

Visions for Theoretical Computer Science: Status and Impact Report

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In Spring 2008, the Computing Community Consortium (CCC) provided funding for a visioning workshop by the Theoretical Computer Science community at the University of Washington on May 17, 2008 (the day before STOC 2008), as well as follow-up efforts. The purpose of this report is to describe the status and impact of those efforts. The main outcome has been the “vision nuggets” that are available for use by the CCC and others at:

<http://theorymatters.org/pmwiki/pmwiki.php?n=Visioning.HomePage>

1 Rationale & Goals

Theoretical Computer Science (TCS) is a major subfield of computer science, with a long track record of producing unexpected discoveries of high impact (e.g. public-key cryptography, quantum computation) and of raising deep scientific questions (e.g. P vs. NP). The purpose of the visioning workshop was to identify and distill broad research themes within TCS that have potential for major impact in the future and highlight the importance of sustained support for long-term, fundamental computing research.

This visioning effort was designed to differ from past “visioning efforts” by the TCS community in three important ways:

Scope. While previous efforts have focused on ‘outreach’ areas in which TCS has potential for external impact in the near term, many of the exciting discoveries of TCS have emerged from the exploration of core TCS questions about the nature of efficient computation. The new effort aimed to also focus attention on these core questions and articulate their broad significance.

Outcomes. While previous efforts have produced detailed reports on research directions, the new effort sought to produce compelling “nuggets” that can quickly convey the importance of a research direction to a layperson. (See Section 3.) These nuggets could be used by the CCC or anyone else making the case for a sustained investment in long-term, foundational computing research.

Participation. We sought participants who were not involved in the previous workshops, and also solicited input from the wider TCS community both before and after the workshop.

2 Process

Participation. The workshop was advertised widely in the TCS community, in particular through the webpage for STOC '08. Leaders in the community were solicited for participation, but anyone in the TCS community was able to apply (up to a limit of 35 participants, in order to maintain a manageable size for discussions and brainstorming). Those who could not attend were encouraged to submit ideas for and comments on the “visions” both before and after the workshop.

The workshop was attended by 32 participants (listed in Appendix A). They represented 21 universities, 3 research labs, and the National Science Foundation. 7 of the attendees were women. 9 of the attendees responded to the open call for participation (as opposed to personalized invitations). 9 non-attendees participated in the development of nuggets before and after the workshop.

Prior to and at the Workshop. Participants were asked to each propose a few visions for discussion at the workshop. We received 32 ideas, which can be found on the workshop program at:

<http://theorymatters.org/pmwiki/pmwiki.php?n=Visioning.Program>

After introductory remarks by Ed Lazowska (chair, CCC), Sanjeev Arora (chair, SIGACT Committee for the Advancement of Theoretical Computer Science), Sampath Kannan (incoming CCF Director at NSF), Salil Vadhan (workshop organizer), most of the workshop was spent in 6 breakout groups to develop the nugget ideas, with the goal of identifying and crystallizing 5–10 of them for refinement and polishing after the workshop. There was a 2-hour plenary discussion in the middle of the day to coordinate our efforts and provide feedback to each other.

After the workshop. In the months following the workshop, there was an extensive group effort to polish the nuggets, carried out on the workshop wiki:

<http://theorymatters.org/pmwiki/pmwiki.php?n=Visioning.Nuggets>

We worked with a graphic designer, Elaine Park, to develop images to accompany the nuggets.

3 Outcomes and Impact

Due to the many good ideas and effort invested by attendees, we produced 16 polished vision nuggets (far more than our original goal of 5–10 nuggets). Each of these nuggets includes:

1. Title
2. Tag line
3. Logo/Image
4. One paragraph summary description in language understandable by people outside of theory (such as science advisors for senators)

5. Longer, but not too long, rationale that still has to be understandable to non-specialists.

The main purpose of these nuggets is to help the CCC and others argue for the importance of computing research to a variety of audiences. However, we hope that some of the nuggets will have additional impacts, such as the the development of new funding programs at NSF or DARPA, or new research centers.

