowledge about supply and demand is imperfect and difficult to obtain in a timely fashion, and there are often unforeseen consequences of any government action.

Industry has its own constraints. Companies are forced by short product life and short product development cycles to hire new employees or reassign existing workers in ways that do not require a lot of break-in training before they can be productive.

The traditional higher education system is constrained by its inability to change directions quickly. This results from its limited ability to allocate resources to new or growing disciplines toward a long-term commitment.

8.   *International considerations.* There is a rising international demand for information technology. There is increasing global competition to supply IT products. The United States will have to assure an adequate supply of IT workers if it wants either to retain its world lead in the IT sector, or remain competitive in other industry sectors that rely on information technology.

Other topics. There are several topics that are important to understand

adequately the IT workforce issues, but which we could only touch on in this study. A number of groups are underrepresented in the IT workforce and in the educational programs that prepare people for careers as IT workers. These groups include women, Hispanics, African-Americans, and Native Americans. If these groups were represented in the IT workforce in proportion to their representation in the U.S. population, this country would have more than an adequate supply of workers to fill even the most dire estimates of shortage. This study group chose to focus its efforts on other issues that have been less thoroughly investigated. However, some basic information and statistics have been collected here about the issues concerning the participation of women and minorities in the IT field.

It may also be true that older workers are underrepresented in the IT workforce. There is certainly a widespread perception that programming is an activity for the young, and that IT workers tend to get "burned out" and leave the field by the age of 40. The absence of almost any data precluded this from being a major topic of study in this report. The study group looks forward to the examination of this important issue in a forthcoming study by the National Research Council.

Some people are concerned about a seed-corn problem: that the high industrial demand for IT workers is siphoning off too many graduate students and faculty from the universities, leaving an insufficient number to educate the next generation of IT workers. This study detected preliminary signs of a seed-corn problem. The coordinated efforts by government, industry, and academia to solve

a seed-corn problem in computer science that occurred around 1980 are recounted in the report.

The authors struggled with the decision whether to include *recommendations* in the report. The mandate for this study was to provide an understanding of the issues surrounding the supply of and demand for IT workers, not to provide a call for action. In most policy reports the recommendations have primacy and the analysis is included merely in a supporting capacity. The study group did not want the presence of recommendations to undermine the attention paid to the analysis. Also, as a study group, we do not have any particular standing within the government, industrial, or academic sectors from which to recommend actions.

On the other hand, a number of important issues were raised and actions suggested by the study group during the course of the study. Given the wide range of knowledge and experience represented by the study group, we decided it would be useful to put these suggestions forward in the hope that they will stimulate further discussion and action. Mostly, the recommendations identify a problem and a general course of action without trying to be specific about implementation mechanisms. The thirty-seven recommendations are grouped around a small number of issues: data-collection practices, industry-academic cooperation, industry hiring and training practices, certification of educational and training programs, broadening the supply pipeline, improving the research and teaching environment to retain and recruit faculty, and curriculum development. ∎

Community News

NAE Elects New Members

The National Academy of Engineering (NAE) has again elected members of the computer science and engineering community to the Academy. This is an honor reserved for those who make "important contributions to engineering theory and practice, including significant contributions to the literature of engineering theory and practice," and those who have demonstrated "unusual accomplishment in the pioneering of new and developing fields of technology."

This year there was a total of eighty engineers and eight foreign associates elected to membership. The announcement was made by William Wulf, president of NAE. There is currently a total U.S. membership of 1,984 and the number of foreign associates is now 154.

This year's newest members from the CS&CE Communities:

Alfred V. Aho, associate research vice president, communications science research division, Bell Laboratories, Lucent Technologies, Holmdel, N.J. For contributions to the fields of algorithms and programming tools.

Robert W. Bower, professor, department of electrical and computer engineering, University of California, Davis. For inventing the self-aligned, gate ion-implanted MOSFET and for establishing ion implantation to fabricate semiconductor integrated circuits.

Wesley A. Clark, principal, Clark, Rockoff, and Associates, Brooklyn, N.Y. For the design of early computers.

James W. Demmel, professor, computer science division, University of California, Berkeley. For contributions to numerical linear algebra and scientific computing.

Louis V. Gerstner Jr., chairman and chief executive officer, IBM Corp., Armonk, N.Y. For technical leadership in enhancing the competitiveness of U.S. industry.

Bruce Hajek, professor, department of electrical and computer engineering, University of Illinois, Urbana-Champaign. For contributions to stochastic systems, communication networks, and control.

Patrick M. Hanrahan, professor of computer science and electrical engineering, Stanford University, Stanford, Calif. For contributions to computer graphics and to the practice of rendering complex scenes.

Aravind K. Joshi, Henry Salvatori Professor of Computer and Cognitive Science, University of Pennsylvania, Philadelphia. For contributions to natural language processing.

William N. Joy, founder and chief scientist, Sun Microsystems, Aspen, Colo. For contributions to operating systems and networking software.

Richard J. Lipton, professor, department of computer science, Princeton University, Princeton, N.J. For application of computer science theory to practice.

Nicky C. Lu, founder and president, Etron Technology Inc., Hsinchu, Taiwan. For contributions to high-speed dynamic memory chip design and cell array technology, and sustained technical leadership in the VSLI/memory industry.

