

CMSC 445
Compiler Design
Fall 2019

<http://marmorstein.org/~robert/Fall2019/cs445.html>

Lecture (Stevens 118): 11:00am – 12:15pm (TR)

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Office Hours: 2:00pm-4:00pm MWF, 3:00-4:00pm R *or by appointment*

To make an appointment to see me, please contact me by e-mail and send me your schedule. Include as much detail as you can about why you need to see me (this saves time). In general, I need at least 24 hours of notice to schedule an appointment.

Course Description: A course covering the basic theory and techniques of compiler and code translation systems. Topics include lexical analysis, parsing, and code generation, and the various techniques used when handling differing source language classes. A programming intensive course. Also covered are the techniques of top-down and bottom-up parsing. 3 credits.

Prerequisite: **CMSC 201 AND CMSC 208.**

Student Learning Outcomes: By the end of the course, the successful student will be able to:

- construct a lexical scanner
- implement a top-down or bottom-up parser
- explain the major challenges of code generation and optimization

Course Structure and Student Expectations:

This course will be a heavily project-driven seminar style course. Each week, you will receive a reading assignment. You should take notes on the reading and come to class prepared to discuss it. In addition to regular attendance in discussions and lecture, you should expect to spend roughly six hours a week reading the textbook, completing projects, and working on homework exercises.

Textbook: The textbook for this course is “Compilers: Principles, Techniques, and Tools, 2nd edition” by Aho, Lam, Sethi, and Ullman, Addison-Wesley, 2006, ISBN: 978-0321486813 (also called the “Dragon Book”). I will also post links on the course web site to other resources you may find helpful.

Course Requirements: The largest part of your grade (50%) will come from successful completion of programming projects. The final exam and the midterm exam will each count for 10% of your grade. Quizzes and homework assignments will comprise an additional 20%. The remainder of your grade (10%) will come from active participation in class.

University Policies:

This course adheres to the university policies found at <http://www.longwood.edu/academicaffairs/syllabus-statements/>.

Grading Policy:

Your final grade in this course is computed using a weighted average of your scores on each assignment. The weights for each category are given in the course requirements section of this syllabus and can be used by applying the following formula:

$$\text{Final Grade} = 0.50 * \text{Projects} + 0.20 * (\text{Homework and Quizzes}) + 0.10 * \text{Participation} + 0.10 * \text{Midterm} + 0.10 * \text{Final}$$

Each of the category grades (such as Projects) can be computed by summing the points you've earned on each assignment in that category and dividing by the total number of points possible. Numeric grades are translated to letter grades using the following grading scale:

	100-91: A	90: A-
89: B+	88-81: B	80: B-
79: C+	78-71: C	70: C-
69: D+	68-64: D	
63 or lower: F	(There is no grade of D- in this course. Anything below a 64 is failing)	

Late Work:

In general, I do not accept late work or grant extensions on assignments unless you have a serious medical or family emergency which prevents you from completing the assignment on time (however, see "Slip days" below). In such cases, you do not need a doctor's note, but you must notify me of the circumstances within a reasonable amount of time.

Since slip days do not apply to homework or quizzes, I may occasionally be persuaded to grant extensions on these assignments. However, in cases where I grant such extensions, I will impose a penalty of 25% per day overdue.

All requests for extensions (whether for an emergency or not), MUST be submitted by e-mail within a reasonable amount of time (typically twelve hours from the original due date). This e-mail should outline (in detail) the reasons your work is late. Granting of extensions is entirely at my discretion – if you have not turned an assignment in on time, you should expect to earn a 0%.

Slip Days:

You will be allocated a fixed number of slip days at the start of the semester. You may use your slip days to extend the due date of one or more *programming projects*. You can use all of your slip days on one assignment or you may use them over multiple assignments.

Slip days are calculated from the minute the assignment is due until you turn it in. The number of slip days used is rounded *up* to the nearest integer value. That means that if you turn an assignment in 24 hours and 1 minute after the due date, you will use up *two* slip days. The slip day clock runs over weekends and holidays. If a lab is due on Friday and you turn it in on Monday, you will have used three slip days, not one. Slip days cannot be shared, traded, bought, or sold, but can occasionally be earned by participation in relevant campus activities I select.

Attendance:

I expect you to attend class unless you are sick or engaged in a school-sponsored sport or extracurricular activity. Please do NOT come to class if you are sick. Instead, contact me within 12 hours of the absence to check whether you've missed any work and make arrangements to make up any missed quizzes. You should also make arrangements to get notes from another student in the class. You should also check the course web site for announcements, new assignments, and other important updates.

I will rely primarily on your honor for enforcement of the attendance policy. However, I will keep a record of your attendance. In accordance with Longwood policy, missing more than 10% of scheduled class time (5 class sessions) to unexcused absences may, at my discretion, result in loss of one letter grade and missing 25% of class or more (14 sessions), whether excused or not may result in an automatic failing grade.

Cell Phones and Laptops:

Cell phones, music players, and laptops are to be turned off and put away during class, except as needed for the lab sessions. Violations of this policy will be considered an **unexcused** absence. I will not interrupt class to notify you if you have been counted absent for use of a prohibited device. Feel free to contact me by e-mail at any point in the semester to check on the number of absences you have in my class.

Food and Drink:

You may bring non-alcoholic beverages, including soft drinks, to class. However, please do not eat in class (it distracts me and the other students). Violations of this policy will be considered an **unexcused** absence. I will not interrupt class to notify you if you have been counted absent for violation of this policy. Feel free to contact me by e-mail at any point in the semester to check on the number of absences you have in my class.