These nuggets are currently packaged in powerpoint format, to make them easy to incorporate them into presentations. Each slide contains a title, tagline and image, and the notes field includes all of the accompanying text (including the summary and rationale). The designer will be providing us with separate jpeg files for the images, for greater flexibility in how they are used.

The nuggets are all available, for anyone to use, on the theorymatters.org wiki:

<http://theorymatters.org/pmwiki/pmwiki.php?n=Visioning.HomePage>

In addition to the CCC, we are also delivering the nuggets directly to people at DARPA (Peter Lee) and NSF (Jeanette Wing, Sampath Kannan, and Richard Beigel). We are exploring the possibility of turning some of the nuggets into CACM Research Highlights.

Note: These nuggets are *not* intended to say which areas within theoretical computer science are most important or should be funded. Many central research areas are not represented here at all, and this is due only to the limited size of our effort. We hope there will be more such efforts in the future.

A Participants

Organizers

Bernard Chazelle (Princeton)
Anna Karlin (U. Washington)
Richard Ladner (U. Washington)
Dick Lipton (Georgia Tech)
Salil Vadhan (Harvard)

Workshop Attendees

Aaronson, Scott (MIT)
Arora, Sanjeev (Princeton)
Beigel, Richard (National Science Foundation)
Chawla, Shuchi (University of Wisconsin - Madison)
DasGupta, Bhaskar (University of Illinois at Chicago)
Drineas, Petros (Rensselaer Polytechnic Institute)
Dwork, Cynthia (Microsoft Research)
Gupta, Anupam (Carnegie Mellon University)
Hartline, Jason (Northwestern U)
Indyk, Piotr (MIT)
Kabanets, Valentine (SFU)
Kannan, Sampath (University of Pennsylvania and NSF)
Karlin, Anna (University of Washington)

Karp, Richard (UC Berkeley)
Lee, James (University of Washington)
Levin, Leonid A. (Boston University)
Mathieu, Claire (Brown University)
Rajaraman, Rajmohan (Northeastern University)
Roughgarden, Tim (Stanford University)
Rozier, Kristin Yvonne (NASA Langley Research Center)
Sahai, Amit (UCLA)
Servedio, Rocco (Columbia University)
Souvaine, Diane (Tufts University)
Steiger, William (rutgers)
Sudan, Madhu (MIT)
Trevisan, Luca (UC Berkeley)
Wieder, Udi (Microsoft Research Silicon Valley)
Wigderson, Avi (Institute for Advanced Study)
Wise, David S. (Indiana University)
Zhang, Lisa (Bell Labs)
Vadhan, Salil (Harvard University)

Non-attending Contributors

Barak, Barak (Princeton)
Chazelle, Bernard (Princeton)
Fortnow, Lance (Northwestern)
Grisinger, John (Vara Data Systems)
Lipton, Dick (Georgia Tech)
Rademacher, Luis (Ohio State)
Sidles, John (U. Washington)
Vempala, Santosh (Georgia Tech)
Vishkin, Uzi (U. Maryland)

Graphic Design

Elaine Park (www.elainepark.com)
Raymond V. Meyer (NASA Langley Research Center, one nugget)

B Budget

The budget for the workshop is \$21,000. This amounts to 35 participants at \$600/participant. In the end there were 31 participants with the following costs: roughly as follows:

- \$4,095.68 Hotel for one night for 25.
- \$3,161.20 Travel to Victoria (round trip) for 17.
- \$870.50 Taxi/Shuttle to hotel in Seattle, Shared vans to Airport
- \$878.69 Dinner, Breakfast, Lunch

- \$1,220.00 Travel stipend for those attending workshop, but not STOC
- \$2,375 Art work for and publication of visions (Elaine Parks)
- \$12,615.81 Total

The final costs were quite a bit less than anticipated due to fewer number of participants and some economies of scale with hotels and travel costs.