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.

1. Incorporation of MathOverflow

On May 17, 2013, MathOverflow became a nonprofit nonstock corporation in the state of Delaware. On March 26, 2014, MathOverflow filed an application for 501(c)(3) nonprofit status, which will allow the corporation to receive donations to ensure its continued operations.

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 nearly 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.
- Filing for tax-exempt status.

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.

At the time of writing, we are waiting a response to our tax-exempt application from the Internal Revenue Service. This process may take several months but it is not expected meet any new hurdles. 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 hire external help.

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. While this is still a prototype (screenshots are available at http://meta.mathoverflow.net/a/1535/3), we expect to be able to deploy a fully functional citation system by the end of 2014.

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 50,000 questions and over 85,000 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. Our plan to address these issues is to create a MathOverflow archive to serve as a buffer between the rapidly evolving site and data preservation services. This archive will also be useful to create reliable permalinks to MathOverflow content, which will facilitate citations of MathOverflow questions and answers in the mathematical literature.

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. We have been in contact with some very promising startups, such as Selected Papers Network, Math Blogging, and Math Talks. with the hope of creating mutually beneficial connections. 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. To start, we plan on having a MathOverflow kiosk at the annual AMS/MAA Joint Mathematics Meetings, one of the world's largest gathering of mathematicians. 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 year has 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 good prototype 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: Testing and preparing for deployment. Acquiring permission to access bibliographic databases.

Feasibility: There are three essentials steps to deploying this feature.
1. Obtain permission from a good source, such as MathSciNet, to use bibliographic data from their database.
2. Submit the javascript module to Stack Exchange, for vetting and deployment, per the 'javascript clause' of our agreement with them.
3. Set up a stable hosting environment for the server component.

We have had an informal conversation with Robert Bryant, the current AMS president, about leveraging the MathSciNet database for tools like this, and we plan to send the AMS a specific proposal shortly.

We have not yet decided on a plan for a stable hosting environment for the server component. As the server component is currently implemented, it requires a server which can run an application in the Java virtual machine, and bind to a specified port to listen for incoming connections. The simplest option may be to run a virtual machine in Amazon's 'Elastic Cloud Compute' facility. This is relatively cheap --- a micro instance reserved and used continuously for 3 years comes to about $240. Even if a larger instance is required, the annual cost would be at most several hundred dollars.

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

MathOverflow Archives

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, and https://archive.org/download/stackexchange/mathoverflow.net.7z for the latest dump from MathOverflow.

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 useful 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.

Feasibility: 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 blog

The newly founded MathOverflow nonprofit needs an official website. Among other things, this website will serve to make official announcements about the operation of MathOverflow, and to record institutional knowledge about the operation of both the MathOverflow nonprofit and the software components. We see this as essential for the long term running of MathOverflow ---

this institutional knowledge must be preserved and made easily available to future moderators and board members. At the same time, such a blog provides transparency into the operations of MathOverflow, and allows for oversight from the community.

After looking at various options, we opted to start a blog for MathOverflow. The more conversational style of a blog fits very well with the planned content and with the open community philosophy that built MathOverflow. Later, we may also open up the blog to community contributions on mathematical topics, or on the interaction of MathOverflow with the broader mathematical community.

Status: Preparing for deployment.

Feasibility: The blog will be hosted on Stack Exchange Blog Overflow platform. This option has the advantage of being reliable and has no cost to us. Because this platform uses WordPress, it would be easy to migrate to a different platform if and when we need to. We are currently waiting on a response from the Stack Exchange to clarify the copyright status of their hosted blogs. We anticipate, however, that this will soon be resolved and we'll be able to move quickly on establishing the blog.

Discussion: http://meta.mathoverflow.net/questions/1548/

MathOverflow presence at major conferences

We plan on having a more substantial presence at major conferences, such as a booth at the annual AMS/MAA Joint Mathematics Meetings. 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.

Status: Preparing for fundraising.

Feasibility: 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.

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. We are currently having discussions with three such 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.

In each case, MathOverflow aims not only to support these projects, but to partner with them to expand the range of services that MathOverflow offers. Partnering with the Selected Papers Network, we hope to increase the visibility of citations to the mathematical literature on MathOverflow. Partnering with Math Blogging, we hope to give bloggers better ways to interact with MathOverflow. Partnering with Math Talks, we may eventually add an event calendar feature to the main MathOverflow site. Such features would be difficult to implement ourselves, so these partnerships are essential for the growth of MathOverflow.

Status: Ongoing discussions with project leaders.

Feasibility: 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.

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

Status: Planning and looking for potential partners.

Feasibility: 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.

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