

Math 307: Introduction to Proof

Fall 2024, CRN: 13323

Instructor: Victor Ostrik

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Office: 319 Fenton

Office hours: M 10-11am, T 2-3pm

Class meets: MTWF 12-12:50pm Columbia 44

Course website: We will use Canvas webpage

All readings and homework assignments will be posted here.

Text: *Mathematical Reasoning: Writing and Proof*, by Ted Sundstrom. An electronic edition is available for free at <http://scholarworks.gvsu.edu/books/9/>

Prerequisites: MATH247 or MATH252 or MATH262.

Course objectives: There are two main—and quite different—objectives in this course. The first is to introduce students to the language and structures surrounding modern mathematical proof. Symbolic logic, quantifiers, set theory, functions, and induction are some of the topics in this area. Perhaps it is fair to call this the *mechanical* part of mathematical proof. The second objective is to help students become better at the problem-solving aspect of finding and creating proofs; perhaps we can call this the *non-mechanical* part. When faced with the problem “Prove that if n is odd then $n^2 - 1$ is divisible by 4”, students are often completely stuck and have no idea how to begin—even though they understand all the words. The course will give students experience with trying examples, looking for patterns, using definitions and theorems, making conjectures, and other mathematical techniques.

Topics covered:

- (1) Symbolic logic
- (2) Basic set theory, including functions and their properties
- (3) Modular arithmetic
- (4) Counting and other problems in discrete mathematics
- (5) Induction
- (6) Convergence of sequences and continuity of functions (the very basics).

Course Learning Outcomes: Students completing this course should be able to

- (1) Interpret and use logical structure in the context of proof. Examples of this are:
 - If one wants to prove “ $P \Rightarrow Q$ ” then one proof technique is to assume P and from there deduce Q .
 - If one wants to prove “ P or Q ” then one proof technique is to assume $\sim P$ and deduce Q .

Students will be able to define and use the biconditional, and to use de Morgan's laws. They will be able to identify the contrapositive, converse, and negation of a conditional statement, give examples, and use these concepts in proofs.

- (2) Interpret and use quantifiers.
- (3) Write basic proofs, including proofs by contradiction.
- (4) Find and use counterexamples to demonstrate that statements are false.
- (5) Write induction proofs, including strong induction.

Workload: Weekly homework, reading, and class attendance. An average well-prepared student should expect to spend about 12 hours per week on this class (including time spent in class).

Homework: Homework assignments will be due weekly, on Wednesdays at the beginning of class. This includes an assignment due Week 10.

Exams: There will be two midterms and a final.

Midterm 1: Friday, October 25, in class.

Midterm 2: Friday, November 22, in class.

Final Exam: Tuesday, December 10, 10:15am–12:15pm, in class.

University regulations prohibit the administering of early final exams. Please do not ask to take the final exam early unless you can show me the specific university rule that allows you to do this.

Grades: Your cumulative score in the class will be based on the following:

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|-----------|-----|------------|-----|
| Homework | 30% | Midterm 2 | 23% |
| Midterm 1 | 23% | Final Exam | 24% |

Grades are based on: A (90–100), B (80–89), C (70–79), D (60–69), F (< 60).

Learning Environment: The University of Oregon strives for inclusive learning environments. Please notify me if the instruction or design of this course results in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic Conduct: The code of student conduct and community standards is at conduct.uoregon.edu. In this course, it is appropriate to help each other on homework as long as the work you are submitting is your own and you understand it. It is not appropriate to copy verbatim someone else's homework and hand it in as your own. It is not appropriate to help each other on exams, to look at other students exams, or to bring unauthorized material to exams.