

COMPILER CONSTRUCTION

Course Overview

Chia-Heng Tu
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National Cheng Kung University
Spring 2018

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Our Team

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    Email subject starts with ``[Compiler2018]''
  - Please check **Moodle** frequently for news update



Class Arrangement

- A 3-hour class is separated into three time slots:
  1. 9:10 ~ 10:30 (1st half)
  2. 10:30 ~ 10:50 (Let's take a nap/rest)
  3. 10:50 ~ 12:00 (2nd half)



Class Arrangement (Cont'd)

- We will cover more than what are in the book(s)
  - Which could prepare you for the future
- If possible, at the beginning of each class, I will:
  - share the latest **Tech News** with you, or
  - introduce example applications of the ***compiler technology***

- **Comments/feedbacks of this course are welcome**



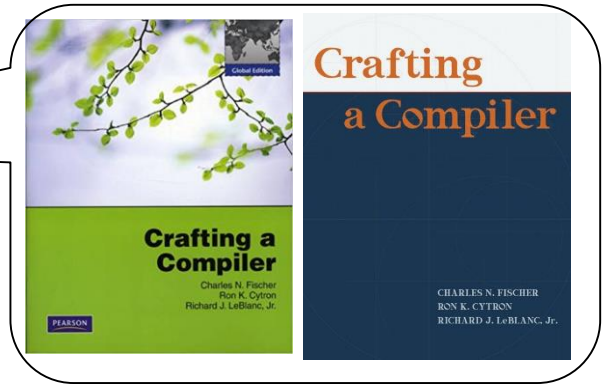
Requirements

- Pre-requisite:
  - Programming in C
  - Computer architecture
  - Computing theory

- Efforts:
  - Attend classes
  - Read the slides/textbook(s)
  - Do/Demo the programming HWs
  - Take the quizzes & midterm/final examinations



Textbooks and References



- **Crafting a Compiler*, Pearson, 2010
  - By Fischer, Cytron, and LeBlanc
    (ISBN: 0138017859, 9780138017859)
    (ISBN: 0136067050, 9780136067054)
  - Thank Prof. Jason Jen-Yen CHEN for his course slides
- ***Compilers: Principles, Techniques, and Tools***, Addison Wesley, 2007 (2nd edition) (a.k.a. Dragon Book)
  - By Aho, Lam, Sethi, and Ullman

- *Lex & Yacc*, , O'Reilly Media, 1995
  - By Doug Brown, John Levine, and Tony Mason
- *The JavaTM Virtual Machine Specification*, Addison-Wesley 1999 (2nd edition)
  - By Tim Lindholm and Frank Yellin
- *Jasmin*, an assembler for Java bytecode



Grading

- In-class Quiz: 20%
- Midterm: 25%
- Final: 25%
- Programming Assignments: 30%

These weights are subject to minor variation



In-class Quiz, 20%

- 2~3 quizzes before Midterm
- 2~3 quizzes before Final
- It will be announced on the **Moodle** one week before



Programming Homework, 30%

- Walk through the process of **building a compiler**
  - Translate source code to machine code
    - e.g., C language to Java assembly language
  - **Three assignments** (30%, 30%, 40%) in total
    - Grade: each assignment has **basic** requirements (100%) and **optional** achievements (extra points)
  - Submit the code/project to **NCKU Moodle** based on the instructions



Programming Homework, 30% (Cont'd)

Honor code

- Homework must be **individual work**
  - While you are allowed (and encouraged) to work together in understanding the concepts of the course, sharing of algorithms or code is NOT ALLOWED
  - **Software plagiarism detection tools** will be used to check the similarity of the code you uploaded
    - I will buy you a coffee if your code is ***similar*** with the other(s)



Programming Homework, 30% (Cont'd)

- Penalty for late upload
  - **30% *discount***
  - **within seven days of the given deadline**

- **Exact deadlines will be announced along with the assignments**



Tentative Time Table

3/2	1.	Course Introduction
3/9	2.	Overview & A Simple Compiler
3/16	3.	A Simple Compiler & Theory and Practice of Scanning
3/23	4.	Lex (**HW #1**) & Quiz
3/30	5.	Theory and Practice of Scanning & Grammars and Parsing
4/6	6.	Spring Break! No Class!
4/13	7.	Top-Down Parsing I
4/20	8.	Top-Down Parsing II
4/27	9.	Yacc (**HW #2**) & Quiz
5/4	10.	Midterm
5/11	11.	Bottom-Up Parsing I
5/18	12.	Bottom-Up Parsing II
5/25	13.	Intermediate Representations & Runtime Support
6/1	14.	Yacc & Jasmin (**HW #3**) & Quiz
6/8	15.	Code Analyses and Optimizations
6/15	16.	Code Analyses and Optimizations & Quiz
6/22	17.	Final
6/29	**18.**	**Project demo (A simple compiler)**

← Could be changed

← Check Moodle



Why Study Compilation?

- Compilers are important system software components
  - They are intimately interconnected with **architecture, systems, programming methodology, language design, etc.**
- Compilers include many applications of theory to practice
  - Scanning, parsing, static analysis, instruction selection
- Many applications have input formats that look like languages
  - MATLAB, Mathematica
- Writing a compiler exposes practical algorithmic & engineering issues
  - Approximating hard problems; efficiency & scalability



CS Topics Related to Compilers Construction

- Theory
  - Finite State Automata, Grammars and Parsing, data-flow
- Algorithms
  - Graph manipulation, dynamic programming
- Data structures
  - Symbol tables, abstract syntax trees
- Systems
  - Allocation and naming, multi-pass systems, compiler construction
- Computer Architecture
  - Memory hierarchy, instruction selection, interlocks and latencies, parallelism
- Security
  - Detection of and Protection against vulnerabilities
- Software Engineering
  - Software development environments, debugging
- Artificial Intelligence
  - Heuristic based search for best optimizations



Challenging and Interesting Problems

- Compiler Construction poses Challenging and Interesting Problems:
  - Compilers must do a lot but also run fast
  - Compilers have primary responsibility for run-time performance
  - Compilers are responsible for making it acceptable to use the full power of the programming language
  - Computer architects perpetually create new challenges for the compiler by building more complex machines
  - Compilers must hide that complexity from the programmer
  - Success requires mastery of complex interactions



QUESTIONS?