McMaster University
Department of Computing and Software
Dr. W. Kahl

COMPSCI 2LC3

Outline

2025-08-28

Logical Reasoning for Computer Science

COMPSCI 2LC3 — Fall 2025

Instructor: Dr. Wolfram **Kahl**, Dept. of Computing & Software, kahl@cas.mcmaster.ca
Office Hours: Mondays, 13:00 – 14:00, and by appointment. (Or catch me after class.)

Calendar Description:

Introduction to logic and proof techniques for practical reasoning: propositional logic, predicate logic, structural induction; rigorous proofs in discrete mathematics and programming.

Goals:

This course teaches logical formalisation and reasoning skills as tools intended ultimately for **software system specification** and for **software correctness arguments**.

To a large degree, this can be seen as analogous to acquiring **language skills**, including **knowledge** and **skills** concerning syntax, semantics, pragmatics, and vocabulary of the **language of logical reasoning and of discrete mathematics**, which can be seen as the mathematics of datastructures and of software correctness.

Conscious and precise use of this language is the foundation for **precise specification and rigorous reasoning**, which take a central place in this course.

Schedule:

	Mon	Tue	Wed	Thu	Fri
10:30– –12:20	T5, T6		T4		
12:30– –14:20	Office hour 13:00–14:00				T1, T3
14:30–15:20					
15:30–16:20	**Lecture**			**Lecture**	
16:30–17:20	T2	**Lecture**			
17:30–18:20	T2				

- **Tutorials start on Friday of the first week**, the 5th of September.
- **Students are expected to attend all lectures and tutorials**.
- The course is conducted fully "in-person".
- **TA office hours** will be scheduled at term start

Course Page: `http://www.cas.mcmaster.ca/~kahl/CS2LC3/2025/`

While most of the internal electronic information exchange for this course will be handled via **Avenue**, the course pages will serve as central fallback location for making information and material available outside Avenue, in particular in the case of Avenue accessibility problems.

It is each student's responsibility to be aware of the information on the course Avenue site, and, while Avenue is down, on the course web page, and to check regularly for announcements (or RSS subscribe, where possible).

Textbook and Course Materials

Optional textbook: **"LADM"**: David Gries and Fred B. Schneider: **A Logical Approach to Discrete Math**, Springer 1993, ISBN 978-1-4757-3837-7 (Last selling price at the Campus Store: $83.95)

> "This is a rather extraordinary book, and deserves to be read by everyone involved in computer science and — perhaps more importantly — software engineering. I recommend it highly [...] . If the book is taken seriously, the rigor that it unfolds and the clarity of its concepts could have a significant impact on the way in which software is conceived and developed."
>
> — Peter G. Neumann

Additional material will be made available electronically via the course pages. in particular in the shape of CalcCheck notebooks.

All materials created for this course (in particular lecture slides, eventual lecture recordings, exercises, homework, assignments, tests, exams, and solutions) remain the intellectual property of the instructor. They are intended for the personal and non-transferable use of students registered in the course. Reproducing, reposting, and/or redistributing any course materials, in part or in whole, without the written consent of the instructor, is a copyright violation and is strictly prohibited.

Laptop Requirement

Students in this course must have a portable computer (typically a laptop) to bring to classes and tutorials and use for coursework. The device must have internet access, a web browser (Firefox or Chrome must be available), and a keyboard suitable for extensive typing. It is recommended that students invest in a single computer that meets the needs of all their courses. Entry-level options start at approximately C$315, while students in computer science may prefer a more powerful, upgradable device starting around C$1,499.

Please bring your computer to all tutorials, midterm tests, and the final exam.

Course Content Outline

Most of the course content will be very close to the presentation in the "LADM" textbook, so the most relevant chapters are indicated here. Not all LADM content will be covered in detail. **Program correctness material will be interleaved the other topics.** Times are rough estimates.

• Introduction to Calculational Reasoning Boolean Expressions, Propositional Logic Quantification, Predicate Logic, Sets	Parts of LADM chapters 1, 15 LADM chapters 1–5 LADM chapters 8–9, 11	≈ 3 weeks
• Induction, Sequences, Trees	≈ LADM chapters 12–13	≈ 2 weeks
• **Relations** and Functions, Graphs	≈ LADM chapters 14, 19; other	≈ 3 weeks
• Correctness of Imperative Programs Other topics as time permits	≈ LADM chapter 10, section 12.4; other	≈ 4 weeks

Using **tool support** will be part of the expectations; in particular, CalcCheck (CalcCheck.McMaster.ca) will be used throughout the course.

