

## **SIAM Activity Group Discrete Mathematics Charter Renewal Application**

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Discrete Mathematics. The SIAG/DM was originally formed under the aegis of SIAM on July 19, 1984 by the SIAM Council and July 20, 1984 by the SIAM Board of Trustees. Its initial operating period began January 1, 1985 and ended December 31, 1987. Its charter has been renewed by the council and board ten times thereafter.

This SIAG had 557 members and, of those, 238 were students as of December 31, 2015.

According to its Rules of Procedure:

It is the purpose of the SIAM Activity Group on Discrete Mathematics to foster research in discrete mathematics and the development of its applications, and to bring together and stimulate interaction between the various and diverse communities of mathematical scientists such as those who specialize in combinatorics, computer science, communications, and operations research. Within the framework of SIAM, the SIAG will conduct activities that implement its purposes.

The SIAG on Discrete Mathematics will organize activities in discrete mathematics. The SIAG is expected to:

- 1) Organize minisymposia at the SIAM Annual Meeting on years when there is no SIAG conference.
- 2) Organize a track of at least six minisymposia at the SIAM Annual Meeting at least once every seven (N.B.: previously, when there were fewer SIAGs, this number was five). The VP for Programs and the VP at Large will coordinate the scheduling with the SIAG chairs.

Other activities can include:

- 3) Organize a biennial SIAM Conference on discrete mathematics. The SIAG will consider dovetailing specialized workshops and conferences with the SIAM Annual meeting or other SIAG conferences. The chair of the conference organizing committee shall be either the program director or the chairperson of the SIAG or their designee. The organizing committee must be approved by the VP for Programs at least 18 months before the conference.
- 4) With the approval of the SIAM Program Committee, the SIAG may organize special sessions at SIAM meetings, and conduct special one- or two-day meetings immediately before or after a regular SIAM meeting. Other SIAG meetings may be organized only with the approval of the SIAM president and vice president for programs.

SIAG meetings, workshops, and conferences may be organized only with the approval of the SIAM president and the SIAM vice president for programs.

The SIAG has complemented SIAM's activities and supported its proposed functions. The answers to the questions below indicate how this was accomplished and what the officers propose as the future directions for the SIAG.

1. How is the field covered by the activity group doing? Is it growing, is the focus shifting? What have been the significant advances over the last two years?

The field of discrete and algorithmic mathematics is vast and growing. Interest in discrete mathematics is in part driven by technological advances, in particular, the means to collect and process dynamic, spatial, temporal data. Network models abound across many fields, including the social sciences and humanities as well as science and engineering. Traditional algorithmic problems must be reformulated and addressed in the context of streaming data, incomplete data, uncertain data, etc. At the same time, recognition of the foundational importance of discrete mathematics and discrete mathematicians continues to grow.

The field is highly international, with particular strength in Europe, where it has deep roots, as well as Asia, and Canada and the US. European researchers (e.g., to name but one, Kurt Melhorn of the MPI for Informatik in Saarbrücken) have inspired and overseen the implementation of extensive libraries of code for combinatorial algorithms and geometry algorithms (e.g., the LEDA and CGAL projects). The principle of these projects is to provide robust, well-documented implementations, so that theory can be put into practice. Such projects, while not arising from the SIAG/DM, do serve to illustrate the impact of the DM field internationally, as well as its alignment with SIAM goals.

It would appear that there is considerable research funding available within the EU for discrete mathematics. Typically group proposals must budget for and plan workshops and collaborative meetings. There are a number of conference centers and organizations of interest to DM that run meetings, newsletters, etc.

Douglas West, a previous officer of the SIAG DM and a long-time leader in the community, maintains, on his website at U. Illinois, a list of conferences of interest to the DM community. Essentially, at this point in time, there is a DM conference going on somewhere in the world every day of the year. (Such a list of links might be mirrored by SIAM as service to the SIAG DM community and other SIAGs; this would also increase visibility for SIAM's activities.)

The international Discrete Mathematics community benefits from a popular, widely used electronic messaging service called DMANET, based in Germany at the U. Köln. Subscribers receive many postings per week. These announcements include funding opportunities, postdoc positions, workshops, schools, conferences, etc. This service is extremely informative and keeps the community aware of events and opportunities both in Europe and internationally. However, it does not provide news articles, survey articles, etc., chapter news, etc., the way a newsletter would do.

