

Suggested strategy for reading mathematics papers efficiently:

1) List what you want to learn

To read efficiently, you need to monitor whether reading is being productive; and to do this, it's very helpful to know what your reading goals are. So start by listing what you want to learn. For example, if the paper is the main source for your term paper, your initial list of questions might include the following:

What is the paper's main result?

What is the big picture of how the main result is obtained/proved?

How does the main result relate to what we've learned in the class?

How did the main result expand the field at the time at which it was published?

What relevant advances have been made since this result was published?*

How do the various lemmas and theorems fit together to prove the main theorem?

2) Orient yourself to the paper by reading the introduction. As you do so,

a) **Write the main result** as stated in the introduction. Often it is indicated twice: once briefly at the start, and later with greater precision after sufficient background is introduced to enable precision.

b) **Write an outline of the paper** in your own words. What is the purpose of each section? A well-written introduction usually enables you to write this outline, but check your outline by looking at the section heads throughout the paper.

c) If the introduction includes one, in your own words **write a summary of how the main result is obtained/proved**. Writing in your own words can help you identify what you don't yet understand.

3) As you do #2 above, you're likely to come across terms and concepts you don't yet know. Add these to the list of things you want to learn if they seem to be prerequisite to answering the other questions on the list. Continue to **revise your list of questions throughout the reading process**.

4) Using your list of questions and your outline from 2b, **identify where you can find the answer to each of your questions**. If you need to go to one of the paper's sources to find an answer, identify which source: when a well-written paper cites a source that is long (e.g., a textbook), it may indicate the relevant section, theorem, or page number so you don't need to search through the entire source. If the paper doesn't provide the answer or a pointer to it, what resource(s) can you go to instead?

5) Once you know the context provided by Steps 1-4 above, feel free to prioritize your questions and tackle each in turn, or read the paper from start to end, whichever works best for you. But in either case, **monitor whether/how the text you are reading is relevant to your questions** (e.g., avoiding reading merely to verify the paper line by line, and don't get bogged down in the proof of a statement that may not be needed for your term paper). **It may help to set a periodic alarm** that you can use as a reminder to check the relevance of what you're reading.

6) If the logic of the paper or of a particular proof is complicated, **it may help to diagram the logic**, showing which statements depend logically on which preceding statements. You can then use this diagram to decide which statements need to be included in your term paper as well as how to structure the paper.

7) **To check/solidify your understanding, it can help to summarize in your own words.** These notes can then provide a starting point for a draft of your term paper.

8) To understand a proof, **try to generate the proof yourself.** Even if you don't succeed, the attempt can help you better understand the subtleties of the proof when you read it.

***To identify advances since the publication of this paper**, there are a few strategies for finding relevant more recent papers:

- Look up the paper on Google Scholar or MathSciNet to see a list of papers that cite this paper (On MathSciNet the link is in a box titled "Citations").
- Search on the paper's index terms for more recent papers
- Asking current mathematicians in the field is also an efficient strategy!

The introductions of the more recent papers should summarize the current state of the field, so you may be able to track the development of the field by looking at introductions between the publication of the paper you're reading and today. Citations of the paper from more recent reviews of the field are, of course, particularly helpful.