I occasionally grant exceptions to this rule for students who must otherwise forgo lunch or have medical needs that require them to eat in class. If you feel that you need such an exception, you must make arrangements with me in advance (i.e. before bringing food to class).

Honor Code and Collaboration:

I firmly believe in the honor code. As such, I encourage you to actively collaborate with other students and to discuss homework problems. However, there is a point at which collaboration becomes cheating. To help you understand the line between acceptable discussion of a project and dishonorable behavior, I ask you to observe the following rules:

- 1. Exams and quizzes are to be completed entirely on your own.** You may not discuss them with anyone or use any resources except those specifically outlined on the exam handout.
- 2. You must give proper attribution.**

Whenever you receive help or use an online resource, you should comment your code to give proper credit. A simple comment like:

/ based on <http://codewarrior.com> */*

or

/* Jessica helped me with the curly braces here */

is fine. This comment should go directly above or on the same line as the code on which you received help, so that it is clear exactly which parts of your program are original and which are not. You do NOT need to cite material you obtain directly from me (in lecture, the assignment handout, or office hours). In general, you also do NOT need to cite material taken from the textbook.

3. The work you submit should, in general, be either your own original work or material which I have provided and you have suitably modified yourself.

At no point should another student touch your keyboard while helping you with a project. *For homework and projects, everything you turn in should be something YOU or someone in your group has personally typed or hand-written. You may NOT copy code electronically from other students or the Internet.*

You MAY NOT share code with other students using flash drives, cell phones, e-mail, web sites, floppies, CDs, or other means unless I specifically direct you to do so. You MAY NOT print out copies of your code to share with other students (personal copies or copies to show me during office hours are fine) unless they are in your group.

You MAY use web sites, books, and the man pages as reference materials. However, you must cite them appropriately and you MUST re-type any code you find and not just download it or copy/paste it.

4. Do not copy large blocks of code from other students or the Internet.

You MAY assist other students or get assistance with simple problems like syntax errors, but you MAY NOT copy large blocks of code, such as entire classes or functions, from each other. A good guideline of what "large" means is that copying more than three complete programming statements is usually too much.

5. You are responsible for securing your code.

Helping other students to cheat is also cheating. Furthermore, it is your responsibility to make sure that other students do not use your work to cheat. Be careful with who you let access your account and report any missing files, flash drives, or other devices to me promptly.

Infractions of these policies will be dealt with harshly under the Longwood Honor Code. Any student convicted of an honor offense involving this class will automatically receive a final course grade of **F** in addition to any penalties imposed by the Honor Board. You should consider all work in this class to be pledged work, whether or not the pledge appears on the assignment.

If you have questions about the honor code policy, PLEASE ask me. It is much better to receive a late penalty on a single assignment than to fail the course and face honor board charges.

You may find the scenarios at <https://integrity.mit.edu/handbook/writing-code> helpful in understanding this policy. While their honor code policy is not identical to mine it is very, very similar.

Tentative Course Schedule:

Week1 (Aug. 27 – 29)	Introduction, Organization of a Compiler (Read Chapter 1)
Week 2 (Sept. 3 – 5)	Syntax-Directed Translation, DFA Review (Read Chapter 2) Lab 0: Language Design and Computer Architecture
Sept. 3	Last Day to Drop (by 5pm)
Week 3 (Sept. 10 – 12)	Lexical Analysis (Read Chapter 3)
Week 4 (Sept. 17 – 19)	Catchup and Project Work Week Lab 1: Lexical Scanning
Week11 5 (Sept. 24 – 26)	Midterm Review, Midterm Exam
Week 6 (Oct. 1 – 3)	Parsing, Grammars, and LL Parsers (Read Sections 4.1 – 4.4)
Week 7 (Oct. 8 – 10)	Bottom-up Parsing, LR Parsers (Read Sections 4.5 – 4.8) Lab 2: Top-down (Recursive Descent) Parsing
Oct. 14 – 15	Fall Break
Week 8 (Oct. 17)	Catchup and Project Work
Week 9 (Oct. 22 – 24)	Syntax Directed Translation (Read Chapter 5) Lab 3: Bottom-up LR Parsing
Week 10 (Oct. 29 – 31)	Intermediate Code Generation (Read Chapter 6)
Week 11 (Nov. 5 – 7)	Catchup and Project Work Week
Week 12 (Nov. 12 – 14)	Code Generation (Read Chapter 8)
Week 13 (Nov. 19 – 21)	Catchup and Project Work Week
Week 14 (Nov. 26 – 28)	Lab 4: Code Generation
Nov. 27 – 29	Thanksgiving Break: NO CLASS
Week 15 (Dec. 3 – 5)	Catchup and Review, Final Project Demos
Dec. 10	Final Exam (Tuesday, 8:00am – 10:30am)

Major Assignments:

Tests: There will be two exams: a midterm exam on Thursday, Sept. Oct. 26th and a comprehensive final exam on Tuesday, Dec. 10th.

Projects: This class is heavily project-driven. You will complete four or five projects over the course of the semester. Some of these will be group projects and I will let you (in fact, require you to) choose your own groups. While I will give you some time in class to work on these, you should budget a sufficient number of hours outside of class to successfully complete the labs. Please see the tentative schedule above for due dates. You will present a demonstration of your project during the final weeks of the class.

Quizzes and Homework Problems: In addition to homework assignments, I will give unannounced (pop) quizzes over topics from the reading assignments.

Reading and Discussion: While I give lectures on the most difficult material from the class, I expect you to read the textbook and come prepared to discuss it with your peers. This includes taking notes. Typically, Tuesdays will be lecture days and Thursdays will be discussion dates. Adequate preparation for discussion includes taking notes on each chapter as you read it and being prepared to share your understanding of the chapter with the rest of the class.