MathOverflow Grant Report

Grant Number: 2013-5-05 MATH

The goals of the grant were threefold:

1. To incorporate MathOverflow as a 501(c)(3) non-profit.
2. To secure continued technical support from and an open content agreement with Stack Exchange.
3. To create a plan for future improvements to MathOverflow with input from moderators, interested users, and Stack Exchange Network staff.

We are happy to report success on all three goals. Moreover, over the last year, we made progress in the development of MathOverflow.

1. Incorporation of MathOverflow

On May 17, 2013, MathOverflow became a nonprofit nonstock corporation in the state of Delaware. On July 14, 2014, the Internal Revenue Service recognized MathOverflow as a 501(c)(3) tax-exempt nonprofit organization.

This process was carried out with the legal assistance of Schwell Wimpfheimer & Associates, LLP, especially Daniel E. Baron, Esq., Louis B. Barr, Esq., and William S. Galkin, Esq. The process involved several steps listed below and took a year to complete.

- Drafting and adopting bylaws.
- Drafting and adopting a conflict of interest policy.
- Appointing a board of directors.
- Incorporation in the state of Delaware.
- Obtaining 501(c)(3) tax-exempt recognition.

Some steps were more complex than anticipated, especially the application for tax-exempt status. As a result, the process was longer and more expensive than originally anticipated. We had originally estimated the cost of this process to be $8,075 and the final costs were over $10,000.

Copies of incorporation and related legal documents can be found in Appendix B.

2. Agreement with Stack Exchange

On June 24, 2013, the newly incorporated MathOverflow organization signed an agreement with Stack Exchange, Inc., to migrate the original site to the newer Stack Exchange 2.0 platform and join the Stack Exchange Network.

The agreement has two important clauses so that MathOverflow can continue to oversee the site and ensure that it meets the needs and expectations of the mathematical community. The first clause ensures that, in the event of a major divergence of interests with Stack Exchange, MathOverflow can choose to separate from the network with all the data necessary to continue operating the site on another platform.

> *[S]hould MathOverflow wish to migrate its data outside of the Stack Exchange network, Stack Exchange shall, within thirty (30) days of receipt of a written request from MathOverflow, provide MathOverflow with a complete and current database that contains all the data necessary to recreate MathOverflow on MathOverflow's own servers and software. Following such transfer, Stack Exchange will cease all use of the MathOverflow database.*

One example where we would decide to exercise this clause is if Stack Exchange ceases to make the MathOverflow database openly available to everyone. Currently, all content on the Stack Exchange Network is made available under the Creative Commons Attribution-ShareAlike (CC BY-SA) license.

The other key clause is the following, which ensures that MathOverflow can continue to develop and implement new features for the site.

> *Stack Exchange acknowledges that moderators may wish to make reasonable adjustments to the operation of MathOverflow 2.0 by means of extra clientside JavaScript. Thus, moderators shall be permitted to submit additional JavaScript to Stack Exchange which, if it does not compromise the technical integrity of the network, will be inserted into the footer, allowing some reasonable modification of the site that is specific to MathOverflow 2.0. MathOverflow and you acknowledge and agree that the Stack Exchange 2.0 HTML is changing all the time, and accordingly, such JavaScript will need to be actively maintained by the moderators or it may stop working. It is understood that this script maintenance will be the sole responsibility of MathOverflow (including moderators) and not of Stack Exchange.*

The entire agreement can be found in Appendix B. With these provisions, we are confident that the MathOverflow organization will be able to maintain the proper functionality of the site, to develop new functionality for the site, and to ensure that the site meets the needs and expectations of the user community and the greater mathematical community.

MathOverflow moved to the Stack Exchange Network immediately after the agreement was signed by both parties. Through great teamwork with the Stack Exchange staff, the transition process went very smoothly. The process was seamless for most users and we were able to resolve most issues immediately. Overall, this was a great success. MathOverflow benefits from the excellent software stack provided by Stack Exchange, and has all hosting and maintenance

provided without charge. At the same time, our agreement with Stack Exchange ensures we maintain sufficient independence.

3. Development Plan

Throughout the year, the MathOverflow moderators have been researching areas of future improvement for MathOverflow. This research centered on four broad themes:

- Facilitating links to the mathematical literature on MathOverflow.
- Ensuring the accessibility and endurance of the MathOverflow database.
- Extending connections with other Math 2.0 projects.
- Community development and outreach.

Through this research, we drafted a development plan for MathOverflow for the next few years. The research was made possible through input from interested users on the Meta MathOverflow companion site as well as input from the greater mathematical community and experts in other areas.

