Math X01: Introduction to Proofs

Johan Cristobal

10-week Quarter Syllabus

Note: This is taken from my vision of teaching an introduction to proofs course. This has yet to be implemented. The set up is the course meets three times per week, for 50 minutes each meeting.

1 Course Objectives

In this course, there are four objectives we hope to achieve. By the end of the term, you should be able to:

Ω1) Understand what a proof in mathematics is;

Ω2) Follow the logical steps of a mathematical proof;

Ω3) Read and write proofs of different techniques; and

Ω4) Read and write the symbols used by mathematicians for shorthand.

2 Course Materials

We will use free, open-source materials in this class. I am drawing from two sources:

- *A Gentle Introduction to the Art of Mathematics* (GIAM) by Joe Fields, which you can access here: https://osj1961.github.io/giam/.
  - There is a link to a YouTube channel with videos that pair with this text. There is on expectation for you to watch these, but it is available for you.
- *Mathematical Reasoning: Writing and Proof* (MRWP) by Ted Sundstrom, which you can access here: https://gvsuoer.github.io/sundstrom-textbook/book-1.html.

◇ Note that these open-source material provide some or all solutions to their exercises. I will sometimes draw upon these exercises for your learning, and I trust that you will keep your integrity when it comes to submitting your work.

In the Course Schedule on the last page, I will note which sections we're doing and their respective chapter and section within GIAM and/or MRWP.

3 Contact Information and Student Hours

If you have any questions or concerns, please do not hesitate in emailing me.

If you want to meet in person, I will be in my office on Xdays from XX:XXam to XX:XXpm. This time is set aside for anyone to drop by and talk to me about anything. If this does not work, emailing me to set up a time or talking after class also works.

4 Course Structure & Assessments

Attendance and Interactions. This class meets Monday, Wednesday, and Friday every week, besides on holidays. On Mondays and Wednesdays, I will use the time to lecture in what you typically expect from a mathematics classroom. On Fridays, I will use the time for inquiry-based and active learning format where students will work in groups to explore the week's lecture content. As such, your attendance is highly valued and expected in this course. If you are missing class, please let me know by email!

Homeworks. I will give suggested problems every week, but these are for your practice and not for grades. Feel free to discuss them with me and your classmates if you have questions. These are meant to keep your skills sharp and a good way to check for yourself the progress.

Exams. There will be two exams within this course, and a final exam during the Finals week. The first exam and Final exam are your typical pencil-on-paper exam. This will assess your logic and proof writing technique skills.

The second exam is a presentation, being held throughout Weeks 8 and 9. For the presentation, you will pick a proposition or theorem from GIAM or MRWP that we have not covered. Within 20 to 25 minutes, you will present the proof to the class as if you wrote and discovered it. This requires providing your interpretation of what intuitions are necessary and why some steps are logical. You should be prepared to answer questions from your peers (and me). More information will be given when the time draws near. This will assess your communication skills.

Grade Breakdown.

Task	Percentage
Attendance and Interactions	10%
Exam 1 On Paper	25%
Exam 2 Presentations	25%
Final Exam	40%

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Lowest Percent	95	90	85	80	75	70	65	60	55	50	45	40	35

These grade cut-offs will not go up, but they may go down a point or two depending on the class performance. There will be no curves during the semester.

There are no curves, but there is an improvement score as extra credit. This is borrowed from my undergraduate Physics course and it gives a hint of mastery-based grading in this course. There will be 3 points possible, which follows this formula:

$$I = 3 \cdot \max\left\{ 0 \ , \ \frac{F - E}{1 - E} \right\} ,$$

where F is your final score as a percentage and E is the average of your Exam 1 and Exam 2 scores as a percentage. Note that you will not receive points if you scored a perfect score on Exams 1 and 2. But, you won't need an improvement score at that point! You've clearly mastered the material then!

5 ADA and Accommodations

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the [University] to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, you can visit them at X.

You can then talk to me about what the SSD office has worked with you, and we can get your accommodations started. Your success in this class is my priority, so please do not let shame stop you from a good experience.

6 Course Schedule

This schedule is subject to change, I will inform you any changes. Red text refers to assessments. Green text refers to class activities during inquiry-based and active-learning days. GIAM refers to *A Gentle Introduction to the Art of Mathematics* and MRWP refers to *Mathematical Reasoning: Writing and Proof.*

Week	Day	Topic	GIAM	MRWP
1	M	Syllabus Day, What is a Mathematical Proof?		
	W	Mathematical Symbols and Propositional Logic		1.1
	F	Truth table and Good versus not-so-good proofs	2.1	
2	M	First Order Logic I: Predicates and Quantifiers		2.1
	W	First Order Logic II: Logical Equivalences	2.3	2.2
	F	Two-column Proofs	2.4	
3	M	Sets and Set Operations		2.3
	W	Contradiction and Contraposition	3.3	3.3
	F	To be or NOT to be		2.4, 3.3
4	M	Number Theory I: Definitions and Direct Proofs	1.4, 3.1	
	W	Number Theory II: Prime Numbers	1.2	2.4
	F	In Your Prime		
5	M	Visual Proofs with Numbers and Graphs		
	W	From Intuition to Writing		
	F	*Exam 1 held in class*		
6	M	Functions, Injections and Surjections	6.5	6.1, 6.3
	W	Composition of Functions		6.4
	F	Doctor Doctor!		
7	M	Induction I: Weak one	5.1	4.1
	W	Induction II: Strong one	5.4	
	F	The Domino Effect		
8	M	(Non-)Constructive Proofs	3.6	3.2
	W	Computer Proof Assistant	3.5	
	F	*Student Presentations*		
9	M	*Student Presentations*		
	W	*Student Presentations*		
	F	*Student Presentations*		
10	M	Cardinality	8.1, 8.2	9.2, 9.3
	W	Catch-up Day or Visual Proofs for Fun		
	F	Course Review		
Finals		*Final Exam held in (to be determined)*		