In summary, there has been an explosion of opportunities for research, professional networking and collaboration within the DM community worldwide. SIAM, largely through its support of the conferences SIAG/ DM and SODA, helps to maintain the strength of DM in North America.

2. How is the activity group doing? Is it remaining vibrant? Is the size of the SIAG stable or increasing? How is the SIAG keeping up with the changes in the field? How are the broader interests of SIAM reflected in the activities of the SIAG?

Recent meetings of the SIAG's biennial discrete mathematics conference SIAM/DM have been very successful and well-attended. Registrations at the SIAM/DM 2016 totaled 340 as of the time of the business meeting, two days before the conference end. The SODA conference (Symposium on Discrete Algorithms), which is co-sponsored by the SIAG/DM and ACM SIGACT is likewise thriving.

The SIAG/DM has kept apace with changes in the field through a long standing tradition of choosing superb conference organizing and program committees, which in turn select outstanding speakers at the SIAM/DM and SODA conferences and propose and invite a variety of topical minisymposia, both pure and applied. Applied and industry speakers are, as a rule, sought after and represented. Quality, leadership in the field, and topicality are key criteria in the planning of these meetings.

In practice, the invited speaker's or symposium organizer's affiliation or non-affiliation with SIAM is (as far as we know) not a consideration, that is, people are not excluded from consideration due to lack of SIAM membership. The SIAG has simply aimed for the best people to keep its membership apace with the field. No doubt for that reason, SODA is consistently ranked as a top tier conference on lists of discrete algorithms conferences.

In keeping with the broader interests of SIAM, the SIAG/DM2016 organizing committee had two co-chairs, one from academia (Dana Randall, Georgia Tech) and one not from academia (Henry Cohn, Microsoft Research New England). The SIAG/DM intends to continue the practice of having two co-chairs, one non-academic and one academic.

The SIAG is crucial to SIAM interests in that it provides a bridge to the theoretical computer science and algorithms communities, the combinatorial optimization and the OR communities, as well as to the ACM and MAA. Keeping these substantial communities and their application areas in contact is a significant feat, and provides a solid base upon which further SIAM interests can be grown. Ideally, the objectives of both SIAM and the SIAG would be well-served if SIAM/DM and SODA can provide a platform for multidisciplinary and interdisciplinary activities that bring other application areas into the mix. At present, keeping the various member areas of the discrete mathematics extended family in contact is a substantial and important enterprise.

The SODA conference continues to host two annual workshops of particular interest to the SIAM/DM community, namely, ALENEX (ALgorithm ENgineering and EXperiments) and ANALCO (ANalytic ALgorithms and COmbinatorics).

3. Please list conferences/workshops the activity group has sponsored or co-sponsored over the past two years, and give a brief (one sentence or phrase) indication of the success or problems with each.

On June 16-19, 2014, in Minneapolis, Minnesota the SIAG/DM conference had 319 attendees of which 44 were students. There were 46 minisymposia sessions, including both traditional combinatorial and discrete mathematics themes (e.g., posets, designs, extremal graph theory, discrete geometry) as well as themes related to other fields (e.g., hardness of approximation, positional and combinatorial games, statistical mechanics, polymer models). The organizing committee was comprised of absolutely superb people in our field as broadly defined.

The SIAG/DM16 conference took place in Atlanta, June 6-10, 2016. The Dénes König Prize (SIAG/Discrete Mathematics) was awarded to Lutz Warnke, who gave a prize talk entitled “Phase transitions in random graph processes”. The prize honors Dénes König, an early pioneer in discrete mathematics and author of the first book on graph theory. The award was established in 2007 and is given every two years, at the SIAG/DM conference. Warnke was the 5<sup>th</sup> recipient of the prize.

SODA14, which was the 25<sup>th</sup> SODA, took place in Portland, Oregon, January 5-7, 2014. It was co-located with ALENEX14 (Algorithm Engineering and Experiments) and ANALCO14 (Analytic Algorithms and Combinatorics). Industrial sponsors included Google, IBM Research, and Microsoft Research. It included a school on Analytic Combinatorics and the Analysis of Algorithms. It was followed by an NSF-sponsored workshop on Self-organizing Particle Systems.