Donald W. Peaceman, consultant, Houston. For contributions to the development and usage of transient three-dimensional multiphase simulators for predicting performance of petroleum reservoirs.

Patricia G. Selinger, IBM fellow and director, database integration, IBM Almaden Corp., San Jose, Calif. For leadership and contributions to relational database technology.

Martin Grötschel, vice president, Konrad-Zuse-Zentrum, Berlin. For contributions to combinatorial optimization and its applications.

Amir Pnueli, professor of computer science, Weizmann Institute of Science, Rehovot, Israel. For the invention of temporal logic and other tools for designing and verifying software and systems. ∎

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for details and registration information.

Tax Credits for IT Training

Bills to amend the Internal Revenue Code of 1986 to allow employers a credit against income tax for information technology training expenses paid or incurred by the employer, and for other purposes were introduced simultaneously in the U.S. Senate and in the House of Representatives in late February.

H.R. 838 and S. 456 were sponsored primarily by Mr. Jerry Moran, Virginia, and Mr. Kent Conrad, North Dakota, respectfully, state:

"In the case of an employer, the information technology training program credit determined under this section is an amount equal to twenty percent of information technology training program expenses paid or incurred by the taxpayer during the taxable year"
and
"The percentage under [the above subsection] shall be increased by five percentage points for information technology training program expenses paid or incurred by the taxpayer with respect to a program operated..."

Examples of programs that would receive the additional five-percent credit include:

- ◆ empowerment zones or enterprise communities;
- ◆ school districts in which at least fifty percent of the students attending schools in such districts are eligible for free or reduced-cost lunches under the school lunch program;
  - ◆ areas designated as disaster areas;
  - ◆ rural enterprise communities; and
  - ◆ Rural Economic Area Partnership Zones.

The amount of information technology training program expenses with respect to an individual that may be taken into account for the taxable year shall not exceed $6,000.

If the legislation is to pass, the amendments made will only apply to tax credits on amounts paid or incurred after the date of enactment of the Act in the taxable year ending after such date.

The House bill has been referred to the Committee on Ways and Means and the Senate bill has been referred to the Committee on Finance. ∎

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three categories having the highest priority. There can be reasonable differences of opinion as to whether the committee's choices are the best, but it is the committee's intent that each suggested addition to the list be accompanied by a suggestion for a removal. In this way FITness will continue to be an accessible body of knowledge.

The recommendations for the three classes of knowledge are given below in keywords. The report provides a fuller explanation.

Skills:

1. Set up a personal computer
2. Understand basic operating system features
3. Use word processing
4. Use graphics, art work, or presentation tools
5. Connect a PC to an ISP
6. Locate information on the WWW
7. Communicate with others electronically
8. Use a spreadsheet
9. Organize and query a database
10. Use online tutorial information

Concepts:

1. Organization of a computer
2. Organization of information systems
3. Networks
4. Digital representation of information
5. Structuring information and searching
6. Modeling phenomena with computers
7. Algorithmic thinking and programming
8. Universality
9. Limitations to computation

10. Social implications of information

Capabilities:

1. Engage in sustained reasoning
2. Manage complexity
3. Test a solution
4. Locate bugs in a faulty use of IT
5. Organize and navigate information structures
6. Collaborate with others using technology
7. Communicate IT concepts to others
8. Expect the unexpected
9. Anticipate technological change
10. Think technologically and reason by analogy

Notice that the entries are not all of "equal size" in terms of the effort to acquire the knowledge.

A key aspect of FITness is that it is not an end state, but rather a continual process of learning and expanding one's knowledge of information technology. Accordingly, the goal of FITness instruction is to provide the foundation that enables students to continue to learn more and apply IT more effectively throughout life.

Project-based Learning

Teaching skills is well understood. Teaching the concepts is standard in computer science curricula. But FITness includes the higher-level thinking abilities of intellectual capabilities, and it requires that the three forms of knowledge be taught in a coherent, integrated way. This presents a serious pedagogical challenge.

The report recommends that FITness instruction be project-based, where a project is defined to be a

multiweek, hands-on exercise in applying IT to solve a substantial problem. The projects use the skills, provide the context for learning the capabilities, and motivate the concepts. By being a sustained effort, a project provides ample opportunities for applying sustained logical reasoning, debugging and trouble shooting, dealing with unintended consequences, and other complex capabilities. To the extent possible, the report also recommends that FITness be acquired in a discipline-specific setting. This allows projects to be discipline specific. And, the skills list can be revised to better serve a given specialty. For example, CAD tools might be added to the skill set for architects.

An example of a FITness-grade project mentioned in the report is an HIV tracking system for a hospital or clinic. The task requires a GUI for entering and viewing data, a database to retain the records, a mechanism (spreadsheet) for presenting summary results, a facility to report to clients and physicians, a focus on security and privacy issues, and a presentation of the system to the users.

It is evident that FITness instruction is desirable, if not essential for all current college students. The elements of FITness are valuable throughout college, as well as being critical to most jobs that college students are seeking. In a steady state, it is likely that K-12 education will include FITness instruction, allowing it to become an entrance requirement for college. In the meantime, college courses must be designed to provide this knowledge to the present college population.

