DALHOUSIE UNIVERSITY
Faculty of Computer Science

THERE WILL BE NO CONVERTING OF FINAL GRADES TO PASS/ILL THIS SEMESTER.
ALL LETTER GRADES WILL BE FINAL!

CSCI-2115 --- Theory Computer Science
Course Syllabus

Instructor Information

Instructor (section 1):	Dr. Alex Brodsky	**Office:**	CS 208
E-mail:	**csci2115@dal.ca**	**Office Hours:**	TBA
Lecture Time (section 1):	Monday and Wednesday 16:05-17:25	**Room No:**	Dunn 117
Tutorial Time	Tuesday 10:05 - 11:25	**Room No:**	Dunn 117
Course Homepage:	https://dal.brightspace.com/		
Microsoft Team:	Join Code: **od6nf4w**		

Important Dates

- Reading Week (no classes): November 13 - 17, 2023
- Quizzes: In class Oct 4, Oct 25, Nov 22, Dec 6
- Final Exam: TBA in the period of December 7 to 19, 2023
- Final Withdrawal Date without academic penalty: October 4, 2023
- Final Withdrawal Date with financial penalty: November 2, 20223
- Deadlines: Five assignments due at 23:59 on Sept. 20 & 27, Oct. 4, 11, 18, & 25, Nov. 1, 8, 22, & 29, & Dec 6.

Course Description

This course introduces students to fundamental ideas in computer science. The first part of the course is an introduction to finite state machines and automata theory and its applications. Students will be introduced to finite automata, push- down automata, Turing machines, and other models of computation, with particular emphasis on finite automata. The second part of the course introduces students to asymptotic notation, complexity, and culminates with an introduction to NP-completeness.

This course will use a lot of examples and provide students plenty of opportunity to practice formal reasoning. Students will also have the option of implementing some of the concepts discussed in class in simple applications. This course expects students to have simple programming ability (CSCI 1110).

Course Rationale

This is a core course for the BCS, BSc.CS, and BA.CS programs.

Class Format and Course Communication

- Content will be delivered using lectures and assignments.
- Course announcements will be posted to Brightspace and MS Teams.
- It is the student's responsibility to check their Dal e-mail, Brightspace, and MS Teams on a daily basis. To access your Dal e-mail, see: https://www.dal.ca/dept/its/o365/services/email.html
- The instructor can be reached via Email and Microsoft Teams (join code: **od6nf4w**)
- Office hours will be posted on Brightspace
- Students must ask the instructor permission before recording class lectures.

High-Level Learning Outcomes

- Describe the classes of languages and corresponding recognizers (DFA, PDA, TM, RAM, etc.)
- Use regular expressions, automata theory, grammars, to specify and reason about languages
- Write simple proofs about computation and properties of languages
- Describe the notions of complexity classes and NP-completeness and their relation to computation

Learning Outcomes

- Specify regular languages using set notation, regular expressions, and finite automata
- Describe applications of automata theory
- Reason about properties of regular languages
- Apply automata theory to solve a problem
- Specify context free languages using both context free grammars and push-down automata
- Reason about properties of context free languages and grammars
- Describe how to implement a parser for a context-free language, e.g., recursive descent, table-driven, etc.
- Describe what a Turing machine is and its importance to computer science
- Construct Turing machines that recognize simple languages
- Describe how Turing Machines can be used to simulate other models of computation.
- Describe what is meant by the space-complexity and time-complexity of an algorithm.
- Define standard complexity classes such as P and NP.
- Describe what it means for a problem to be considered NP-complete
- Describe why the notion of NP-completeness is so important in computer science.

Required Texts and Resources

- There is no required text for the course, but students may find a text book such as "Introduction to Automata Theory, Languages, and Computation" by John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, (any edition) useful.
- The lecture slides will be posted on the learning management system (Brightspace).
- Lecture recordings will be made available where possible and posted on the learning management system (Brightspace).
- Additional assistance is available from the Student Learning Centre (2nd floor, Goldberg CS Building)

Prerequisites

PREREQUISITES: CSCI-1110, CSCI-1120, and (CSCI-1315 or CSCI 2112 or MATH 2112)
EXCLUSIONS: CSCI-3136

Academic Standards

Failure to properly attribute sources in your work will be treated as an academic standards issue and points may be deducted for not following citation requirements. For example, forgetting to quote text taken from other sources, failure to include in-text citations, or a failure to include required information in the citations or references. Please see the resources on proper citation provided by the Dalhousie Writing Center (https://dal.ca.libguides.com/c.php?g=257176&p=5001261).

Please note that if it appears that the error was made with intent to claim other people's work as your own such as a lack of both citations and references, an allegation of plagiarism will be submitted to the Faculty Academic Integrity Officer, which could result in consequences such as a course failure.