SODA15 was held January 4-6, 2015, in San Diego. It was co-located with ALENEX15 and ANALCO15. A workshop on Algorithmic Challenges in Machine Learning took place following the conference. Industrial sponsors were Google, IBM Research, and Microsoft Research.

SODA16 took place January 10-12, 2016, in Arlington, Virginia. It was co-located with ALENEX16 and ANALCO16. A workshop on Sublinear Algorithms took place immediately before the conference, and a workshop on Multi-dimensional Proximity Problems took place immediately after the conference.

The format of all these SODA conferences featured three plenary speakers. The set of invited speakers has good representation of women, industrial researchers, and researchers in the international research community. The conferences attract industry sponsorships.

SODA consistently appears as a top-tier conference on various ranked lists of conferences. The SIAG/DM has liaison officers to interact with SIGACT for purposes of SODA co-ordination. These officers are currently Daniel Král' and Pavol Hell. Pavol was kind enough to discuss his experiences in this role in a recent skype interview. He reported satisfaction with the interactions, and felt strongly that the interests of the SIAG DM community are currently being respected and well represented in every aspect of his SODA interactions.

He later sent the following communication.

From: Pavol Hell <pavol@sfu.ca>  
Sent: Tuesday, May 3, 2016 5:01 PM  
To: Sue Whitesides  
Subject: SODA

The SODA Steering Committee consists of the Chair, currently Cliff Stein, and two representatives each from the ACM SIGACT and SIAG DM. The current SIAG members are Daniel Kral and Pavol Hell. (The SIGACT members are Dana Randall and Shang-Hua Teng.)

SODA is the best venue for interaction between the SIGACT and SIAG DM researchers. The Steering Committee jointly selects a PC Chair agreeable to both communities, who then works with at least one representative from each group to select PC members. It is understood by both groups that it is crucially important to have respected names from both communities on the PC, in order to encourage submissions from both communities.

The SODA conferences are one of the most successful aspects of our SIAG.

--- end of message from Pavol Hell (SIAM fellow).

Likewise, SIGACT Chair Michael Mitzenmacher, whom I met with personally, and Phil Klein, the PC Chair of SODA 17, whom I met with by skype, have been very positive and supportive. Michael is particularly interested in broadening the scope of SIGACT and SODA activities, and is highly supportive, for example, of implementation forums such as ALENEX. Indeed Michael co-chaired ALENEX16 (with Michael Goodrich).

4. Please indicate the number of minisymposia directly organized by the activity group at the last two SIAM Annual Meetings. When did the SIAG last organize a track of minisymposia at an annual meeting?

*\*Because of the number of Activity Groups, the current guidelines are that an Activity Group should organize a track about every seven (7) Annual Meetings or meet jointly with the Annual Meeting within a seven (7) meeting period.\**

The SIAG/DM contributed 10 minisymposia to the International Congress for Industrial and Applied Mathematicians ICIAM, August 10-14, 2015, in Beijing; in support of the International Congress, of which SIAM is a member, SIAM did not hold its own annual meeting in 2015. The minisymposia were coordinated by outgoing SIAM/DM officer Guantao Chen of Georgia State University.

Looking ahead to 2017, SIAM/DM outgoing officer Lenore Cowen is coordinating a contribution of 10-12 minisymposia from SIAG/DM to SIAM/AN2017 in Pittsburgh.

Evidently there are serious scheduling difficulties that have in previous years presented a barrier for SIAG/DM participation in SIAM annual meetings. Most notably, since 2007 there has been a scheduling conflict with the CanaDAM conference (Canadian Discrete Applied Mathematics conference, co-sponsored by the Fields Institute, the Pacific Institute of Mathematical Sciences, the Canadian Math Society, and the Centre de Recherche en Mathematiques). CanaDAM was founded by Pavol Hell and Derek Corneil, among others. Pavol and Derek have both provided much service to SIAM and the SIAG/DM. Their vision was to create CanaDAM as a mirror of the SIAM/DM conference, taking place in odd numbered years (SIAM/DM takes place in even numbered years). CanaDAM first ran in 2007.

The same community of people internationally is involved (in both planning and presenting) in both conferences, and both conferences occur around mid-June in their respective years. For example, CanaDAM2017 takes place in Toronto, June 12-16, 2017. The SIAM AN17 takes place in Pittsburgh, July 10-14, 2017.

