Programming Languages and Translators
ECE251, Fall 2010

Patrick Lam

Brief Overview

Compilers are everywhere (behind the scenes). While you may think that you'll never have to write a compiler, you're just thinking about compilers for general-purpose programming languages, which are indeed rare and specialized. The action is at domain-specific languages, from PHP to screen scrapers for web pages.

In this course, you will learn about when you should be using compiler construction tools to augment your programming powers, and how to wield these tools. In particular, you will build an interpreter for a data manipulation language; a frontend for a subset of the SQL database query language; and a web application language.

Objectives. More specifically, after this course you will be able to:

- read a language specification, generate a lexer and parser for that language, and defend your design and implementation choices;
- create intermediate code for a language;
- implement a type checker and symbol tables; and,
- implement simple interpreters/virtual machines.

General Information

Course Web Page: `http://patricklam.ca/plt`

Schedule:

Regular lectures	TWTh 9:30-10:20			RCH302
Extra lectures	Th 10:30-11:20		09/23, 10/07, 10/21, 11/18, 12/02	RCH302
Midterm	10:00-11:20		MC 4021/RCH302	
Tutorials	Th 16:30-17:20	TUT101		RCH207
	T 16:30-17:20	TUT102		DWE3517
	F 09:30-10:20	TUT103		MC4045
Lab Hours	T 1:30-4:20	LAB201	09/14, 09/28, 10/12, 10/26, 11/09, 11/23	RCH108
	W 1:30-4:20	LAB202	09/15, 09/29, 10/13, 10/27, 11/10, 11/24	RCH108
	Th 1:30-4:20	LAB203	09/16, 09/30, 10/14, 10/28, 11/11, 11/25	RCH108

Regular lectures are cancelled for midterm week, October 26-28, and on November 3 and 4. Tutorials will be announced on the web page a week in advance.

Instructor:

Prof. Patrick Lam
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Teaching Assistants:

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Course Description

Topics. Here is a detailed list of topics and estimated lecture hours for each topic.

Introduction	1
Regular Expressions	2
Lexing: scanners, finite automata	3
Parsing: grammars (2), top-down parsing (2), bottom-up parsing (2)	6
Abstract Syntax Trees	2
Type checking	4
Symbol tables	3
Interpreters and Virtual Machines	
executing ASTs (2)	
executing bytecode—JIT compilers, binary translation (2)	4
Survey of domain-specific languages	4
Programming Paradigms: functional (2), logic (2), scripting (2)	6

Reference Material

The textbook for the class will be:

Michael L. Scott. Programming Language Pragmatics, Third Edition. Morgan Kaufmann, 2009.

I intend to post reasonably complete lecture notes for the material that I'm lecturing on. The textbook contains a lot of material that's not in this course, but which you may well find useful in your later career, including content on functional programming. It will also help you understand what you're implementing in Lab 1. You could probably get by without the book, but then you might be at a disadvantage should there be a open-book final.

Evaluation

This course includes assignments ("labs"), a midterm, a course project, and a final examination.

2 individual "labs"	5%	(each)
Course project (in pairs)	30%	(two equally-weighted milestones)
Midterm	10%	
Final exam	50%	

Labs. I'm going to experiment with the scheduled lab sessions and use them as office hours held in RCH108 on weeks with labs. For the other weeks, see the TAs in their offices. The course web page will tell you where and when you can consult a TA. You don't have to show up during lab hours.

Exams. I will run a poll asking you whether you'd prefer open-book or closed-book exams.

Schedule. Assignment handin will be done via links on the course webpage.

September 21	L1 out
October 5	L1 due, L2 out
October 19	L2 due
October 28	Midterm (10-11:20AM)
November 12	Project part 1 due
December 6	Project part 2 due
Exam period	Final exam

Group work. The project will be done in groups of up to 2. You may discuss labs with others, but I expect each of you to do the lab independently. I will follow UW's Policy 71 if I discover any cases of plagiarism. I will not use turnitin.

Lateness. You have 4 days of lateness to use on submissions throughout the term. Each day you hand in something late consumes one of the days of lateness. The fifth day of lateness causes your lowest lab mark to be halved, while the sixth day causes both lab marks to be halved. If you hand in something and you have more than 6 days of lateness, I'll start converting marks to 0 and dropping the associated late days. You can only hand in a submission up to the time I return all of the submissions. You don't get any credit for unused late days.

For example, you may hand in L1 one day late, L2 two days late, project part 1 one day late, and project part 2 on time. Or you can hand in L1 on time and L2 four days late, if you hand in both project deliverables on time. Finally, if you hand in L1 3 days late, L2 1 day late, project part 1 3 days late, and project part 2 on time, I will either give you a 0 for L1, leaving you with 4 late days, or give you a 0 for L2, leaving you with 5 late days and causing your mark for L1 to be halved. I'll choose the option which gives you more marks.

Required inclusions

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check `www.uwaterloo.ca/academicintegrity/` for more information.]
Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, `www.adm.uwaterloo.ca/infosec/Policies/policy70.htm`. When in doubt please be certain to contact the departments administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check `www.uwaterloo.ca/academicintegrity/`] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, `www.adm.uwaterloo.ca/infosec/Policies/policy71.htm`. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.
Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) `www.adm.uwaterloo.ca/infosec/Policies/policy72.htm`. Note for Students with Disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

r2: corrected tutorial timeslot.