Committee Process

The Committee on Information Technology Literacy was convened

by the NRC's Computer Science and Telecommunications Board (CSTB). The committee members were:

Lawrence Snyder, University of Washington, Chair
Alfred V. Aho, Lucent Technologies
Arnold Packer, Johns Hopkins University
Marcia Linn, University of California, Berkeley
Andries van Dam, Brown University
Allen Tucker, Bowdoin College
Jeffrey Ullman, Stanford University

The period of the study was approximately a year and a half.

The committee received testimony from educational standards organizations, professional societies, the library and information community, computer science educators, and the community at large. Electronic input was solicited broadly on issues of importance to the committee's mission. An invitation-only workshop was held in Irvine, California, in January 1998 at which approximately forty participants spent a day and a half discussing the relevant issues. Input was sought from the computer science department chairs at the 1998 CRA Conference at Snowbird. The committee winnowed the testimony, formulated the recommendations in their tripartite form, and enumerated the "top ten" in each of the three categories. A draft report was submitted for peer review across a broad spectrum of interested parties, and all reviewer comments were addressed. Printed copies of the final version of report should be available by mid-May. A preprint version is available online at the CSTB webpage at http://www2.nas.edu/cstbweb.

Next Steps

The committee established the content for *Fluency with Information Technology*, but it did not reduce that content to curricula. The FITness proposal is aggressive, so Fluency classes must be offered to gather experience with integrating the three kinds of knowledge and to gauge student success with acquisition. (The author is currently prototyping a FIT class at the University of Washington (CSE100.))

The target audiences for curriculum divide into three groups: college students need FITness instruction immediately; the K-12 curriculum is the desirable place for FITness instruction, but there are many challenges; and much of the population wants and needs fluency instruction, but they are now beyond their educational years –– instructing this latter group also carries significant challenges.

Larry Snyder is a professor of Computer Science and Engineering at the University of Washington, a member of the CRA Board of Directors, and author of "A Programmer's Guide To ZPL," published last month by MIT Press. (See also, www.cs.washington.edu/homes/snyder.) ∎

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Please submit proposals for tutorials and workshops to the Workshop Chair (rwerger@cs.tamu.edu) by July 19, 1999.

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Author notification: September 26, 1999
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FY 2000 IT² Agency Budget Proposals

Agency	Fundamental Information Technology Research	Advanced Computing for Science and Engineering	Social Implications and Workforce Programs	Total
	(In Millions of Dollars)			
National Science Foundation (NSF)	$100	$36	$10	$146
Department of Defense (DoD)	100	--	--	100
Department of Energy (DoE)	6	62	2	70
National Aeronautics and Space Administration (NASA)	18	19	1	38
National Institutes of Health (NIH)	2	2	2	6
National Oceanic and Atmospheric Administration (NOAA)	2	4	--	6
Total, IT²	228	123	15	366

Budget from Page 1

$3.95 billion, an increase of 5.8 percent.

The total budget request for the **Computer and Information Sciences and Engineering (CISE)** Directorate is $422.5 million, an increase over estimated FY 1999 spending. Most of the increase, $110 million, would be for the IT² initiative; an additional $13.8 million would be distributed among the existing divisions. The $110 million increment would be divided as follows: $80 million would support increased individual and team research projects and $30 million would be used to establish new IT research centers.

Beyond the initiative, CISE would also increase funding, by nearly $7 million, for the Partnerships for Advanced Computational Infrastructure (PACI) program to focus on broadening and accelerating the capability of the research community to utilize PACI's advanced technology to work on cutting-edge research problems in all NSF disciplines.

CISE would also provide support for research and education efforts associated with the other Foundation-wide efforts, Biocomplexity in the Environment and Educating for the Future. To the former, which is a set of increasingly coordinated activities in environmental science, engineering, and education, CISE would provide $6 million. This would be a 50

percent increase above FY 1999 base funding of $4 million for activities formerly organized under Life and Earth's Environment.

CISE also supports a range of programs that encourage innovative approaches to meeting the challenge of educating students for the 21st century. A total of $22.62 million, an increase of $1.75 million over the FY 1999 level, would support such programs, including Research Experiences for Undergraduates (REU), Integrative Graduate Education and Research Training (IGERT), and Faculty Early Career Development Program (CAREER). Of note, $500,000 would be used to initiate a prototype program in Teaching Experiences for CISE Students, an experiment in having undergraduate and graduate students help bring the challenges, excitement, and rewards of IT into the K-12 learning environment.

The NSF's **Education and Human Resources** budget request includes $6.8 million to be invested in unspecified information technologies activities. The funding could be distributed among education programs, education research programs, and/or the EPSCoR program.

The EHR budget also includes a line item of $33 million to be spent on strengthening the IT workforce with funds coming from H-1B Nonimmigrant Petitioner Fees, as it was directed to do by the FY 1999

omnibus appropriations bill. At this writing, NSF is still in the process of defining the details and mechanism(s) to be used for these activities. The programs will start in FY 1999 (this year) with $27 million in funds from the same source.

Department of Defense (DoD):

The FY 2000 budget for the Department of Defense includes $1,113 million for basic research, an increase of 0.5 percent above the FY 1999 level, and $2,959 million for applied research, a decrease of 6.1 percent.

