Department of Mathematics

AM 4615F / AM 9563F Course Outline

Applied Computer Algebra - Fall 2026

1. Course Information

Component	Day(s)	Time	Location
Lectures	Monday, Wednesday, Friday		

Academic term: Fall 2026. Delivery mode: In person. The course has three lecture hours per week and is cross-listed as the undergraduate essay course AM 4615F and the graduate course AM 9563F.

Prerequisites and Enrolment

Undergraduate prerequisite: Applied Mathematics 2814A/B (Mathematical Computation), or the former Applied Mathematics 2814F/G (Numerical Analysis). Graduate enrolment in AM 9563F is governed by departmental and School of Graduate and Postdoctoral Studies regulations. The official Academic Calendar listing takes precedence in the event of a discrepancy.

Unless students have either the prerequisites for this course or written special permission from the Department of Mathematics to enroll in it, they may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on their academic record. This decision may not be appealed.

2. Instructor Information

Instructor	Email	Office	Office Hours / Availability
Dr. Taylor Brysiewicz	tbrysiew@uwo.ca		
Teaching Assistant	TBD	TBD	TBD

Students must use their Western (@uwo.ca) email addresses when contacting the instructor or teaching assistant and should include “AM 4615F/9563F” in the subject line. Changes to office hours and additional help opportunities will be announced through OWL Brightspace.

3. Course Syllabus, Schedule, and Delivery Mode

Course Description

This course surveys topics in computer algebra, ranging from the representation and manipulation of algebraic objects on a computer to sophisticated algorithms and open questions at the forefront of mathematical research. Students will become experienced users of mathematical software and will study computational tools drawn from linear algebra, polyhedral geometry, symbolic computation, computational algebraic geometry, and numerical algebraic geometry. Problems and algorithms will be motivated by applications.

Course Overview

Computer algebra sits at the interface of mathematics, algorithms, and software. The course emphasizes both mathematical structure and computational practice: how algebraic objects are represented, how standard algorithms work, what their computational limitations are, and how symbolic and numerical methods complement one another. A substantial writing project asks students to investigate a topic in applied computer algebra, verify its mathematics and computations, communicate it clearly, and defend the submitted work orally.

Course-Level Learning Outcomes

- explain the benefits and limitations of symbolic, exact, and numerical computation;
- use at least one computer algebra system proficiently and work effectively with several pieces of mathematical software;
- represent and manipulate common algebraic objects computationally and implement elementary algorithms;
- describe and apply standard algorithms in computer algebra, including algorithms for univariate polynomials and Gröbner bases;
- use ideals, varieties, term orders, and Gröbner bases to analyze polynomial systems;
- apply computer algebra methods to examples arising in geometry and other applications;
- compare symbolic and numerical approaches to solving polynomial systems;
- locate, evaluate, and correctly cite mathematical sources; and

- write, verify, and orally defend a coherent mathematical exposition supported by reproducible computations.

Undergraduate and Graduate Expectations

AM 4615F is an essay course. Undergraduate students normally complete the project in self-selected pairs, with individual accountability established through identified authorship, an individual verification statement, and an individual oral defense. AM 9563F students complete an individual project and are expected to write a more technically advanced paper with greater depth of mathematical detail and engagement with advanced literature. The graduate-level distinction is supplied primarily through this individual and more advanced project expectation and the corresponding oral defense.

Tentative Schedule

Week	Dates	Tentative Topic	Assessment / Note
1	Sept. 9-11	Introduction to computer algebra	Classes begin Sept. 9
2	Sept. 14-18	Computer algebra systems; exact, symbolic, and numerical computation	
3	Sept. 21-25	Representing numbers; basic algorithms; Euclidean algorithm	Assignment 1 due Sept. 25
4	Sept. 28-Oct. 2	Polyhedral geometry	No class Sept. 30; project proposal due Oct. 2
5	Oct. 5-9	Univariate polynomials	
-	Oct. 10-18	Fall Reading Week	No classes
6	Oct. 19-23	Polynomial systems, ideals, and varieties	Assignment 2 due Oct. 23
7	Oct. 26-30	Term orders and Buchberger's algorithm	
8	Nov. 2-6	Gröbner bases	Assignment 3 due Nov. 6
9	Nov. 9-13	Gröbner bases in applications	Assignment 4 due Nov. 13
10	Nov. 16-20	Numerical algebraic geometry	Near-complete project drafting
11	Nov. 23-27	Numerical algebraic geometry and applications	Individual oral defenses
12	Nov. 30-Dec. 4	Open questions and contemporary applications	Final essay revision