Solutions to this scheduling problem and the consequent lack of the SIAG/DM's contributions to SIAM ANs are being solicited and discussed. These include co-located workshops co-organized with other SIAGs, schools for graduate students in topics of mutual interest to SIAG/DM and other SIAGs, implementation and visualization challenges of interest to more than one SIAG, etc. Such activities could also be held outside the context of a regular SIAM or SIAG meeting. Lenore Cowen (an outgoing SIAG/DM officer who has made tremendous and ongoing contributions to the SIAG) mentioned that a previous attempt to contribute to the SIAM AN was frustrated by scheduling complications, as other SIAGs and workshops within SIAM are not aware of the CanaDAM complication. As noted above, Lenore is co-ordinating a contribution of 10-12 minisymposia from SIAG/DM for the Pittsburgh meeting in 2017.

The main barrier to lack of SIAG/DM participation in SIAM ANs appears to be not lack of interest, but rather schedule coordination issues with other groups and people, many of whom are likely to be involved in CanaDAM. This can be worked out, with input from the SIAM and DM communities.

A promising, potentially on-going solution to the scheduling problem arose in discussions at the SIAG/DM2016 meeting, namely, a suggestion that the SIAG/DM officers would each year

contact DM colleagues working in the vicinity (say, a few hour's drive radius) of the next AN, and ask for/coordinate minisymposia contributions. That way, the AN could provide an opportunity for DM people in the geographic region to get meet at the AN. Trying out this idea right at SIAM/DM2016 netted several expressions of interest from people at the meeting (e.g., Alan Frieze and Po-Shen Loh from CMU in Pittsburgh, Mike Malloy of U. of Toronto, and Sandra Kingan from Brooklyn College CUNY), as well as suggestions of others not present at the meeting.

The DM community has regularly and actively supported the contributions of SIAM to the AMS MAA joint meetings JMM, e.g., by contributing SIAM special sessions, participating in planning, etc.

5. Please indicate other activities sponsored by the activity group, to include newsletters, prizes and web sites. Have each of these been active and successful?

As noted above, the SIAG/DM awards biennially the Dénes König Prize. There is a process in place for seeking nominations and selecting the winner. This process appears to be working well. This year's winner was Lutz Warnke, who presented the König Prize lecture at SIAM/DM 2016.

SIAG/DM Newspaper: this newsletter is apparently no longer produced in paper form. In its place, the SIAG/DM Secretary (currently Geir Agnarsson) monitors an electronic mailing list. Previously, the newsletter was managed by Mark Kayll at the University of Montana and Ryan Martin of Iowa State; they are being contacted for their feedback. Publically available lists of meetings and open problems are maintained by members of the DM community, Douglas West and Bojan Mohar.

A new liason officer with SIAM with regard to the SIAM Newsletter has been appointed: Dorit Hochbaum, who also serves as the current Vice Chair of DM. Indeed a number of articles with a discrete math flavor have appeared in recent SIAM Newsletters, and the SIAG aspires to a continuing stream of such articles. Furthermore, the invited speakers at SIAM/DM2016, including the König Prize winner, have been asked for suggestions for people to write about the themes of their presentations. They were generally receptive, as were the organizers of minisymposia of particular interest to industry. One such example is Cynthia Dwork of Microsoft Research, who spoke about differential privacy. Thus, the biennial SIAM/DM meeting can provide an excellent source of topics and meeting highlights for the SIAM newsletter.

6. What activities are planned and proposed for the next period of the charter? Please describe scheduled and suggested future activities in detail.

Our understanding from SIAM is that the next period of the charter as envisioned by SIAM is to be of 1 year duration, namely 2017. This is a very short time frame that creates some difficulties for the SIAG; indeed, further below we request a three-year renewal.

*In the short term*, the SIAG/DM plans to contribute several minisymposia to the SIAM Annual Meeting in Pittsburgh in 2017. Lenore Cowen, the previous SIAG Vice Chair, is serving as coordinator of this effort. A number of proposed topics and suggested minisymposia organizers arose during the SIAM/DM 2016 conference (e.g., attendees Alan Frieze and Pho, both of CMU, informally agreed to organize minisymposia, as did Sandra Kingan of CUNY). Apparently, the invited speakers at the SIAM AN 2017 are still under discussion by the organizing committee.

