Math 341: Real Analysis

Fall 2018

Basic Logistics

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Meeting times The course meets Monday-Tuesday-Thursday-Friday in Howard 242:

Textbook There is no official textbook for this course. You are expected to attend each lecture and take good notes during class. If you would like additional resources, I suggest the following:

- *Principles of Mathematical Analysis* by Walter Rudin
  https://www.mhprofessional.com/9780070542358-usa-principles-of-mathematical-analysis
- Michael Taylor's notes *Introduction to Analysis in One Variable*, available at https://www.ams.org/open-math-notes/omn-view-listing?listingId=110664
- *Advanced Calculus* by Patrick M. Fitzpatrick
  https://bookstore.ams.org/amstext-5/

Educational Goals

Goal 1: The real numbers Students should obtain an understanding of what properties of the real numbers must be assumed in order to "do calculus". This involves both knowing the properties and knowing what the purposes/consequences of the various properties are. Students should aspire to understand the logical connections between the various properties. Students should understand the importance of the construction of models of the real numbers, as well as understand the importance of example number systems that do not have all the properties required of the real numbers.

Goal 2: Continuous functions Students should understand the role that continuity plays in motivating, and describing, the completeness axiom of the real numbers. Students should also become fluent in the properties of continuous functions, as well as the construction of important classes of continuous functions.

Goal 3: Metric spaces Students should have a basic working understanding of the concept of a metric space, and be able to work with several important examples. Students should be able to understand/prove various abstract statements about metric spaces, and then understand the manifestation of those statements for specific examples.

Goal 4: Advanced calculus Students should get a general sense of what is required to put the basic concepts of single-variable calculus on a more rigorous footing. Students should be able to execute parts of the rigorous development of the calculus.

Throughout, students should demonstrate the understanding of the above topics by being able to construct technical mathematical proofs as well as provide "intuitive" explanations of what those proofs accomplish.

The assessment of each goal is based on student performance on the relevant homework assignments and exam problems.

Homework

- Homework is assigned each week. Be sure to start the homework as soon as it is assigned!
- Students are encouraged to collaborate on assignments, but must submit their own work for evaluation. If you work with other students, be sure that you understand each step of what is being done!
- When submitting work, please make sure that
  - your name and the assignment number/title are clearly written at the top of the first page,
  - your work is neatly presented, and
  - all pages are stapled together.

  Work that does not meet these standards are at risk of being placed in to one my "miscellaneous" folders, from which few documents ever return.
- All homework is to be submitted to the box outside Paul's office door.
- In general, credit is not given for late or incomplete work. I may, at my discretion, accept late work and file it away; such work is considered only if your course grade is borderline.

Quizzes and Exams

- There are a small number of in-class quizzes. The primary purpose of these quizzes is to provide a "reality check" about your progress in learning the course material.
- There are two hour-long exams. Exam dates will be confirmed one week prior to the exam. Exams cannot be rescheduled without documentation of extenuating circumstances. (Students receiving accommodations through the Student Support Services office should arrange to take the exams through that office.)
- There is a cumulative final exam, given during the official final exam time. The final exam cannot be rescheduled. Make your holiday travel plans accordingly.

Citizenship

I expect good academic citizenship from all students in this course.

Citizenship in this class It is important to treat our joint academic endeavor respectfully and responsibly. This includes

- being respectful of yourself;

- being respectful of your fellow classmates, faculty, staff, etc; and
- begin respectful of the course material and the learning process.

Citizenship in the LC community All students are expected to be an active and responsible member of our college community. In order to encourage this, you are required to attend two (2) official LC events during the semester. These events cannot be required of another course you are enrolled in, and must be officially advertised or sponsored in some way. After you have attended each event, send me an email that:

- tells me what the event was, and includes a link to the advertisement or description of the event,
- describes the content or activity of the event, and
- tells me your impressions of the event (what you learned, enjoyed, etc.).

You can find out about events on campus via the online campus calendar.

4.0 grading scheme

All coursework is graded on the 4.0 scale. The mapping between numerical and letter grades, together with the official definitions (taken from "Policies and Procedures" section of the Undergraduate Catalog), is as follows. The italics indicate an interpretation of the official definitions for the purposes of mathematics courses.

Grade A (4.0) Outstanding work that goes beyond analysis of course material to synthesize concepts in a valid and/or novel or creative way.

Computational problems are completely and correctly executed in a manner which displays a complete grasp of the theory behind the computation. Theoretical responses display a thorough understanding of the both precise details and the larger framework at hand.

Grade B (3.0) Very good to excellent work that analyzes material explored in class and is a reasonable attempt to synthesize material.

Computational problems are executed with minimal, insignificant errors (such as dropping a sign) and contain some indication that the relevant theory being used is understood. Theoretical responses display significant progress towards understanding of how the details fit in to a larger framework.

Grade C (2.0) Adequate work that satisfies the assignment, a limited analysis of material explored in class.

Solutions to computational problems display significant, though perhaps mechanical, understanding of basic procedures. Theoretical responses display an preliminary understanding of the topic at hand, but lack connections to the larger framework.

Grade D (1.0) Passing work that is minimally adequate, raising serious concern about readiness to continue in the field.

Both computational and theoretical responses display some non-trivial knowledge and skills, but raise concerns about whether basic ideas and methods are understood.

Grade F (0.0) Failing work that is clearly inadequate, unworthy of credit.

Fundamental misunderstandings, mis-use of methods or theory, seemingly random or un-related material, etc.

Course grades

Course grades are determined as follows:

1. For each category of educational goals above you will receive a grade determined by your performance on the corresponding portion(s) of exams, homework assignments, etc. Using these grades, I compute a preliminary course grade according to the following weighting:

   - Goal 1: 25%
   - Goal 2: 25%
   - Goal 3: 25%
   - Goal 4: 25%

2. After computing the preliminary grade, I make adjustments based on inconsistent coursework (such as disregarding an outlier), trends throughout the semester (such as improvement), and other factors I deem relevant. Students who have not demonstrated good academic citizenship will have their grades adjusted downward during this phase of the grading procedure.

3. Finally, I revisit the individual grades in view of the grade definitions provided by the College Catalog, seeking indicators of the synthesis of course material.

I emphasize that **ultimately grades are assigned according to the definitions in the college catalog**, based on my assessment of the student's knowledge and synthesis of the course material, as documented by the assignments and exams. While a weighted average of individual scores is a critical tool for making this assessment, in no way is such an average definitive.

Finally, I note that students fail the course if either of the following occurs:

Insufficient participation Missing the equivalent of two weeks of class sessions, or missing one of the exams, will lead to a failing grade. Exceptions to this policy require documented extenuating circumstances.

Gross negligence Demonstration of gross ignorance or complete lack of understanding of key concepts on exams will lead to a failing grade. In particular, a student who has accumulated what might be construed as 'technically enough points to pass' but demonstrates a "clearly inadequate" lack of understanding which is "unworthy of credit" will be awarded a failing grade.