Final classes on December 7 and 9 will be used for concluding examples, synthesis, and review. The final essay and individual verification statement are due on December 7. The order and pace of topics may be adjusted according to the needs of the class; any changes will be announced through OWL Brightspace.

Key Sessional Dates

- Classes begin: September 9, 2026
- National Day for Truth and Reconciliation: September 30, 2026 (no classes)
- Fall Reading Week: October 10-18, 2026
- Last day to withdraw from a Fall 12-week course without academic penalty: November 30, 2026
- Classes end: December 9, 2026
- Study Day: December 10, 2026
- December examination period: December 11-22, 2026

4. Course Materials

Textbooks and Other Learning Materials

No textbook purchase is required. Required readings, course notes, examples, and links to software documentation will be posted or linked through OWL Brightspace. Approximate required learning-material cost: $0.

The instructor may identify optional reference books for students who want further reading, including texts on modern computer algebra, Gröbner bases, computational geometry, and numerical algebraic geometry. Students are not expected to purchase these references. Any excerpt required for assessment will be made available through an appropriate course or library channel at no additional cost to students. Approximate recommended learning-material cost: $0.

Software

The course will use several mathematical software systems. Julia and Oscar are free and open source (approximate cost: $0). Macaulay2 is free and open source (approximate cost: $0). Maple may also be demonstrated, but students are not required to purchase a personal licence; all required work can be completed using free software or software made available through Western. Approximate required software cost: $0.

Students may use other suitable computer algebra systems with the instructor's approval, provided that submitted work is readable and reproducible. LaTeX is recommended for the writing project, but another suitable mathematical typesetting system may be used. No paid typesetting software is required.

OWL Brightspace

Course materials, announcements, assessment instructions, and submission links will be posted to OWL Brightspace: https://westernu.brightspace.com/. Students are responsible for checking the course site regularly; it is the primary method by which information will be disseminated to the class.

Students who need assistance with OWL Brightspace may consult the OWL Brightspace Help page at https://brightspacehelp.uwo.ca/ or contact the Western Technology Services Helpdesk at 519-661-3800 or extension 83800.

Technical Requirements

Students require regular access to a computer and an internet connection for software installation, computational work, research, and electronic submission. Personal ownership of a particular computer or software package is not required. Students are responsible for ensuring that submitted code and output can be read and reproduced by the instructor.

5. Methods of Evaluation

Grading Scheme and Assessment Dates

Assessment	Weight	Date / Timing
Computational assignments (best 3 of 4)	30%	See schedule below
Project proposal and annotated bibliography	5%	Friday, October 2, 2026
Individual oral defense of near-complete draft	10%	By appointment, November 23-25, 2026
Final essay	20%	Monday, December 7, 2026
Individual author and verification statement	5%	Monday, December 7, 2026
Cumulative final examination	30%	Scheduled by the Registrar
Total	100%	

