MTH 200: Mathematical Proofs and Structures

Cam McLeman, Winter 2021

Instructor:	Cam McLeman Office: MSB, Room 406A	email: mclemanc@umich.edu Phone: 810-237-6689

Office Hours: M/R 7-8pm, W11-12

Official office hours will be conducted on the course Discord server at the times, but the channel will remain open 24/7 for help.

`https://discord.gg/2JZngSF8t7`

Textbooks: *Mathematical Reasoning: Writing and Proof*, by Ted Sundstrom.

Class Meetings: TR, 9:30-10:45pm, on Zoom.
`https://umich.zoom.us/j/99465382049`

Final Exam: Tuesday, April 27, 7:45-10:15am, on Zoom.

Catalog Description: Introduction to propositional and predicate logic; reading and writing of mathematical proofs; naïve set theory; number systems.

If only I had the theorems! Then I should find the proofs easily enough.

- Georg Bernhard Riemann

I have had my results for a long time, but I do not yet know how to arrive at them.

- Karl Friedrich Gauss

Course Goals and Outcomes

The two quotes above, by the two of the greatest mathematicians history has ever known, show rather different perspectives on the process of doing mathematics. Riemann (of Riemann integral fame) laments that he can justify for any theorem he can observe, but the discovery of the results themselves often elude him. Conversely, Gauss (of just about everything fame) observes that he knows *what* is true, but not how to deduce these facts from first principles. These two facets of the process of doing mathematics very nicely reflect the two major themes of this course: discovering mathematical truths, and writing down proofs.

With luck, your journey through mathematics has yet to teach you to become scared of the word "proof," for a proof is quite simply an explanation of why a certain fact must indeed be true. The standard of argument is albeit higher than in most disciplines: We do not, for example, settle for the somewhat laxer legalistic standard of "beyond a reasonable doubt." Rather, we call something a proof only when a reader of sufficient mathematical background can read our proof and be completely convinced of its correctness. To pharaphrase yet another great mathematician (Yuri Manin), a proof only becomes a proof by going through the process of being accepted by its readers as mathematical certainty.

My hope for the course is to learn to appreciate each of these aspects, regardless of whether you interest is in pure mathematics, applications to the sciences, acturial mathematics, or in the teaching of mathematics. Further, I hope that we can do so in such a way that we pick up relevant and interesting (dare I say fun?) content as we go. Occasionally, it is helpful to make these course goals more precise, in terms of what I'm trying to accomplish, and also what I'm expecting that an attentive and diligent member of the course should be able to accomplish. As such, I've outlined below such lists of the course goals and outcomes.

Course Goals

The goals of this course are numerous include:

1. to appreciate the notion of a proof and its role in mathematics and society;
2. to develop and deepen strategies for problem-solving;
3. to gain familiarity with the process of doing, reading, and writing mathematics;
4. and to introduce content that will to be of relevance as you proceed through later mathematical courses.

Course Outcomes:

By the end of this course you will be able to:

1. Complete proofs by contradiction, contrapositive, and induction, identifying when each is appropriate.
2. Identify and correct lapses in mathematical reasoning.
3. Simplify expressions from modular arithmetic.
4. Discover and prove properties of recurrence relations.
5. Determine logically equivalent statements via propositional logic or truth tables.

Assessment

Assessment in this class will take place through a variety of mechanisms: First, participation, a crucial component of the course, measured as a mix of basic attendance and participation during Zooms, especially during breakout groupwork sessions. Second are roughly-weekly homework assignments, which will involve reading from the book and writing proofs for the content that we make it through. Third are the two mid-terms and the final, which probably need no further explanation. Finally, and most non-standardly, are writing projects which involve the reading, processing, and writing of mathematics. I'll have a more detailed rubric as the semester progress, but basically the process is to find an article from an appropriate level journal (e.g., the College Mathematics Journal) and write a summary of the mathematics contained therein, and comment on some aspects (e.g., things you didn't understand at all, things you'd be curious in learning more about, etc.).

All of your grades can be accessed via 'My Grades' in Blackboard. I'll keep old papers, exams, etc. for at least 30 days after the end of the semester, after which time they may be shredded. Your final grade is the weighted average of the grades described above, with weights as in the table on the left, and an overall letter grade assignment based on the table on the right.

Participation	15%
Homeworks	20%
Midterms (x2)	10% each
Mini-Projects (x3)	10% each
Final Exam	15%

92.5%-100%	A	72.5%-77.49%	C
89.5%-92.49%	A-	69.5%-72.49%	C-
87.5%-89.49%	B+	67.5%-69.49%	D+
82.5%-87.49%	B	62.5%-67.49%	D
79.5%-82.49%	B-	59.5%-62.49%	D-
77.5%-79.5%	C+	$< 59.5\%$	E

Accessibility Services

It is our intention to support the full participation of all students in the learning process of this class. To this end, we have incorporated a variety of instruction techniques and evaluation methods in the course process. In spite of these efforts, situations may occur in which the learning style of individual students is not met by the instructional climate. It is our expectation that students who require specific or additional supports in acquiring the course content or demonstrating their achievement of the objectives will inform us of such needs immediately. Assistance is available in the office of Accessibility Services in 264 UCEN, 762-3456.

Writing Center

The Writing Center can help you with any writing or speaking project, from starting an assignment to the finished paper or speech. You can get help with papers or speeches for any course on campus, graduate or undergraduate. Take a draft of your paper or speech to the Writing Center and the tutors will help you complete it. If you have an assignment sheet, bring that too. For more information about the Writing Center or to schedule an appointment, go to the Writing Center website at http://www.umflint.edu/writingcenter/ or call (810) 766-6602. The Writing Center is located in 559 French Hall.

Academic Integrity

The following are excerpts of the policy of academic integrity as it in the Students Rights and Responsibilities section of the UM-Flint Catalog.

"Intellectual integrity is the most fundamental value of an academic community. Students and faculty alike are expected to uphold the highest standards of honesty and integrity in their scholarship. No departure from the highest standards of intellectual integrity, whether by cheating, plagiarism, fabrication, falsification, or aiding and abetting dishonesty by another person, can be tolerated in a community of scholars. Such transgressions may result in action ranging from reduced grade or failure of a course, to expulsion from the University or revocation of degree."

UM-Flint considers the following (among other things) as academic dishonesty and defines them as:

Plagiarism: taking credit for someone else's work or ideas, submitting a piece of work (for example, an essay, research paper, assignment, laboratory report) which in part or in whole is not entirely the student's own work without fully and accurately attributing those same portions to their correct source.

Cheating: using unauthorized notes, or study aids, or information from another student or student's paper on an examination; altering a graded work after it has been returned, then submitting the work for regrading; allowing another person to do one's work, then submitting the work under one's own name.

Fabrication: fabricating data; selectively reporting or omitting conflicting data for deceptive purposes; presenting data in a piece of work when the data were not gathered in accordance with guidelines defining the appropriate methods of collecting or generating data; failing to include a substantially accurate account of the method by which the data were gathered or collected.

Aiding and Abetting Dishonesty: providing material or information to another person when it should reasonably be expected that such action could result in these materials or information being used in a manner that would violate this code of academic integrity.