CS 410P/510 Programming Language Compilation – Winter 2024

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Office Hours: By appointment, in person or via zoom.
Course web page: `http://web.cecs.pdx.edu/˜apt/cs510comp`

Description

This is a course about basic techniques for generating machine code from a high-level language. We will build complete compilers from high-level abstract syntax down to X86 machine code for a series of languages, each adding new features, including integers, booleans and conditionals, assignment and loops, records and garbage collection, and functions.

Goals

Upon the successful completion of this class, students will be able to:

- Understand the roles of interpretation and compilation.
- Implement a machine code generator and simple register allocator.
- Apply dataflow analysis techniques to implement simple code optimizations.
- Implement and interface with a simple garbage collector.
- Use modern idioms such as pattern matching to manipulate program representations.

Prerequisites

- Comfort with basic Python programming. (Experience with more advanced Python features such as list comprehensions, class inheritance, type annotations and pattern matching is helpful, but not essential.)
- Comfort with low-level programming idoms and a good understanding of machine-level architecture (CS201 or equivalent).
- Familiarity with basic software engineering tools such as `git` (CS300/314 or equivalent).
- Understanding of grammars and abstract syntax (CS320 or CS558 or equivalent).

Readings

We will be using a the textbook *Essentials of Compilation* by Jeremy Siek (Python edition). A free, on-line version of this book will be made available via the course web page. There may also be small number of additional readings, also made available on the course web page.

Requirements

There will be homework exercises involving compiler implementation due each week. The implementation language is Python version 3.10+ (which includes support for pattern matching). You wil be formed into teams of 2-3 people to do the homework.

There will also be in-class midterm and final exams. They will primarily used to confirm your understanding of the homework material.

The course grade will be distributed as follows:

50%	Homework
25%	Midterm
25%	Final

Moreover, you must obtain a certain minimum score (to be determined) on both the midterm and the final in order to obtain a passing grade in the course (B or better for 510 students, C or better for 410 students).

Although it will not be formally assessed, class participation is strongly encouraged, and may affect borderline grades.

Computing Facilities

The course will require use of the Python language (version 4.10 or later) on a unix-like system (linux, MacOS, etc.), running on an x86-64 machine. (MacOS on an Apple M1/M2 ARM machine will also work.) You can use the CS linux lab machines, or (better) install the language on your own computer. The course web page has pointers to the installation instructions.

Individual Work

You are strongly encourged to work on the homework on a 2-3 person team. Every member of the team is jointly responsible for the team's submissions, and should be able to explain them on request. In addition, you are welcome to collaborate across teams or use any other resources available on the web or elsewhere to complete the homeworks. It is acceptable to use AI tools like copilot to help in your coding.

The exams must be completed individually without any collaboration or use of computers. Plagiarism or collaborating on an exam will result in an automatic zero grade and the initiation of disciplinary action at the University level.

Disabilities

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.

Title IX Reporting Obligations

Portland State is committed to fostering a safe, productive learning environment. Title IX and our school policy prohibit gender or sex-based discrimination and sexual misconduct (including harassment, domestic and dating violence, sexual assault, and stalking). We expect a culture of professionalism and mutual respect in our department and class. You may report any incident of discrimination or discriminatory harassment, including sexual harassment, to either the Office of Equity and Compliance (`https://www.pdx.edu/diversity/equity-compliance`) or the Office of the Dean of Student Life (`https://www.pdx.edu/student-life/dean-of-student-life`).

Please be aware that members of the faculty have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of prohibited discrimination to PSU's Title IX Coordinator, the Office of Equity and Compliance or the Dean of Student Life and **cannot keep information confidential**. If you would rather share information about sexual harassment or sexual violence to a confidential employee who does not have this reporting responsibility, you can contact a confidential advocate at 503-725-5672 or by scheduling on-line (`https://psuwrc.youcanbook.me`) or another confidential employee found on the sexual misconduct resource webpage (`https://www.pdx.edu/sexual-assault/get-help`).

Recording

We will use technology for virtual meetings and recordings in this course. Our use of such technology is governed by FERPA, the Acceptable Use Policy and PSU's Student Code of Conduct. A record of all meetings and recordings is kept and stored by PSU, in accordance with the Acceptable Use Policy and FERPA. Your instructor will not share recordings of your class activities outside of course participants, which include your fellow students, TAs/GAs/Mentors, and any guest faculty or community based learning partners that we may engage with. You may not share recordings outside of this course. Doing so may result in disciplinary action.