Transition to Advanced Mathematics

Fall 2018

Math 265-01
MWF
12:00 - 12:50 pm
Hirt 209

Instructor

Dr. Lauren Williams
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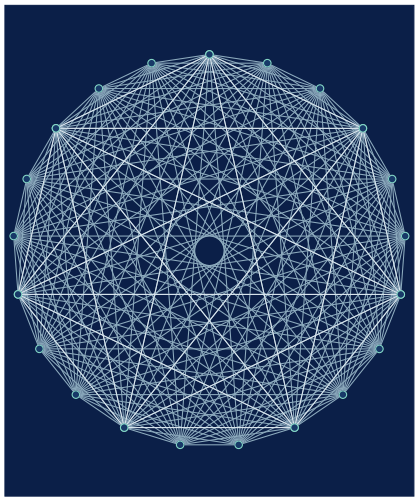


Office Hours

Monday 9:00 - 10:00
Tuesday 12:30 - 1:30
Wednesday 1:00 - 3:00
Thursday 8:00 - 9:00
Friday 1:00 - 2:00
and by appointment

Course Description

This course is designed to facilitate the mathematics student's transition to courses requiring a higher level of mathematical maturity. Emphasis will be on the reading and writing of proofs, and on communicating mathematics both orally and in writing. Topics will include logic, set theory, functions, relations, and number theory.

Course Objectives

In this course, you will:

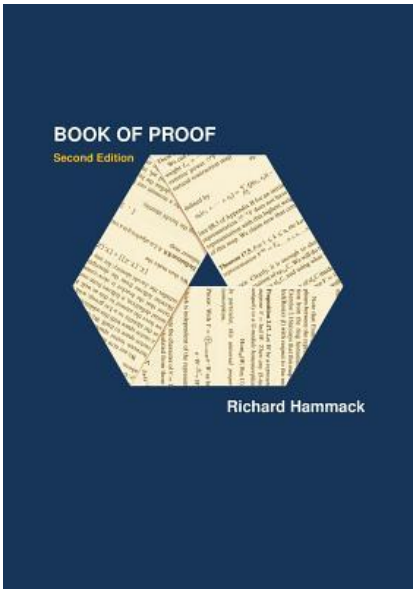
- learn to write using formal, mathematical language with correct notation;
- learn to construct direct proofs, proof by contradiction, and proofs by induction;
- learn to read mathematics critically, and be able to determine whether a proof is sound or flawed;
- define relations between sets of objects and the properties of those relations;
- learn the basic definitions and principles of logic, set theory, combinatorics, and number theory;
- be exposed to several different areas of mathematics, via direct study or within examples designed to clarify other topics;
- learn to apply new techniques of problem solving to challenging material, both in this course and in future study.

Prerequisites

This course is intended for students pursuing a major or minor in mathematics. Calculus I and Linear Algebra, or instructor permission, are required.

Course Website: http://math.mercyhurst.edu/~lwilliams/Math265/index.php

Textbook



Book of Proof, 2nd Edition, by Richard Hammack
ISBN-10: 978-0-9894721-0-4

The textbook is available as a free PDF from the author's website:
https://www.people.vcu.edu/~rhammack/BookOfProof/
Additional sources may be suggested during class, but will not be required.

You will not be expected to bring the text to class, so the electronic version is all you'll need. However, inexpensive ($\sim$ \$15) paperback copies are available through the website above if you would prefer a hard copy.

You are strongly encouraged to read ahead in the text, and work on the practice problems at the end of each section after we've covered the topic in class. Solutions to many problems are at the end of the textbook. Your work on these problems will not be collected, but the questions may appear on exams.

Additional Resources

There are several free textbooks and websites that you may find useful and inspiring while taking this course:

- The American Institute of Mathematics maintains a list of reviewed, open source textbooks, several of which focus on an introduction to proofs. There are also texts on prerequisite subjects, including calculus, linear algebra, and more.
  https://aimath.org/textbooks/approved-textbooks/
- CoCalc is a cloud based, online computing environment that allows you to write programs in SageMath, GAP, Maxima, R, Python, Julia, and many more. You can also learn and practice typesetting in LaTeX, highly recommended for all mathematics students.
  https://cocalc.com/
- Cut the Knot features an enormous collection of interesting mathematics problems, puzzles, proofs, and games.
  https://www.cut-the-knot.org/front.shtml

Other Course Information

- Be warned - you will struggle in this class! The material here is unlike anything you've seen before, and is not at all like a traditional math course. You'll be learning a new language along with some new abstract mathematics. Be prepared to spend plenty of time on the homework and reading.
- Please ask questions - in class or office hours - whenever you're stuck, but make an effort to find a solution or proof before seeking help. The process is more important than the result in this course, and the only way to become comfortable is to work through it on your own.
- I will attempt to answer email as quickly as possible, but please allow up to 24 hours for a response (particularly on weekends).
- Attendance is not required, but coming to class regularly will generally improve your grade. You are responsible for any work material covered in your absence. Please contact me if you are absent for an extended period.

