Department of Computer Science, University of Western Ontario

CS3331A - Theory of Computing -- Fall 2025

Class time

- Wednesdays, 2:30 - 4:30pm [redacted]
- Thursdays, 2:30 - 3:30pm [redacted]

Prerequisites

- Computer Science 2214A/B or Mathematics 2155F/G
  Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Advisors) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Instructor information

- Prof. Lucian Ilie
  - Office hours: Thursdays, 3:30pm - 5:30pm [redacted]

Course Syllabus, Schedule, Delivery Mode

Course description

We live during the computer revolution, which is changing fast everything around us. While programming languages change quickly, the fundamental underlying theory does not. This course covers the basic concepts of the theory of computation. To study computation thoroughly, we need models, ideally, the simplest models that can solve the problem at hand. This is what the theory of computation is about: computational models and their power, with a vast array of applications. The practical models we study in this course include finite state machines, regular expressions, push-down automata, and context-free grammars. A crucial aspect is studying the limits of computations, which involves investigating all powerful models, such as Turing machines. Some problems are intractable, that is, it takes ages to solve them, others are provably impossible to solve even on an infinitely powerful computer. Good news: ChatGPT cannot solve all problems! Computability theory sheds light on these issues of fundamental importance to anyone attempting to understand what computers can do for us.

Topics

- Regular Languages
  - Finite State Machines (FSM), Deterministic (DFSM), Nondeterministic (NDFSM), Regular Expressions, Regular Grammars
  - Minimizing DFSM, Conversions between DFSM, NDFSM, Reg. Exp., and Reg. Grammars
  - Proving regularity, Closure properties
  - Proving nonregularity, Pumping theorem, Using closure properties
  - Decision Problems, Membership, Emptiness, Totality, Finiteness, Equivalence, Minimality
- Context-free Languages
  - Pushdown Automata (PDA), Context-free Grammars (CFG)
  - Conversions, PDA ↔ CFG, CFG → Chomsky Normal Form
  - Ambiguity
  - Proving context-freeness, Closure properties
  - Proving noncontext-freeness, Pumping theorem, Using closure properties
  - Decision Problems, Membership, Emptiness, Finiteness
- Turing Machines and Undecidability
  - Turing Machines (TM), Deterministic TM
  - Decidable languages (D), Semidecidable languages (SD)
  - Multi tape TM, Nondeterministic TM
  - Universal TM, Halting Problem
  - D and SD, Enumeration

- Reduction, Using reduction to prove undecidability
- Rice's Theorem, Non-SD languages
- Unrestricted Grammars
- Non-TM Problems, Post Correspondence Problem (PCP), Context-free language problems

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TAs and office hours

TBD

Course Materials

Textbook (required)

- Elaine Rich, *Automata, Computability, and Complexity. Theory and Applications,* © Person Prentice Hall (2008), ISBN 978-0-13-228806-4.
  - The textbook is out of print. A free PDF is available from the author's web site. You can find a hard copy from previous students or from AbeBooks.

Lecture Notes

- Click "Lecture notes" button at the top of the page
- Username and password are given in the Announcements

Tools

- JFLAP
- You are allowed to use any external tools, such as JFLAP, ChatGPT, etc., as a source of information to help you solve the assignments. Make sure you understand the solutions as no tools will be available during the exams!

Class email

- All questions are to be sent to this email address: cs3331@uwo.ca. For long questions, please attend the office hours.

OWL

- 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.

Methods of Evaluation

Evaluation

- Assignments will be available in OWL. The assignments will consist of a set of exercises related to the material covered in class. The solutions for the exercises should be neatly written or typed.
- Assignments -- best 3 out of 4 will be considered; these due dates are tentative - the date on the assignment supersedes this:
  - Assignment 1 (10%) -- due Oct. 8
  - Assignment 2 (10%) -- due Oct. 18
  - Assignment 3 (10%) -- due Nov. 26
  - Assignment 4 (10%) -- due Dec. 2
- Exams - written format, closed book, no cheat sheet, no devices
  - Midterm Exam (30%) - Wednesday, Oct. 22, 2:30 - 4:30pm, [redacted]
    - Material required for midterm: everything taught in class before the exam
    - *There is no midterm makeup (see below)*
  - Final Exam (40%) - TBA
    - Material required for final: everything taught in class during the entire term
  - Final exam makeup: TBA

Evaluation rules

- **Exam passing rule**
  - In order to pass the course you must pass the exams, that is, your weighted average grade for the two exams should be at least 50/100. Otherwise, your final grade for the course will be the weighted average of the exam grades.
- **Missed homework or exam**
  - There is no midterm makeup. In case of missed midterm, you need approved accommodation from the Dean's office for the weight of the midterm to be moved to the final. All documentation must be submitted to the Academic Counselling office of a student's Home Faculty.
  - In case of missed assignment, you need also approved accommodation from the Dean's office for the weight to be moved to the exams as follows: the weight of assignments 1 and 2 is moved to the midterm exam, the weight of assignments 3 and 4 is moved to the final exam. (This effectively means that, with approved accommodation, A1 and A2 will get the grade of the midterm exam, A3 and A4 will get the grade of the final exam.)
- **Best 3 out of 4**
  - The best 3 assignments will be considered. If some assignments are missing, with accommodation from Dean's office, then their grade is the grade of the corresponding exam, as explained above. (Assignments missed without accommodation receive 0.) Therefore, in the end, every student will have 4 assignment grades, of which the best 3 are chosen for the final grade computation.
- **No ACRs**
  - Due to the above-mentioned built-in flexibility, no ACR (academic consideration request) that does not require documentation can be used.
- **Mark inquiries**
  - The goal is to make grading as objective and consistent as possible. The assignments and exams will have detailed evaluation schemes. For consistency, the same question will be graded, whenever possible, by the same grader for all students.
  - Inquiries for marks will be addressed first to the TA who graded the question. In case of disagreement, the complaint will be resolved by the instructor. In case of multiple complaints for one exam from a student, the entire exam of that student will be regraded from scratch by the instructor.
  - Mark inquiries can be made only within **one week** from the day the marks are made available.

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.

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

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.

Additional Statements

Religious Accommodation

When conflicts 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 or 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.

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.

Academic Policies

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

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 e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.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.

Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, appeals, 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. You may also wish to contact Accessible Education at http://academicsupport.uwo.ca/accessible_education/index html if you have any questions regarding accommodations.