

Preparing a math presentation

Watching a math presentation is very different from reading a math paper: with a paper the reader is in control, while with a presentation the presenter is in control. The reader of a paper who forgets the meaning of a word can flip back to find it; a reader of a paper who needs time to think may stop reading momentarily and start reading again at the same place later; a reader who wants to see where the paper is headed may flip ahead. In contrast, there is no way to rewind, pause, or fast forward through a live presentation. If someone watching forgets the meaning of a word, wants to pause to think, or doesn't see where the presentation is headed, that person is likely to become lost and may remain lost for the rest of the presentation. This difference has serious implications for how to prepare a presentation: you must try to anticipate those places where the audience will want reminders, time to think, or guidance, and you must try to give the audience what they need, when they need it.

Audience

In order to accurately anticipate what the audience will need, you must know your audience well. So the first step of preparing a presentation is to inform yourself about your audience. What do they want to get from the presentation? How much do they already know? Which parts of the presentation will be most difficult for them to understand?

To get to know your audience, talk to them to find out what they know and what interests them. If you can't talk to them, talk to someone like them, or to someone who knows them. For example, if you are presenting to your class, you could ask the professor for the class about the range of mathematical backgrounds of the others in the class.

Purpose

Once you know your audience, you can begin to determine the presentation's purpose and content. There is a major difference between a stand-alone chalk talk (for example, a talk in 18.096, 18.821, or a colloquium talk) and a class lecture (one installment in a semester-long class). For the former the purpose is simply to *introduce* the audience to your work, while for the latter the purpose is to *teach* a certain amount of material.

If you are giving a stand-alone chalk talk, your purpose may be to introduce the audience to your work, but what does your audience want to get from the presentation? They probably want to learn something new and interesting; in short, they want to be entertained mathematically. So don't present all of the details of your work. Instead, limit yourself to the most interesting material. There is no need to prove everything—you can tell the audience to read your paper if they want to see the details. Include proofs and details only when they are mathematically interesting, provide insight into the math, or are necessary to convince your audience of the validity of the content. (There are many other tools you can use to convince your audience: conceptual explanations, citation, a well-chosen example or picture.) Remember that your objective is to introduce your work while entertaining the audience mathematically.

On the other hand, if you are presenting in a seminar, then you may need to teach the audience a certain amount of information. Providing mathematical entertainment is a secondary goal that serves the primary goal of teaching the assigned content. Identify which concepts are likely to be most challenging, and pay particular attention to teaching those concepts well. It takes time for people to absorb new concepts; you can give the audience that time by presenting the same concept in multiple ways (e.g., conceptual explanations, examples, etc.).

Structure & Technique

Once you know the presentation's audience and purpose (and the available time), you can begin to determine the specific content, structure, and techniques that you will use. This section describes how you can anticipate when the audience might wish they were in control (able to rewind, pause, or fast forward through the presentation), and the techniques you can use to give the audience what they need at those moments.

When the audience wants to rewind

The audience is likely to want to rewind to remind themselves of the meanings of unfamiliar terminology and notation that you're using. So consider putting brief, helpful reminders on a board that can stay up throughout the talk. Many rooms have a side board where you can write such information. If you write the information before the talk starts, be sure to draw the audience's attention to the board two or three times during the talk so they realize it's there for their reference. Try to anticipate points during the talk at which the audience will need a reminder, and give it to them.

The audience is also likely to want to rewind if they miss an important statement. So emphasize important statements by saying them verbally, writing them on the board, and perhaps repeating them verbally. It's fine (and even helpful) to repeat yourself occasionally during a talk. (How often do you reread sentences when you're reading a math paper? Your audience is likely to need similar repetition.)

Important statements that deserve emphasis include not only mathematical statements but also statements of transition: when you end one part of the talk and start a new part of the talk, you will lose anyone in the audience who doesn't happen to be listening during the transition. To emphasize a transition, take the time to summarize what you've just done and connect it to the main goal of the talk; pause and take a sip of water (silence gets peoples' attention); consider asking for questions, especially if the audience seems confused. (Are they studying old things you wrote on the board instead of looking at you? If so, they probably have questions.) Once you have everyone's attention, you can say what you're going to do next and go on.

When the audience wants to pause

It's normal for people to stop listening occasionally to think about something you've said, but it can be difficult to predict when people will stop listening, because different people are interested in different things so different people stop listening at different times. Because it's difficult to predict when to pause, you must always write enough on the board so that people can look at the board to catch back up with what you're saying. Be sure the board structure is sufficiently clear: for example, if you prove a theorem, don't just write the theorem statement on the board; also use the helpful abbreviations "Thm" and "Pf" to clarify that the statement is a theorem and to signal where the theorem statement ends and the proof begins. Use a Halmos box or "QED" to mark the end of the proof. Think of the boards as logical chunks of content and decide ahead of time what content to put on each board; when you move on to a new idea, move on to a new board, even if the old board isn't full yet. Obviously, be sure your handwriting is legible at the back of the room. (Practice ahead of time and go to the back of the room to check.) Your goal is to clearly provide just enough information on the board so that people can figure out what you're doing by looking at the board.

Also, do try to anticipate when people may want to pause to absorb a new concept. You can give them the time they need by presenting the same idea in multiple ways.

When the audience wants to fast forward

People want to fast forward when the presentation is boring or gets lost in details. If you must present uninspiring details, clearly explain why you're presenting them, and come back to that reason occasionally so people remember why the details are important. When possible, emphasize what's interesting about the information.

People also want to fast forward when they lose track of what you're doing and why you're doing it. It can be helpful to write an outline of the talk and leave it up throughout the talk so that people can remind themselves of what's going on. Like the list of new terms and notation, the outline can go on a side board; but it's likely to be overlooked unless you draw attention to it.

When the audience wants to stop

People would love to be able to stop the presentation when time is up. Plan to end a few minutes early, and practice to be sure that you actually do end a few minutes early. Even with practice, though, unexpected things can happen on presentation day, so be prepared to be flexible. Plan *time checks* throughout the talk—points at which you can drop or add information if the talk is going more slowly or more quickly than anticipated. Practice those modifications so that you can make them without the audience noticing. It can be difficult to keep close track of time while presenting, so if necessary, ask a friend in the audience to keep time for you and to signal you at the time checks if you need to modify the talk.

If you want the audience to remember the main point of your presentation for more than just a few minutes, be sure to clearly and concisely restate that point at the end of the talk.

Prepare for questions

Try to anticipate questions that may be asked and be prepared to answer them. If possible, practice the talk in front of friends who can point out likely questions. If you don't know an answer to a question, simply say so. If possible, after acknowledging that you don't know the answer, give your best answer based on what you do know. For example, you can say, "I'm not sure, but based on _____ I think that perhaps _____." Another option is to say "I don't know, but I'll check and get back to you" (Then *do* check and get back to the person!) Treat all questioners with respect, no matter how "stupid" or off-topic the question.

The bottom line

What kinds of math presentations do you most like to watch? Which presentations do you learn from? Which inspire you? Prepare a presentation for your audience that you would want to watch yourself.