After notations, presentation rules, and basic definitions, axioms, proof rules, etc. have been introduced in class, **students are expected to know them at all times**.

Exercises and Tutorials, Homework and Assignments

There will be three kinds of CalcCheck$_{\text{Web}}$ notebooks to work through on a regular basis, "Exercises", "Homeworks", and "Assignments". Each of these notenooks can be saved arbitrarily many times, throughout the whole term. **None of these enter the grading scheme.** However, you will receive autograded feedback for your last save before the respective **deadline** of homeworks and assignments. (Midterm tests and the final exam will also be written on CalcCheck$_{\text{Web}}$, and will contain questions similar to some of those found in exercises and assignments (and possibly homeworks), and will be graded in a similar manner as assignments.)

> **Timely completion of homeworks and assignments will be necessary for success in midterm tests and final exam.** In this course, you cannot expect to be able to cram the material of several weeks in three days before a test!

Exercises and Tutorials: In most weeks, **Exercises** will be provided, from which the main material for the tutorials will be taken.

Every tutorial week (running Friday to Wednesday), starting September 5, there will be **two-hour** tutorial sessions in separate tutorial groups as scheduled. The main purpose of the tutorials is to **discuss student work** on exercise problems. Therefore, every student is expected to have attempted the exercise problems of the current week **before** the corresponding tutorial session, and to bring solutions and solution attempts to the tutorial.

Since the tutorials are not in computer labs, bring your laptop to be able to interact with CalcCheck during the tutorial session. Your laptop will also be needed for writing the **quizzes** conducted during tutorial sessions, see below under "Grading".

Since space in the tutorial rooms is limited, the TAs are responsible to keep the tutorial rooms from overcrowding, for the safety of everybody, and are therefore under strict guidelines to ask students not registered for the currently-scheduled tutorial group to leave if the tutorial room is overcrowded.

Homework: After many (but not all) lectures, there will be **Homework Notebooks** that students are expected to work through on CalcCheck$_{\text{Web}}$ essentially from one lecture to the next, **normally posted in the evening after a lecture by 8 p.m.**. These will be due (that is, have their autograding deadline) normally one hour before the next lecture; in some cases an extended deadline will be announced, typically where the subject matter will not be followed up in the next lecture.

Homeworks will be very frequent at the beginning of the term, and possibly less frequent later.

Timely completion of homeworks helps you stay up-to-date!

Assignments: There will be longer **Assignments**, each with one to two weeks available to work on it. Assignments will be less frequent at the beginning of the course, and more frequent later. Each assignment will have its deadline (see above) announced when it is posted.

Homeworks, exercises, and assignments are there to provide you with the practice you need for succeeding in the exams.

Grading:

All examinations in this course will be **"closed-book"**. This means that no unauthorized aids may be used, and no unauthorized materials consulted during the examinations. It also means that these examinations are **designed** to be completed without reference to any written or printed material and without use of a calculator or any other electronic aids except for the tools specified for use in each exam, and that reference to such extra material or use of extra tools would only waste time that is then not available anymore for the actual thinking necessary to solve the problems.

The midterm tests and final exam will be written (as far as possible) in-person in computer labs on campus, by working in the CalcCheck$_{\text{Web}}$ web application that is used also for tutorial exercises, homeworks, and assignments.

Students with additional exam time specified in their **SAS accommodations** will automatically be seated in an appropriate lab and provided their additional time. This way, students with SAS accommodations have access to CalcCheck$_{\text{Web}}$ and to asking questions to the course team just like other students; this would not be possible when writing in SAS testing centers. Students with SAS accommodations are encouraged to contact the instructor early in the term, so that optimal implementation of accommodations can be arranged.

All test and exam grades will be counted as percentage grades.

For every student, the course grade is calculated as a weighted average of test and exam grades as specified below.

Quizzes: In some (not necessarily all) tutorial sessions, graded **Quizzes** will need to be answered via CalcCheck$_{\text{Web}}$. These will typically take up recent homework and exercise questions, and given usually 15 to 20 minutes for completion.

For k being the number of **quizzes conducted in your tutorial section**, **10% of the course weight** are given to your $\lceil \frac{5}{6} \cdot k \rceil - 1$ best quiz results. This allows you to miss probably 2 quizzes — there will be **no further accommodations for missed quizzes**. (***In particular, MSAFs for quizzes will not be processed.***)

Midterm Tests: There will be **two closed-book 90-minute midterm tests** written in-person in computer labs on campus.

