Crisis and Opportunity in Computer Science

The future of the field depends on winning back student enrollment, public interest in technology, and government research funding.

The field of computer science faces a crisis of national confidence in the U.S., as well as in many other countries around the world. The crisis involves several facets, each threatening the field's future ability to play a major role in the economic and social health of these countries. In the U.S. these facets include:

- Declining student enrollment, while growth continues in law, medicine, biology, economics, and business; the decline among women is particularly alarming;
- Reduced government and industry support for basic research;
- Low public interest, even antipathy; and
- An unsympathetic political climate, typified by the nonrenewal in June 2005 of the President's Information Technology Advisory Committee.

In response, computer scientists must acknowledge that there is indeed a crisis and begin to address it. However, it also represents an opportunity to re-examine the discipline and invigorate it in ways that will make it even more exciting and important than it has been. Computer science has been enormously successful over the past 50 years, generating an intellectually rich discipline and producing a major international industry that has reshaped modern life for everyone no matter where they live.

As a mature discipline today, we can consider how to expand our scope beyond the traditional technology focus that produced contributions in commerce, communication, and entertainment. Our new research agenda might more directly address the major problems facing society and contribute to interdisciplinary teams in emerging applications related to national security, personal privacy, community support, health care, and quality of life for everyone. None of these problems will be solved by computer scientists on their own. All involve complex policy, cultural, and economic factors, along with scientific and engineering challenges.

Internationally, computer scientists could add their efforts to existing programs that aim to eradicate extreme poverty and hunger, improve education, develop civil infrastructures while ensuring environmental sustainability, and combat HIV/AIDS, malaria, and other diseases.

By reorienting computer science to deal more directly with societal problems in interdisciplinary teams, academic leaders may also address the need for greater diversity among their faculty colleagues and students while reversing the decline in enrollment [1]. Young people with a broader range of talents, interests, and backgrounds would be attracted to the new computer science themes and to emerging applications, including digital government, distance education, social computing, health care, and services sciences.

The new research agenda will not diminish the importance of such core computer science topics as theory, systems, artificial intelligence, graphics, data-

LISA HANEY

bases, human-computer interaction, and networking but would expand the range of their applications and impact through interdisciplinary collaboration. For example, an expanded focus on electronic patient records would advance basic research in databases, networks, security/privacy, search, visual analytics, and user interfaces.

Increased emphasis on education through active learning and service-oriented team projects would spawn new forms of collaboration while benefiting the communities in which the students apply their skills. Dramatically expanding social computing would make online communities more engaging, inclusive, and rewarding. It would also facilitate computer-supported cooperative work and improve email by reducing spam, viruses, and other threats. The pursuit of universal usability would inspire advanced research in how to provide an exciting and educational user experience on low-bandwidth networks and small displays. Universal usability research would also help improve voting technology and other digital government services, including access to public information. Some forward-looking companies in the technology industry have recognized the importance of pursuing novel themes, including Intel in proactive health care and IBM in services sciences.

If the commercial success of new technologies plays a role in guiding curricular revisions, then computer science courses will more regularly cover such flourishing commercial applications as Web site design, mobile devices, and cell phone services. Another increasingly popular topic is multimedia (music, photos, video, animation, and podcasting), which has a profound influence but shallow presence in most computer science courses. A prompt effort by ACM and IEEE curriculum committees might suggest short-term refinements to courses while debating a longer-term revision.

Addressing the diversity of users, computer science researchers would face new challenges in designing hardware, software, and user interfaces for people in developing nations, as well as for older adults and low-literacy users anywhere. Improving the lives of hundreds of millions of people in needy nations can help improve international relations and reduce the appeal of terrorism. Helping older adults would engage them productively so communities benefit from their experience and demonstrated willingness to help others. Low-literacy users would see their opportunities increase while the worldwide work force is enlarged.

One indication of students' strong interest in new applications is the success of information schools and information systems programs in business schools that emphasize information, Web design, information architecture, social computing, and online communities, especially in health care, education, e-business, and digital government. This success reflects the attraction of these new topics for students, as well as the strong job market for students with the related skills.

First steps might include raising faculty and student awareness about possible new applications, inviting speakers to present seminars, and calling for articles and special issues in professional magazines. Changes to classroom projects and course descriptions, coupled with interdisciplinary collaborations with other university departments and new degree programs, would begin to reorient the discipline to make it more attractive to students and better able to respond to the needs of society. Research agendas in government agencies that have historically supported computer science could expand to include these new directions and provide interdisciplinary graduate student fellowships.

Computer scientists can advance basic research while developing groundbreaking applications in collaboration with other disciplines. Doing so would once again help attract the brightest students, inspire public interest, and expand resources. Let's get started. C

Reference

1. Patterson, D. Restoring the popularity of computer science. *Commun. ACM 48*, 9 (Sept. 2005), 25–28.

Maria Klawe (klawe@princeton.edu) is Dean of Engineering and Applied Science and a professor of computer science at Princeton University, Princeton, NJ, and past president of ACM.
Ben Shneiderman (ben@cs.umd.edu) is a professor in the Department of Computer Science at the University of Maryland, College Park, MD, and founding director of the Human-Computer Interaction Lab.