Tentative Assessment Schedule

Assessment	Stated deadline / date	No-late-penalty period ends	Tentative focus / format
Assignment 1	Fri., Sept. 25, 11:59 p.m.	Sun., Sept. 27, 11:59 p.m.	Computer algebra systems, exact arithmetic, and basic algorithms
Project proposal	Fri., Oct. 2, 11:59 p.m.	Sun., Oct. 4, 11:59 p.m.	Approved topic, question, outline, division of work, and annotated bibliography
Assignment 2	Fri., Oct. 23, 11:59 p.m.	Sun., Oct. 25, 11:59 p.m.	Polyhedral geometry, univariate polynomials, ideals, and varieties
Assignment 3	Fri., Nov. 6, 11:59 p.m.	Sun., Nov. 8, 11:59 p.m.	Term orders, Buchberger's algorithm, and Gröbner bases
Assignment 4	Fri., Nov. 13, 11:59 p.m.	Sun., Nov. 15, 11:59 p.m.	Gröbner bases and applications
Near-complete draft	96 hours before the individual oral-defense appointment	48 hours before the appointment	Required in order to attend the oral defense
Individual oral defense	By appointment, Nov. 23-25	Not applicable	Approximately 10 minutes per student
Final essay and verification statement	Mon., Dec. 7, 11:59 p.m.	Wed., Dec. 9, 11:59 p.m.	Final PDF, accompanying code, and individual statement

Assessment	Stated deadline / date	No-late-penalty period ends	Tentative focus / format
Final examination	Scheduled by the Registrar	Not applicable	Cumulative, in person, software-enabled

The assessment dates are tentative until confirmed on OWL Brightspace. An exact assessment schedule will be provided as soon as dates are confirmed. Any necessary change will be announced with reasonable notice.

Computational Assignments

Four individual computational assignments will be posted to OWL Brightspace. They will ask students to use computer algebra software to solve mathematical problems, implement or investigate algorithms, interpret output, and explain the results. The best three assignment grades count, with each counted assignment worth 10% of the final course grade. Students are encouraged to submit all four assignments.

Writing Project: Group Structure and Topic Approval

AM 4615F students are required to complete the writing project in self-selected groups of two. Groups of three may be approved when enrolment or the proposed topic makes this appropriate. Individual undergraduate projects are permitted only in exceptional circumstances. Students choose their own topic in applied computer algebra, but the topic must be approved by the instructor. A student who has not joined a group by the date announced on OWL may be assigned to a pair or approved trio.

AM 9563F students complete the project individually. Their paper must be more technically advanced than the undergraduate paper, with greater depth of mathematical detail and engagement with advanced or research-level literature.

The project proposal is graded jointly for an undergraduate group. The final essay normally receives a common group grade, subject to the individual and shared accountability rules below. The oral defense and author and verification statement are graded individually. Every listed author is responsible for the entire submitted document, not only the section for which they are identified as primary author.

Essay-Course Writing Requirements

For AM 4615F, the project is structured so that every student produces at least 2,500 words of connected prose and demonstrates individual competence in mathematical writing. The following minimums apply:

- a pair submits a joint essay of approximately 4,000-5,000 words;
- an approved trio submits a joint essay of approximately 6,000-7,500 words;
- an exceptional individual undergraduate project contains at least 2,500 words;
- each student in a shared project is identified as the primary author of at least 1,750 words of the joint essay; and
- each student submits an individual author and verification statement of approximately 750 words.

The joint essay should read as a coherent paper rather than as disconnected individual submissions. The identified primary-authorship sections establish minimum individual writing responsibility, but every listed author is responsible for the entire submitted document. AM 9563F students submit an individual, more technically advanced paper of approximately 4,000-5,000 words and an individual verification statement.

Project Proposal and Annotated Bibliography

The proposal should identify the topic and motivating question, provide a preliminary outline, describe the planned mathematical and computational content, identify the software likely to be used, and include an annotated bibliography of credible sources. Undergraduate groups must also state the intended division of primary writing responsibility. Topic approval is required even if the proposal component is missed under the Flexible Completion rules below.

Near-Complete Draft and Individual Oral Defense

Each student will book an individual oral-defense appointment of approximately 10 minutes. A near-complete draft of the full paper, together with its code and computational output, must be submitted 96 hours before the appointment. The automatic 48-hour no-late-penalty period ends 48 hours before the appointment. A sufficiently complete draft is a requirement for attending the defense.

