model. And if your experiences are like ours, it will be well worth your effort!

Rohini Ramadas          Isabel Vogt

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# Organizing a Summer School

## *Ben Elias and Nicholas Proudfoot*

Summer schools can be wonderful venues for graduate students and postdocs to meet other people in the community and learn some interesting mathematics. We run an annual summer school called WARTHOG (Workshop on Algebra and Representation Theory, Held on Oregonian Grounds), which will celebrate its tenth anniversary in the summer of 2019. Below we will describe some of the organizational details that have worked well for us, from the high level down to the nitty gritty, in the hope that you, our dear

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[1]*The 2019 iteration of WARTHOG was our first experiment with having two Main Speakers who work closely together to develop the program.*

**Figure 1.** WARTHOGgers in their natural habitat.

reader, can emulate the parts you like. You'll have to find your own acronym, though.

### Overview

Our workshops always have a relatively narrow focus. We start with the basics and aim to reach one specific new and exciting result by the end of the week while being exposed to various ideas of broad interest along the way. The school is led and "mathematically organized" by one[1] Main Speaker. The Main Speaker need not be the progenitor of the result; this has been the case for only about half of our workshops. Our practice is to invite people whom we know to be excellent speakers and thoughtful planners and allow them to pick whatever topic they would like. We often have one or two assistants to give lectures and help with the exercise sessions. You can see a list of topics and speakers on either of our websites.

Perhaps one indication of the success of our summer school model is the number of students who return year after year, often to learn about subjects that are not directly related to their research. The first-named organizer (Ben) was a participant for three years, then was invited to lead his own workshop, and finally joined the faculty at the University of Oregon and became a coorganizer. (Disclaimer: Due to a shortfall in the Oregon state budget, not all repeat participants of WARTHOG will be offered faculty positions.)

We have been fortunate to receive NSF support for WARTHOG in the form of two CAREER grants, but it is worth noting that summer schools can be run rather inexpensively. We pay the airfare of the Main Speaker and the assistants. The Main Speaker usually stays in one of our houses. All of the other nonlocal participants stay in a dormitory, which we pay for directly. We expect most

[2]*The first Talbot workshop was held at a farmhouse called Talbot House, and the name stuck.*

[3]*The first of these workshops was coorganized by Sam Payne, and the third by Hannah Markwig.*

participants to obtain travel funding from their advisors or departments. We pay for coffee and pastries in the mornings and a pizza party at a local park on Wednesday evening. This typically amounts to approximately $15,000. We use the remainder of our budget toward travel for participants who are unable to obtain outside support.

## Antecedents

The original model for WARTHOG came from the MIT Talbot[2] workshops (running every summer since 2004), as well as from a series of workshops at the University of Michigan organized by Renzo Cavalieri between 2006 and 2008.[3] Each of these workshops has been similarly framed around a single topic with the guidance of one or two experts in the subject, with the additional feature that nearly all of the talks are given by (typically nonexpert) participants. We used the same model for the first few years of WARTHOG, but we found it difficult to sustain. It turned out to be a huge amount of work for the Main Speaker (helping a nonexpert graduate student prepare a talk is much harder than preparing it yourself), and the participant talks often suffered from a lack of perspective. We have the utmost respect for the people who have run such successful workshops based on this model, but we decided to steer WARTHOG in a different direction. In recent years the Main Speaker has given about half of the lectures and the assistants about a quarter, with the remaining few lectures scattered among a small number of more senior participants (usually including the two of us). This format is not so different from that of the MSRI summer schools, where the organizers work together to plan a coherent program of lectures.

## Exercise(s)

As we moved away from the Talbot model, we still wanted to give the students a chance to participate actively, so we began to place a very strong emphasis on exercises. Rather than just having one set of exercises each day, we hold an exercise session after *every* lecture (with just one exercise). In addition to helping the participants to absorb the material from the lectures, this format gives the speaker immediate feedback on which ideas made it through and which did not. From time to time it becomes obvious that some key idea or technique was not sufficiently well explained, and the speaker gets the opportunity to rectify this during the next lecture. We have had so much success with this model that we want to advocate for it in strong terms.

It is readily apparent that the participants who stop doing the exercises quickly check out of the workshop, so encouraging them to do exercises is paramount. This is true for any workshop, so even if you are running a more traditional workshop with several minicourses, you should ensure that speakers produce exercises and that participants have ample time to work them. The more the exercise sessions are clearly built into the structure of the workshop,

the more it reinforces the expectation that participants take them seriously. This applies not only to the students: the two of us always join the other participants in working on the exercises. We also discuss how important we feel the exercises are in our introductory spiel at the start of the workshop.

It takes serious thought to produce good exercises. An exercise that asks you to check the technical details of some argument can be a slog and is often unhelpful for understanding what comes next. This type of exercise might be appropriate for a semester-long course, but on the week-long time scale it is much more important to work through examples. If the talk covers the first two examples, the third example can be an exercise. We consider it one of our main jobs as organizers to give advice to help the Main Speaker produce good exercises.