Evaluation Criteria

- Academic Integrity Module: https://dal.brightspace.com/d2l/home/178166
  - **Must be completed by October 1st to pass the course.**
  - **Must receive 75% or better on each of the four quizzes in this module.**
- Post-Lecture Quizzes (5%)
  - After each lecture there is a short quiz to be taken in Brightspace
  - These quizzes must be completed one hour before the start of the next lecture.
  - It is recommended that they be done after each lecture as a self-check on the material covered in the lecture.
  - For each question, 50% of the mark is awarded for doing the question, and 50% for the right answer.
- Assignments (25%)
  - Eleven (11) assignments, best 10 will count.
  - Please see course schedule for description and dates of assignments.
  - Most assignments will be submitted via CrowdMark https://crowdmark.com/
  - Since solutions are released after assignment deadlines, late assignments will not be accepted.
- Quizzes (35%)
  - Each quiz covers a module.
  - Please see course schedule for description ond dates of quizzes
  - The top 3 quizzes will be worth 10% each and the worst quiz will be worth 5%
  - Quizzes will be conducted in class.
  - Weight of missed quizzes will be moved to the final exam.
- Final Exam (35%)
  - Scheduled by the university.
  - The exam will consist of four parts, one for each module.

Notes

- A minimum grade of C is required in this course if it is core to your FCS degree, or if it will be used as a prerequisite for a subsequent CSCI course.
- As of 2019, students who receive a grade lower than C in the same required CS course twice, will be dismissed.
- The grade conversion scale in Section 17.1 of the Academic Regulations, Undergraduate Calendar will be used. https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=7302&topicgroupid=32188&loaduseredits=False
- **A student must pass (50%) both the assignment component and the quiz/exam component to pass the course.**
- The instructor reserves the right to adjust a student's evaluation criteria, with the student's consent, if the instructor deems than an adjustment is warranted.

Quiz and Final Exam Requirements

- Photo ID is required
- Closed book
- No dictionaries, notes, calculators, cell phones, PDAs, talking slide rulers, or other aids allowed.

Student Declaration of Absence

The Student Declaration of Absence policy shall apply. https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html The student has a maximum of two (2) SDAs per course per semester. The student **must** notify the instructor of their inability to meet a deadline **before** the deadline by contacting the instructor or submitting the completed SDA. Upon notification the student has 3 days after the deadline to submit the SDA.

Tentative Schedule

Date	Event	Topics
Sept 6	Lecture 1	Introduction and Review of Discrete Math
Sept 11	Lecture 2	Review: Sets, Set operations, Proof techniques
Sept 13	Lecture 3	Review II: Proof techniques
Sept 18	Lecture 4	grep, Regular Expressions and Regular Languages
Sept 20	Lecture 5	Finite Automata with Examples and Applications
	Assn 1 due	**Review of Discrete Math** (released on Sept 13)
Sept 25	Lecture 6	Implementation of Finite Automata
Sept 27	Lecture 7	Nondeterministic Finite Automata with Examples
	Assn 2 due	**Using grep and creating DFAs** (released on Sept 20)
	Quiz 1	**Regular Languages and Finite Automata** (start of class)
Oct 4	Lecture 8	Scanners
	Assn 3 due	**Creating DFAs and simple proofs** (Released on Sept 27)
Oct 11	Lecture 9	Equivalence between RLs, REs, and FAs;
	Assn 4 due	**Implement an FA and prove a language is regular** (released on Oct 5)
Oct 16	Lecture 10	Subset Construction with Examples
Oct 18	Lecture 11	Closure Properties and Proofs Using Closure Properties.
	Assn 5 due	**Subset construction and minimization** (released on Oct 11)
Oct 23	Lecture 12	Context Free Languages, Grammars, and Derivation
Oct 25	**Quiz 2**	**Scanners and Properties of Regular Languages** (start of class)
	Lecture 13	Pushdown Automata
	Assn 6 due	**Proofs using closure properties** (released on Oct 18)
Oct 30	Lecture 14	Designing Grammars and PDAs
Nov 1	Lecture 15	Introduction to Parsing
	Assn 7 due	**Parse trees and derivations** (released on Oct 25)
Nov 6	Lecture 16	Recursive Descent Parsing
Nov 8	Lecture 17	Parser Generators (Antlr)
	Assn 8 due	**Create simple context free grammars and PDAs** (released on Nov 1)
Nov 13		READING WEEK
Nov 20	Lecture 18	Turing Machines and the Church-Turing Thesis
Nov 22	**Quiz 3**	**Parsers and Context Free Languages** (start of class)
	Lecture 19	RAMs and Turing Machines
	Assn 9 due	**Implement a simple parser** (released Nov 8)
Nov 27	Lecture 20	Complexity: Space, Time, and Nondeterminism
Nov 29	Lecture 21	Complexity Classes
	Assn 10 due	**Create simple Turing machines and RAMs** (released Nov 22)
Dec 4	Lecture 22	NP-Completeness
Dec 5	Lecture 23	Slack / Catchup
Dec 6	**Quiz 4**	**Turing Machines and Complexity** (start of class)
	Lecture 24	The Halting Problem
	Assn 11 due	**Describe the Complexity of simple problems** (released Nov 29)
Exams		