Students attend individually. They may consult the submitted paper and accompanying code, but may not use generative AI during the meeting. Questions may concern any definition, theorem, claim, example, citation, computation, figure, algorithm, or piece of code appearing in the draft. The 10% oral-defense grade is individual.

If a student does not demonstrate the minimum required understanding at the first defense, a second defense will be required to satisfy the essential oral component of the course. The grade earned on the first defense remains the grade for the 10% component; the second defense is an additional opportunity to demonstrate the competence required to pass and does not recover those marks.

First Draft and A-Range Eligibility

The first near-complete draft is an accountability checkpoint. Students may use generative AI in preparing it, but they remain responsible for every part of the submitted work. A materially false or unsupported mathematical claim, fabricated or materially misrepresented reference, substantively incorrect computation, or inability to explain and defend material submitted content, when confirmed through the oral defense, makes the responsible student ineligible to receive more than 79% on the final essay component, even after the final version is corrected.

If a potentially substantial error occurs in a joint document, every author will be questioned about it. If, after that questioning, the issue is judged substantial, all authors are responsible because all authors submitted the document, and the 79% cap applies to each author's final-essay grade. The same cap applies individually to a student who cannot explain or defend other substantive content in the submitted draft. The cap applies only to the 20% final-essay component; it does not cap the oral-defense grade, the individual verification-statement grade, or any other course component.

Minor typographical errors, stylistic imperfections, or small technical slips that are promptly recognized and correctly resolved during questioning are not intended to trigger the cap. This academic grading rule does not replace the University's scholastic-offence procedures where plagiarism, fabrication, or another offence may have occurred.

Individual Author and Verification Statement

Each student submits an individual statement that identifies their contributions, explains one central mathematical idea or algorithm in their own words, describes how the paper's mathematical claims, computations, code, figures, and references were checked, and contains the required AI-use statement. The statement is graded individually and is separate from the shared essay grade.

Use of Generative AI Tools in Assessments

Generative AI tools may be used freely on all take-home work in this course, including for brainstorming, explanations, research assistance, drafting, editing, programming, debugging, and mathematical problem solving. Every take-home submission must contain an AI-use statement identifying the tool or tools used and briefly describing how they were used. A statement that no generative AI was used is also acceptable. Complete prompt transcripts are not required.

Students remain fully responsible for understanding, verifying, and being able to defend everything they submit, including every mathematical claim, citation, computation, conclusion, figure, and line of code. AI output is not itself a scholarly source: cited references must be located, read, and checked by the students. AI may not be listed as an author. Permitted AI use does not excuse plagiarism, fabricated references, unsupported claims, or inaccurate mathematics.

Generative AI tools are prohibited during the individual oral defense and the final examination. Using such tools during either assessment will be treated as a scholastic offence.

Final Examination

The final examination is cumulative, in person, and worth 30% of the course grade. It will assess students' ability to use computer algebra software to solve mathematical problems in theory and applications and to explain the methods and results.

The examination is closed-note. Students may use approved mathematical software, including Julia/Oscar, Macaulay2, Maple, or another system approved in advance. Official built-in or official online software help documentation is permitted. Personal notes, course notes, saved solutions, search engines, forums, messaging platforms, cloud-based assistance, and generative AI tools are prohibited. Internet access, where available, is restricted to official software documentation. Detailed technical arrangements and the list of approved software will be announced before the examination.

Essential Learning Requirements

The writing and oral-defense outcomes are essential to AM 4615F and AM 9563F and cannot be replaced by the final examination. To pass the course, each student must:

- submit the final essay and the individual author and verification statement;
- successfully complete the oral-defense requirement, including a second defense if required; and
- earn at least 50% on the combined project components (proposal, oral defense, final essay, and verification statement).

A failed first oral defense does not by itself cause a course failure: it results in the grade earned on that defense and requires a second defense for the essential-competency check. If a student does not complete an essential project requirement, they have not met the requirements of the course. Under the Faculty of Science approach, the default outcome is withdrawal (WDN); the student may submit a Request for Relief to the Associate Dean (Academic) for an Incomplete (INC) standing where appropriate.