The original assumptions for doing this involved a certain amount of travel for key staff to work together on prototypes and to study the feasibility of our projects. These travel plans were complicated when one of our key staff had to temporarily withdraw for family reasons. We nevertheless went ahead with the task and used some of the funds earmarked for travel to begin progress on our development plan.

Facilitating links to the mathematical literature on MathOverflow was the easiest to plan. In fact, we were able to use some of the funds of this grant to begin implementation. With the help of Manish Goregaokar, we developed a prototype mechanism that allows users to search and insert properly formatted citations in their posts. These citations contain metadata that can used to link users to the content, either as free or open content, through their university library, or other resources available on a user-per-user basis. Moreover, the same metadata can be used by content providers to link back to MathOverflow in a manner similar to the arXiv trackback mechanism that we have used for years. (Screenshots are available at http://meta.mathoverflow.net/a/1535/3.) Using grant funds, we secured a reliable cloud server from Amazon Web Services to support this new feature. At the time of writing, we are waiting for an agreement with AMS Math Reviews to use their extensive journal database for our new tool. Once we are able to secure database access, we will deploy this exciting new feature on MathOverflow.

Ensuring the accessibility and endurance of the MathOverflow database is one of the more complex issues that we are facing. Since its creation in Fall 2009, MathOverflow has gathered nearly 60,000 questions and 100,000 answers. Many of these contain valuable and original insights from leading experts in a wide spectrum of subjects. It is clear that efforts must be

made for the long-term preservation of this database. Since MathOverflow content is constantly created and updated at a rapid pace, the MathOverflow database is difficult to monitor and ingest into data preservation services.

The MathOverflow database is currently archived along with the entire Stack Exchange Network every few months on the Internet Archive (https://archive.org/details/stackexchange). Over the past year, we have had several meetings with preservation specialists, in particular with Jennifer Mullins, who have generously given their time to explain the complex web of data preservation. With their help, we are currently looking at solutions which would offer additional services, such as better search tools and stable identifiers.

MathOverflow is an outstanding example of a successful startup in the world of online mathematics. While this success is certainly entirely due to the fact that MathOverflow was a great and timely idea, the road to success was not without hurdles. With our expertise and the creation of the MathOverflow nonprofit organization, we are now in a unique position to help other outstanding online mathematics projects navigate similar hurdles. In the long term, we hope that such connections will create a community of online mathematics projects that will help each other grow and prosper.

Community development and outreach activities are key to ensure that MathOverflow will continue to grow and prosper. The creation of the MathOverflow non-profit opens the door to funding interesting outreach activities. MathOverflow had a small presence at the 2014 International Congress of Mathematicians in Seoul and we are planning on being present at more events in the near future. In the longer term, we are planning on collaborating with other organizations to organize meetings and to create prizes to support and encourage research collaborations initiated on MathOverflow. These activities will increase the visibility and presence of MathOverflow as an integral part of the canvas of mathematical research.

The MathOverflow development plan details can be found in Appendix A.

Conclusion

The past two years have seen several milestones for MathOverflow. With the formation of the MathOverflow nonprofit and with the new service agreement with Stack Exchange, MathOverflow will continue to prosper and reach new milestones. We are very grateful to the Alfred P. Sloan Foundation for this generous grant which made this immense progress possible.

Appendix A: MathOverflow Development Plan

Citations to the mathematical literature

We now have a working javascript module and server component to support adding citations to the mathematical literature in MathOverflow. The javascript module modifies the 'edit box', which users use to ask questions or post answers. It adds a button to the toolbar, labelled '\cite', as well as a keyboard shortcut. Clicking the button pops up a dialog, which allows searching the mathematical literature, based on free form input which is matched against titles, authors, and citation data. The best search results are provided, along with, when possible, previews. The user can then select a result, and a nicely formatted citation is pasted back into the edit box. This citation contains full bibliographic information and the best available URL for access to the article.

Status: The javascript module is ready. We have secured a reliable cloud server from Amazon Web Services. We are currently working with AMS Math Reviews to arrange access to their bibliographic database. Once database access has been secured, the new citation feature will be deployed on MathOverflow.

Discussion: http://meta.mathoverflow.net/questions/1485/

Archiving MathOverflow

Currently the only archiving of MathOverflow that takes place is a database dump containing all public data every three months. This data is preserved by the Internet Archive. See https://archive.org/details/stackexchange for an overview of the data available.

This database dump is not in a human readable format and it cannot be directly linked to. While it provides good insurance against disaster and it is of some use for data mining purposes, we would also like to provide a simple archive that is human readable and provides permalinks to static views of MathOverflow posts.