Course Components

Homework

There will be 10 homework assignments throughout the semester, typically due one week after they are assigned. Some problems will be marked "suggested" and will not be collected. These will usually be problems from the textbook; solutions to many of these problems are available on the website for the textbook. These problems may appear on exams, so you are strongly recommended to work through them.

For collected problems, you are expected to submit your final work. Problems involving calculations should include work and an explanation of the steps used to arrive at your answer. Proofs should use formal language and notation, as covered in class. Work should be clear and neatly written.

You should expect to spend a fair amount of time on each assignment - don't wait until the night before it's due to get started! You are free to work together on your assignments, but everyone must submit their own work, in their own words. Late homework will be accepted with a 2 point per day penalty, until the graded assignment is returned to class.

If you are unable to submit your work in class, you can email a clear scan or photo of your work.

Exams

We will have two midterm exams and a final exam. The final exam will be cumulative, while the midterm exams will focus on more recent material. Both exams will be based on homework problems and the suggested textbook problems that do not need to be turned in.

You will be able to make up exams for excused absences. If you know in advance that you will not be able to take an exam at its schedule time, please let me know as soon as possible. All make ups must be completed within one week of the exam date. You are required to take the final exam for this course regardless of your average on earlier exams or homework.

The final exam is scheduled for Thursday, December 13, 10:30 am - 12:30 pm.

Progress

Homework and exam grades will be posted on Blackboard throughout the semester.

Learning Differences

In keeping with college policy, any student with a disability who needs academic accommodations must call Learning Differences Program secretary at 824-3017, to arrange a confidential appointment with the director of the Learning Differences Program during the first week of classes.

Grading

160 points	**Midterm Exams** Two exams, 80 points each
240 points	**Homework** Ten assignments, 24 points each
100 points	**Final Exam**
500 points	**Total Possible**

Grading Scale

D	D+	C	C+	B	B+	A
300	330	350	380	400	430	450
60%	67%	70%	77%	80%	87%	90%

Course Schedule

Aug	**22**	Class Introduction	
	24	Intro to Sets, Cartesian Product	
	27	Subsets, Power Sets	
	29	Set Operations, Venn Diagrams	
	31	Indexed Sets, Number Systems	
Sep	**3**	*No Class - Labor Day*	
	5	Statements, And, Or, Not	
	7	Conditional and Biconditional Statements	HW 1 Due
	10	Truth Tables, Logical Equivalence	
	12	Quantifiers	
	14	Symbolic Logic	HW 2 Due
	17	Negation	
	19	Factorials, Counting Subsets	
	21	The Binomial Theorem	HW 3 Due
	24	Theorems and Definitions	
	26	Direct Proof	
	28	Direct Proof	HW 4 Due
Oct	**1**	Catch Up / Make Up Day	
	3	**Exam I**	
	5	*No Class - Fall Break*	
	8	Proof by Cases	
	10	Contrapositive Proofs	
	12	Proof by Contradiction	
	15	Combining Techniques	
	17	Biconditional Proofs, Equivalent Statements	
	19	Existence and Uniqueness	HW 5 Due
	22	Proofs Involving Sets	
	24	Set Equality	
	26	Counterexamples and Disproof	HW 6 Due
	29	Proof by Induction	
	31	Proof by Induction	
Nov	**2**	Relations	HW 7 Due
	5	Equivalence Relations	
	7	Equivalence Classes and Partitions	
	9	Integers Modulo n	HW 8 Due
	12	Functions	
	14	**Exam II**	
	16	Injective and Surjective Functions	
	19	Injective and Surjective Functions	
	21	*No Class - Thanksgiving Break*	
	23	*No Class - Thanksgiving Break*	
	26	Pigeonhole Principle, Composition	HW 9 Due
	28	Inverse Functions	
	30	Cardinality	
Dec	**3**	Countable and Uncountable	
	5	Comparing Cardinalities	HW 10 Due
	7	Outro	
	13	**Final Exam 10:30 am**	

Other Important Dates

August 27
Add/Drop Deadline

October 23
Advising Day

November 16
Withdrawal Deadline

November 23
Fibonacci Day

December 10
Reading Day

Use this schedule to check which topics are coming up in class, so you can read ahead in the textbook.

We will attempt to adhere to this schedule as closely as possible. Topics may be covered on other dates, but exams will be held as scheduled.

All changes to the course schedule, including due dates for homework assignments, will be announced in class.