DoD would invest $100 million in the IT² initiative including, $70 million for focused research programs at the Defense Advanced Research Projects Agency (DARPA); $20 million for a new Advanced Research and Development Activity (ARDA, a joint effort of the Defense Department and the intelligence community to support long-term research on problems and enabling technologies relevant to intelligence and information security); and $10 million for fundamental IT research through the DoD-wide University Research Initiative, a competitive program managed through the office of the Director of Defense Research

and Engineering.

DoD's strategies for IT R&D follow from broader defense and warfighting strategies, developed at higher levels in DoD and the Joint Chiefs of Staff, which identify the growing importance of information superiority to U.S. objectives.

DARPA's total proposed funding for applied research includes $322.9 million for Computing Systems and Communications Technology, reflecting no change from the FY 1999 level; the $70 million for Extensible Information Systems (providing for participation in IT²); and $40 million for the Next Generation Internet initiative, a decrease from the FY 1999 level of $49.5 million.

The Administration budget documents note also that DoD would provide $500 million, a 6.4 percent increase, in R&D funding for advanced critical infrastructure protection technologies, with emphasis on combating cyberterrorism.

Department of Energy (DoE):

The Department of Energy is requesting an $18.1 billion budget for FY 2000, of which $7.5 billion, or 41

Summit from Page 3

systems. Bajcsy, as the head of the IT² working group, described inter-agency issues as well as CISE's research priorities: major software challenges; human-computer interactions and information management; broadband tetherless communications to help enable new technologies such as telemedicine and distance learning; understanding, modeling, and predicting the behavior of networks; and computational research. Krebs described DoE's proposed Scientific Simulation Initiative, which encompasses DoE's role in IT², and its relationship

to the defense-related Accelerated Strategic Computing Initiative.

The prospects for obtaining congressional support for IT² and other congressional science policy issues were also discussed by various participants. In the afternoon, a subgroup of participants met with Rep. Zoe Lofgren (D-CA), a member of the House Science Committee, to discuss IT², IT workforce issues, and other matters.

The summit also featured a presentation from Peter Jaszi, Professor of Law at American University, who spoke about issues in intellectual property protection and described recent and pending legislative actions in this area. ∎

National Science Foundation
Computer and Information Sciences and Engineering Directorate(CISE) Budgets, Actual and Projected 1998, 1999, 2000

Division	1998 Actual	1999 Estimate	2000 Proposed	Percent Change
	(In Millions of Dollars)			
Computer-Communications Research (CCR)	$56.43	$60.21	$62.23	3.4
Information and Intelligent Systems (IIS)	36.17	41.66	43.05	3.3
Experimental and Integrative Activities (EIA)	56.52	57.67	59.87	3.8
Advanced Computational Infrastructure and Research (ACIR)	75.82	78.17	85.40	9.2
Advanced Networking Infrastructure and Research (ANIR)	44.15	60.97	61.98	1.7
IT² Initiative	--	--	110.00	--
Total CISE Directorate	269.09	298.68	422.53	41.5

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Abilene Christian University
Department of Computer Science

Abilene Christian University invites applications for a tenure-track position in Computer Science open to applicants at all levels available Fall 1999. Applicants must have at least a Master's degree in Computer Science or a closely related field; a doctorate is preferred. In addition, the successful candidate will have a commitment to teaching in an undergraduate environment and demonstrated professional development and/or research activities. Applicants are sought in all areas of computer science and computer engineering.

Applications will be accepted until the position is filled. Send curriculum vitae, graduate transcripts, and references to:
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Review of applications will begin immediately and will continue until the position is filled. For more information about Butler University and the Department of Mathematics and Computer Science please visit http://www.butler.edu. Butler University is an AA/EO employer. Women and minorities are encouraged to apply.

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CS Search
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Pasadena, CA 91125

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Knox College
Department of Computer Science

The Department of Computer Science invites applications for one or more positions at the Assistant Professor or Instructor level to begin Sept. 1, 1999. Candidates must have a Ph.D. in Computer Science or a closely related field for consideration at the tenure-track, Assistant Professor level, and at least a Masters degree for instructor. The candidate should demonstrate the potential for excellence in teaching and research in a liberal arts environment. All areas of specialization will be considered.

Knox is a four-year independent liberal arts college, recently ranked for the third year in a row as one of the five "Best Values" among national liberal arts colleges in the U.S. News & World Report survey of quality and price in higher education. For more information about the College and the department, please visit www.knox.edu.

Knox College is an Equal Opportunity/ Affirmative Action employer. In keeping with its 161-year commitment to equal rights, the College welcomes applications from individuals in underrepresented groups. To apply, please send a curriculum vitae, a letter of interest which includes a discussion of teaching philosophy and research goals, and three letters of reference, at least one of which addresses teaching experience, to:
Sahnny Johnson, Chair
Department of Computer Science
Knox College #67
Galesburg, IL 61401-4999
E-mail: sjohnson@knox.edu

Review of applications will begin as soon as they are complete and will continue until the position is filled.