The midterm tests are planned to be written within the following time slots:

Midterm 1: Wednesday, 8th October 18:30 to 20:30
Midterm 2: Wednesday, 12th November 18:30 to 20:30

These time slots are intentionally longer than 90 minutes to allow for setup time in the labs. **You will receive an e-mail specifying your lab and seat number the night before each midterm.**

Those **midterm tests** where your result is better than your result in the final count **25%** each, and those midterms that are not better than the final count **15%** each.

You are expected to write both midterms. As accomodation for missed midterms, normally the grading weight of the midterm will be added to the final exam. **Frivolous skipping of midterms usually leads to poor final exam performance.**

If you submit MSAFs for both midterms, the accomodation for the second midterm will be an **oral** deferred midterm.

For any MSAF, the weight of a midterm should be reported as "15%".

Final Exam: The **remaining course weight (between 40% and 60%)** is given to the **final exam**.

The final exam will be scheduled by the Registrar's Office in the usual way. It will be a closed-book examination of 2.5 hours (150 minutes) duration and cover the material of **all** lectures, handouts, tutorials, exercises, homeworks, and assignments.

The current expectation is that the final exam will be written in the labs using CalcCheck tool support, but it may turn out that this will not be possible due to organisational reasons beyond the control of the instructor.

The instructor reserves the right to conduct any deferred midterm or final exams orally.

The current plan is to have all midterms and the final exam written on lab computers using CalcCheck tool support. To be able to circumvent issues with individual lab computers, you are asked to also bring your own computer to exams as fallback option.
In addition, technical or other issues may prevent availability of CalcCheck during tests and/or exam to individual students, or to all students. In case of such issues, tests and exams may still need to be (partially) written by hand.

Therefore, you need to be both **fluent in producing formalisations and proofs using the CalcCheck tool** *and* **fluent in writing syntactically correct formalisations and proofs by hand**.

Academic Integrity (see also page 6) — Course-Specific Notes

Academic credentials you earn are rooted in principles of honesty and academic integrity.

In the context of COMPSCI 2LC3, in particular the following behaviours constitute academic dishonesty:

1. **Collaboration where individual work is expected.**

   You have to produce your submissions for homework and assignment questions yourself.

   For each assignment question there will normally be exercise questions similar to it — you **are allowed** to collaborate on these **exercise questions**. (The tutorials are typically not expected to cover all exercise questions.)

   - You are not allowed to post full or partial homework or assignment solutions on discussion boards or websites (e.g., github, FaceBook, etc..).
   - You are not allowed to solicit solutions to the problem on on-line forums or purchasing solutions from on-line sources.

2. **Copying or using unauthorised aids in tests and examinations.**
3. **Accessing another students' Avenue or other relevant online account, or providing others access to your accounts.**
4. **Accessing or attempting to access midterm or exam material outside the individually-assigned writing time and space.**
5. Meddling or attempting to meddle with online services used for course delivery.

Note: **If you cheat, you are cheating yourself.**

Generative AI: Use Prohibited

Students are not permitted to use generative AI in this course. In alignment with the McMaster academic integrity policy, it "shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also stated in the policy is the following: "Contract Cheating is the act of 'outsourcing of student work to third parties' with or without payment." Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

The assessments in this course are not intended to test your ability to find the answer by any means available to you. The questions might be too easy for that! Rather, exams are supposed to test your understanding of the course material, which you will need in order to use logical reasoning correctly in subsequent courses and in the real world. Homeworks, exercises, and assignments are there to provide you with the practice you need for succeeding in the exams.

Automatic Copyright of Course Materials

This is a reminder to students of copyright: In accordance with Canadian statutory and common law, any written or visual material that the instructor produces is automatically copyrighted. The instructor may pursue any violator of that copyright whether or not a notice is placed on the course material. Copyright does not dampen any ordinary use that colleagues or students make of the material.

Discrimination

The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department's Associate Chair for Undergraduate Studies, the Department Chair, the Sexual Harassment Office or the Human Rights Consultant, as soon as possible.

McMaster-Prescribed "Approved Advisory Statements"

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. Avenue to Learn, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-Line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins. Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students With Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult *McMaster University's Academic Accommodation of Students with Disabilities* policy.

Requests For Relief For Missed Academic Term Work

In the event of an absence for medical or other reasons, students should review and follow the *McMaster Student Absence Form Policy (MSAF Policy).*

Academic Accommodation For Religious, Indigenous Or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The *Copyright Act* and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or by McMaster email.