Math 3150 Analysis 1, Fall 2020

Basics

- Instructor: Luke Rogers
- Office hours: TBA, on webex
  https://uconn-cmr.webex.com/meet/lur07001
- Classes: MWF 1010-1100. Online at:
  https://uconn-cmr.webex.com/uconn-cmr/j.php?MTID=m2ca16e17693ef3bcdaaab4c745832068
  All online classes will be recorded and available for later viewing, but we may use break-out rooms to discuss problems, and it is possible these may not be recorded, so you really need to attend. You will also make presentations in class.
- Text: Kenneth Ross, Elementary analysis (second edition). You definitely need this!
- Readings, videos and homework will be on HuskyCT
- Assessment: 40% Homework, 20% Class presentations, 20% Midterm, 20% Final, and up to 10% bonus for constructive input in class and on Piazza.

Course outline and learning goals

We will attempt to cover at least chapters 1–6 from the book, plus some other material, though not all of it will necessarily be done in order and some sections in these chapters may be omitted. Some supplementary notes may also be provided. A plan for covering the material is on HuskyCT.

By the end of the course you will definitely need to:

1. Know the basic properties of the real numbers, including how existence of suprema and infima distinguishes them from the naturals, integers and rationals.
2. Be able to work rigorously with sequences of numbers: boundedness, monotonicity, convergence, Cauchy property, limit, limit points, subsequences, Bolzano-Weierstrass Theorem.
3. Be able to work rigorously with series of numbers: partial sums, convergence, absolute convergence, tests for convergence (comparison, ratio, root, alternating), geometric and p-series.
4. Be able to work rigorously with the formal definitions of limits and continuity of functions, including one-sided limits, infinite limits and limits at infinity.
5. Know the definition of compact set, the Heine-Borel Theorem, and the properties of continuous functions on compact sets: existence of maxima and minima, intermediate value theorem, image is a closed bounded interval, uniform continuity.
6. Be able to work rigorously with the basic concepts of differential calculus: definition of derivative, Rolle's Theorem, Mean Value Theorem and their consequences.
7. Be able to work rigorously with the basic concepts of integral calculus: Riemann sums, integrable functions, Fundamental theorem of Calculus.
8. Be able to work rigorously with sequences and series of functions and their convergence, both pointwise and uniform. Know the significance of uniform convergence for continuity and integrability of the limit function, especially in the case of a power series.

I hope we will also have time to cover some of the following material

1. The Arzela-Ascoli theorem.
2. Metric spaces: examples, continuity and limits in metric spaces, compactness, connectedness.
3. The Weierstrauss approximation theorem.

What is expected of you

My primary expectation is that you read and attempt to understand the material outside of class. I do not intend to lecture on all or even most of the material in the course, though there will be videos that will support your reading. Class time will be spent on discussing the concepts and the material you have read in the book, and in doing problems. You should anticipate spending 3-4 hours per week reading the text and watching my videos to make sure you understand the concepts as well as the techniques, and another 4+ hours doing homework, for a total time commitment of at least 8-10 hours per week (including class time). In addition to discussing material in class you should also plan to talk (or message, or whatever) with your fellow students frequently about concepts from the text and homework problems. We will have a Piazza discussion board to facilitate this. Your aim is not just to be able to solve problems, although that is very important, but also to be able to explain the concepts and techniques used in an understandable and mathematically accurate fashion. You will also be asked to be creative in applying known methods and creating new methods to solve problems.

You are expected to attend class, whether it is held in-person or online. Online classes will be recorded, but I do not know whether these recordings will include breakout groups, etc, where we may be working on problems. If you have to miss a class and the recording is not sufficient to answer your questions, you should talk to me or to a classmate about what was discussed, or post a question or questions on Piazza. There will be homework and readings assigned. It is critical that you do them. We will spend class time discussing questions from the reading and assigned problems, and you will not be able to participate if you have not done them. You may also be called upon in class to explain what you understood the main points to be in the reading, or what you did on a problem.