Middle Tennessee State University
Computer Science Department

Tenure-track position (#137160). Rank and salary open. A Ph.D. in Computer Science is required by appointment date. All areas of specialization considered. Evidence of excellence in teaching ability and demonstrable potential for research in computer science required.

The department currently offers an MS and a CSAB/CSAC accredited BS in computer science. Application review begins March 29. Contact: Richard C. Detmer, Chairperson, Computer Science, Box 48, Middle Tennessee State University, Murfreesboro, TN 37132.

More information available from rdetmer@mtsu.edu or www.mtsu.edu\~csdept. EO/AA employer.

New Mexico Institute of Mining and Technology
Department of Computer Science

The Department of Computer Science seeks applicants for both a tenure-track and a visiting position. Candidate for the tenure-track position must have an earned Ph.D. in Computer Science or Computer Engineering at the time of appointment and demonstrated potential for excellence. The ability to teach graduate and undergraduate courses and conduct research in major areas of computer science is essential. We are particularly interested in applicants who can take on responsibilities in our systems curriculum.

We have Masters and Ph.D. programs and research efforts that include interaction with nearby institutions including the National Radio Astronomy Observatory and the Sandia and Los Alamos National Laboratories.

For more information about the department, please browse http://www.cs.nmt.edu.

Send your application (include the names of at least three references, a one-page description of research interests and accomplishments, a statement of teaching philosophy, and transcripts of graduate work; indicate tenure-track/visiting/ both) to:
New Mexico Institute of Mining and Technology
Human Resources
Wells Hall
Box 96D (for tenure-track)/
Box 48D (for visiting)
Socorro, NM 87801

Screening will begin immediately and continue until positions are filled. E-mail applications NOT accepted. EOEAA

Old Dominion University
Computer Science Department

The Department of Computer Science seeks to fill tenure-track positions at the Assistant Professor level beginning in the fall of 1999. A Ph.D. in Computer Science or closely related field augmented by experience in computer science is required. Successful candidates will be expected to establish a funded research program and to excel at teaching. Areas of interest include high performance computing and communication, networked multimedia, mobile computing, systems programming, security, web technology, and object oriented programming. The Department offers BS, MS and Ph.D. degrees and provides an environment that encourages and supports research. Collaborative opportunities exist across departments, as well as with other institutions in the area. Sites of collaborative interaction within thirty minutes of campus include Eastern Virginia Medical School, NASA Langley Research Center, Thomas Jefferson National Laboratory, and Virginia Modeling, Analysis, and Simulation Center.

To apply, send a curriculum vitae and the names, addresses, and telephone numbers of three references to:
Larry Wilson, Chair Recruiting Committee
Department of Computer Science
Old Dominion University
Norfolk, VA 23529-0163
Fax 757-683-4900

This is the continuation of a search. Applications will be accepted until the positions are closed. Minorities and women are particularly encouraged to apply. Old Dominion University is an Equal Opportunity/Affirmative Action Employer and requires compliance with the Immigration Reform and Control Act of 1986.

University of California, Irvine
Department of Information and Computer Science
Adjunct Faculty Positions

The UCI Department of Information and Computer Science invites applications for positions as Adjunct Faculty with primarily research responsibilities and limited teaching activities. Positions are open in the following areas of research emphases: software, human computer interfaces, computer supported cooperative work, embedded systems, networks, databases, artificial intelligence, intelligent agents, medical informatics, and bioinformatics. Applicants are expected to conduct research in one of the above areas supported by external funding.

Positions at all ranks (Assistant, Associate, and Adjunct Professor) are available dependent upon the candidates' qualifications. Applicants must possess a Ph.D. in Computer Science or a related field, strong research credentials as evidenced by scholarly publications, and record of extramural funding.

Interested candidates should forward a cover letter indicating area of research emphasis, curriculum vitae, and names and addresses of three references. Screening of applications will begin immediately upon receipt of curriculum vitae. The deadline for receipt is May 31, 1999. Salary is commensurate with experience.

The ICS Department is organized as an independent campus unit reporting to the Executive Vice Chancellor. It runs the second most popular major at UCI and has designed an undergraduate honors program that attracts the campus' most qualified students. The Department currently has thirty-two full-time faculty and 125 Ph.D. students.

UCI is located three miles from the Pacific Ocean near Newport Beach, approximately forty miles south of Los Angeles. Irvine is consistently ranked among the safest cities in the U.S. and has an exceptional public school system. The campus is surrounded by high-technology companies that participate in an active affiliates

Professional Opportunities Ads Available on Web

Not all departments and organizations choose to run their Professional Opportunities ads in *CRN*—their ads can only distributed electronically to the Computing Research Association's website and jobs listserv. If you are interested in seeing more Professional Opportunities ads, access the Jobs webpage at http://www.cra.org/Jobs. If you would like to subscribe to jobs@cra.org so you can read the announcements before they are published in *CRN* (or see the ones that don't appear in *CRN*), send the following mail message to listproc@cra.org: subscribe jobs firstname lastname.

Professional Opportunities

program. Both the campus and the area offer exciting professional and cultural opportunities.

Send the requested information to:

ICS Adjunct Faculty Position
Attention: Arleene Parsons
Department of Information and Computer Science
Irvine, CA 92697-3425

The University of California is an Equal Opportunity Employer, committed to excellence through diversity.

