Grand Challenges Conference Application

Societal Grand Challenges

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Summary:

The CRA workshop should explore a mix of "technology push" grand challenges (e.g. information discovery and retrieval in a world of distributed exabyte databases; real-time language translation; scaling networks to billions of connected devices, holodeck-quality telepresence, etc.) and "demand-pull" grand challenges. I am interested in presenting some of the work that CITRIS is doing to identify research areas that have the potential to help address major societal problems.

Background

Recently, researchers from UC Berkeley, Davis and Santa Cruz have launched the Center for Information Technology Research in the Interest of Society (CITRIS), with $100 million of funding from the State of California and roughly $170 million in matching funds from leading high-tech companies, private donors, and the federal government. CITRIS is different in a number of respects from a traditional EECS research initiative. First, the mission of CITRIS is to conduct research and development on information and communications technologies, and to use them to help address major societal challenges. Existing CITRIS projects are developing the technologies for "societal-scale information systems" – and exploring their use in applications such as increasing energy efficiency, reducing traffic congestion, and improving our ability to respond to man-made and natural disasters. Most electrical engineering/computer science research projects focus much more on the underlying technologies, and on making them "smaller, faster, and cheaper." Second, CITRIS will require significant multidisciplinary collaboration between computer scientists and researchers in other fields (e.g. civil engineering, biomedical engineering, education, architecture, economics, law – to name only a few).

This is not the first time that these ideas have been discussed within the computer science research community. The importance of broadening computer science and engineering research to include applications is discussed in the 1992 NRC report *Computing the Future*, the 1994 report from the federal HPCC initiative which identified a set of "national challenges" for IT, PITAC's 1999 report outlining 10 societal transformations enabled by IT, and the 2000 NRC report, *Making IT Better*. To my knowledge, however, there has never been an effort of CITRIS's size and scope to actually pursue a set of socially relevant IT applications.

As part of CITRIS, I am working with the faculty and the leadership of the Berkeley campus to identify a set of 10-20 year societal "grand challenges" that technology could help meet. Some examples might include:

- Use advances in multi-modal human-computer interaction, assistive technology, and universal design principles to cut the unemployment rate for Americans with disabilities in half.

- Create ultra-low cost devices and networks that make Internet access affordable and useful to everyone on the planet, including the 4 billion people currently earning less than $1,500/year.

- Give every senior citizen the opportunity to live independently for another 5 years.

- Develop a "reading tutor" (using technologies such as speech recognition, speech synthesis and intelligent tutoring systems) that reduces by 50 percent the number of Americans who are reading at the 5th grade level or below.

- Demonstrate a technology-enriched learning environment that, coupled with appropriate school reforms and changes in teaching practice, can reliably, significantly, and cost-effectively improve student performance in middle-school and high-school. ["Significantly" would mean an "effect size" of 0.5 to 1.0 standard deviations from the mean; "cost-effectively" would mean that the use of technology is affordable relative to other proven educational reforms; and "reliable" would mean that results can be replicated by third-party evaluators using experiments with random assignment.]

- Use IT and sensor networks to reduce the energy intensity of the U.S. economy (BTU per dollar of GDP) enough to meet environmental, energy security, and global climate change goals.

- Use electronic medical records and other IT solutions to reduce serious and fatal medical errors by 75 percent.

<u>What's different about societal grand challenges?</u>

I am also interested in exploring what will make organizing a research program around a societal grand challenge different from a more traditional CS research initiative. For example:

- A research program to help achieve societal objectives will require participation by a broader range of researchers and practitioners.

- Many of these "grand challenges" will lack an obvious federal patron with the resources and expertise needed to support a world-class extramural research program. The Department of Education, for example, has never had the ability to fund long-term research on educational software by teams of computer scientists, cognitive scientists, instructional designers, and subject matter experts.

- The process of "technology transfer" and widespread adoption of socially relevant technologies may be complicated, messy, and slow. For example, a recent study of educational technology in Silicon Valley K-12 schools found that only 5 percent of teachers were using the technology in innovative or transformational ways.

BIO:

Thomas Kalil is currently the Special Assistant to the Chancellor for Science and Technology at UC Berkeley. He has been charged with developing major new multidisciplinary research and education initiatives at the intersection of information technology, nanotechnology, microsystems, and biology. He will also help develop a broad range of partnerships between 2 of the California Institutes of Science and Innovation (Center for Information Technology Research in the Interest of Society, California Institute for Bioengineering, Biotechnology and Quantitative Biomedical Research) and potential stakeholders in industry, government, foundations, and non-profits.

Previously, Thomas Kalil served as the Deputy Assistant to President Clinton for Technology and Economic Policy, and the Deputy Director of the White House National Economic Council. He was the NEC's "point person" on a wide range of technology and telecommunications issues, such as the liberalization of Cold War export controls, the allocation of spectrum for new wireless services, and investments in upgrading America's high-tech workforce. He led a number of White House technology initiatives, such as the National Nanotechnology Initiative, the Next Generation Internet, bridging the digital divide, e-learning, increasing funding for long-term information technology research, making IT more accessible to people with disabilities, and addressing the growing imbalance between support for biomedical research and for the physical sciences and engineering. He was also appointed by President Clinton to serve on the G-8 Digital Opportunity Task Force (*dot force*).

Prior to joining the White House, Tom was a trade specialist at the Washington offices of Dewey Ballantine, where he represented the Semiconductor Industry Association on U.S.-Japan trade issues and technology policy. He also served as the principal staffer to Gordon Moore in his capacity as Chair of the SIA Technology Committee.

Tom also serves as a consultant for organizations such as the Semiconductor Industry Association, Internet2, CommerceNet, RAND, and the "Digital Promise" initiative proposed by Newton Minow and Larry Grossman.

Tom received a B.A. in political science and international economics from the University of Wisconsin at Madison, and completed graduate work at the Fletcher School of Law and Diplomacy. He is the author of articles and op-eds on S&T policy, nanotechnology, nuclear strategy, U.S.-Japan trade negotiations, U.S.-Japan cooperation in science and technology, the National Information Infrastructure, distributed learning, and electronic commerce.