

Computing Community Consortium Implementation Plan For the period beginning October 2009

August 11, 2009

The CCC is fledgling. It remains an experiment. In addition, our field is still young. Other disciplines have consortia that guide their fields, notably astronomy and physics. In these fields advancement is both enabled and limited by esoteric, expensive instrumentation. Their consortia serve to set priorities among the competing proposals for such instrumentation, and derivatively they determine what science challenges will be addressed in what order. The computing field is very different. First, few of our sub-fields are constrained by esoteric instrumentation (high performance computation being a notable exception). Second, computing and information science and engineering are directly and critically related to societal needs.

For these reasons, the goals and the strategies of the CCC have to be different from those of the guiding consortia in other disciplines. The CCC Council recognizes that it is charting a new course, and is resolved to be opportunistic. Therefore our Implementation Plans change over time. In the next section we describe the desired Outcomes. However, it is quite likely that in the near future the Council will identify a promising opportunity to contribute to the advancement of the field, to an improvement of its infrastructure, or to the enhancement of the intellectual vitality of the community. If so, the CCC Council will pursue it. The Computing Innovation Fellows Project is an example of such an opportunistic activity. It was only in February, 2009 that the need for preserving human talent in the “pipeline” to the research community was recognized. Acting in an agile fashion, in a few months the Council, with support by enlightened NSF CISE leadership, created the project to select Fellows to be supported by postdoctoral fellowships during a period of substantially reduced hiring by universities and laboratories. Likewise, members of the CCC Council authored position papers for OSTP; those papers are finding significant traction. The Council is actively seeking new opportunities that CCC uniquely can exploit.

Outcomes

During this period CCC will emphasize five Outcomes:

Outcome 1. Agency understanding of the role computing research must play in addressing national priorities.

Examples of such national priorities include:

- a) Healthcare
- b) Energy, and
- c) Cybersecurity.

For the first two (and many others), there is still a considerable lack of understanding of the role that computing, and computing research, must play in the solution of these problems. For example, digitizing medical records is understood but the role of privacy in dealing with these records while making maximum use of them is not. The role of machine learning and data mining to allow for the most effective possible medical advice from the huge number of contradictory studies and advertisements is not well understood. Similarly, simulation as a key technology for understanding physical systems as a key technology is well appreciated. But the role of the smart grids, sensor nets, and smart transportation in conserving energy is not. Neither are the research challenges of creating better simulations.

Outcome 2. Clear actionable roadmaps for visionary research.

Roadmaps have been used successfully in some instances as a mechanism to bring a community to a consensus about key research directions. To complement our visioning workshops we are working with a few research communities to develop actionable research roadmaps to see if roadmaps serve to advance visionary research more effectively than their absence. To date, one community, the robotics community, has translated the ideas from their visioning workshops to develop a clear roadmap. One hope for these roadmaps is that they offer clearly articulated goals and strategies so that multiple funding agencies can in a complementary way implement the roadmap. We seek to work with one or two more communities to define suitable roadmaps for their purposes, possibly the Cyber-Physical Systems community and the Big-Data Computing community. Roadmaps are a form of documentation of the result of our visioning efforts that may prove to be particularly useful when working with funding agencies to derive new programs.

Outcome 3. New programs for computing research funded in multiple agencies.

With the development of comprehensive research roadmaps for problems of societal interest, we will lay the groundwork for collaboration with funding agencies for the implementation of new and enhanced funding programs. We realize that such implementation takes considerable time due to the budget process but it is important to begin. Such beginnings will emphasize to the research community the need/value of CCC. We will continue to work to engage funding agencies beyond NSF.

There are five large funding agencies for science and engineering in the U.S.: NSF, DoD, HHS/NIH, DoE and NASA. Only NSF and DoD have a history of funding basic

computing research in computer and information science and engineering at a substantial scale. DoE, HHS/NIH and NASA fund other disciplines that make heavy use of computation for the purpose of research and practice in the discipline, but they have historically depended upon NSF and DoD to advance basic computer science and electrical engineering. Regrettably, DoD in very recent times has substantially reduced its basic research funding in these areas. Our first priority is to attempt to revitalize DoD, particularly DARPA-funded programs. Our second priority is to work with program officers in other agencies. Since the potential interest of a program officer as well as the relation between individual CCC Council members and those program officers are both important, we will be opportunistic and pursue agencies and funding of specific sub-areas, e.g., robotics versus Cyber-Physical Systems, on a case-by-case basis.

Outcome 4. Societal understanding of the foundational impact of computing research.

Society ultimately is the necessary supporter of our research activities and we must inform the citizenry as well as members of government why such research needs to be supported. Further, developing societal understanding will aid in our long-term goal of attracting the best and brightest individuals into our field. It will help us to engage a new generation of leaders. CCC is a minor player in this arena. Our professional societies and CRA itself have a larger contribution to make.

