Western Science

Department of Mathematics

Applied Mathematics 4615b/9563b Course Outline (ver 2)
Introduction to Applied Computer Algebra

1. Course Information

Course Information
Applied Mathematics 4615b/9563 (AM 4615b/ AM 9563), Introduction to Applied Computer Algebra
Term: Winter 2026 (January – April)
Lecture Times: Tuesdays 10:30 am -12:30 pm, Thursday 11:30 am -12:30 pm

Prerequisites: Applied Mathematics 2814F/G (Numerical Analysis)

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this course or written special permission from the Department of Mathematics to enroll in it, you may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record.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

2. Instructor Information

Instructor: Professor Greg Reid
Email: reid@uwo.ca
Teams: (also available to chat on Teams)

Students must use their Western (@uwo.ca) email addresses when contacting the instructor. Please include am4615 in the subject line of all emails.

Office Hours: I will usually be available immediately after class on Thursday, at the class location. Plus I will have an office hour at my office (in person if not announced otherwise), weekly Friday 10:30 – 11:30 am. On occasion, extra times will be announced on Zoom (online).

3. Course Syllabus, Schedule, Delivery Mode

Course Description AM 4615: Strengths and limitations of computer algebra systems (CAS); complexity of exact computations versus possible instability of numerical computations; selecta from Groebner bases and other applications. The emphasis is on preparing the student to use CAS in mathematics, science, and engineering.

This course will survey a handful of topics in computational mathematics, ranging from representing/manipulating algebraic objects on a computer, to complex algorithms and open questions at the forefront of mathematical research. By the end of this course, students will be experienced users in at least one computer algebra system and will have a grasp on the breadth of modern mathematical software. The computational tools discussed in this class will involve linear algebra, and computational algebraic geometry, and analytic mathematics. Problems will be motivated by applications.

Learning Outcomes: Learning outcomes include the abilities to
• Articulate several ways in which symbolic and numerical computations differ
• Write functions proficiently in at least one computer algebra system

• Identify the appropriate software to solve several problems (i.e. software systems, packages, or functions which have the functionality required)
• Understand the weaknesses and strengths of AI approaches and their judicious use
• Demonstrate knowledge of several standard algorithms in computer algebra through explaining the basic steps, executing those steps, and justifying why they work
• Be knowledgeable of some of the milestones of computational mathematics, such as the 4-color problem, Fermat's last theorem and implications for the way mathematics is done
• Use Grobner bases efficiently

Schedule: Tues 10:30 am -12:30 pm, Thurs 11:30 am -12:30 pm. In-person delivery.

Key Sessional Dates: Classes begin Jan 5, 2026; Reading Week Feb 16–22, 2026; Classes end Apr 9, 2026; Final Exam Period Apr 12–30.

Week	Dates	Topics / Activities	Notes
1	Jan 5–11	Intro, overview. Intro to symbolic computation. Comparison vs numeric computation.	First class Mon Jan 5
2	Jan 12–18	Intro to & advantages/disadvantages of AI as computational aid	
3	Jan 19–25	Misc applications of symbolic, numeric & AI approaches	Assignment 1 due Sun Jan 25
4	Jan 26–Feb 1	Exact computer algebra. Exact Linear Algebra & Univariate Polynomials (gcd etc).	
5	Feb 2– 8	Systems of exact polynomials, rings, ideals & Grobner Bases.	Project Update1 due Feb 8
6	Feb 9–15	Applications of Grobner Bases (incl AI assisted explorations)	Assignment 2 due Frid Feb 13
7	Feb 16–22	**Spring Reading Week** (no classes), Family Day Feb 16	**Spring Reading Week**
8	Feb 23–Mar 1	Differential elimination, diff ideals, PDE, & the RIF algorithm	
9	Mar 2 – 8	Applications of differential-elimination and AI assisted explorations.	
10	Mar 9 – 15	Numerical approaches for systems of polynomials with approximate coefficients. Numerical algebraic geometry. Finite case (points).	Assignment 3 due Sun Mar 15
11	Mar 16 –22	Numerical algebraic geometry (infinite case, components).	Project Update2 due Mar 22
12	Mar 23 –29	We will actively explore applications for symbolic, numeric with AI assistance. The aim is to assist you to synthesize the main ideas and techniques of the course.	
13	Mar 30–Apr 5	Case studies concerning open problems will be explored to assist you complete your projects with a description of current algorithmic AI assisted research.	Assignment 4 due Sun Apr 5, Project due Sun Apr 5
14	Apr 6 – 12	**Wrap-up & exam prep Apr 6 – 9 (Thursday April 9 is the last day of classes)**	**Classes end Apr 9, Study days Apr 10-11**
Exam Period	Apr 12–30	**Final Exam (3 hrs, TBA)**	

4. Course Materials

All course materials, except the text book, announcements, and assignments will be posted on OWL (https://westernu.brightspace.com/).

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) on a regular basis for news and updates. This is the primary method by which information will be

disseminated to all students in the class. All course material will be posted to OWL: http://owl.uwo.ca. If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Recommended Software:

- Maple (used in class - not free for personal use)
- Bertini (free)
- julia (free)

Textbooks:

No textbook is required. Resources include the lectures, possible course notes distributed on the course OWL site, and the documentation of the software used.

