SIGACT FY'06 Annual Report
July 2005 - June 2006
Submitted by: Richard E. Ladner, SIGACT Chair

1. Awards

- Gödel Prize: Manindra Agrawal, Neeraj Kayal, and Nitin Saxena for their paper "PRIMES is in P" in the *Annals of Mathematics* 160, 1-13, 2004. The Gödel Prize is awarded jointly by SIGACT and EATCS.

- Donald E. Knuth Prize: Mihalis Yannakakis for his seminal and prolific research in computational complexity theory, database theory, computer-aided verification and testing, and algorithmic graph theory. The Knuth Prize is given jointly by SIGACT and IEEE Computer Society TCMFC.

- Paris Kanellakis Theory and Practice Award: Gerard J. Holzmann, Robert P. Kurshan, Moshe Y. Vardi, and Pierre Wolper recognizing their development of automata-theoretic techniques for reactive-systems verification, and the practical realization of powerful formal-verification tools based on these techniques. This award is an ACM award sponsored in part by SIGACT.

- Edsger W. Dijkstra Prize in Distributed Computing: Marshal Pease, Robert Shostak, and Leslie Lamport for their paper "Reaching agreement in the presence of faults" in *Journal of the ACM* 27 (2): 228-234, 1980. The Dijkstra Prize is given jointly by SIGACT and SIGOPS.

- ACM-SIGACT Distinguished Service Award: Tom Leighton for his exemplary work as Chair of SIGACT, Editorships, Program Chairships and the establishment of permanent endowments for SIGACT awards.

- Best Paper Award at STOC 2006: Irit Dinur for "The PCP Theorem via Gap Amplification".

- SIGACT Danny Lewin Best Student Paper Award at STOC 2006: Anup Rao and Jakob Nordstrom for "Extractors for a Constant Number of Polynomial Min-Entropy Independent Sources" (Anup Rao) and "Narrow Proofs May Be Spacious: Separating Space and Width in Resolution" (Jakob Nordstrom).

2. Significant papers on new areas published in proceedings

These are summaries that were prepared by Madhu Sudan and Jon Kleinberg for a news release. The intention is to make these results accessible to science oriented readers.

Venkatesan Guruswawmi and Atri Rudra. Explicit Capacity-Achieving List-Decodable Codes or Decoding up to the Singleton Bound using Folded Reed-Solomon Codes.

The authors present a new approach for correcting errors in data, an inevitable concern in any system for communication or storage of information. For example in Internet communication it is standard to assume some fixed percentage of the packets that are transmitted will be lost or corrupted. A fundamental challenge to the designers of communication systems is to build error-correcting mechanisms, known as ``codes'', which can add enough redundancy so as to automatically recover from the errors.

A designer of error-correcting codes must deal with questions such as the following: if five percent of packets are corrupted during transmission, how much redundancy should one add? Classical research in the field of Information Theory (dating back to the work of Claude Shannon in 1948) shows that if errors are introduced at random, then the data should have five percent redundancy. But what if the errors are not random, and instead are created maliciously by an attacker? In their breakthrough work, "Capacity-achieving codes for list-decoding", Guruswami and Rudra extend the classical results to handle the case of malicious errors as well. As part of a general result, they give codes that, for example, require only five percent redundancy and come with efficient algorithms to recover from five percent error. Enhancing the practical interest in their result is the fact that their new codes are virtually the ones already in use in many storage devices (CDs, DVDs etc.). The new results suggest that if the data were laid out more carefully, then we may be able to recover from more errors than previously suspected: almost all earlier work suggested that five percent redundancy could protect us from at most 2.5% error.

Irit Dinur. The PCP Theorem by Gap Amplification.

The best-paper award at the Symposium went to another paper dealing with errors, but now in logic. When dealing with mathematical derivations, proofs, or any other form of reasoning, even a single error can often be catastrophic. Indeed it is possible to provide "proofs" of any mathematical statement (true or false) that have only one error. Reviewers of mathematical papers are only too familiar with this state of affairs, having seen thousands of incorrect proofs of famous mathematical conjectures. Theoretical computer scientists have long sought ways to make the reviewers' task easier, by asking: Is there a format in which proofs can be written, that amplifies the error? (So a "random" scan would reveal the error!)