Outcome 5. Addressing issues raised in the self-assessment.

Our self-assessment exposed several areas where our level of activity is not what we had originally projected. Some of these gaps are essentially unavoidable given our resources and prioritization, while others need to be addressed as a priority – either ramping up activity, or conducting an evaluation to determine why it is not necessary or appropriate. These areas are described in Section 9 of the Self-Assessment. They include issues such as enhancing the transparency and the inclusiveness of CCC activities and evaluating the value of our visioning workshop process.

To close this section, it is useful to consider two items that are not on the above list. First, we do not seek to institute the CIFellows Project. It does need to continue through the period of economic downturn. The CIFellows Project is a “stimulus project”; we will seek sufficient funding for Fellows over that time period, but no further, pending a detailed assessment of its impact.

Second, one of the reasons that CCC was proposed initially was concern by a broad community about the constitution of the GENI effort at that time. The CCC Council has been instrumental in working with NSF and with the network research community to find alternative constructs for GENI. As part of that activity, last year the CCC Council created the NetSE Council with a charter to create a research agenda for networking, broadly interpreted. A representative NetSE Council followed an open process and has created an agenda document, thus discharging their task. NSF has funded an industrially led GENI Program Office. It is acting to increase capacity in the research community to perform network research and experimentation, at a suitable scale. That

Program Office has acted to make the network resources of Internet2 and the National Lambda Rail available for researchers. It is in dialog with the chief information officers of a variety of universities to assure that substantial network experiments can safely coexist with the network infrastructure of the universities. We see this as a reasonable pathway to at least medium-scale network experimentation. It will require several years to reach fruition. The CCC Council does not intend to guide the GENI project over that time. Possibly, when very large-scale experimentation is envisioned, the CCC Council can help broker some relationships. But that would be in the future.

Relationship of Outcomes to Strategic Goals

Our goals, as documented in the CCC Strategic Plan, are:

0. *Establish the Computing Community Consortium as a widely accepted catalyst and voice for the computing research community.*
1. *Bring the computing research community together to discuss, prioritize and envision our future research needs and thrusts.*
2. *Communicate these challenges, needs and thrusts to the broader national community.*
3. *Create within the computing research community more audacious thinking.*
4. *See the ideas developed in (1) and (3) turn into funded research programs and/or instruments.*
5. *Increase the excitement within computing research and use that excitement to attract students of both genders and all ethnic groups into computing research careers.*
6. *Inculcate values of leadership and service in the computing research community –by example, by inclusion, and by mentoring.*

Our Implementation Plan Outcomes serve those goals as indicated by the following chart.

	Goal 0 Establish CCC	Goal 1 Community	Goal 2 Commun- icate	Goal 3 Audacious	Goal 4 Programs	Goal 5 Attract	Goal 6 Leadership
Outcome 1 Agency Understanding	X	X	X		X		X
Outcome 2 Actionable	X	X		X	X	X	X
Outcome 3 Programs	X		X	X	X		X
Outcome 4 Societal Understanding	X		X			X	X
Outcome 5 Issues	X	X		X		X	X

Our Outcomes are inter-related. Our Goals are re-enforcing. Each of our Outcomes can be achieved by actions that serve multiple Goals.

Actions Leading to Outcomes

In this section we describe quite specific actions that the CCC intends to take in order to achieve the five Outcomes listed above.

Outcome 1. Agency understanding of the role computing research must play in addressing national priorities.

We will broaden and strengthen ongoing conversations with representatives of funding agencies in addition to the ongoing relationship with NSF, recognizing that creating understanding and changing the attitudes within an organization is a long-term activity. It involves learning and flexibility on the part of all involved. DARPA, DoD more generally, DoE (both the Office of Science and the energy laboratories), and HHS/NIH should receive particular attention. We anticipate a much higher likelihood of success over the coming years because federal agencies appear to be more interested in engaging with academic researchers to provide the long-term fundamental research that they need:

- A. At the July 2009 CCC Council meeting, both Zach Lemnios, the incoming Director, Defense Research and Engineering, and Steve Koonin, Undersecretary for Science, US Department of Energy, were willing to allocate time in their schedules to discuss these issues with the CCC Council and to explicitly assert their interests in such engaging with us.
- B. CCC Council member and CRA Board Chair Peter Lee has accepted a position at DARPA to head a new office focused on engaging university researchers in potentially game-changing research of importance to DoD. (This necessitates that he will be stepping down from both CRA and CCC.)
- C. NIH (along with other agencies) is keenly aware that healthcare is a major issue for both the administration and the country. This issue will not be resolved without the active participation of the computing research community. However, NIH is an agency that uses the results of basic research in computing, but has little culture of funding that research.

