Math 79SI

Proof Positive: Principles of Mathematical Proof

Instructor: Mason Rogers, masonr@stanford.edu

Faculty Sponsor: Professor Brian Conrad, conrad@math.stanford.edu

Course Webpage: https://math79si.stanford.edu

Office Hours: Thursday, 3-4PM at Tresidder, on the side nearest to Old Union

Prerequisites: Concurrent or prior enrollment in Math 51 and an interest in proof-based math

Textbooks: *Mathematical Proofs: A transition to Advanced Mathematics* by Chartrand, Polimeni, and Zhang will be the primary resource (available for free online). Additional resources will be distributed through the webpage.

Homework/Grading Policy: Each week, students will be required to solve a specified number of problems from an extensive list and write up their solutions. Students may also opt to give solutions to additional problems and will receive feedback within one week on anything they submit. Late homework will not be accepted for credit, but the lowest homework score will be dropped. Grading will be based entirely on homework assignments, and a minimum of 70% is required to pass the class. Corrected work may be resubmitted within a week of receiving initial feedback for additional credit, as the point of the class is to *improve* the level of students' mathematical skills.

Weekly Content Outline: The first 5 weeks will each discuss a fundamental proof-writing strategy. Weeks 6-8 will focus on constructing and communicating more difficult arguments. In the last 2 weeks, we will develop the notion of a vector space to cement our skills and foster an appreciation for the utility of appropriate generality in math. Each week's content is summarized below:

1. Statements and definitions, proof/disproof by construction and counterexample
2. Direct proof
3. Proof by contrapositive
4. Proof by contradiction
5. Mathematical induction I: the basics
6. Mathematical induction II: advanced inductive arguments
7. Common mistakes in proofs, good mathematical writing habits
8. Choosing techniques and solving advanced problems
9. Vector spaces I: developing an abstract object
10. Vector spaces II: answering familiar questions with a new framework

Classes will be example-driven, and students are encouraged to participate by offering their ideas and asking questions. Several weeks will also feature an activity for students to practice skills such as constructing useful mathematical definitions and detecting common errors in arguments.