

CSCI-3136 — Principles of Programming Languages

Course Syllabus

Instructor Information

Instructor:	Alex Brodsky	Office:	208
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Class Meeting Time:	WF 10:05-11:25	Room No:	Killam MACME
Course Homepage:	http://dal.brightspace.com	Course TAs:	TBA
Tophat Join Code:	925103		

Important Dates

1. Midterm Exam: Wednesday, June 19, 2019, 10:05 - 11:25, in CHEB 170
2. Final Exam: TBA in the period of July 31 to August 6, 2019
3. Final Withdrawal Date without academic penalty: June 5, 2019
4. Final Withdrawal Date with academic penalty: July 5, 2019
5. Deadlines: 9 assignments due at 9:00am on May 24 & 31; Jun 7, 14, & 28; Jul 5, 12, 19, & 26

Course Description

This course provides a comparative study of advanced programming language features. Topics include statement types, data types, variable binding and parameter passing mechanisms. Formal methods for syntactic and semantic description of programming languages are examined.

Learning Outcomes

- Recall the history and major paradigms of programming languages.
- Describe the functions and the main structure of compilers.
- Describe lexical analysis, syntactic analysis and semantic analysis in compiler construction.
- Describe regular expression and its usage in token generation.
- Describe deterministic and non-deterministic finite automata.
- Describe how automated scanner generators construct a finite automation from regular expression.
- Implement a scanner for a simple language.
- Understand language specification and syntactic analysis by context free grammars.
- Design a simple language with context free grammar.
- Describe various parsing algorithms: bottom up and top down parsing.
- Implement a recursive descent parser for a simple language.
- Describe semantic analysis and the use of attribute grammars to enforce semantic rules.
- Describe basic concepts, computational model and language constructs of functional programming.
- Identify core issues in programming language design (1): names, scopes (static and dynamic) and bindings (early and late).
- Identify core issues in programming language design (2): control flow construct and exception handling.
- Identify core issues in programming language design (3): data and types.
- Identify core issues in programming language design (4): subroutines and parameter passing methods.
- Implement an interpreter for a simple language.
- Use a functional programming language to write simple programs.

Assessment Criteria

1. In Class Participation and Quizzes (5%)
2. Assignments (20%)
 - Nine (9) assignments, best 8 will count.
 - Assignments may be done in groups of three or fewer.
 - All assignments must be submitted via Brightspace⁴.
 - **Late assignments will not be accepted.**
3. Midterm Exam (25% or 0%)
 - The midterm is optional. If you choose not to write the midterm or do better on the final exam then your midterm will be worth 0% and your final will be worth 60%.
4. Final Exam (50% or 75%)

Note: The instructor reserves the right to adjust a student's evaluation criteria, with the student's consent, if the instructor deems that an adjustment is warranted.

Midterm and Final Exam Requirements

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

Tentative List of Topics to be Covered

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| <ol style="list-style-type: none">1. Overview<ul style="list-style-type: none">• Overview of Programming Languages• Introduction to Program Translation2. Lexical Analysis<ul style="list-style-type: none">• Scanners and Formal Languages• Regular Languages and Regular Expressions• DFAs and NFAs• Equivalence between FA / RE / RL• NFA and DFA Transformations• Properties of Regular Languages• The Pumping Lemma3. Parsing<ul style="list-style-type: none">• Parsing and Grammars and CFGs• Parse Trees, Ambiguity, and Derivations• Constructing an LL(1) Parser• Recursive Descent Parsing• PDAs, DPDAs, and Parsing with a DPDA4. Semantic Analysis<ul style="list-style-type: none">• Semantic Analysis• Attribute Grammars• S-Grammars and L-Grammars | <ol style="list-style-type: none">5. Naming and Binding<ul style="list-style-type: none">• Naming, Binding, and Storage• Scope• Closures• Modules6. Flow Control<ul style="list-style-type: none">• Expressions and Statements• Sequencing and Selection• Iteration• Recursion7. Computation Abstraction<ul style="list-style-type: none">• Subroutines, Functions, Parameters• Exception Handling• Continuations8. Type Systems and Memory Management<ul style="list-style-type: none">• Type Systems• Arrays Implementation• Garbage Collection9. Functional Languages<ul style="list-style-type: none">• Introduction to Haskell• Functions and Currying• Lazy Evaluation and Other Features |
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Prerequisites