There is no separate requirement to pass the final examination. A student whose calculated overall grade is at least 50% and who satisfies the essential project requirements passes the course.

Information about Missed Coursework

Undergraduate students must familiarize themselves with the University Policy on Academic Consideration - Undergraduate Students in First Entry Programs: https://uwo.ca/univsec//pdf/academic_policies/appeals/academic_consideration_Sep24.pdf.

The policy does not apply to requests submitted for attempted or completed work, whether online or in person. It also does not apply to students experiencing longer-term impacts on their academic responsibilities; those students should consult Accessible Education. Procedures for undergraduate requests are posted at https://registrar.uwo.ca/academics/academic_considerations/. Requests must normally be made within 48 hours after the assessment date or submission deadline. Graduate students should follow the applicable graduate procedures and consult their graduate program when necessary.

Computational assignments and the project proposal are handled automatically through the Flexible Completion rules below; students do not submit Academic Consideration requests for those components. The oral defense, final essay, and individual verification statement are essential project components and fall outside Flexible Completion. A student who cannot complete one of those essential components because of an extenuating circumstance must use the applicable Academic Consideration process.

Computational Assignments: Flexible Completion

This course has four computational assignments, and the best three submissions count toward the 30% assignment component. A student may therefore miss one assignment without requesting Academic Consideration; the missed assignment will not count against them.

If a student completes fewer than three assignments, missing counted slots are recorded as zero and included in the assignment-component average. Students are encouraged to submit all work, even if incomplete, because partial credit is preferable to a zero. If the cumulative final-examination grade is higher than the resulting assignment-component grade, the entire 30% assignment component shifts to the final examination.

Project Components: Flexible Completion and Essential Threshold

The project category consists of the proposal, oral defense, final essay, and individual verification statement. The proposal is the only project component that may be omitted without violating an essential learning requirement. If the proposal is not submitted by the firm cutoff, its 5% weight shifts to the final essay for that student; topic approval is still required. The transferred 5% remains a separate gradebook item and is not subject to the 79% cap that may apply to the 20% final-essay component.

The oral defense, final essay, and verification statement are essential and form the minimum completion threshold for the project category. They cannot be dropped or replaced by another assessment. Failure to complete any of these essential components has the consequence described under Essential Learning Requirements above.

Missed Oral Defense and Essential Project Work

A student who cannot attend an oral-defense appointment because of an approved religious accommodation or university-sanctioned schedule conflict should notify the instructor as early as possible. For another extenuating circumstance, the student must use the applicable Academic Consideration process. When consideration is granted, an alternate appointment will be arranged. An unsuccessful first defense is not treated as an absence; it is handled through the required second defense described above.

If extenuating circumstances continue beyond the 48-hour no-late-penalty period for the final essay or individual verification statement, the affected student must use the applicable Academic Consideration process. If consideration is granted, the instructor will determine an appropriate extension or alternate arrangement, taking account of the shared authorship of an undergraduate group paper.

Deadlines: 48-Hour No-Late-Penalty Period

Every take-home assessment with a stated deadline includes an automatic 48-hour period after the deadline during which it may still be submitted without a late penalty. The exact firm cutoffs are listed above. The near-complete draft uses the same rule: its stated deadline is 96 hours before the oral-defense appointment, and its firm cutoff is 48 hours before the appointment.

After a firm cutoff, computational assignments and the project proposal are handled through the Flexible Completion rules above and are not accepted late. Essential project work may be accepted after the firm cutoff only when an extension or alternate arrangement has been granted through the applicable Academic Consideration process. Academic Consideration for a take-home deadline may be granted only for extenuating circumstances that began before the stated deadline and lasted longer than the 48-hour no-late-penalty period.

Special Examination

Per university policy, an Academic Consideration request with supporting documentation is required for a final examination scheduled during the official examination period. Students must submit the request through the Student Absence Portal. A student approved to write a Special Examination (SPC) will be assigned an SPC and it will be scheduled according to university policy.

