

University of Windsor - School of Computer Science
COMP-3540 Theory of Computation - Fall 2024

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Off. Hrs.: TR, 03:30 pm - 04:30 pm or by appointment

Teaching Assistants:

- GA: Aaron Barnoff, barnoffa@uwindsor.ca
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Please refer to the course home page on Blackboard for their office hours and office locations.

Prerequisites

You should have passed COMP-2140, COMP-2310 and COMP-2540 or have obtained my permission in order to take this course. No student is allowed to take a course more than two times without permission from the Dean.

Lectures

(TR) 01:00 pm - 02:20 pm in ERIE 3123

Office Hours:

From 3:30 pm - 4:30 pm on Tuesdays and Thursdays, starting 10 September, 2023 till the end of the term.

Reference Textbook

Introduction to Automata Theory, Languages and Computation, by John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, 3rd. Edition, Addison Wesley, 2007.

Required Material

A set of course-notes, prepared by me, is available under the Resources directory in the course

home page on Blackboard. My lectures will be based on these course-notes.

Copyright of Course Materials

Lectures and course materials prepared by the instructor are considered by the University to be an instructor's intellectual property covered by the Copyright Act, RSC 1985, C-42. Course materials such as PowerPoint/Beamer slides and course-notes are made available to you for your own study purposes. These materials cannot be shared outside of the class or "published" in any way. Posting course-notes or slides to other websites without the express permission of the instructor will constitute copyright infringement.

Course Goals

The primary goal of this course is to lead you to an answer to the question: "What problems can be solved by a computer?" Towards this, we shall seek answers to the following questions: "What is a problem?" "What does it mean to solve a problem?" "What is a reasonable yet comprehensive model of a computer?"

While the theory of *NP*-completeness classifies problems into those that can be solved in "reasonable" time (polynomial time) versus those that take an "unreasonable" amount of time (exponential time), the theory here (which preceded the theory of *NP*-completeness) shows that there are "problems" that a "computer" simply cannot "solve", even if we allow an "unreasonable" amount of time.

We will start with the simplest computing machines, called Deterministic Finite Automata (or DFAs), determine their computing power and go on to show that adding non-determinism does not increase their computing power. We next introduce another class of computing device known as Pushdown Automata (or PDA) and show that their computing power is "greater" than that of DFAs. Finally, we introduce the famous computational model known as Turing Machine, and show that their power is strictly greater than that of PDAs. We then use this to show that there are problems which are inherently "undecidable", which means that there are no algorithms to solve these problems.

For a calendar description of this course see: <https://web4.uwindsor.ca/units/registrar/>

Learning Outcomes

On successful completion of the course, you will be able to:

- Discuss and explain the relative powers of different computational models (e.g., Finite State Machines, Pushdown Automata, Turing Machines).
- Classify and explain a regular language, a context-free language, a recursively enumerable language.
- Demonstrate that languages belong in given classes by designing suitable automata that accept them.
- Identify and formulate mechanisms for generating languages accepted by relevant computational models (right-linear grammars, context-free grammars, etc.)

- Determine and assess that there are problems for which no algorithms can be designed – that is, some languages are undecidable.
- Explore what lies beyond “undecidability”, for example, Oracle Turing Machines.

Evaluation scheme

2 Quizzes	5% each
2 Midterms	25% each
Final Exam	40%

Tentative Midterm and Quiz dates

Quiz 1: Tuesday, 24 Sept., 2024 (in class)

Midterm 1: Friday, 11 Oct., 2024 (Time: 5pm - 7pm), Place: TBA

Quiz 2: Tuesday, 05 Nov., 2024 (in class)

Midterm 2: Friday, 22 Nov., 2024 (Time: 5pm - 7pm), Place: TBA

Final Exam: Date and Time TBA

Grading Scheme

Grades are assigned based on the University of Windsor's 100% grading scheme, according to the evaluation scheme described above. A minimum grade of 50% is required to pass this course

Policies

Quizzes and midterm tests which are missed for any reason whatsoever cannot be made up. In such cases, where a student has missed a test for medical reasons, the mark for this test will be carried over to the final. **A doctor's note will have to be a copy of the official Student Medical Certificate and must specifically say that you were not fit to write the test on the particular day.** Along with the doctor's note, please provide a covering letter providing details of the exam missed, your name and SID. This is for my records. The final exam must be written in order to obtain a grade for the course. If you are not able to write the final exam for medical reasons you must contact me immediately to let me know so that a make-up final exam can be arranged as soon as possible.

Cases of cheating and plagiarism will be dealt in accordance with University by-laws (take time to check out this link: <http://www1.uwindsor.ca/academic-integrity/>).

SET (Student Evaluation of Teaching) will be conducted in the last two weeks of class, via UWinsite.

The last date for voluntary withdrawal from this course is 15 November, 2023.

Mental Health Resources

Feeling overwhelmed? From time to time, students face obstacles that can affect academic performance. If you experience difficulties and need help, it is important to reach out to someone. For help addressing mental or physical health concerns on campus, contact (519) 253-3000: - Student Health Services at ext. 7002 (<http://www.uwindsor.ca/studenthealthservices/>) - Student Counselling Centre at ext. 4616 (<http://www.uwindsor.ca/studentcounselling/>) - Peer Support Centre at ext. 4551 24 Hour Support is Available - My Student Support Program (MySSP) is an immediate and fully confidential 24/7 mental health support that can be accessed for free through chat, online, and telephone. This service is available to all University of Windsor students and offered

in over 30 languages. Call: 1-844-451-9700, visit <https://keepmesafe.myissp.com/> or download the My SSP app: Apple App Store/Google Play. A full list of on- and off-campus resources is available at <http://www.uwindsor.ca/wellness>. Mental health and physical health issues are a basis for requesting an alternative evaluation or accommodation.

Sexual Misconduct

Visit <http://www.uwindsor.ca/sexual-assault> for details, or contact Dusty at ext 4550 or dustyj@uwindsor.ca.

Some Important Dates, from www.uwindsor.ca/registrar/events-listing)

Thurs., 05 Sep., 2024	Classes begin
Wed., 18 Sep., 2024	Last day for Add/Drop
Mon., 14 Oct., 2024	Thanksgiving Day
Mon., 14 Oct., 2024 - Friday., 18 Oct., 2024	Reading week
Wed., 13 Nov., 2024	Last day for voluntary withdrawal from courses
Tue., 05 Dec., 2024	Last Day of Fall Classes
07 Dec., 2024 - 18 Dec., 2024	Final Exam period

Tentative Lecture Schedule

Chapter in Courseware	# of Lectures
1	1
2	4
3	3
4	4
5	3
6	3
7	6