It is easy to assign too many exercises! Participants who receive a sheet of exercises are immediately overwhelmed, even if it is understood that they will only have time for a few. If instead only one exercise is assigned and the participants complete it, they feel a sense of accomplishment and encouragement. Another advantage of assigning only one exercise is that the Main Speaker can reasonably assume that all of the participants have worked on it. We recommend that each lecture be aimed at students who have thought deeply about the previous exercise without assuming that they have understood every detail of the previous lecture. This keeps the workshop going at a steady pace. It demands a high level of engagement from the participants, but we have found them to be willing and able to rise to this challenge.

We also make available but do not emphasize a supplementary sheet of exercises for each lecture. This can be helpful for the more advanced participants or for those who want to keep working through problems later over dinner or for people trying to learn the material at home (including people who have not attended the workshop). Another reason to have supplementary exercises is that the Main Speakers are usually enthusiastic and have lots of good problems in mind; this gives a place for them to vent their enthusiasm.

We avoid using a room with stadium seating or individual desks; instead, we work in a room with tables that can be configured into small clusters. It is fine to use a more traditional lecture room as long as you are able to shepherd students into a space more conducive to working in groups. We usually budget one hour for the main exercise (which we expect to take half an hour), skimming the supplemental exercises, and taking a break before the next lecture.

## Why Only One?

It is of course possible to invite good speakers and hold exercise sessions at a more traditional summer school with multiple courses on different topics. However, we would

like to highlight some of the ways in which having only one topic allows things to run more smoothly.

First, we find that there is a noticeable feeling that everyone has come together for a common purpose. We of course have participants with different levels of expertise and different areas of focus, but everyone has come in an effort to understand the same piece of mathematics, and this makes it easier to get people talking with each other and working together.

Second, it makes it easier for us to assume a little bit of background knowledge. We usually ask participants to read 20–30 pages of material (carefully referenced on our webpage) before they arrive, and we find that almost everyone comes prepared. This would be a much bigger ask if they had to do something comparable for multiple courses, not all of which held their interest to an equal extent.

Third, we are able to be very flexible with our schedule. If a talk goes long but the final words are crucial, we let it run over. If we need to take extra time at the beginning of a lecture to clarify a point that caused confusion during the exercise session, we do it. This is much more difficult when there are multiple courses competing for time.

One potential pitfall of going deep into a single topic comes from the fact that each lecture usually relies upon the previous ones, and it is easy to fall off the path. One cannot go too deep too quickly; it takes time to build layers of understanding. We work with the Main Speaker to try to spread out and diversify topics. Often the Main Speaker gives us a lecture plan in which Monday covers the first big idea, Tuesday the next, and so on: a vertical organization. We may suggest a horizontal reorganization, where the second chunk of Monday is independent of the first chunk, but the big ideas from Monday are pursued further on Tuesday or Wednesday after they have had some time to be digested. This parallel branching is a very important aspect of schedule design, one that is built in to the multiple minicourse model but can also usually be adapted to a focused workshop.

## Final Thoughts

We are always impressed with the energy that the Main Speaker devotes to planning a really great workshop and with the persistence that the participants show to keep with it for the whole week. You can really get somewhere from nowhere with this model. We hope you will join us next summer!
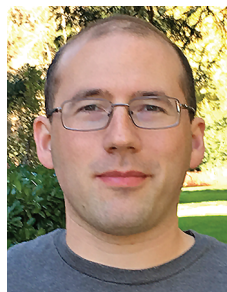

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**Credits**

Figure 1 is by Greg Knapp.
Author photos are courtesy of the authors.

# Organizing a Graduate Advising Workshop in Mathematics

## Daniel J. Thompson

In June 2019 María Angélica Cueto, David Penneys, Krystal Taylor, and I organized a Graduate Advising Workshop (GAW) in Mathematics at Ohio State.[1] This was the third iteration of what is becoming a regular biennial event. The first Graduate Advising Workshop took place at Tufts University in 2015, organized by Moon Duchin and Larry Guth. The second Graduate Advising Workshop took place at the University of Michigan in 2017, organized by Moon Duchin and Sarah Koch. This article describes how the 2019 workshop was developed and the activities we undertook. It is also a call to the mathematical community to help us turn these workshops into an ongoing tradition.

The purpose of the workshop is to ease the transition into advising for early-career faculty who are starting out as advisors and those who expect to be advising soon. The idea is to collectively develop best mentoring practices and to dispel potential anxiety about becoming an advisor through sharing our experiences and through reflection and discussion on common challenges in advising. While many universities have programs to improve faculty advising skills, often these activities are aimed at lab-based scientists or attempt to span all disciplines at the university. We believe it is valuable to develop mentoring resources focused on the specific challenges and environment that we experience as mathematicians. The workshop took place over a weekend and was a mixture of group work activities

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