University of Delaware
Department of Computer & Information Sciences

Visiting faculty positions are available to begin September 1, 1999 for the 1999/2000 academic year. Candidates with research interests in all areas of computer science will be considered.

For information about our department and it's activities see our website, http://www.cis.udel.edu/home.html. For status of the faculty recruitment see http://www.cis.udel.edu/~saunders/facultyrecruiting.html.

To apply, please send curriculum vitae to:

Dr. B. David Saunders
Chair of the Faculty Search Committee
Department of Computer and Information Sciences
University of Delaware
Newark, DE 19716

In addition candidates should have three confidential letters of reference sent directly to the above address or by e-mail to csfacsch@cis.udel.edu.

Applications are due by May 15, 1999, however applications will be accepted until the position is filled.

Qualified minority group members and women are particularly encouraged to apply. The University of Delaware is an Equal Opportunity employer.

University of Houston-Downtown
Department of Computer & Mathematical Sciences
Tenure-track position at the rank of Assistant Professor

A Ph.D. in Computer Science, commitment to excellence in teaching and scholarship required. The deadline for applications is May 1, 1999, and will be reopened at thirty-day intervals. Starting date: August 1999. Send statement of interest, curriculum vitae, transcripts, and three letters of recommendation to:

Ongard Sirisaengtaksin
CMS Department
University of Houston-Downtown
One Main Street
Houston, TX 77002
Email: ongards@dt.uh.edu.

University of Illinois at Chicago
Electrical Engineering & Computer Science Department

The Electrical Engineering & Computer Science Department invites applications for tenure-track faculty at all levels, as well as Instructors. A Ph.D. degree in Electrical Engineering, Computer Engineering, or Computer Science or its equivalent is required for tenure-track positions. Candidates in all areas of EECS will be considered but we are especially interested in the following areas: computer networks, communication systems, wireless systems, multimedia systems, operating systems, computer systems security, hardware/software co-design, MEMS, CAD, power electronics, computer architecture, object-oriented design and systems, computer graphics, HCI, collaborative design, intelligent agents, interactive learning environments, VLSI, high-assurance systems, robotics and control systems. All candidates should have outstanding research and teaching potential.

For more information about the department, visit our webpage at http://www.eecs.uic.edu. For full consideration, send a curriculum vitae and the names and addresses of at least three references to: Prof. Jeffrey J.P. Tsai, Search Committee Chair, Department of EECS (M/C 154), 851 S. Morgan Street, Room 1120 SEO, Chicago, Illinois 60607-7053

The University of Illinois at Chicago is an Equal Opportunity/Affirmative Action Employer.

University of Ottawa
School of Information Technology and Engineering

The School of Information Technology and Engineering (SITE) has several openings for tenure-track and replacement faculty appointments at the Assistant/Associate Professor level in the general areas of computer engineering, computer science, software engineering, and electrical engineering.

Candidates must have a Ph.D. in Computer Engineering, Computer Science, Electrical Engineering or related discipline. Bilingualism (English and French) would be an asset.

The School currently has more than 1,500 undergraduate students, 260 graduate students and forty-one faculty. See http://www.site.uottawa.ca/school/positions for additional information about the fields in which the openings exist, the positions, and the School.

Processing of applications will continue until the positions are filled.

The starting date is July 1, 1999. Applications including a curriculum vitae and the names and addresses of three referees should be sent to: The Director of the School of Information, Technology and Engineering, Faculty of Engineering, 150 Louis Pasteur, Ottawa, ON, K1N 6N5

Positions are subject to budget approval. The University of Ottawa is committed to employment equity, welcomes diversity in the workplace, and encourages applications from all qualified individuals including members of visible minorities, aboriginal persons, and persons with disabilities. The University strongly encourages applications from women.

In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

University of Pennsylvania
Department of Computer and Information Science
Chair of the Department of Computer and Information Science

Recommendations and nominations are invited for the Chair of the Department of Computer and Information Science at the University of Pennsylvania. The Department has outstanding programs and superb research facilities in algorithms and computational biology, computer graphics and animation, computer vision and robotics, databases, logic and computation, natural language processing, networks and distributed systems, programming languages, and realtime systems. In addition the Department is central to several interdisciplinary initiatives across the University through the Institute for Research in Cognitive Science (IRCS), jointly sponsored with the School of Arts and Sciences, and the Bioinformatics Center, sponsored by IRCS and the Institute for Medicine and Engineering (IME).

The University is seeking candidates with distinguished research backgrounds interested in leading a significant increase in the size and scope of the Department over the next several years. Since the Department has been selected as one of the six thrusts of the University's Agenda for Excellence, the new Chair will oversee substantial growth in faculty size and construction of its new building.

The Committee will now begin reviewing applications; the search will remain open until the position is filled. Recommendations and applications, accompanied by a curriculum vitae and appropriate supporting materials, should be sent to: Professor David Pope, Chair of the Search Committee, c/o Department of Materials Science and Engineering, School of Engineering and Applied Science, University of Pennsylvania, 3231 Walnut Street, Philadelphia, PA 19104-6272.

The University of Pennsylvania is an Equal Opportunity/Affirmative Action institution.