Our activities include:

- A. Continue efforts to keep the computing research community actively engaged in the broadband rollout supported by stimulus funds.
- B. Remain engaged with the cybersecurity programs of the federal government. Since CCC Council members Fred Schneider and Stephanie Forrest are involved in such programs, we are well positioned to continue to be engaged.
- C. Continue a newly initiated effort in computing research and energy. It is clear that relevant staffers do not understand that computing has far more to provide to the energy debate than simulation of physical systems and visualization. For example, a smart grid or energy efficient transportation system cannot be implemented without fundamental research in computing to pave the way. We currently have a white paper on this subject in late-stage draft form. We have commenced discussions with Department of Energy staff and are planning for a possible workshop to develop a concrete roadmap. A major effort must be to educate the relevant players as to the potential of computing research as an enabler of energy efficiency.

- D. Initiate an effort in computing research and healthcare. This topic has recently been highlighted by a CSTB study and we hope to follow up by developing a research roadmap. As with energy, computing plays a far more fundamental role than simply digitizing medical records (although understanding how to do this while simultaneously handling issues such as privacy and other issues is still an area of research). Issues in machine learning to enable doctors to make the use of modern medical research when diagnosing and medicating patients is a clear challenge. Our starting point is the recent CSTB study in this area, but we need a mechanism for engaging the key players such as NIH.
- E. Consider how CCC or individual Council members can contribute to the quality of the DARPA ISAT activity, and more generally how CCC can be of assistance to the new DARPA leadership team.
- F. Individuals on the CCC Council who are also on agency advisory boards and committees will seek ways to have those boards and committees assert that the agencies should support fundamental computing research.

Outcome 2. Clear actionable roadmaps for visionary research.

We intend to move forward as follows:

- A. Become much more vigilant at ensuring that our workshop organizers maintain the websites describing their activities, that they provide us with all relevant materials, and that they generate reports in a timely fashion. We have found, as have many others before us, that the excitement of the discussion during a workshop often fades when participants return home and to their normal obligations. This applies not only to workshop participants but also to CCC Council members, of course. We have become, and will continue to be, much more forceful on requiring the various reports and other informational items before reimbursements are received. This is a very difficult balance, however, since making the process too onerous ensures a total lack of participation by those whom we most want to include.
- B. Hire additional staff to support interaction with the multiple research communities, the agencies and other part of government.
- C. Place emphasis on actionable items rather than visionary outputs with no clear next step. A model for this effort is the CCC-funded robotics effort which has generated a roadmap for robotics research and has presented the roadmap to the congressional robotics caucus. The principals in this effort subsequently met with Tom Kalil of OSTP and have additional promotional activities planned.
- D. Explore alternatives to the visioning workshop approach such as directed shorter-term reports (similar to the transition papers or academies letter reports), and commissioned studies (similar to ISAT studies).
- E. As an example of such an effort, CCC will be co-sponsoring a multi-agency workshop on IT and Healthcare, to be held in mid-to-late September. The purpose of the invitation-only workshop is to advance a collaborative research agenda for the use of information technology in facilitating all aspects of high-

quality healthcare. Susan Graham, UC Berkeley and CCC Council co-Chair, and Isaac (Zak) Kohane, Harvard Medical School, are the co-chairs.

Outcome 3. New programs for computing research funded in multiple agencies.

Above, we have discussed planned activities that are designed to engage both the research community and agencies. But, funding agencies must take concrete steps to make use of the visioning outputs of CCC. Only then will CCC efforts result in meaningful, funded programs. Key to the developing new programs is the opportunity to work with agency leaders and program officers. We will:

- A. Dialog with the new Director of Defense Research and Engineering to identify military-critical basic research.
- B. Work with the new Director of DARPA, and Peter Lee in his capacity as program officer at DARPA, to develop ideas for re-vitalizing the relations between DARPA and the university computing research community.
- C. Work in similar ways with leaders and program officers in other agencies able to fund basic research.

Outcome 4. Societal understanding of the foundational impact of computing research.

Creating and communicating research visions is the core of our approach to increasing societal understanding of the importance of computing research for all areas of society. We envision the following actions to make use of the visions created:

- A. Communicate the excitement and impact of computing research in a way that is accessible by a wide range of audiences. For example, for the “Computing Research that Changed the World” symposium we have made available via YouTube the presentations and are in the process of producing short descriptions of each talk. Our hope is that institutions will be able to make use of these descriptions and the video segments in their outreach, recruiting and educational missions. We intend to produce similar materials for our most promising visioning results.
- B. Explore the use of events, such as the above referenced symposium for making the results and promise of computing research more accessible.
- C. Hire an individual who can provide the communication skills necessary. While we currently use the services of a communications firms to place material, an in-house staffer who is familiar with the community and the promise and can communicate both in a more direct and personal way.
- D. Work to integrate the new CIFellows into the research community. Two activities currently planned are:
 - i. Participation of the fellows in CRA’s Career Mentoring Workshop in February 2010. This workshop is designed to provide an excellent introduction to a research career, whether in academia or industry.
 - ii. A session at CRA’s Snowbird conference for the computing research leadership on the CIFellows project.