*Also in the short term*, the current officers fully support a membership drive. The SIGACT Chair and the SODA17 PC Chair have been contacted and are highly supportive. However, the intent to propose a change to conference registration practice, as mentioned in the preliminary charter renewal dated May 31, 2016, no longer seems advisable, at least, not without a careful survey of the SIAG membership. Discussions with attendees of SIAM DM 2016 in June in Atlanta indicated that, while many attendees have grants that can refund conference registration fees (and in particular, increased registration fees), there are also many SIAG members or potential members in the US who have very limited access to funds for travel of any sort. Those people see the biennial SIAM /DM conference as THE conference they must attend: unlike AMS meetings, the SIAM /DM conference focuses directly on discrete mathematics and its applications.

Fee structure continues to be a barrier to membership, and a membership drive is needed to jumpstart the DM membership in SIAM again. It is essential, however, to carry out a carefully designed survey of meeting attendees (whether or not they are SIAM members) and also those with either current or lapsed SIAM membership to determine what would attract new and former members.

The Business Meeting at SIAM/DM 2016 unanimously endorsed a proposal from University of Colorado, Denver to host the SIAM/DM 2018 conference in Denver. Proposed conference co-chairs will be forwarded to SIAM for approval in the coming weeks. Local industry and government organizations include HP Enterprise and the National Center for Atmospheric Research.

Looking ahead to 2020, members of the discrete math group DIMATIA and the current Dean of the Faculty of Mathematics and Physics at Charles University in Prague (Jan Kratochvíl) are very excited about the possibility of hosting SIAM/DM2020. This was also mentioned at the Business Meeting, where it was noted that 2020 would present the next available opportunity to hold the SIAM/DM conference together with the SIAG Optimization Conference on Optimization OP, which is on a 3 year cycle. At the Business Meeting at SIAM/DM2014, interest was expressed in holding the SIAM/DM conference in Paris; however, the potential organizer (Reza Naseri) is currently changing institutions in Paris, and did not generate a proposal for DM2018. However, SIAM/DM 2020 in Paris could remain a possibility. If the location for SIAM Optimization Conference in 2020 has not yet been chosen, then it might be



possible to hold both meetings together in either Paris or Prague. This remains to be investigated.

The SIAM/DM conference has yet to be held outside North America. One attendee of the Business Meeting of SIAM/DM2016 inquired as to the proportion of conferences around discrete mathematics themes in North America versus, for example, Europe.

#### 7. How can SIAM help the activity group achieve its goals?

SIAM can support the membership drive by providing mailing lists of former members whose membership has expired as well as mailing lists of SODA attendees, SIAM/DM attendees, and attendees at workshops and SIAG meetings that are likely to be most related to DM, especially the workshops on combinatorial computing and network science.

SIAM can work with the SIAG to find a solution to the registration/membership fee issue. Discussions at SIAM/DM2016 indicated that some meeting attendees can get conference registrations, but not professional society membership fees, reimbursed by grants, and they therefore support the idea of raising conference fees to essentially offset the cost of lowered SIAM membership fees; at the same time, other meeting attendees have little to no access to funding to attend conferences, and they therefore very much oppose the idea of increasing conference registration fees. Perhaps some kind of tiered membership or registration fees might be possible, to be worked out with SIAM.

SIAM can assist the SIAG/DM in surveying the other SIAGs as to areas of intersection of interests with SIAG/DM. This should probably be a regularly scheduled survey, given the dynamic nature of the application areas involving discrete mathematics.

SIAM can assist the SIAG/DM in raising awareness of SIAM and the SIAG's relation to it, again by running surveys. These should be carefully and professionally thought out for maximum usefulness, and the results should be collected by SIAM for maximum visibility. The questions, for members, former members, and non-members, can solicit feedback on proposed SIAG activities, particularly at the AN, e.g., poster sessions, problem sessions, prizes for student papers, short-courses, visualization challenges, education forums, contests, activities for graduate students, colocations with other workshops. For example, the AN could feature an annual poster contest event for graduate students in all SIAM areas in which the theme is discrete mathematics and its intersections with other fields. The SIAG/DM should survey the potential interest and support of such activities, which would also serve to heighten interest in SIAM more generally.

