

Math 672 - Projective Geometry I

Fall 2026

Basic Information

Instructor: Maria Gillespie, Maria.Gillespie@colostate.edu

Office: Weber 125

Course web page: <http://mathematicalgemstones.com/maria/Math672Fall26.html>

See also the Canvas course page.

Class time and location: MWF 2:00 - 2:50, Engineering building room B105

Office hours: Wednesdays, 3-4 pm in Weber 125 (after class)

Books: We will be generally following Shafarevich's "Basic Algebraic Geometry", books 1 and 2. These appear to be available currently at the links on the Canvas course, but it is recommended to buy or download the books. Other materials that we may look at are:

- Vakil's online notes "The Rising Sea" <https://math.stanford.edu/~vakil/216blog/FOAGjul3123public.pdf>
- Introduction to cohomology of the flag variety, by Billey, Gao, Pawlowski: <https://arxiv.org/pdf/2506.21064>
- Introduction to Intersection Theory in Algebraic Geometry by William Fulton
- Shivkumar's notes on the Chow Ring <https://web.ma.utexas.edu/users/abhishek/files/notes/ChowRing.pdf>

Grades and Policies

The following table summarizes how the course will be graded.

Activity	Percent of Grade	Date
Problem of the Week writeups (15 total)	45%	End of each Friday in class
Homework 1	5%	Sept 2
Homework 2	5%	Sept 16
Homework 3	5%	Sept 30
Midterm Homework	10%	Oct 7
Homework 4	5%	Oct 21
Homework 5	5%	Nov 4
Homework 6	5%	Nov 18
Final Homework	15%	Dec 9

Problem of the Week: Each Friday at the start of class, I will write a problem on the board that has to do with the material we covered that week. You will have 10 minutes to work on it, we will discuss it together as a class, and then you will have 10 minutes to write up the solution and hand it in. We will then have more lecture for the end of the class period. Phones and electronic devices are not allowed to be consulted during this time.

This is designed to ensure that you have some focused work time during class each week that by its nature cannot be AI-assisted in either helping you figure out the solution or write it up.

Your lowest two Problem of the Week scores will be dropped, to take into account illness or absence.

Homework: You may hand in any number of problems from each homework (besides the Midterm Homework and Final Homework) between 2 and 5 inclusive, and your score on the homework will be based on what you hand in. For instance if you hand in 4 problems and get 3 completely right and one completely

wrong, then you get 75% on the homework. But if you handed in 5 of the problems including the one you got wrong, you get 80%, and if you handed in only two problems but both were correct, you get 100%.

Partial credit will be given as well, so if there are two parts to a problem for instance and you only got one, or an if and only if and you only got one direction, then you'll get half score for that problem or an appropriate weighting based on difficulty.

Please scan and upload your homework to Canvas for grading. Homeworks will be posted on Canvas and also on the course web page.

If you are just getting started with LaTeX, a good place to start is the website Overleaf, which allows you to create LaTeX documents on the cloud without having to download and install LaTeX on your computer or laptop. There will be a template provided for you to get started with as well.

Late homework policy: You may hand in homework late, but 10% will be deducted for each day it is late, with a minimum score of 0 after ten days. This will be automatically applied on Canvas.

Midterm and Final Homework: These are essentially cumulative take-home exams, and you must complete all the problems to get full credit. Collaboration is allowed according to the rules described below.

Collaboration: on all homeworks is permitted, but as in research, you must list all coauthors on a problem's solution at the top of the page. Your writing must also be your own; if I see strong evidence of copying solutions word for word from each other, the assignment will be marked as a zero.

AI policy: An AI counts as a collaborator; again, your writing must be your own and not copied from an AI output, and you must list the AI you consulted at the top of the page. This includes Google searches in which you read the Google AI output at the top.

Tentative Schedule

- Week 1: (Aug 24, 26, 28) Introduction, intersection problems, why projective space (Shafarevich Ch 1 Section 1)
- Week 2: (Aug 31, Sep 2, 4) Projective plane, duality, projective space (finish Shafarevich Ch 1 Section 1)
- Week 3: (Sep 9, 11) Affine varieties (Shafarevich Ch 1, Section 2)
- Week 4: (Sep 14, 16, 18) Affine varieties from Spec construction perspective (Shafarevich Ch 5 Section 1)
- Week 5: (Sep 21, 23, 25) More Spec examples and commutative algebra practice, maps and functoriality (finish Shafarevich Ch 5 Section 1)
- Week 6: (Sep 28, 30, Oct 2) Rational maps (Shafarevich Ch 1, Section 3)
- Week 7: (Oct 5, 7, 9) Quasiprojective varieties (Ch 1 Section 4), Midterm homework due Oct 7
- Week 8: (Oct 12, 14, 16) Sheaves (Ch 5 section 2)
- Week 9: (Oct 19, 21, 23) Sheaves and start of Schemes (Ch 5 section 2,3)
- Week 10: (Oct 26, 28, 30) Schemes (Ch 5 section 3)
- Week 11: (Nov 2,4,6) Products, classically and schemey (Ch 1 Section 4 and Ch 5 Section 4)
- Week 12: (Nov 9, 11, 13) Dimension (Ch 1 section 5)
- Week 13: (Nov 16, 18, 20) Line bundles and vector bundles on projective space (Ch 6 Section 1)

- FALL BREAK
- Week 14: (Nov 30, Dec 2,4) Chow ring of projective space (Shivkumar's notes)
- Week 15: (Dec 7, 9, 11) Fun with Flags (Billey, Gao, Pawlowski). Final homework due Dec 9

Classroom environment

In order to help make our classroom an excellent place to be in and learn mathematics, please keep in mind the following principles:

- *Speak up in class!* If you don't understand something, no matter how small, chances are someone else in the class doesn't understand it either, and asking will help me address the confusion and make things clearer. Off-the-wall ideas and comments are also always encouraged.
- *Talk to each other!* If I give a problem for you all to think about during class, chatting with your neighbor is allowed and encouraged; explaining helps both the explainer and the listener to understand better.
- *Kindness:* The students in this class will be coming from many different backgrounds, both mathematically and as human beings. Please be respectful and encouraging towards each other.
- *Mask up or go remote when you're sick:* I have an immunocompromised kid at home and will be masking in class. I'll bring masks to class and if you're feeling under the weather I'd appreciate if you grab one and wear it during class to the extent that you're able! If you're sick, I'm also happy to accommodate remote learning by pointing the laptop at the board. This especially goes if you have covid. Let's keep each other healthy.

Academic Integrity

This course will adhere to the CSU Academic Integrity Policy as found on the Student Responsibilities page of the CSU General Catalog and in the Student Conduct Code. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Student Resolution Center.

Disabilities

Colorado State University is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations must first contact the Student Disability Center (SDC) before requesting accommodations for this class.