If a student misses the SPC examination and is approved for Academic Consideration, they will be withdrawn from the course without academic penalty. A student experiencing exceptional circumstances such as prolonged illness may submit a Request for Relief to the Associate Dean (Academic), on a case-by-case basis, for the opportunity to write the final examination at the next offering. If a student misses the SPC and Academic Consideration is not approved, or was not requested, they will receive a grade of zero on the examination.

6. Additional Statements

6.1 Religious Accommodation

When a recognized religious holiday either requires a student to be absent from the University, or requires or prohibits an activity that makes it impossible to complete a scheduled academic requirement, the student is entitled to accommodation. No student will be penalized for an absence for religious reasons, and an alternative means of satisfying the requirement will be arranged in accordance with the University's policy on Accommodation for Religious Holidays: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf.

Students should submit requests through the Student Absence Portal (SAP), identifying the conflict and the specific course component affected. For an oral-defense appointment, students should submit the request and contact the instructor as early as possible, preferably no later than one week before the appointment, so that an alternate appointment can be arranged. If a religious observance conflicts with the final examination, the request should be submitted no later than two weeks before the examination; a Special Examination will be arranged.

Students are responsible for finding out what was covered in any class missed because of a religious observance and for taking appropriate steps to keep up with the course. If a suitable arrangement cannot be reached with the instructor, students should consult the Undergraduate Chair of the department and, if necessary, the Associate Dean (Academic) of the Faculty of Science.

For a list of recognized religious observances, consult the calendars posted on Western's Equity, Diversity & Inclusion website: https://www.edi.uwo.ca (About Us -> Resources -> Additional Resources -> Calendars).

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing.

Academic Accommodation for Students with Disabilities:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/AcademicAccommodation_disabilities.pdf

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: In accordance with university policy, the centrally administered email account provided to students is considered their official university email address. Account holders are responsible for ensuring that messages received from the University at that address are attended to in a timely manner.

University Email Policy: https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf

Requests for Relief (formerly known as "appeals"):

Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision - Undergraduate:
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Procedures on Request for Relief from Academic Decision - Graduate:
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences: https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences - Undergraduate:
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences - Graduate:
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment is strictly prohibited. This includes, but is not limited to, mobile phones, smart watches, smart glasses, hidden cameras, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at a student's desk, on their person, or within reach during an assessment will be treated as a scholastic offence, even if the device is not in use. Effective September 2026, the typical penalty for this offence is a failing grade in the course and a 12-month prohibition on retaking the course.

A computer is expressly permitted for the final examination only under the conditions stated in Section 5. This permission does not authorize phones, smart watches, earbuds, personal notes, unauthorized websites, messaging tools, or generative AI. Students are responsible for reviewing and complying with the detailed examination instructions.

Use of Generative AI Tools

Generative AI tools are permitted on take-home work under the conditions stated in Section 5. Every take-home submission must include an AI-use statement, and students must understand, verify, and be able to defend everything they submit. Generative AI tools are not permitted during the individual oral defense or final examination. Using such tools on an assessment where they are prohibited will be treated as a scholastic offence.

Instructor disclosure: Generative AI was used to assist in drafting this course outline. The instructor reviewed and takes responsibility for its contents.

6.5 Support Services

Academic Advising: Information about adding or dropping courses, academic considerations, requests for relief, examination conflicts, and other academic matters is available at https://www.uwo.ca/sci/advising/.

Mental Health Support: A complete list of support options is available through Mental Health@Western: https://uwo.ca/health/.

Gender-Based and Sexual Violence: Support services and emergency contacts are listed at https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To contact a case manager, email support@uwo.ca.

Accessibility for Coursework: Contact the instructor about alternate formats or other arrangements, or consult Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html.

Learning and student support: https://learning.uwo.ca, https://westernusc.ca, and https://www.westernssc.ca.

Course outline revision date: August 31, 2026