While various versions of this question have found positive answers in the past, Irit Dinur's new work gives a stunning positive answer to this quest. She shows that if we allow the proofs to be slightly longer (by only a constant factor), then the probability of detecting an error can be amplified by a constant factor. So if reviewers of a mathematical proof want to make their job easier, they can simply ask for a longer proof and then errors, if any, will be more evident. Building on this result, Dinur derives a new, vastly simpler, proof of a previously acclaimed result called the "PCP Theorem". The PCP theorem has long served as a beacon to the field of approximation algorithms, a field whose goal is to design efficient algorithms to solve computational problems near-optimally.

The Complexity of Computing a Nash Equilibrium. Constantinos Daskalakis, Paul Goldberg, and Christos Papadimitriou.

The authors present new results establishing the computational difficulty of a classical problem in the study of strategic interaction. When economists and political scientists study multiple parties in competition with one another (for example, in a negotiation, in a political campaign, or in warfare), they often analyze the situation using the concept of a "Nash equilibrium": a collection of strategies from which no party has the incentive to deviate. This notion, proposed originally by John Nash (the subject of the biography and movie "A Beautiful Mind") has been a valuable research tool for half a century, but a long-standing puzzle has surrounded it: when presented with the "rules" for one of these competitions, how difficult is it to actually compute a Nash equilibrium?

Daskalakis, Goldberg, and Papadimitriou provide new, powerful evidence that the problem is in fact computationally very hard, even when the number of participants is very small. In particular, Nash originally used sophisticated tools from the mathematical subject of topology to establish his results about equilibrium; in their new work, the researchers establish a connection in the opposite direction, showing that computing
an equilibrium is in fact as difficult as solving certain of the topological problems on which Nash based his original analysis. These new results on computational difficulty provide an important contribution to recent reconsideration of the role of Nash equilibrium: if it is hard for participants in

even modest-sized competitive situations to even determine an equilibrium, then it should not be surprising when they in fact behave in ways not predicted by the Nash equilibrium model.

3. Significant programs that provided a springboard for further technical efforts

The new *ACM Transactions on Algorithms* was launched this past year. Although SIGACT itself was not directly involved in the creation of the new journal, its leadership and members were. This new journal provides a stable and affordable publication venue for a large segment of SIGACT members.

4. Innovative programs which provide service to our technical community

The TCS Funding Committee sponsored by SIGACT has been very active this past year. The committee meets by conference call monthly and has developed and executed action plans to help increase the funding base for theory of computation at the NSF. Examples of actions are two NSF-sponsored workshops on the Theory of Networked Computing leading to the possible creation of a new program within the NSF.   In addition, a brochure targeted at policy makers in business and government is being created. The brochure will explain the exciting future directions in the field.

SIGACT, with the help of ACM headquarters, has produced four press releases for the Gödel and Knuth Prizes and for the SODA and STOC conferences. This effort is intended to make our research more accessible to the general public.

SIGACT and SIGOPS asked and received approval from the ACM Awards Committee to add EATCS as a co-sponsor of the Edsger W. Dijkstra Prize in Distributed Computing and double the award from $1,000 to $2,000. The added funding comes from EATCS.

SIGACT continues to support student attendance at SODA, FOCS, and STOC by funding Student Best Paper Awards, travel, lunches, and reduced registration fees. This helps ensure that the maximum number of students can attend these conferences.

There are plans to participate in the ACM Student Research Competition at the undergraduate level.   At FCRC 2007, SIGACT will sponsor an undergraduate poster competition.   Involving undergraduate students at our conference is new to SIGACT, and we hope to interest more undergraduates to pursue theoretical research by involving them more in our conference.

Improvements are being made to the SIGACT sponsored Automated Conference Submission System. The SIGACT server at the University of Nevada, Las Vegas hosts the system that is used by a number of theory conferences around the world.

5. Summary of key issues that the membership of the SIGACT will have to deal with in the next 2-3 years

As was mentioned last year, the key issue for our community is funding for research. The TCS Funding Committee is tackling this problem directly.

Related to the funding issue is the image of theoretical computer science within computer science, the science community as a whole, and the public. Articulating the importance of theoretical computer science research is essential so that these outside communities understand and appreciate what we are all about.

There is also concern about the academic job market which is affected by the lack of growth in computer science majors.

The rising costs of proceedings and journals and the move toward electronic publication is of concern. University libraries are cancelling subscriptions to some journals completely and are moving toward electronic, non-paper, access to save money.1. Awards that were given out

2. Significant papers on new areas that were published in proceedings
3. Significant programs that provided a springboard for further technical efforts
4. Innovative programs which provide service to some part of your technical community; and
5. A very brief summary for the key issues that the membership of that SIG will have to deal with in the next 2-3 years.
6. Updates on volunteers