How (and Why!) to Write a SODA Paper

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The Symposium on Discrete Algorithms (SODA) is in some sense a cross-cultural experiment. Discrete mathematicians and theoretical computer scientists have a huge overlap of interests, especially in the area of algorithms; and SODA's two sponsoring organizations, ACM Sigact and SIAM's Special Activity Group in Discrete Math, felt initially that these two groups could meet in equal numbers at SODA and benefit greatly from interaction.

The format chosen for SODA was that of FOCS and STOC, the general annual meetings of the CS Theory community, and of several other, more specialized annual meetings. This format has some significant advantages, and disadvantages, relative to the typical format of a discrete mathematics meeting such as SIAM's own Conference on Discrete Mathematics. The issue, however, is not which format is better; the fact is that by and large, computer scientists are accustomed to the SODA format and mathematicians are not.

The result should, perhaps, have been predicted: submissions from the mathematical community are in short supply. Mathematicians are put off by the strict deadlines, the uncertain acceptance, and the unfamiliar requirements of an "extended abstract." Eventually they are put off by the shortage of mathematicians at the meetings themselves.

Does that mean it was unfair to the mathematicians to use the computer science format for SODA? In fact it is possible to argue the opposite. The mathematical community can, in principle, benefit hugely from SODA: it really does need a meeting where (1) all the material presented is up-to-date, (2) talks are selected by content rather than by speaker, and (3) written versions of the talks are instantly available. SODA is a wonderful meeting for a student, or any newcomer to the world of algorithms, to attend. Extended abtracts and "proceedings papers" are a useful way to get stuff quickly into print, and serve as pointers to the full journal article appearing later. Finally, SODA can serve to acquaint mathematicians with the computer science way of life, helping them to submit to STOC and FOCS and other computer science conferences.

To some extent, SODA is "just another standard meeting" to the computer scientists, although one that happens to be a good place to submit work on algorithms (including applications and experimental work). One could argue that computer scientists could use some meetings more like discrete math meetings, where talks can be contributed and informally presented, and can be expository or dedicated to conjectures instead of results. But they don't have these opportunities at SODA.

Thus I would like to encourage mathematicians to attend SODA and submit papers, rather than lobby to change the format. But I sympathize with those who have submitted good work only to have it rejected by the SODA committee; this article is part of an effort to put that right.

Let me first assure you all that the SODA committees are not prejudiced against submissions by mathematicians, and in fact the two on which I have served have tried especially hard to accept mathematical submissions that vary somewhat from expected format. The leaders of the sponsoring organizations have also tried to make sure the committees contained people who would recognize good non-computer-science work when they saw it.

However, some (in retrospect) excellent papers have been rejected in past SODAs, and some pretty junky ones accepted. This is regrettable but unavoidable, and occurs in all such competitive meetings; computer scientists are (mostly) used to it, regarding the committees as part intelligence, part lottery. The value of having the overall program meet a reasonable threshold of significance is thought to outweigh the inequities of an imperfect decision mechanism.

What mathematicians *can* do is to maximize the probability of acceptance by knowing what the committees are looking for, and formatting their submissions accordingly. This is what I will, in what follows, try to help you do. Why me? Am I particularly good at writing extended abstracts? No, but I did start life outside the computer science theory community and know the growing pains. I've submitted lots of extended abstracts (with lots of rejections) and been to many meetings of both formats. But mainly, I'm the sucker they asked to write the article...

Form

There are just two major points which mathematicians need to remember when preparing an extended abstract for SODA (or any similar meeting). The first concerns the background, or "setting," of a piece of research. Papers in discrete math are often intended for small, specialized audiences, who know what's happening in a given subfield. But SODA papers are read by a wide audience (including, especially, the organizing committee) and thus have to be set in context. You should be willing to spend as much of the ten pages explaining background and motivation as in presenting results and proofs—maybe more; remember, you don't have to include the proofs!

The background should be reasonably self-contained. Don't say "For motivation, see [9]"; instead, "The brick-tiling problem, originally motivated by road construction [9], has generated renewed interest on account of its connection with electronic knitting machines." Similarly, instead of "we solve the following problem of Swackhammer [4]", give a history of the problem and explain why, even if there is no practical motivation, its solution is of interest in the theory of algorithms.

Chase down references which pertain, or even look like they pertain, to your results; if the latter explain why they are different. The SODA committee members will often know of a recent work which sounds relevant, and will ask themselves if you have taken it into account. In theory they should look it up and compare, but they don't always have the time; best if you say "Note that Beck and Call's algorithm [15], while it also runs in time $n^2 \log n$, applies only to *acyclic* digraphs."

The second major point concerns modesty. Contrary to what you might have heard this commodity does exist in the computer science world, but it is not highly valued in an abstract. Right at the top of your paper, in the abstract of your extended abstract, you should say what you've done, why it's important, and how much better it is than what's been done before!

There is an admirable tradition of understatement in mathematics, and it's kind of nice to incorporate an element of suspense when you write a paper. How nice to have the reader smile when he hits your elegant Theorem 3.4 on page 8, and compares it with Van den Snikkerheuven's clumsy, weak result. But for your SODA paper, forget suspense: sell your results immediately in the abstract, and resell them in the body. "Our algorithm is faster than Thistlethwaite's by a factor of n and even outstrips Abercrombie's popular strip-mining heuristic, as our experimental results show, while providing a guaranteed performance ratio in the low thousands." Be accurate and complete, but positive: "Our modification would seem to be difficult to implement and does not offer improved performance for data in the most commonly observed range, but as the first to break the $\exp(\sqrt{\log n}\sqrt{\log \log n})$ barrier, it suggests that practical, efficient new algorithms may be around the corner." And if you're the first to do something, say so: "Our proof that the set of fungible graphs is recursive is the first which does not rely on the classification of finite simple groups."

Substance

I expect most of you have a pretty good idea of what topics are considered appropriate for a SODA paper, but let me just add that the study of algorithms is very broad and SODA committees welcome, indeed strongly encourage, submissions which are far from the standard "better algorithm for doing X." Some topics (maintenance of data structures, communication in parallel machines) will naturally be more of interest to computer scientists, others (construction of block designs, generation of constrained permutations) to mathematicians, but most SODA papers are of some interest to both groups.

Papers about heuristics and empirical results are especially encouraged, and the SODA committee will bend over backwards to accept papers which deal with practical algorithmic problems. Theorems are nice to have but not always obtainable, and results of well-thought-out experiments can be very valuable indeed.

When you do obtain theorems, remember that the proof can be left out of your SODA abstract (hopefully in favor of useful background information). But if the proof is the interesting part, you should of course leave it in or sketch it as space permits. Also, if the result is particularly surprising, a sketch of the proof will help persuade cynical referees that it really is true. (Yes, false theorems have appeared with embarrassing frequency in extended abstracts; a shortcoming of the format.) If you *have* a long, detailed proof written out, you should include it (as an Appendix) with your submission. After your extended abstract is accepted, when you write the slightly fleshed-out paper which will actually appear in the proceedings, you can replace the appendix by indications of the proof in the body of the paper.

Finally, you'll find it's useful to have a draft of the journal version of your paper ready when the meeting is held. *Lots* of people read the SODA papers—likely many more than would see the journal version if they were not led to it by the SODA Proceedings. You may be asked for a draft of your journal paper and this is a great opportunity to spread your fame and get valuable comments for the final version.