

Carleton University, School of Computer Science

Comp 3002 Compiler Construction, Winter 2022

Class Times/Instructor: Mon 6pm (3 hours), via Zoom **W.R. Lalonde**

Contact: wilf.lalonde@gmail.com

Help Sessions (voluntary but recommended) via Zoom: Tues 6pm (3 hours), Wed 8pm (2 hours), Sat 9am (as long as you want).

Course Description: This course will provide students with several important skills:

- (a) A better understanding of parser/scanner constructors since we will be implementing most parts.
- (b) A better understanding of compilers since we will learn how to build one.

Course Goals: To develop the tools needed to write a compiler for a simple language and to write a compiler using those tools.

Contact: wilf.lalonde@gmail.com

Notes: Through Wilf LaLonde's web page <http://www.scs.carleton.ca/~lalonde> or directly via <http://www.scs.carleton.ca/~lalonde/comp3002>.

Text: None although you may reference any compiler book using LR(k) technology. The course, however, deals with more advanced technology.

TA: None

Help session: Provide advice and help as you work on the assignments at home.

Prerequisites: One of COMP 2402, SYSC 2100.

Course Work: Because of the special circumstances, 6 or more programming assignments (exact number not yet determined) in Smalltalk or Swift (100%). No tests or exams.

Handing in: Via <https://carleton.ca/brightspace/>

Course Outline

Novelty

Compilers consist of a 3 translators: scanner, parser, code generator. The details are traditionally introduced in that order. Instead, we consider code generators first making it clear that translation is the essence of each stage.

Introduction:

A quick review of the components of a compiler, table driven scanners, table driven tree building parsers, tree walkers for code generation. A quick review of the process of designing a language for which a compiler is to be built.

Scanner/Parsers

A discussion of the details of a table driven scanner/parser and how it works.

The infrastructure for parsers/scanners

Detailed discussion of finite state machines and regular expressions and their use in transduction grammars. This includes operations such *,+,&|,-, and . (concatenation).

Converting a transduction grammar with regular expression right parts into a transduction grammar with FSM right parts.

This is a tree walking process akin to code generation but used instead in the context of grammar conversion.

Theoretical underpinnings for transduction grammars

Regular grammars, context free grammars, regular right part grammars, parse trees versus abstract syntax trees, handles, regular right part transductions grammars, LL(k) versus LR(k) grammars.

Constructing tables for regular right part grammars

More than shift-reduce tables; specifically, how to construct readahead FSMs for finding the right end of a handle, readback FSMs for finding the left end of a handle, and semantic action states for tree building along with their conversion into table format for use by scanners/parsers. Overview of the process followed by detailed coverage.

Symbol tables

Techniques for dealing with scoping in typical programming languages.

Code Generation Basics

Machine versus virtual machine instruction sets. Code generation basics for virtual machine instruction sets. The distinction between expression contexts which requires a value on the virtual machine stack versus statement contexts which do not with several examples of language constructs that can be in used in both contexts.

More advanced code generation

Dealing with if statements, while loops, for loops. Dealing with short circuit boolean operations such as &&, ||, and ! which DO NOT require the use of And, Or, or Not virtual machine instructions.

Other Topics

Chain reduction optimizations for parsers. Non-canonical parsers.

Undergraduate Academic Advisor

The Undergraduate Advisor for the School of Computer Science is available in Room 5302C HP; by telephone at 520-2600, ext. 4364; or by email at undergraduate_advisor@scs.carleton.ca. The undergraduate advisor can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisor will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and Writing Tutorial Services.

SCS Computer Laboratory

SCS students can access one of the designated labs for your course. The lab schedule can be found at: <https://carleton.ca/scs/tech-support/computer-laboratories/>. All SCS computer lab and technical support information can be found at: <https://carleton.ca/scs/technical-support/>. Technical support is available in room HP5161 Monday to Friday from 9:00 until 17:00 or by emailing support@scs.carleton.ca.

University Policies

Student Academic Integrity Policy

Every student should be familiar with the Carleton University student academic integrity policy. A student found in violation of academic integrity standards may be awarded penalties which range from a reprimand to receiving a grade of F in the course or even being expelled from the program or University.

Some examples of offences are: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found in the Undergraduate Calendar.

Plagiarism

As defined by Senate, "plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own". Such reported offences will be reviewed by the office of the Dean of Science.

Unauthorized Co-operation or Collaboration

Senate policy states that "to ensure fairness and equity in assessment of term work, students shall not co-operate or collaborate in the completion of an academic assignment, in whole or in part, when the instructor has indicated that the assignment is to be completed on an individual basis". Please refer to the course outline statement or the instructor concerning this issue.

Academic Accommodations for Students with Disabilities

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable) at <http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines>

Religious Obligation

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: <http://www2.carleton.ca/equity/>

Pregnancy Obligation

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: <http://www2.carleton.ca/equity/>

Medical Certificate

The following is a link to the official medical certificate accepted by Carleton University for the deferral of final examinations or assignments in undergraduate courses. To access the form, please go to <http://www.carleton.ca/registrar/forms>