

Spreading the Love for Mathematical Research Data

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Abstract: The Mathematical Research Data Initiative (MaRDI) is the NFDI consortium for the mathematics community. We outline some of the challenges we face in spreading a culture of mathematical research data to a large community and starting a cultural change. We highlight our approach to tackling these challenges and present some successful activities: a colorful newsletter, personal interviews, an entertaining rabbit, FAIR chocolate, and interactive formats.

Keywords: Research Data Management, Mathematics, Dissemination

1 The MaRDI project

The Mathematical Research Data Initiative (MaRDI) [1], [2] is the NFDI consortium for the mathematics community. Modern research in mathematics relies heavily on research data. Many areas of mathematics use not only pen, paper, and large libraries of books and articles but also software for running complex computations, modular libraries to build models, large experimental datasets to run statistical analysis or machine learning techniques, catalogs, and classifications of mathematical objects, etc.

MaRDI aims to furnish the necessary tools for efficient research data management in mathematics, but also to educate the mathematical community on the importance of and the benefits of following good practices of data management, and ultimately helping mathematicians and researchers to do their work easier and better. However, MaRDI is a complex project, it pushes some users out of their comfort zone, and for many researchers reflecting on tools to make your work more efficient seems like arid and bureaucratic duties.

2 Challenges and our approach

For some mathematicians, the modern data paradigm has entered stealthily and unnoticed. Many of them claim that “they use no data”, although they get surprised by realizing how many items they use can be considered “data”. Every theorem, every

formula, and every result is potentially a piece of research data. Even your own identity is data that must be curated.

To enable a cultural change is a long-term and tedious process. Our approach is to be very direct and professional about communicating the benefits of research data management while at the same time being very honest and inclusive. We involve the community - also on an international level - from the very beginning and establish communication channels that are colorful (in design), personal (in telling stories) and interactive (in its tools), and, wherever possible, entertaining. The idea is to change the dry image of adding the extra bureaucracy burden to researchers and make data care a useful and joyful necessity. We believe that spreading our own enthusiasm and motivation is key to reaching a tipping point for cultural change. In the next chapter, we give an overview of our most successful activities.

3 Activities spreading MaRDI

3.1 Make it colorful

We started "Math Data Quarterly" [3], a periodical newsletter to reach the mathematical community at large. We devoted four issues of the newsletter to the four FAIR principles (Findability, Accessibility, Interoperability, and Reusability), in connection with mathematics. We describe how mathematical research data is Found today, which requires persistent identification (e.g. DOI, ORCID), comprehensive catalogs (zbMATH, MathSciNet), repositories (e.g. Zenodo), and search engines that can explore and retrieve mathematical knowledge, not only articles and books. We discuss how mathematical data is Accessed, which includes publication models and licenses, but also access protocols and common interfaces to retrieve. We discuss practical problems of Interoperability between different platforms and propose solutions that MaRDI is implementing. We advocate for good practices of documenting data and metadata in order to make it Reusable, to make results verifiable, and to make the community work together. Our newsletter is prepared for an international readership, not limited to German researchers working in data management. We set our goal to become a resource for current trends in the field. The newsletter offers surveys, regular sections, videos, and colorful illustrations, see Figure 1.

3.2 Make it personal

Part of the newsletter are the "Data Dates" video interviews, see Figure 2. In an informal setting, researchers are invited to discuss personal experiences related to research data. We have diverse interview partners, from young researchers to Fields medal winners. Videos are recorded online and edited to be 5-8 minutes long, adding subtitles for accessibility.

Who are the people behind MaRDI, and what motivates them? We introduce you to the people who shape MaRDI with their expertise and vision. Every two weeks, an interview is published in the "Making MaRDI" series available on Twitter [4] and our website [5], see Figure 3.

3.3 Make it entertaining

We started the "MaRDI Movies" series of entertaining and informative videos. The first episode is called 'Mardy, the happy math rabbit' [6], see Figure 4. Follow Mardy



Figure 1. Illustrations by Constanza Rojas-Molina, licensed under CC BY-NC-SA 4.0.



Figure 2. Screenshots of our Data Date video series (from left to right: Christiane Görden (host), Johan Comelin, Ulrike Meyer Yang, Cedric Villani, and Elisabeth Bergherr).



Figure 3. Two MaRDI Makers.

through the pitfalls of reproducing software results: An introduction to software review in mathematics by Jeroen Hanselmann.

In 2022, we engaged with the public in a mini-symposium at the annual meeting of the German Mathematical Society [7] and had a booth with a large interactive media installation. A highlight was FAIR chocolate offered to anyone interested in chatting for a few minutes about math research data, see Figure 4. Similarly, we organized a ‘Pizza and Data’ event, where students talked about their experiences with research data while enjoying their slices of delicious pizza.



Figure 4. Left: Mardy, the rabbit looking at a proof of the Riemann hypothesis. Right: MaRDI at a conference booth, offering “FAIR”-trade chocolate.