Outcome 5. Address issues raised in the self-assessment.

Through our self-assessment process, we have raised a number of issues that we intend to address. These are not all of equal priority, but all are issues which need to be given due consideration:

- A. Engage the services of an evaluator. We are currently collecting routine information to address process metrics, how many people wished to participate in an activity, how many participated, etc., but we need outside expertise to address questions of institutional change which are at the heart of the CCC effort.
- B. Initiate the evaluation of the effectiveness of the CIFellows Project. Some of this is simple data analysis but we are also interested in the impact of the program on lives and careers. Because there are some highly novel aspects to the program, particularly the emphasis on mentoring, we anticipate considerable interest in our evaluation. We contemplate one or more articles describing the program, what we were trying to accomplish and what we did accomplish. *Communications of the ACM* has been in contact to do an article, for example.
- C. Engage the services of additional staff support to run CCC, develop reports, analysis data and reports, etc. Our intent is that this be the same staff position as mentioned in (2B and 4C) above.
- D. Ensure that the workload of CCC is met by the entire CCC Council by ensuring that individual members of the Council provide sufficient return to the effort.
- E. Work on increasing transparency and inclusiveness. We have been quite conscious from the outset that CCC is the entire computing research community, not simply the major players, and have been quite careful to include representation from a broad range of institutions. However, there is a natural tendency for the major players to dominate and we need to work more to include a broader range. For example, we will be inviting contributions to the CCC blog from researchers outside the usual participants. We will be working to ensure a broad range of participation in our various visioning activities.
- F. Re-assess participation in issues related to computer science education. Computer science education is a topic of considerable interest to our community because of its centrality to the entire research activity. Without high quality education we are not likely to get the high quality researchers that we need. Yet this is a very broad endeavor with a large number of actively engaged parties. Rather than address the issues broadly, we intend to seriously evaluate in order to determine where CCC involvement is both most suitable and most likely to have real impact. This will be done in concert with an ongoing CRA effort to reposition its committee on education. CRA's Board has decided that CRA-E should be structured as a broad umbrella for high impact projects within distinct boundaries. For example, K-12 policy issues are already well handled by other organizations. Former Dean of the College of Computing at Georgia Tech Rich DeMillo is leading this effort for CRA and we will engage with him.

- G. Re-assess goals and plans for incorporating non-U.S. interactions with the activities of the CCC. Understanding the European context has been assigned to Andrew McCallum, CCC Council member, who will be spending the year in Europe.
- H. Work towards uniform engagement across the CCC Council. Of course the members are all quite busy with their own research, administrative and service positions but we intend to ensure that each provide their unique contribution to the success of the whole. This is a somewhat delicate matter and the mechanisms to deal with it are not detailed here.
- I. Continue our highly successful efforts to be agile, flexible and quick to respond. This is one of our greatest assets (repeatedly and well tested this year) — there is simply no organization that could so effectively have pulled off the transition papers, the “Computing Research that Changed the World” symposium and the CIFellows project over a time period of six months.

Evaluation of Proposed Activities

In addition to the metrics discussed in the original CCC proposal, the CIFellows proposal and the Strategic Plan, we here address additional process metrics focused on the Outcomes discussed above.

Outcome 1. Agency understanding of the role computing research must play in addressing national priorities.

Process metrics include: the number and quality of the contacts between CCC and the relevant agencies, the quality of the roadmaps and other reports generated from both our visioning workshops and our targeted efforts, feedback from the agencies as to their agreement in the relevance of computing research their missions.

Outcome 2. Clear actionable roadmaps for visionary research.

Process metrics include the quality of the reports generated by our activities, the degree to which an agency program plan can be based on a roadmap, and the degree to which a roadmap can be the basis for defining multiple complementary programs, each funded by a different agency.

Outcome 3. New programs for computing research funded in multiple agencies.

The metric is simply agency interest and willingness to fund the proposed research activities. Due to the budget cycle, this is a many years process, but we seek to begin.

Outcome 4. Societal understanding of the foundational impact of computing research.

Process metrics include the quality and quantity of the materials that we produce for dissemination.

Outcome 5. Addressing issues raised in the self-assessment.

The metrics for these are linear scales from “not begun” to “accomplished”.