Organizing a Short Online Math Program Successfully

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1. Introduction

Since 2012 the University of North Carolina at Greensboro (UNCG) has held an annual summer school in computational number theory aimed at first- and second-year graduate students. In 2020 we were in charge of running the school, entitled *An Introduction to Ergodic Theory via Continued Fractions*. Given the ongoing COVID-19 outbreak, we decided, in mid-March 2020, to run the school entirely online.

In this article we will describe how we carefully tried to preserve as many desirable features of an intensive summer school experience as we could online. Since surveys indicated that the participants were uniformly pleased with their experiences, we hope that our account will help others who wish to organize similar online events.

2. Planning

We decided to organize the summer school around mini-lectures and small group problem solving sessions in order to promote active engagement with the material and each other. Group size was the major factor in determining how many participants to accept: five groups of three students each enabled us to realistically prevent any student from falling behind. We began advertising the summer school and soliciting applications six weeks before the start date. In a window of three weeks, we received more applications than spots for the program. Before the program began, we wrote detailed lecture notes and problem sets to be distributed to the students each day of the school. *We believe that the lecture notes and the small highly monitored and advised problem solving groups we created were the crucial factors that made our good results possible.*

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DOI: https://dx.doi.org/10.1090/noti2300

3. Technology

With the majority of the participants' time spent in problem sessions, we wanted to make sure that they would be able to communicate mathematical ideas to each other easily and clearly. We were able to get funding-agency approval to redirect travel funds to purchase webcams for participants who needed them, provided they were returned to UNCG at the end of the school. We also offered handheld whiteboards and markers to participants as a low-tech way to present mathematics over the internet.

We settled on Zoom as a medium for the summer school. Many people were already familiar with Zoom from their home institutions and it satisfied most of our requirements. The four lecturers each used their own method to present material during their lectures.

- Writing on a tablet screen that was shared to participants.
- Presenting at a wall-mounted whiteboard via webcam.
- Writing on paper using a webcam as a document camera.
- Screen-sharing a Mathematica notebook to discuss its code.

All the methods were reasonably successful, bolstered by our posting of complete lecture notes and problem sets online daily. Most methods do not allow the lecturer to simultaneously monitor the Zoom meeting, so when points were raised via the Zoom chat it was the responsibility of the other organizers to alert the lecturer if an immediate response was needed.

We used the "breakout rooms" feature of Zoom for the problem sessions, with the host partitioning participants into five breakout rooms at the end of each lecture.

We set up a separate chat in Discord for the organizers to discuss matters such as who would help in which breakout room, what would be discussed after the problem sessions, and hints and solutions to specific exercises. It was very helpful to have a place to chat outside Zoom, both to keep organizer discussions separate from discussions with participants, and because the chatroom persisted beyond the current Zoom meeting.

4. Experience

Students enthusiastically engaged with each other during the 90 minute breakout room problem sessions, routinely forgoing the suggested 15 minute break. In an effort to reduce fatigue and avoid settling into a routine, we changed the composition of the small groups each session; held a special lecture on computational aspects of the material; offered a research-level lecture at the end of one day; and held a "social hour" in the middle of the week in which we shared stories, showed off our pets, and played online games.

The online format made monitoring students' reactions to the lectures and problem sessions more of a challenge

than usual. In addition to pausing frequently to allow students to ask questions, we sent an email after the first day asking students about the experience. In response to the feedback, we adjusted how much guidance we gave during the problem sessions. On a few occasions we changed problem session group compositions on the fly to support participants who didn't feel their current group was a good fit for them. *We felt it important to get feedback on potential problems midsession while we could still do something to fix them*. After the summer school ended, we sent out a survey to ascertain how the participants felt about the school as a whole. Some of the questions specifically asked for feedback on the online organization of the school.

The responses to the surveys were mostly positive: participants enjoyed the school, were happy with its organization, except for the necessary requirement that they spend many hours in front of a computer. Importantly, they did not feel that their learning was impacted and said they were able to get their questions answered easily in our format.

We sent out a concluding email pointing out additional resources and what further steps could be taken to continue learning about ergodic theory and continued fractions. Our lecture notes also pointed to further results.

5. Conclusions

Our experience indicates that technology makes it possible to run a summer school such as ours online, and that students will participate enthusiastically. While the possibilities we lost—such as working together at the board, informal one-on-one chats, and external social activities—are valuable, we gained by being able to hold the school at all given the current situation, not having to spend very much money to run the workshop, and not needing to travel away from home to be together. With a few tweaks to the technology, and broad access to it, there is no reason why online summer schools shouldn't play a prominent role in promoting and disseminating mathematics. Be it by choice or necessity, we wish you the best in organizing a similar meeting online.

As a service to those who would like to organize a similar event, we have collected a list of helpful technology tips and tricks here: `go.uncg.edu/ergodictheory`.


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Credits

Photo of Daniel Glasscock is courtesy of Daniel Glasscock.
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Virtual Workshop on Ricci and Scalar Curvature Draws Unexpected Attendance

Christina Sormani

Every year or two my collaborators and I co-organize a workshop about the convergence of manifolds. Sometimes the event is held at CUNY but we've held them also at IAS and SCGP and in Canada, Mexico, and Italy. Each event drew a group of 20–40 participants after an open call for participants on the geometry listserv. Postdocs would fly in from around the world for an opportunity to present their work and collaborate. However, due to rising concerns about the cost of air travel and its contribution to global warming, we decided that in the summer of 2020 we would hold a virtual workshop.

We had no idea there would be a pandemic and that our workshop would be one of the few conferences in geometric analysis that wasn't canceled completely. In the end our Virtual Workshop on Ricci and Scalar Curvature in honor

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DOI: https://dx.doi.org/10.1090/noti2303