COSE312: Compilers

Lecture 0 — Course Overview

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Basic Information

Instructor: Hakjoo Oh

- **Position:** Assistant professor in Computer Science and Engineering, Korea University
- **Expertise:** Programming Languages and Compilers
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- **Office Hours:** 1:00pm–3:00pm Mondays and Wednesdays (by appointment)

TA:

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Course Website:

- `http://prl.korea.ac.kr/~hakjoo/courses/cose312/2015/`
- Course materials will be available here.

What is Compiler?

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A compiler is a software system that translates programs written in a high-level programming language into a low-level machine language.

Why bother to take a compiler course?

- Compilers are one of the most important software systems.
- To deeply understand computer science in general.
  - computation theory (automata, grammars), algorithms (greedy/dynamic programming), fixed point theory (data-flow analysis), software engineering, etc.
- A good application of theory to practical problems.
- Writing a compiler is a substantial programming experience.

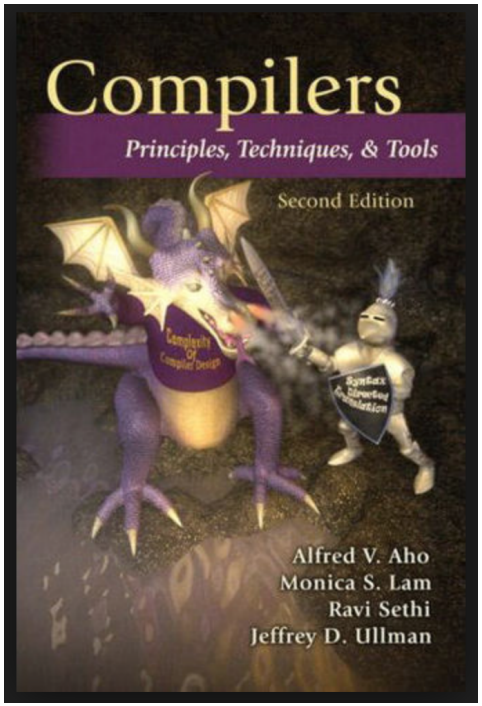
Course Overview

Learn principles and techniques for compiler construction.

- **Lexical analysis:** lexical tokens, regular expressions, finite automata, lexical analyzer generators
- **Syntax analysis:** context-free grammars, top-down parsing, bottom-up parsing, parser generators
- **Translation:** syntax-directed translation, three address code, control flow graph, basic blocks
- **Semantic analysis:** optimization, verification, data-flow analysis, abstract interpretation
- **Code generation (optional):** register allocation and assignments, instruction selection, machine code generation

References

- Self-contained slides will be provided.
- Compilers: Principles, Techniques, and Tools (Second Edition) by Aho, Lam, Sethi, and Ullman. MIT Press.



Prerequisites

- Extensive programming experiences
- Major CS courses: discrete maths, data structures, algorithms, programming languages, theory of computation, architecture, etc
- Programming experiences in functional languages (optional)

Grading

- Homework – 15%
  - 3 paper-and-pencil assignments
- Term project – 20%
  - consists of 4 programming assignments
- Midterm exam – 30%
- Final exam – 30%
- Attendance and participation – 5%

Assignment policy:

- No late submissions will be accepted.
- All assignments must be your own work.
  - Copying gets you 0 for the entire HW (Term project) score.

Term Project

Write a compiler for C--- (a small subset of the C language):

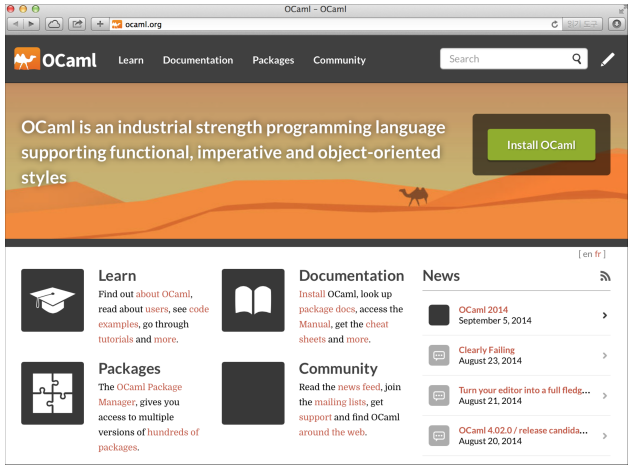
- assignment 1: lexical analyzer
- assignment 2: syntax analyzer
- assignment 3: C--- to IL translator
- assignment 4: optimization

Programming Assignments in ML

ML is a family of programming languages including SML, OCaml, F#, etc.

- Support higher-order, strict, mostly pure, and typed, with algebraic data types.
- Inspired the design of many modern programming languages.
- Suitable for implementing language processors.
- A good deal of syntax.

We will use OCaml:



Schedule (tentative)

Weeks	Topics
1	Introduction
2	Lexical Analysis
3	Lexical Analysis
4	Syntax Analysis
5	Syntax Analysis
6	Syntax Analysis
7	Syntax Analysis
8	Intermediate Representation
9	Mid-term exam
10	Intermediate Representation
11	Code Optimization
12	Code Optimization
13	Program Analysis
14	Program Analysis
15	Code Generation (optional)
16	Final exam