In addition, suggestions for nominations for SIAM fellows in DM areas could be sought. It is important to survey the community, not just those who already belong to SIAM.

SIAM can assist the SIAG in determining whether some co-ordination/collaboration with the Workshops on Combinatorial Computing and on Network Science could be possible. In skype meetings with both Fred Roberts and John Gilbert (two of the co-authors of the report of the 2003 Ad Hoc Committee on Discrete Mathematics, chaired by Bruce Hendrickson), the theme of network models would be an obvious candidate around which to plan some events. Such a theme could bring together groups interested in disease modelling, biological networks, social network analysis, network visualization, etc. Discussions will continue at the upcoming Network Science Workshop at the SIAM AN16 in Boston.

8. How can the activity group help SIAM in its general role of promoting applied mathematics and computational science?  
  
and ...
9. How can the activity group help SIAM in its general role of promoting discrete mathematics?

These questions are closely linked and are answered together below.

The SIAG/DM can continue to maintain and grow its connections with European and international researchers in discrete mathematics and algorithmic and theoretical computer science. This is essential for the overall well-being of discrete applied mathematics and computational science in North America.

The SIAG/DM can use its existing contacts with researchers in Asia to promote participation in EASIAM, the East Asia Section of SIAM.

The SIAG/DM can work with SIAM to identify candidates for SIAM fellows (see discussion above). Whatever the reason may be, there are currently rather few SIAM fellows in the discrete math area, and there are some glaring omissions, which likely does not attract membership to SIAM among the discrete mathematics community.

Contests have often provided means of attracting young people to STEM fields (for example, lego robot contests, math Olympiads, ACM-IEEE international programming competitions). Discrete mathematics could provide resources for competitions, perhaps encourage team problem solving/programming efforts. Annual competitions held in connection with the SIAM/AN could be a contribution of SIAG/DM to SIAM/AN. See above re the graduate student poster contest with discrete mathematics and its applications.

SIAM can help the SIAG/DM in a fund raising drive to endow a prize for graduate students, for example, for a best paper award or for a poster in a DM and its applications forum. This could be an annual event at AN, and serve to attract the entire community, as well as stimulate interaction among the various SIAGs. Funding from sponsors such as Microsoft Research, Google, etc. could be sought. (Microsoft and Google do not

appear to be industrial members of SIAM. This might be an avenue for getting them involved.)

Two important discrete applied areas from which SIAG/ DM could possibly attract participation are:

i) computational geometry (Note that ACM Symposium on Computational Geometry recently voted to remove itself from the ACM. This year 2016, SoCG has organized its own meeting adjacent in time and place to ACM STOC. However, SIAM DM and SIAM might provide a more natural fit.)

and

ii) graph drawing and network visualization. The current Chair of the Steering Committee of this community (Giuseppe Liotta of U. Perugia) has already been approached and is very receptive to collaboration with SIAM. In particular, the GD community runs an annual workshop/school for graduate students about some topic in network layout/visualization, and it would like to explore the possibility of running such a workshop at SIAM/AN every year. Likewise, the annual GD symposium features a visualization and layout challenge contest. Industries have been involved in providing the visualization challenge problems. This has stimulated a lot of research, encouraged implementation of theoretical work, and brought people together across a range of interests.

If this application for SIAG renewal is viewed positively by the SIAM Council and Board of Trustees, the SIAG would appreciate renewal for a three-year operating period beginning January 1, 2017. The three-year period is requested so that i) the SIAG does not have to request renewal twice in one year, and so that ii) the new SIAG officers in 2018 are not immediately faced with a charter renewal due before the SIAG/DM 2018 meeting, and most importantly so that iii) there is a reasonable time frame to develop and to carry out the program outlined here.

The SIAG/DM thanks SIAM for the opportunity to submit this updated version of the charter renewal application. This has made it possible to obtain input and feedback at the recent biennial meeting, SIAM/DM 2016, in Atlanta earlier this June.

Signed

Sue Whitesides  
SIAG/DM Chair  
June 21, 2016

With collaboration of other SIAG/DM officers Jeanette Janssen (Programs), Dorit Hochbaum (Vice Chair), Geir Agnarsson (Secretary), and Douglas West (Past Chair) and Lenore Cowen (Past Vice Chair)