Basic Information

**Instructor:** Dr. Maria Gillespie, mgillespie@math.ucdavis.edu
**Office:** 2145 Mathematical Sciences Building (MSB)

**Course web page:** [http://math.ucdavis.edu/~mgillespie/Math108Fall17.php](http://math.ucdavis.edu/~mgillespie/Math108Fall17.php)

**Class times and location:**
- Section A01: MWF 11-11:50am, Haring 2016; Discussion Thurs 3:10-4:00, Hart 1128
- Section A02: MWF 11-11:50am, Haring 2016; Discussion Thurs 4:10-5:00, Hart 1128
- Section C01: MWF 3:10-4pm, Haring 2016; Discussion Tues 4:10-5:00, Olson 141
- Section C02: MWF 3:10-4pm, Haring 2016; Discussion Tues 3:10-4:00, Olson 141
(Please attend the class you are registered for so that we can ensure there is enough space.)

**Office hours:**
- Dr. Gillespie: Wednesday 12:00-1:00 PM, Friday 1:00-3:00 PM, 2145 Math Sciences Building (MSB)
- Samuel Fleischer (TA for A sections): Friday 12:15-2:15, 5350 Storer Hall, samfleischer@ucdavis.edu
- Lang Mou (TA for C sections): Tuesday 1:00-3:00, 3229 Math Sciences Building (MSB), lmou@math.ucdavis.edu

**Final Exam Schedule:**
- Class 1: Thursday, December 14, 10:30 AM - 12:30 PM
- Class 2: Wednesday, December 13, 8:00 AM - 10:00 AM

**Add date:** October 12; **Drop date:** October 24

**Books:**
Eggen, Smith, St. Andre, *A Transition to Advanced Mathematics*, 8th Ed.

Goals and Topics

In this course we will introduce the rigorous foundations of abstract mathematics. The goal of this course is for participants to come away with:

- Familiarity with the language of mathematics; improved ability to read advanced math texts
- Understanding of what a mathematical proof consists of, and how to verify that one is correct
- Plenty of practice with various methods of mathematical proof
- LaTeX typesetting skills and good proof writing style

In particular, we will aim to cover formal logic and natural deduction, methods of proof such as induction and contradiction in practice, set theory and functions, bijections and cardinality, combinatorial proofs, and the basics of abstract algebra (groups, rings, and fields).

The course will roughly follow the order this material is covered in the textbook, *A Transition to Advanced Mathematics*. However, the course will also rely heavily on the instructor’s lecture notes online and the material covered in class, which will sometimes cover additional material that is not in the textbook. It is important to attend all lectures and discussion sections in order to learn all of the relevant material.
Grades and Policies

The following table summarizes how the coursework will be graded.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percent of Grade</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
<td>Due Mondays in class</td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
<td>Monday, Oct. 30</td>
</tr>
<tr>
<td>Project</td>
<td>20%</td>
<td>Due Wednesday, Nov. 22</td>
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<td></td>
<td></td>
<td>Revision: Dec. 8</td>
</tr>
<tr>
<td>Final exam</td>
<td>35%</td>
<td>Dec. 14 or 13</td>
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</tbody>
</table>

**Homework policies:** Homework will be posted each Monday and will be due the following Monday in class. The problems will be proof-based, and full work should be shown. Two of the problems will be randomly selected per week to be graded. Collaboration and discussion among your peers is fully encouraged in solving the homework problems, but each student must write or type up their own solutions themselves, without simply copying from another student’s work.

No late homework will be accepted under any circumstances. A missed homework assignment is counted as a zero. In order to account for the possibility of an illness or other unexpected emergency, your lowest homework grade will be dropped when computing your final homework average.

**Term project policies:** In lieu of a second midterm exam, there will be a written project, designed to give you practice thinking about a difficult mathematical problem for a longer period of time, and to give you feedback on your proof writing style. The project will consist of a mathematical investigation starting from any one of the provided prompt problems, in which you should write, with full proofs of all claims, at least four typed pages on what you have discovered in your investigation. The project must be typeset in LaTeX.

The first draft of your project is due on the Wednesday before Thanksgiving break. The instructor and TA's will provide detailed feedback on your draft, and you should then revise your draft according to the feedback. Your final draft is due the night before the last day of class. The paper will be graded mostly on correctness of the proofs and style of the writeup, as long as the theorems are nontrivial and relevant to the problem at hand.

You may not consult other students or any material on the internet for help with your project. You can ask questions pertaining to the project to your TA or the instructor during office hours.

