In this short note, I would like to share 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 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. Unfortunately, the current pandemic forces us to adopt an hybrid system, with some of you following all lectures remotely through a live-stream or even through a recording. Said that *I have thousands of reasons to recommend your physical attendance* whenever possible, there are some cases where it is simply not feasible: it is quite clear, for such cases, that a remote-learning system like the one above requires, to be effective and meaningful, a high degree of self-discipline, so that 'you don't lose the pace' and end up accumulating an unreasonable amount of material to be studied at a later stage.

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 topic we will cover, and the points you have to study most carefully. While in class (or watching the live-stream) you should try to follow the lectures very carefully and take some notes. In 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 screen, and let me give 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 colours, make an asterisk next to the point you do not understand. *Recall (among other things) that the full transcript of each lecture is uploaded on the course website right after the lecture in question!*

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, or perhaps during the exercise classes taught by the assistants. While real-time feedback is most valuable, delayed complaints of the form 'I didn't get anything out of that class' are unlikely to lead to

any constructive development! For indeed, *identifying the issue is, almost by definition, the first step towards its solution!*

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 your geometric intuition. When reading a proof (in the rare cases when we actually prove something!) check carefully the point(s) where each assumption (hypothesis) is needed.

My past experience here at ETH, and especially in teaching this course, forces me to stress a seemingly obvious but fundamental principle:

you don't learn how to play football by reading a book about football

which means: studying textbooks is good but (insofar math is concerned) it is only the first step of the learning pyramid, and in order to acquire some scientific maturity you need to get your hands dirty on examples, baby cases and work hard on the homework problems. Sorry to be so frank, but this simple principle is often times the discriminating factor determining success in this course.

Some of the problems you will do are quite standard, but others might be less so. 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. This course is not about blindly applying

cooking-style recipes, but also about developing a basic degree of understanding for certain tools and methodologies in modern mathematics!

Lastly, let me add here an aside remark. In the past I have also noticed a marginal (but not negligible) tendency of *copying* solutions of the homework problems that have been discussed during the exercise classes. This is not only useless (at all levels) but actually somewhat counterproductive, since you end up wasting time you could rather devote to more effective (and, in fact, more pleasant and creative) activities.

Time management. And here is another 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. We meet once a week, so it's not that tricky! 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 two office hours every week of the semester: that seems to be quite an experiment here at ETH, and my hope is that such a 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. As an alternative, given the current circumstances, you may also wish to consider posting your questions on the D-Math forum, where we will try to answer in a couple of days at most.

Besides the office hours offered by the assistants, and the virtual interactions on the forum, 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.