Computational Algebra and Algebraic Geometry

MWF 2:30 – 3:20 pm

Instructor: Susan Jane Colley
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Office Hours:
Monday 3:30 – 5:00 pm
Tuesday 10:00 – 11:00 am, 3:00 – 4:30 pm
Wednesday 10:30–11:30 am, 3:30 – 4:30 pm
Thursday 4:30 – 5:30 pm
Friday 10:30 – 11:30 am
Also by appointment

Text: D. Cox, J. Little, and D. O’Shea, Ideals, Varieties, and Algorithms, 4th. ed., Springer. This text is required and is available at the bookstore. It is also available electronically at https://doi.org/10.1007/978-3-319-16721-3.

Goals:
• Explore topics from commutative algebra (particularly ring theory) and elementary algebraic geometry (i.e., varieties).
• Examine both theory and examples in concrete terms through algorithms enabling computer computations within abstract algebra.
• Understand how some key algebraic ideas can be applied to other areas in the mathematical sciences.
• Learn additional, related topics through independent work.
• Practice technical mathematical writing and speaking.

Homework: There will be weekly, hand-in problem sets during the semester. You may work together on this homework, but you must submit your own write-up of the problems and indicate with whom you had any significant collaboration. No late assignments will be accepted (emergencies excepted, of course). Solutions to the hand-in problem sets will be available online through Blackboard.

Exams: There will be two open-book, take-home exams, tentatively due on Wednesday, October 10 and Wednesday, November 14. Please let me know as soon as possible if there is a problem with either of these dates.
There will also be closed-book final exam on Thursday, December 20 from 2:00 to 4:00 pm.

**Project:**
You will work either alone or with another student on an independent project related to computational algebra. The project may involve material from the text or from other sources, or it may represent independent work. Each group will submit a written report (~ 5–7 pages) concerning the project and participate in a Special Computational Algebra Session to be scheduled between December 5 and 9. Additional details concerning the special project will be forthcoming.

**Participation:**
Since this is a small class, it is important that you come to class—on time and for (nearly) every meeting. Further, you should attempt to participate actively in class by asking questions, offering problem solutions, etc.

**Grading:**
- Take-home midterms (each) 20%
- Final exam 20%
- Homework 20%
- Special project and class participation 20%  
  (percentages of final grade)

**Deadlines:**
I will try to be as clear as I can about the nature of assignments, and I will provide fair warning about when they are due. Late assignments normally will not be accepted. At the same time, I do understand that emergencies arise, so if unforeseen circumstances are interfering with your ability to complete some work in the course (e.g., significant illness, but not assignments for other classes), please contact me immediately, preferably before the assignment is due.

**Online:**
Copies of assignments, handouts, etc. will be posted on the course Blackboard site. Go to blackboard.oberlin.edu (and your “Academic Hub”) to access these materials.

**Note:**
If you have a documented disability I am happy to discuss academic accommodations with you; please contact me as soon as possible so I can understand how to be of assistance.

**Outline of the Course**

<table>
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<tr>
<th>Topic</th>
<th>Weeks</th>
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<tr>
<td>Introduction and basic notions (Chapter 1)</td>
<td>2.5</td>
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<tr>
<td>Gröbner bases (Chapter 2)</td>
<td>3.5</td>
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<tr>
<td>Elementary elimination theory (Chapter 3)</td>
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<tr>
<td>Correspondence between ideals and varieties (Chapter 4)</td>
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<td>Additional topics</td>
<td>as time permits</td>
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</tbody>
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Selected Bibliography

Here are some suggestions for supplementary reading. You may find some of these references helpful for putting together your project, but in no way should you feel constrained by them. An asterisk (*) indicates that the book is on reserve in Mudd.

BOOKS


PAPERS/ANTHOLOGIES

Homework

You are permitted, even encouraged, to collaborate on homework. For homework that is not graded, feel free to consult anyone at all: your classmates, me, other students, friends, relatives, Donald Trump (this last one not really). For homework that is to be handed in and graded, I expect you to be somewhat more careful. Specifically, you should continue to ask questions of me regarding homework problems and you may collaborate with one or two of your classmates (per assignment). Please do not undertake significant collaboration with more than two students without permission. If you do collaborate, you are expected to write your own solution to problems (i.e., not to copy) and to indicate the name(s) of any student(s) with whom you worked.

You may consult any written sources for hand-in homework, provided that you give appropriate citations. Please write your homework solutions with care.

Examinations

Unless specifically indicated otherwise, in-class tests are assumed to be closed-book. Collaboration of any sort (other than to ask me questions) will not be permitted. Take-home exams will have specific provisions for using books and notes, but, again, you are not to discuss the content of the exam with anyone other than me. Any time limits will be indicated with each test.

Independent Project

Obviously, your primary contacts for your project should be me and your partner. It is also acceptable for you to consult with others, provided you give appropriate citation in your poster presentation and your written report.

Honor Pledge

On every assignment that you submit for credit, you are expected to sign the Oberlin College Honor Pledge:

“I have adhered to the Honor Code on this assignment.”

If you need clarification of the policies above, please do not hesitate to ask. Should you require some variation in these rules, you must discuss the matter with me well in advance of any assignment.

For general information about the Honor System at Oberlin, consult
<https://www.oberlin.edu/dean-of-students/student-conduct/academic-integrity/students>.