**Exam policies:** The midterm will be an in-class exam on Monday, Oct. 30. The final exam, which falls on Dec. 14 for the 11am class and Dec. 13 for the 3pm class, will be a comprehensive exam on everything covered during the course. No books, notes, or Internet access will be allowed on any exam. Non-programmable calculators will be allowed but will probably not be very helpful.

In the case that an emergency arises (with proof, such as a doctor’s note) that causes a student to miss the midterm exam, a student can make up for it by writing a longer term paper (at least ten pages) on more of the given problems. There will be no way to make up a missed final exam, and if an emergency does arise for the final then the student should petition for a grade of Incomplete.

If you have questions on the grading or wish to request a re-grade of a certain problem, you should bring your graded exam (or homework) to your TA’s office hours.

**Bonus points:** A separate, informal Bonus Points score, having no impact on grades whatsoever, will be tallied for each student throughout the class. Students can earn Bonus Points through answering the bonus problems on the homework correctly, going above and beyond on the term project, or writing a particularly clever proof for one of the homework problems. There will be a brief Bonus Points awards ceremony on the last day of class.

**SDC policy:** Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Student Disability Center (SDC). Faculty are authorized to provide only the accommodations requested by the SDC. If you have any questions, please contact the SDC at 530/752-3184 or sdc@ucdavis.edu.
Tentative Schedule of Topics

- Sept 27: Introduction, Formal Axiom Systems
- Sept 29: Propositional Logic 1 - Truth tables and statements
- Oct 2: Propositional Logic 2 - Rules of Inference (Homework 1 due in class)
- Oct 4: Propositional Logic 3 - More Rules of Inference and Formal Proofs (Preparation: Read sections 1.4 and 1.5 of textbook and pages 7-9 of Supplementary Lecture Notes)
- Oct 6: Introduction to Quantifiers (Read section 1.3 of textbook)
- Oct 9: Proofs with Quantifiers (Homework 2 due) (Read Supplementary Lecture Notes pages 10-13, sections 1.6 and 1.7 of textbook)
- Oct 11: Peano Axioms for the natural numbers (Read pages 16, 17 in Lecture Notes)
- Oct 13: Induction! (Read section 2.4 of textbook)
- Oct 16: More Induction: strong induction, inducting starting at later values, etc (Homework 3 due) (Read section 2.5 of textbook)
- Oct 18: Set Theory 1: Basic notions, proofs of set equality, subsets, power sets (Read section 2.1 of textbook)
- Oct 20: Set Theory 2: Intersection, union, complement, Venn diagrams (Read section 2.2 of textbook)
- Oct 23: Relations 1: Cartesian product and equivalence relation (Homework 4 due) (Read sections 3.1, 3.2)
- Oct 25: Relations 2: Partitions (Read sections 3.3, 3.4)
- Oct 27: Relations 3: Orders and partial orders (Read section 3.5)
- Oct 30: Midterm 1 (No homework due, a set of problems called Homework 5 will be posted online as midterm practice only)
- Nov 1: Functions 1: What is a function? (Read sections 4.1, 4.2)
- Nov 3: Functions 2: Injective, surjective, bijective (Read section 4.3)
- Nov 6: Functions 3: Composition, inverse functions, restriction (Homework 6 due) (Read section 4.4)
- Nov 8: Cardinality 1: What is cardinality, different infinite cardinalities, Cantors theorem (Read sections 5.1, 5.2, 5.4)
- Nov 13: Cardinality 2: Counting basics, combinatorial interpretations (Homework 7 due) (Read TBA pages of lecture notes)
- Nov 15: Combinatorial Proofs 1: Counting in Two Ways (Read TBA pages of lecture notes, section 2.6 of textbook)
- Nov 17: Combinatorial Proofs 2: Bijections (Read TBA pages of lecture notes)
- Nov 20: Combinatorial Proofs 3: Inclusion/exclusion (Homework 8 due, on combinatorics and cardinality) (Read TBA pages of lecture notes)
- Nov 22: Groups 1: Definition and examples, symmetric group (First draft of projects due) (Read sections 6.1, 6.2 of textbook)
- Nov 27: Groups 2: Permutation groups and symmetry groups (Homework 9 due) (Read TBA pages of Lecture Notes)
• Nov 29: Groups 3: Subgroups and order (Read section 6.3)
• Dec 1: Groups 4: Cosets and Lagranges theorem (TBA pages of lecture notes)
• Dec 4: Groups 5: Group Actions, orbit-stabilizer (Homework 10 due, on group theory)
• Dec 6: Groups 6: Rings and Fields (Read section 6.5)
• Dec 8: Groups 7: [Surprise exciting lecture!] (Final draft of projects due)