For further reading, consider the following:
- Cox, Little, O'Shea, Ideals, Varieties, and Algorithms
- Sommese and Wampler, The Numerical Solution of Systems of Polynomials Arising in Engineering and Science

Technical Requirements: Access to a computer with the recommended software (or other similar software, like Macaulay2 and Mathematica) installed. (optional) For the projects, students may consider learning how to use Latex

Course material will be posted to OWL: https://westernu.brightspace.com/
Assignments and Projects will be submitted on Gradescope: https://www.gradescope.ca

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Technical Requirements
You require a stable internet connection, and a computer with a working microphone &/or web cam for this course.

5. Methods of Evaluation

Grading Scheme and Assessment Dates

The overall course grade will be calculated as listed below:

Assignments (4)	36%	(9% each, due Jan 25, Feb 13, Mar 15, Apr 5)
Project Update 1	5%	(Due: Feb 8)
Project Update 2	10%	(Due: Mar 22)

Project	15% (Due: Apr 5)
iClicker	4%
Final Exam	30% TBD, 3 hours

Assignments & Quizzes: 3 quizzes and 3 graded assignments equally weighted 5% (Choose Best 5) Quiz 1: is on Wed Sep 21 in class; Quiz 2: Frid Sep 30 in class, Quiz 3: Frid Oct 7 in class Assignment 1: due Frid Oct 14, Assignment 2: due Mon Nov 7, Assignment 3: due Sun Nov 20. Note if you miss a single quiz or assignment, then the accommodation is by the reweighting described above, and a request for accommodation is not needed.

iClicker: Marked on participation only using iclicker. Your score is based on the % of questions you answer:

80%–100% = 4; 70–79% = 3.2; 60–69% = 2.4; 50–59% = 2; 40–49% = 1.6; 0–39% = 0

In order to receive any credit for the iClicker component, you must:

- Create a free iClicker account using your Western email address. Please refer to the instructions at https://presswestern.uwo.ca/ . If you already have an iClicker account, please go into the settings and verify that it uses your uwo.ca email address.
- Attend, and answer iClicker questions at lectures in person.
- If your web-enabled device is not working properly, try refreshing the page or restarting the app. It is your responsibility to ensure that your device is working properly.

Missed Lectures (iClicker Questions): We understand that you will not be able to attend class from time to time. Therefore, the participation-based iClicker marking scheme was designed to take into account the occasional missed class. Accordingly, iClicker marks will not be adjusted for the occasional missed class. If you have a long-term absence (three or more consecutive classes) that is supported by academic consideration, then your iClicker marks will be adjusted to take your accomodated absence into account. In particular you will receive an iclicker score = # days for which you have academic consideration that overlap with days in which iclicker was used.

Final: A makeup is only offered for the final exam and only with the appropriate documentation and approvals. For consideration of a prorated grade, notification of valid reasons, together with appropriate documentation, for missed quizzes or assignments should be given at the time of the event.

Use of Generative AI Tools, Computers and Calculators

No use of calculators, computers or AI on the final exam. Use, and only under the stated conditions will be occasionally allowed where indicated on iClicker questions and Assignments. Our goal here is to make intelligent use of computational tools, and become aware of their strengths and weaknesses, while strengthening your human only math skill. Some innovative training techniques will be used to strengthen your endurance in human only mode.

General information about missed coursework
Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs,* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/
All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Examinations scheduled during official examination periods (Defined by policy)
- Practical laboratory and performance tests (Defined by policy)
- Midterm (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments
Clearly define how each missed assessment will be handled (e.g., an extension, make-up opportunity, or reweighting).

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

Coursework with Assessment Flexibility
By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

Deadline with a No-Late-Penalty Period
Assignments. Students are expected to submit each of the assignments by the deadline listed. Should extenuating circumstances arise, students do not need to request Academic Consideration and they are permitted to submit their assignment up to 48 hours past the deadline without a late penalty. Should students submit their assessment beyond 48 past the deadline, a late penalty of 20% per day will be applied. Academic Consideration requests may be granted only for extenuating circumstances that started before the deadline and lasted longer than the No-Late-Penalty Period of 48 hours.

6. Additional Statements

6.1 Religious Accommodation

When conflicts arise with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible, but not later than two weeks prior to the writing of the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays - https://www.edi.uwo.ca

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. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_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 policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally 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:
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_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 (such as tests, midterms, and final examinations) is strictly prohibited. This

includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

IClicker will be used to encourage and enhance participation. Typically one iclicker poll will be used for each class, and occasionally more than one. However, the net result is a score of 1 for each class for participating (regardless of the correctness of the response), and 0 for non-participation. To receive this you must be physically present in class. Data will be used to enhance and gauge class participation, together with effectiveness of teaching approaches.

Note that Remote Proctoring Software may be used in this course, including in the event of a health lockdown. In such a case, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at:

https://remoteproctoring.uwo.ca.

6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

Learning-skills counsellors at Learning Development and Success (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.