The basic idea is to have a companion site archive.mathoverflow.net which responds to queries of the form http://archive.mathoverflow.net/question/12345/2010-04-08 by returning a static view of question 12345 as it appeared on 2010-04-08 along with a prominent link to the current version of the question on the main MathOverflow site.

Because of implementation details, it would not be possible for this service to be entirely accurate --- in particular, if a comment or entire answer or question were deleted in between the requested date and the date the post was archived, then the deleted content would not appear

on the archive. Similarly, it would not be possible to request archive URLs for the current date, because it is important that the service provides immutable responses.

Status: Planning and drafting specifications for the interface.

We expect that this service would be quite straightforward to implement, based on the existing Stack Exchange API. It would require a server component that uses the Stack Exchange API to build as complete a snapshot as possible of the given question on the given date. This component would save a copy of the response before returning it to the client, and all subsequent requests for the same URL would be answered with this saved copy.

If it proves possible to find a willing programmer from the MathOverflow community, it should be possible to implement this service for only a few thousand dollars. Hosting requirements would be rather low, and essentially covered by existing hosting arrangements. We will need to do a certain amount of further planning and specification before it is possible to come up with sharp estimates on the cost, and determine if the project is achievable by a programming from the MathOverflow community or if we will need more professional, and more expensive, help.

Discussion: http://meta.mathoverflow.net/questions/800/

MathOverflow presence at major conferences

We plan on having a more substantial presence at major conferences, such as the International Congress of Mathematicians (ICM) and the AMS/MAA Joint Mathematics Meetings (JMM). This will increase the visibility of MathOverflow and give us more opportunities for advertising and fundraising. Additionally, such a booth will provide a place for MathOverflow community members to meet in person.

Booths are reasonably priced, especially for nonprofits. Along with equipment, the total cost of one such event is estimated to be between one and two thousand dollars. Even with travel and lodging for volunteer staff, total costs are within reach of a targeted fundraising campaign.

Status: MathOverflow had a small presence at the 2014 International Congress of Mathematicians in Seoul (http://www.icm2014.org/). We are looking for additional volunteers to represent MathOverflow at future events.

Discussion: http://meta.mathoverflow.net/questions/1416/

Partnerships with other Math 2.0 projects

Since the creation of the MathOverflow nonprofit, we are now in a great position to support and partner with other Math 2.0 projects and projects of interest to the greater mathematical community. Over the past two years, we have been involved with several projects:

- Selected Papers Network: a social network based framework to allow users to discuss research papers.
- Math Blogging: a managed aggregator for mathematics blogs.
- Math Talks: a global listing of announcements for mathematics talks, organized by major area.
- hypothes.is: a tool to discuss, collaborate, organize your research, or take personal notes using web annotations.
- MathJax: a JavaScript display engine for mathematics that works in all browsers.

In each case, we have been offering some of our technical expertise and knowledge to help these projects along their goals. In the longer term, we plan on building up resources at MathOverflow to assist Math 2.0 projects in other ways. A common request is to assist projects in securing adequate funding for their ideas. Because MathOverflow currently has limited means, we can only offer very little in that direction. However, as MathOverflow grows, we hope to be able to offer direct or indirect financial assistance for Math 2.0 projects to attain their goals.

In our contract with Stack Exchange, we ensured that we would maintain control of advertising space on the main site. That space is thus available for the promotion of other projects as well as for other uses.

Status: Ongoing contacts with project leaders. Exploring possibilities to expand the range of ways MathOverflow can help, such as advertising and fiscal sponsorship.

Links: https://selectedpapers.net, http://www.mathblogging.org, http://mathtalks.org, http://hypothes.is, http://www.mathjax.org

MathOverflow awards

There have been multiple success stories of research collaborations initiated on MathOverflow. These are the best witnesses the impact of MathOverflow to mathematical research. To advertise and encourage collaborations initiated on MathOverflow, we are currently investigating the possibility of offering awards. The idea is to partner with American Institute of Mathematics (AIM), Mathematisches Forschungsinstitut Oberwolfach (MFO), or similar organizations to offer a MathOverflow themed SQuaRE or Research in Pair, where the awardees can meet in person to continue their collaboration. It is unclear at this time whether partners such as AIM and MFO will be interested in such a project. In the event that partners cannot be found, we could simply offer travel funds.

Status: Early planning and looking for potential partners.

Links: http://aimath.org/programs/squares/, http://www.mfo.de/scientific-programme/long-term/research-in-pairs.