

CS 321 Languages and Compiler Design I - Fall 2004

Instructor:

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Course home page: <http://www.cs.pdx.edu/~apt/cs321>

Description

CS321/322 studies, in parallel, the design and implementation of programming languages and the design and implementation of compilers. The course is centered around a substantial programming project: implementing a complete compiler for a realistic language. We will study formal methods for specifying the syntax and semantics of languages, and, in some cases, use tools based on these methods to help build the compiler. We will examine the structure and capabilities of programming languages with an emphasis on the demands of efficient implementation. A detailed list of lecture topics may be found below.

Prerequisites

Formal prerequisites are CS202, 300, and 311. Substantial experience with the C, C++, or Java programming language is *essential*. Java will be used as the implementation language for the compiler project, but no previous experience with Java programming is required. Experience with the Unix operating system, familiarity with a block-structured language such as Pascal or Modula-2, and some prior exposure to basic automata theory will be very helpful. For CS322, some experience with machine-language programming will be extremely desirable.

Texts

The required textbook is

- Keith D. Cooper and Linda Torczon, *Engineering a Compiler*, Morgan Kaufmann, 2004.

Additional required readings from other sources may be handed out in class or made available on the web page.

You'll also definitely want a Java textbook. There are many good possibilities; here are two I suggest:

- Ken Arnold, James Gosling, and David Holmes, *The Java Programming Language*, Addison Wesley. (This book is currently in its third edition);
- Bruce Eckel, *Thinking in Java, 3rd ed.*, Prentice-Hall, 2002. This book is available free on the web at <http://www.mindview.net/Books/TIJ>.

You will also need documentation for the particular version of Java that you choose to use (typically available online) and for two Java-based tools that will be needed in the project:

- JLex (<http://www.cs.princeton.edu/~appel/modern/java/JLex/>)
- CUP (<http://www.cs.princeton.edu/~appel/modern/java/CUP/>)

Lecture notes will be available electronically in pdf (Acrobat) format via the course home page.

Project

Over the course of CS321/322 you will write a complete compiler for the PCAT programming language, a distant relative of Pascal. A description of the language will be made available on the course web page. Your compiler must be written in Java.

Exams

There will be one mid-term and a final exam. Both are *closed-book*. Exams will cover topics from lectures and readings, emphasizing material that is not directly relevant to the programming project. Not all the material is covered in the readings, so lecture attendance is important. Exams are scheduled in advance; unless prior arrangements are made, a grade of zero will be recorded for missed exams.

Homework problems may be assigned from time to time as an aid to help you study for the exams; they will not be collected or graded.

Grading

Approximately 1/2 on programming assignments and 1/4 on each of the two exams (including the final).

Programming assignment grades will be determined primarily by observing program behavior on test inputs. Computer programming being what it is, this policy means that “small” errors in your code can have a large effect on your grade. Sample test inputs and a correctly-behaving executable will be provided for you to compare your program against. It is your responsibility to apply these tests and others of your own devising before submitting your assignment. We will apply some non-public tests to your programs as well.

Computing Facilities

All parts of the project will be implemented in Java. For CS321, you may develop your project solutions on any machine and operating system you like, so long as it supports Java (SDK version 1.2 or later, corresponding to “Java 2”). However, the code you hand in will be tested and graded on the CS department’s Sparc machines, using SDK version 1.4.2. It is *your* responsibility to make sure that your code works properly on this system; since Java is highly portable, this should not be a significant difficulty.

You should have been given an account on the Solaris machines automatically by virtue of registering for this course; to obtain your password, take your PSU id to one of the CAT front desks (e.g. FAB 135-01). Once your account is setup, do an “addpkg” command to add `jdk1.4.2` to your environment. Documentation for this version of the Java can be found on the web at <http://java.sun.com/j2se/1.4.2/docs>.

Files associated with assignments will be made available for download via the course web page.

Submitting Programs

Programs should be submitted by email to `cs321-01@cs.pdx.edu`. Details on how to submit programs will be provided with each assignment. Do not send mail other than program submissions to `cs321-01`, as it is not regularly read.

Mailing List

Important information will be distributed throughout the term via a mailing list called `cs321list`. To subscribe to the list, visit <http://webmail.cecs.pdx.edu/mailman/listinfo.cgi/cs321list> and follow the directions there. Please mail questions to the instructor directly (at `apt`) rather than to this list; the instructor will copy mail of general interest to the list. The list is archived so you can consult previous messages.

Tentative Schedule (subject to change)

Date	Asgn	Reading	Topics	
Sep	27	0	CT1	Introduction
	29		skim Java	Learning a new language: Java
Oct	4	1		Language Processing in Java
	6			Language design; Historical survey
	11	2	CT2	Lexical Analysis; Regular expressions
	13		JLex	Finite automata; Scanner generation
	18	1*	CT3.1–2	Syntactic analysis; Grammars
	20		CT3.3	Top-down parsing; Recursive descent
	25			Table-driven LL parsing
	27	2* 3	CT3.4	Bottom-up parsing
Nov	1			Midterm Exam (in class)
	3		CT3.6,CUP	Parser generators
	8		CT4.1,4.3–4	Syntax-directed translation
	10		CT4.2	Data types
	15	4		Type declarations and equivalence
	17	3*		Type checking
	22			Abstract data types and modules
	24			Object-oriented programming concepts
29			Functional programming concepts	
Dec	1	4*		Review
	8			Final Exam (Wednesday starting at 12:30 pm)

Readings column key: CT = Cooper and Torczon textbook; Java = your preferred Java textbook; JLex = JLex user manual; CUP = CUP user manual.

Additional readings will be assigned from time to time. Assigned selections should be read *before* the associated date.

Assignments

Programming assignments, listed below, are distributed on the dates the assignment number appears in the schedule above and are due when the starred number appears.

- 0 Java warm-up (not to be turned in)
- 1 simple language processor
- 2 PCAT lexical analysis
- 3 PCAT parsing
- 4 PCAT type checking

Rules

Programs are due *by 1:30 p.m.* on the specified due date, i.e., just *before* class. Late programs are *not* accepted except in extraordinary circumstances, and then preferably by prior arrangement. The project deadlines are there to help you, by forcing you to keep up during the term.

All programming assignments must represent your own, individual work. It is permissible to discuss the assignment with other students, but you must develop the solution yourself (although you can consult the tutors for help in debugging). *Do not, under any circumstances, copy another person's program and submit it as your own.* Writing code for use by another or using another's code in any form (even with their permission) will be considered cheating. Cheating on an assignment or exam will result in an automatic zero grade for that piece of work, and the initiation of disciplinary action at the University level.

If you are a student with a disability in need of academic accommodations, you should register with Disability Services for Students and notify the instructor immediately to arrange for support services.