3.4 Make it interactive

“Infrastructure for Mathematics” is a one-semester university course at University Leipzig on research data management aimed at mathematicians. The course is prepared and held by MaRDI team member Christiane Görden, the idea is based on [8]. The lectures are highly interactive and flexible. They welcome math undergraduates, graduate students, and early postdocs. Students can integrate the class into their final diploma examination. This is the first course of its kind and is a prototype for future MaRDI short courses.

“Love Data Week” [9] is an annual international celebration of data during the week of Valentine’s Day. In 2023, we created an interactive website [10] that allows you to play around with various mathematical objects and learn interesting facts about their file formats.

Next to the Barcamp format, we also organize reproducibility exercises: participants choose one publication that contains research data, especially software, and try to reproduce it. These sessions have led to lively discussions and a new perspective of the participants on the publication of their own research data.

References

- [1] The MaRDI consortium, *MaRDI: Mathematical Research Data Initiative Proposal*, May 2022. DOI: [10.5281/zenodo.6552436](https://doi.org/10.5281/zenodo.6552436).
- [2] The MaRDI consortium. “Mardi website.” (2023), [Online]. Available: <https://www.mardi4nfdi.de/> (visited on 04/25/2023).
- [3] The MaRDI consortium. “Mardi newsletter.” (2023), [Online]. Available: <https://www.mardi4nfdi.de/community/newsletter> (visited on 04/25/2023).
- [4] The MaRDI consortium. “Mardi twitter.” (2023), [Online]. Available: <https://twitter.com/mardi4nfdi> (visited on 04/25/2023).
- [5] The MaRDI consortium. “Making mardi.” (2023), [Online]. Available: <https://www.mardi4nfdi.de/community/making-mardi> (visited on 04/25/2023).
- [6] The MaRDI consortium. “Mardi movies: ‘mardy, the happy math rabbit’.” (2023), [Online]. Available: <https://vimeo.com/781454778/c131cd0a1a> (visited on 04/25/2023).

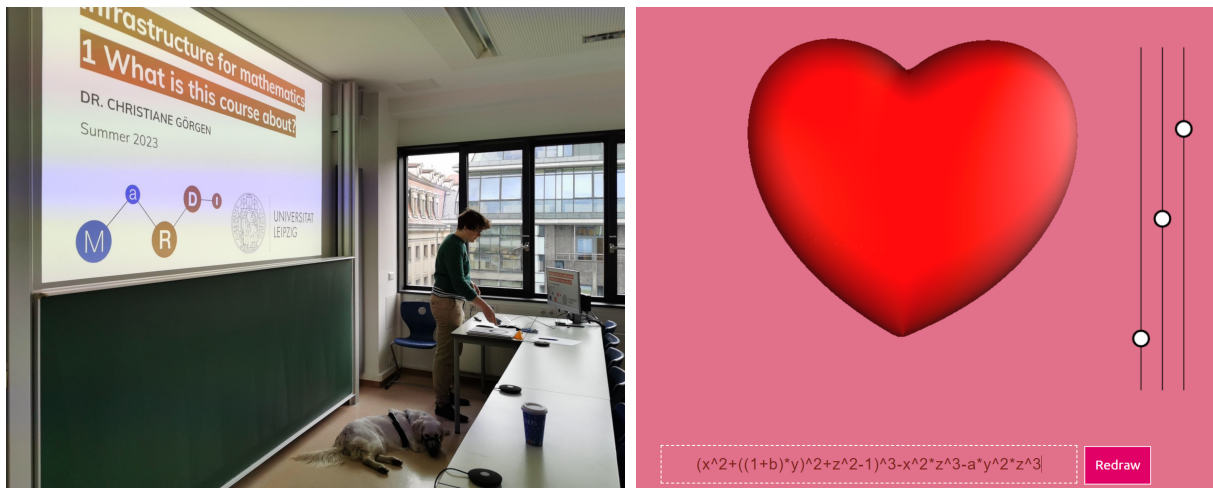


Figure 5. Left: A relaxed course on RDM. Right: An algebraic surface for Love Data Week.

- [7] Deutsche Mathematiker-Vereinigung (DMV). "Dmv annual meeting 2022." (2023), [Online]. Available: <https://www.mi.fu-berlin.de/dmv2022/program/minisymposia/index.html> (visited on 04/25/2023).
- [8] C. Wiljes and P. Cimiano, "Teaching research data management for students," *Data Science Journal*, Aug. 2019. DOI: [10.5334/dsj-2019-038](https://doi.org/10.5334/dsj-2019-038).
- [9] Inter-university Consortium for Political and Social Research (ICPSR). "Love data week." (2023), [Online]. Available: <https://www.icpsr.umich.edu/web/about/cms/3799> (visited on 04/25/2023).
- [10] The MaRDI consortium. "Mardi for love data week: 'a long and lasting love file format'." (2023), [Online]. Available: <https://www.mardi4nfdi.de/community/love-data-week> (visited on 04/25/2023).