University at Stony Brook
Department of Computer Science
http://www.cs.sunysb.edu
Lecturer in Computer Science

Applications are invited for the position of Lecturer beginning August 1999 or January 2000. Lecturer candidates must hold a graduate degree in Computer Science or closely related field, should have a strong commitment to excellence in teaching, and must have experience teaching computer science at the university level. These are one- to three-year renewable positions possibly leading to permanent appointment.

Industrial Coordinator/Liaison for Computer Science

Applications are invited for a position of Research Assistant Professor, beginning August 1999 or January 2000, with primary responsibilities for increasing interaction between the Stony Brook Computer Science Department and local industry under the Strategic Partnership for Innovative Research (SPIR). Candidates should hold a Ph.D. in Computer Science or closely related field, and have a commitment to excellence in teaching and research at the university level.

Applicants for either position must send a curriculum vitae and the names of three references to:

Prof. Steven Skiena
Instructor Search Committee
Department of Computer Science
State University of New York
Stony Brook, NY 11794-4400
or E-mail: skiena@cs.sunysb.edu.

We will start the review of applications on May 1, 1999, and will continue to consider applicants until the position is filled.

Professional Opportunities

Compensation is competitive and depends on experience and qualifications. The University at Stony Brook is an EEO/AA employer.

University of Tennessee
Computer Science Department
Research Positions available at The University of Tennessee in High-Performance Distributed Computing (3/3/99)
The NetSolve project is expanding and the Innovative Computing Laboratory of the University of Tennessee is looking for qualified people who want to participate. NetSolve is a software environment for high-performance network computing that aggregates distributed computational resources for remote scientific problem solving. We invite applications from capable students, masters level programmers, and postdoctoral researchers who want to work and learn in this area. The candidates selected will help lead collaborative research projects investigating both NetSolve and other innovative software technologies and tools for building computational grids and problem solving environments.
The benefits of the positions available include a competitive salary, participation in leading research collaborations in the national and international scientific community, opportunities for publication and professional development, travel opportunities, and ready access to state-of-the-art computing facilities, such as supercomputers, high-performance workstations and laptops, and high-performance networks.
The position requires experience in the development of parallel and distributed computing tools, especially in C, C++, Java, and Fortran. Familiarity with scientific computing, parallel architectures, networking, and emerging network technologies is also desired. Responsibilities as a participant in the research team include designing, prototyping, experimentally testing, maintaining, and documenting computer systems related to this project.
This project is supported in part by the NSF NPACI, the NSF Alliance, NSF CRPC, and the DOE2000 activities.
More information can be found at: http://www.cs.utk.edu/netsolve/; http://icl.cs.utk.edu/
Inquiries should be directed to dongarra@cs.utk.edu.

University of Texas at Arlington
Computer Science and Engineering Department
Chair
The University of Texas at Arlington (UTA) invites applications and nominations for the position of Chairperson, Department of Computer Science and Engineering in the College of Engineering. Candidates for this position must have an earned Ph.D. in Computer Science, Computer Engineering, or a closely related field, as well as a distinguished record in teaching, research and service. The successful candidate will also possess excellent leadership and administrative abilities and have broad knowledge of the computer science fields.
UTA, part of The University of Texas System, is located in the heart of the rapidly growing Dallas/Fort Worth area, the nation's third largest high-technology region, with a flourishing industrial base and excellent opportunities for industry/university collaboration. The CSE department (URL: www.cse.uta.edu) currently has twenty faculty members with 387 undergraduate and 356 graduate students and last year received $2.7 million in external funds. Research areas in the department include telecommunications encompassing networks and multimedia, database systems and applications, artificial intelligence, software engineering, and systems including distributed and high-performance computing.
Applicants should submit a complete curriculum vitae along with the names, addresses, and telephone numbers of at least five references. We seek to fill the position by August 1, 1999. Review of applications will begin on March 22, 1999, and will continue until the position is filled. Send applications to: Ronald L. Elsenbaumer, Chair, CSE Chair Search Committee, Box 19031, 325 Woolf Hall, The University of Texas at Arlington, Arlington, Texas 76019
Phone: 817-272-2398, FAX: 817-272-2538, E-mail: chairsearch@cse.uta.edu.
The University of Texas at Arlington is an Equal Opportunity/Affirmative action employer.

Xerox Palo Alto Research Center
Systems and Practices Laboratory
Computation and Matter Area
Research Positions at Xerox PARC
The Computation and Matter Area (CMA) of the Systems and Practices Laboratory of the Xerox Palo Alto Research Center is recruiting.
We are looking for someone to join us in a team effort to conduct pioneering research and to build practical software systems for the Smart Matter Diagnostics Project. This person should have knowledge in analyzing complex data and strong software development skills, with experience in at least one of the following: machine learning, stochastic decision processes, pattern recognition, image analysis, model-based diagnosis, and distributed sensor fusion. Candidates at both Master's and Ph.D. levels will be considered.
CMA is an interdisciplinary group of scientists and engineers conducting research that bridges computer science and information technology with microelectromechanics. CMA is part of PARC's research in Smart Matter, which is creating the ability to embed large quantities of sensors, actuators, and computation in the world around us. The Smart Matter Diagnostics Project is developing highly scalable techniques to analyze large amounts of sensor data to support diagnosis and monitoring of a new generation of sensor-rich physical systems and processes.
To apply please submit: a cover letter explaining your interest in the Smart Matter Diagnostics position, a resume, and reprints of publications if applicable. Also, you are responsible for having references sent to us from at least two people who are qualified to evaluate your work and potential.
Direct all material to:
SPL/CMA Administrator
Xerox Palo Alto Research Center
3333 Coyote Hill Road
Palo Alto, CA 94304
E-mail: cmajobs@parc.xerox.com
Fax: 650-812-4334
Applications by e-mail will be accepted.