Use of Plagiarism Detection Software

All submitted code may be passed through a plagiarism detection software, such as the plagiarism detector embedded in Codio, the Moss (https://theory.stanford.edu/~aiken/moss/) Software Similarity Detection System, or similar systems. If a student does not wish to have their assignments passed through plagiarism detection software, they should contact the instructor for an alternative. Please note, that code not passed through plagiarism detection software will necessarily receive closer scrutiny. https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf

Responsible Computing Policy

Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies (https://www.dal.ca/dept/university_secretariat/policies/information-management-and-technology/acceptable-use-policy-.html) and the Faculty of Computer Science Responsible Computing Policy. For more information please see https://www.dal.ca/content/dam/dalhousie/pdf/faculty/computerscience/policies-procedures/fcs_policy_local.pdf

Student Health and Wellness

Taking care of your health is important. As a Dalhousie student, you have access to a wide range of resources to support your health and wellbeing. Students looking to access physical or mental health & wellness services at Dalhousie can go to the Student Health & Wellness Centre in the LeMarchant Building. The team includes: registered nurses, doctors, counsellors and a social worker. Visit **dal.ca/studenthealth** to learn more and book an appointment today.

Students also have access to a variety of online mental health resources, including telephone/texting counselling and workshops/training programs. Learn more and access these resources at d**al.ca/mentalhealth**.

Culture of Respect[1]

Every person has a right to respect and safety. We believe inclusiveness is fundamental to education and learning. Misogyny and other disrespectful behaviour in our classrooms, on our campus, on social media, and in our community is unacceptable. As a community, we must stand for equality and hold ourselves to a higher standard.

What we all need to do:

1. **Be Ready to Act:** This starts with promising yourself to speak up to help prevent it from happening again. Whatever it takes, summon your courage to address the issue. Try to approach the issue with open-ended questions like "Why did you say that?" or "How did you develop that belief?"
2. **Identify the Behaviour:** Use reflective listening and avoid labeling, name-calling, or assigning blame to the person. Focus the conversation on the behaviour, not on the person. For example, "The comment you just made sounded racist, is that what you intended?" is a better approach than "You're a racist if you make comments like that."
3. A**ppeal to Principles:** This can work well if the person is known to you, like a friend, sibling, or co-worker. For example, "I have always thought of you as a fair-minded person, so it shocks me when I hear you say something like that."
4. **Set Limits:** You cannot control another person's actions, but you can control what happens in your space. Do not be afraid to ask someone "Please do not tell racist jokes in my presence anymore" or state "This classroom is not a place where I allow homophobia to occur." After you have set that expectation, make sure you consistently maintain it.
5. **Find or be an Ally:** Seek out like-minded people that support your views, and help support others in their challenges. Leading by example can be a powerful way to inspire others to do the same.
6. **Be Vigilant:** Change can happen slowly, but do not let this deter you. Stay prepared, keep speaking up, and do not let yourself be silenced.

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[1] Source: Speak Up! © 2005 Southern Poverty Law Center. First Printing. This publication was produced by Teaching Tolerance, a project of the Southern Poverty Law Center. Full "Speak Up" document found at: http://www.dal.ca/dept/dalrespect.html. Revised by Susan Holmes from a document provided April 2015 by Lyndsay Anderson, Manager, Student Dispute Resolution, Dalhousie University, 902.494.4140, lyndsay.anderson@dal.ca www.dal.ca/think.

University Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&loaduseredits=False

Territorial Acknowledgement

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Dalhousie acknowledges the histories, contributions, and legacies of the African Nova Scotia people and communities who have been here for over 400 years.

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect. As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. (read more: http://www.dal.ca/dept/university_secretariat/academic-integrity.html)

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion please contact: https://www.dal.ca/campus_life/academic-support/accessibility.html for all courses offered by Dalhousie with the exception of Truro.

Conduct in the Classroom — Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion — Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). (read more: http://www.dal.ca/cultureofrespect.html)

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation.

When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. (read more: https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/Code%20of%20Student%20Conduct%20rev%20Sept%202021.pdf)

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. (read more: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work, and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. (read more: https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf)

Student Use of Course Materials

These course materials are designed for use as part of the CSCI courses at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading material to a commercial third party website) may lead to a violation of Copyright law.

Learning and Support Resources

Please see https://www.dal.ca/campus_life/academic-support.html