CSCI 2110.03, CSCI 2112.03, and CSCI 2132.03

Tentative Schedule and List of Topics

	Lecture	Assignment	
		Due	Notes
May 8	1: Welcome		
May 10	2: Program Translation and Formal Languages		
May 15	3: Regular Expressions and Finite Automata		
May 17	4: Equivalence between Automata, REs, and RLs		
May 22	5: Minimization, Scanners, and RL Properties		
May 24	6: Pumping Lemma and Intro to Parsing	A1	Released on May 17
May 29	7: Derivation, Parse Trees, and Ambiguity,		
May 31	8: LL(1) Parsing and Refactoring	A2	Released on May 24
June 5	9: Recursive Descent and Pushdown Automata		Released on May 31
June 7	10: Semantic Analysis and Attribute Grammars	A3	Implement a scanner
June 12	11: Semantic Analysis and Attribute Grammars 2		
June 14	12: Midterm review and slack lecture	A4	Released on June 7
June 19	13: Midterm		
June 21	14: Naming, Binding, and Storage		
June 26	15: Scope		Released on June 14
June 28	16: Closures	A5	Implement a parser
July 3	17: Closures and Modules		Released on June 28
July 5	18: Control Flow	A6	Implement expression evaluation
July 10	19: Iteration and Recursion		Released on July 5
July 12	20: Computation Abstractions	A7	Implement variables
July 17	21: Continuations		Released on July 12
July 19	22: Introduction to Types	A8	Implement closures
July 26	23: Memory Management		Released on July 19
July 28	24: Garbage Collection / Review	A9	Implement conditions

Class Format and Course Communication

- Content will be delivered using lectures and assignments.
- Students will be expected to use the Top Hat Student Response System (<http://app-ca.tophat.com/e/925103> or SMS: +1 647 931 6504)
A TopHat account may be purchased at <http://www.tophat.com>.
- Students must ask the instructor permission before recording class lectures.
- Course announcements will be posted to Brightspace. It is the student's responsibility to check both their Dal e-mail and Brightspace on a daily basis. To access your Dal e-mail account please see: <https://www.dal.ca/dept/its/o365/services/email.html>

Texts and Resources

The optional text for the course is: *Scott M., "Programming Languages Pragmatics, 4th ed.", Morgan Kaufmann, 2015, ISBN: 0124104096.*

Culture of Respect

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:

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. **Appeal 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.

Responsible Computing Policy

Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies (<http://its.dal.ca/policies/>) and the Faculty of Computer Science Responsible Computing Policy. (https://www.cs.dal.ca/downloads/fcs_policy_local.pdf)

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>

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 (The Center for Academic Integrity, Duke University, 1999). 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.

http://www.dal.ca/dept/university_secretariat/academic-integrity.html

¹Source: 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.

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of: a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (NS, NB, PEI, NFLD).

http://www.dal.ca/campus_life/student_services/academic-support/accessibility.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.

https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-life-policies/code-of-student-conduct.html

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).

<http://www.dal.ca/cultureofrespect.html>

Recognition of Mikmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mikmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the McCain Building (room 3037) or contact the programs at elders@dal.ca or 902-494-6803 (leave a message).

Learning and Support Resources

General Academic Support — Advising http://www.dal.ca/campus_life/student_services/academic-support/advising.html

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/guidelines/fair-dealing-guidelines.html>

Dalhousie University Library <http://libraries.dal.ca>