D-MATH   **Topology**   ETH Zürich

Prof. A. Carlotto   **How to take a Math course**   Spring 2020

In this short note, I would like to try to give you some advice aimed at making your study of the topics we will cover effective and possibly pleasant. In this class you will come in contact with some beautiful Mathematics and the tools you will acquire will be a central part of your scientific background. For many of you this will be the very first journey in the landscape of twentieth century Mathematics and you will face its most challenging sides for the first time: probably you will find some of the theorems that we will see (and the corresponding proofs!) quite abstract, but you should **never feel discouraged** as that is the natural price to pay to get closer to the border of human knowledge.

In class. Coming to class might be very helpful for your success in understanding the content of this course: we will do our very best in order to make your efforts valuable. The lectures should guide you in getting some feeling and intuition for the topics we will cover and, more practically, should guide your personal study: they will enable you to understand what are the conceptual keys of each chapter of the textbook, the points you have to study most carefully. While in class you should try to follow the lectures very carefully and take some notes. With this respect, everybody has his/her own style and there is no general recipe that works for everyone. I suggest to avoid just copying what the instructor writes on the blackboard and there are two main reasons for this. First: often what the instructor says is more helpful than what he actually writes down (at least in conveying ideas). Second: your work in class should be **active** and you should do a sort of minimal (since it is necessarily real-time) re-elaboration of the material. Concretely: write down concepts in your own words, add an extra picture, use different colors, make an asterisk next to the point you do not understand. Another fundamental principle is: ask questions! Do not be scared to stop the instructor when something is not clear, since often your doubts are common to other students as well. Moreover, asking questions might also help the instructor to select the points that should be reviewed and/or recalled in the course.

Your study. Making the most profit out of the lectures might help you a lot, but still you will have to spend some time studying the material covered in class and doing your homework. Notice that I did not simply say 'doing your homework' since I believe that any effective study session should always begin with a brief review of the theory, both on your notes and on the textbook. While studying try to have a critical/skeptical attitude: ask yourself simple questions (and try to answer them!), play with the tools you learn, draw pictures to help geometric intuition. When reading a proof check carefully the point(s) where each assumption (hypothesis) is needed. Ideally (but this might be a bit hard at the beginning) you should try to prove a

theorem by yourself before actually studying it: even if you do not succeed, your study will be much easier and faster then and you will remember the proof much better. Some of the problems you will do are quite standard, but others might require a bit of creativity and some original idea. You should not be scared by these problems, instead you should progressively acquire your skills in attacking them. Be at the same time flexible and stubborn. Flexible in the sense that you should consider several different approaches before committing to one. Stubborn in the sense that you should not give up if your approach does not work immediately. Remember that if you can solve a problem immediately, then there is not much gain out of that solution. You should never be frustrated: be optimistic and **enjoy** the process of learning!

Writing a mathematical argument. A relevant fraction of the time you will spend for this class will be in writing down solutions of problems. Try to take this seriously: working in groups is great and may help in the learning process, yet you should then always write down your own solution. Your solutions should be neat and complete. 'Neat' means well-structured, not only aesthetically, but also logically. 'Complete' means that a solution is not really about giving an answer (like: yes or 27, which can be derived by infinitely many correct and infinitely many wrong procedures), but to produce an argument that is solid, irreproachable and explains why one is led to a certain conclusion, and nowhere else.

Time management. This is a very important point: studying Mathematics is effective only if it is a regular activity, by which I mean that you should build your own weekly routine, like an avid athlete would do when preparing for a race. You should try to fix every day the topics covered in class that day. Do not postpone! Studying right before the exam is both (almost) useless and frustrating. With little but regular effort you will not only pass this exam with an excellent grade, but also (and most importantly) you will learn something.

Resources. First of all, I do encourage active and regular participation to our weekly problem sessions: they will give you the opportunity to review the topics in smaller groups, to discuss problems and see some of them solved in great detail.

Secondly, if you do not feel comfortable with some topic, or if you simply wish to discuss something with us you should definitely come to office hours. When you do so, my advice is to prepare quite precise questions so that you can come back home with precise answers. Things have been arranged so to have office hours every week of the semester: that seems to be quite an experiment here at ETH, and my hope is that such choice will turn out to be successful. This will depend on each of you, on

your attitude towards this course and to your willingness to take on the challenge you have in front of you. Besides the hours offered by the assistants, please feel free to contact me whenever you want. You can either send me an email to arrange a meeting or simply stop by. *Whenever you see my door open, please do not hesitate: come in and feel welcome, for* **you** *are the reason why I am here.*