Applications will be acknowledged by e-mail, if possible, and each applicant will be notified individually as soon as a decision has been reached on the application. Applications will be processed as received and positions will be filled as suitable candidates are identified, so please submit your information as soon as is possible.
Xerox is an Equal Employment Opportunity company committed to the principles of workforce diversity.
http://www.parc.xerox.com/spl/groups/cma/

Rensselaer

DEPARTMENT CHAIR

Department of Electrical, Computer, and Systems Engineering

Rensselaer is seeking a Chair for its Department of Electrical, Computer, and Systems Engineering (ECSE). ECSE is highly ranked in research, with many new and exciting thrusts in image and signal processing, networking, microelectronics, robotics and automation, and in computer architecture and systems. As one of the largest and fastest growing departments, its thirty-three faculty contribute significantly to the $34M annual research budget of the School of Engineering.

ECSE is also a leader in curriculum reform and instructional delivery, innovating in interactive learning, distance learning, and studio format instruction. The department has more than 700 fulltime undergraduates and 200 graduate departmental majors. It offers degrees in two curricula: electrical engineering and computer and systems engineering.

See the departmental website at www.ecse.rpi.edu.

This dynamic environment, coupled with a new president and a supportive engineering administration, provides an unparalleled opportunity for aggressive leadership and growth. Candidates must be eligible for a tenured full professor appointment. Send resume and names of references to:

Professor Michael J. Wozny, Chair
ECSE Department Chair Search Committee
CII 8015
Rensselaer Polytechnic Institute
Troy, NY 12180-3590

Tel. 518-276-2898
Fax: 518-276-4897
E-mail: wozny@cat.rpi.edu

If not filled by the Fall 1999 semester, the search will continue until a suitable candidate is found. Rensselaer Polytechnic Institute is an Equal Opportunity/Affirmative Action employer.

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percent of the total, would be for R&D. This R&D budget would be about $500 million, or 7 percent, greater than the FY 1999 level. About $2.8 billion of the R&D budget is for civilian activities funded through the Office of Science; the remainder supports DoE's defense and nuclear weapons mission and includes, for instance, the Accelerated Strategic Computing Initiative.

DoE's FY 2000 budget would include an increase for the ASCI program as well as new funding for a civilian counterpart, the Scientific Simulation Initiative (SSI), which would be DoE's contribution to the IT initiative. While ASCI serves the DoE's nuclear weapons mission, SSI would be a civilian program with the following goals: 1) to design, develop, and deploy computational simulation capabilities to solve scientific and engineering problems of extraordinary complexity; 2) to

discover, develop, and deploy crosscutting computer science, applied mathematics, and other enabling technologies; and 3) to establish a national terascale distributed scientific simulation infrastructure.

Total funding for the Office of Advanced Scientific Computing Research (ASCR) would grow from $157.5 million to $198.9 million, with nearly all of the increase devoted to SSI activities. The primary research unit of ASCR is its Mathematical, Information, and Computational Sciences Division. The MICS budget would grow from $138.8 to $184.6 million in FY 2000.

National Aeronautics and Space Administration (NASA):

NASA's FY 2000 budget request totals $13.6 billion, which reflects a slight decrease from its FY 1999 budget. With its IT initiative funding, NASA would support activities in three areas: fundamental intelligent systems research focused

on advances in software, human-centered computing and information management, and high-end computing; research in applications and use of terascale infrastructure; and training and education efforts. The activities would be designed to serve a number of NASA objectives and missions.

National Institutes of Health (NIH):

The biomedical research agency's budget request is for $15.9 billion, an increase of 2.1 percent over the FY 1999 level. (The NIH budget increased 14.4 percent between FY 1998 and FY 1999.) The NIH's participation in the IT initiative underscores the increasing interdependency of biomedical research and computing.

National Oceanic and Atmospheric Administration (NOAA):

NOAA's overall budget would grow from about $2.2 billion to about $2.5 billion, a 13 percent

increase. Computer modeling is central to NOAA's missions in weather forecasting and climate research. With its IT² initiative funding, NOAA would address important challenges in the development and implementation of climate and weather applications for advanced computer architectures, pushing the state of the art in the use of advanced high-speed computing, visualization, and data communications for these applications.

National Institute of Standards and Technology (NIST):

NIST's FY 2000 budget request is for $735 million, up from $641 million in FY 1999. NIST laboratory funding for Computer Science and Applied Mathematics would grow by about $3 million to a total of $47.8 million. The additional funds are for development and dissemination of standards, measurements, and testing methodologies needed to protect the information technology elements of critical national infrastructures. ∎