Assessment

Since we cannot have in-person exams, we will have a greater emphasis on continuous assessment. There will be homework worth 40%. You will be asked to present and explain homework problems and material from the readings, in class, on at least two occasions during the semester; each presentation will count for 10% of your grade. Exams will be open book/materials and the questions will be provided at least 24 hours in advance. The midterm will be 20% and the final 20% of your grade. I will also give up to 10% in bonus points based on your overall input to the class. This latter is not about asking lots of questions or always raising your hand – it is about asking well-thought out questions and making constructive comments that help to make the material clearer to your peers or make the difficulties you are having with the material more clear to me. Put another way, it is about using the class effectively for yourself and your peers. Your participation in discussions on Piazza will be considered in assigning bonus points.

Exams may include questions from any topic discussed in class videos or discussions, whether or not it is in the text, or from any part of the assigned reading from the text. Some exam questions may be routine, but you should expect some questions that require creativity and a deep understanding of the material, and are just plain difficult.

The midterm covering Chapters 1 and 2 will be due on Monday 10/5 before class. Questions will be handed out at least 24 hours in advance (i.e. by Sunday morning, 10/4). The date of the final is set by the registrars office, see the Registrar's Exam Website at registrar.uconn.edu. Exam questions will be available in advance of the exam time.

I will provide a list of problems and topics on which you can make class presentations. You may pre-record and play a presentation or do it live, but in either case you should expect questions from me and (I hope) from other students. It should take 5-10 minutes. You don't need to make slides – handwritten working will be fine – your focus should be on trying to clearly explain how you thought about the problem

or concept, the essential ideas in your treatment of it, and how you see it as fitting into the course material up to that point.

Your first presentation should be on material from Chapters 1 or 2, and your second from material in Chapters 3,4,5,6. If you want to make an additional presentation to improve a grade, it will likely be from Chapter 6 or the subsequent material on series or metric spaces.

LaTeX and HuskyCT

I am requiring that all homework be produced in LaTeX or a comparable program. I do this a little reluctantly, as I don't really want to burden you with extra work typing things up, but I know from past experience that if I permit handwritten work much of it will be indecipherable. If you need to learn how to use LaTeX, an easy way to begin is to get an Overleaf account. Note: You should not submit your LaTeX file, but only the pdf it produces. If you can produce pdf homework using something other than LaTeX that I cannot distinguish from that produced by LaTeX, then I am fine with it, but if it is not of LaTeX quality I will not grade it.

All your reading and homework assignments are on HuskyCT. This also provides you with a due-date calendar.

Advice

I strongly encourage you to form study groups and/or discuss problems with your fellow students. I hope that the Piazza discussion boards will be useful for this. If you want to form a small group on Piazza rather than discuss with the whole class, I can arrange this, but I think with 20 students this will not be necessary. I emphasize that when you first look at a problem, you need to try to solve it for yourself! After that you are encouraged to discuss problems with other students, including your solutions to homework problems. Look at what each person in the group has done, criticize it, try to find and fix the holes in each others proofs. And then remember that **the solution you hand in must be your own**!

Don't be afraid to try a lot of different approaches and ideas in solving a problem. It is not unusual to go through 20 pages or more of scratch work to produce each page of homework solutions. Hands-on work with the material is where the learning really happens, so make it count.

Academic Misconduct, Plagiarism, etc

Quite simply, you should never hand in work that is not your own – whether you copied from a friend or the internet or a book or whatever. If you struggled with a problem, looked somewhere for an idea, and used that idea, then you should make a note on your solution of where you got help. If you have any doubt about the acceptable standards for academic conduct, consult the university's community standards:
https://community.uconn.edu/academic-misconduct/

If you plagiarize and I notice, I will report it and will penalize you 10% of the course grade. For a second offense it will be an additional 30% of the course grade, and for a third offense you will get an F in the course.

Non-Academic Support

The university has many support services for the stresses and difficulties encountered by students. I urge you to make use of these early – don't wait and let a small problem get bigger before you deal with it!. Among the many offices some of you may find useful are the Dean of Students, Student Health and Wellness (the Mental Health division may be particulary helpful if you are stressed) and the Center for Students with Disabilities. It is worth looking at what each of these offices do, so you know where to find help if you or a friend needs it. I should also mention the Office of Institutional Equity, which deals with matters of discrimination and harassment; I hope you will not need their help, but it is good to be aware of the support they offer.