

课程简介



联系方式

- 主讲教师：王刚，李忠伟
- 办公地点：计控楼409
- 邮 件：wgzwp@nbjl.nankai.edu.cn
lizhongwei@nbjl.nankai.edu.cn
- 雨课堂、智慧树、学院教学网站
- 助 教：刘欣瑀、王灿灿、潘宇、徐子越

联系方式

○ QQ 群号: 634645072



群名称: 南开编译原理2019

群 号: 634645072



课程目的

- 学习一些基础的编译理论和一些基本的编译技术
- 学习一些辅助工具的使用
- 能用这些理论、技术和工具设计一个简单的通用编译器（简化C编译器）
能将编译技术应用于其他程序的设计



课程内容

- 理解源程序的理论和技术
词法分析、语法分析、语义分析
- 将理解的结果转化为等价的目标程序的
理论和技术
中间代码生成、目标代码生成
- 关于做得更好的理论和技术
一些基本的优化方法

为什么学编译原理

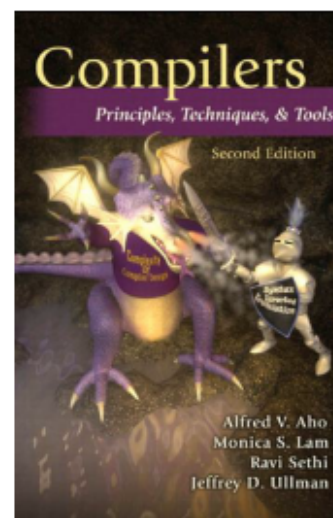
I have always enjoyed teaching the compilers course.

Compiler design is **a beautiful marriage of theory and practice**

-- it is one of the first major areas of systems programming
for which a strong theoretical foundation has developed that
is now routinely used in practice.



Alfred V. Aho





为什么学编译原理（续）

- 对专业学习成果的一次很好的综合性的实践练习——**系统能力**
- 更好地理解现有的程序设计语言，更好地设计、优化程序
- 实现新的通用程序设计语言
- 实现一些专用语言、其他类型的应用
HTML/XML、SQL、Latex

为什么学编译原理（续）

○ MIT不上编译课？

6.035: Computer Language Engineering					Fall 2018
<div>Home Overview General Administrative Schedule Reference Materials CyberPortal 1.1</div>					
Links to notes, labs, etc. on future days are copies of materials from the previous year to give you an idea what the future will bring. We will update the notes as the course progresses. We anticipate that we will be dynamically updating this schedule as appropriate during the course of the semester.					
Monday	Tuesday	Wednesday	Thursday	Friday	
sep 3	sep 4 Registration Day	sep 5 L1: Course Administration and Overview (old slides: S16, OCW) Miniquiz Handouts: Projects overview	sep 6 L2: Regular Expressions and Formal Grammars (old slides: S16, OCW) Miniquiz	sep 7 L3: Regular Expressions and Formal Grammars (old slides: S16, OCW) Miniquiz Assignment: P1, Scanner / Parser Project Scanner / Parser Project	
sep 10 Project 1 Information Session L4: Bottom-up Parsing (old slides: S16, OCW) Miniquiz Handouts: Decaf language specification, course tools guide, Project 1 info session slides	sep 11 L5: Bottom-up Parsing (old slides: S16, OCW) Miniquiz	sep 12 L6: Bottom-up Parsing (old slides: S16, OCW) Miniquiz	sep 13 L7: Top-down Parsing (old slides: S16, OCW) Miniquiz	sep 14	
sep 17	sep 18	sep 19 DUE: Project 1	sep 20 Project 2 Information Session L8: Intermediate Representations (old slides: S16, OCW) Miniquiz Semantic Checker Project, Project 2 info session slides	sep 21 Career Fair	
sep 24 L9: Intermediate Representations (old slides: S16, OCW) Miniquiz	sep 25 L10: Semantic Analysis (old slides: S16, OCW) Miniquiz DUE: Teams must be finalized	sep 26 L11: Semantic Analysis (old slides: S16, OCW) Miniquiz	sep 27 L12: Unoptimized Code Generation (old slides: S16, OCW) Miniquiz	sep 28 L13: Unoptimized Code Generation (old slides: S16, OCW) Miniquiz	
oct 1 L14: Unoptimized Code Generation (old slides: S16, OCW) Miniquiz	oct 2	oct 3	oct 4 Office hours for project 2 Project 3 info session slides Assignment: P3, Code Generator Project	oct 5 ADD DATE DUE: Project 2	
oct 8 Columbus Day	oct 9 Columbus Day	oct 10	oct 11	oct 12 QUIZ #1 2018 Fall (2018 Fall) Practice Exams (Exam 1): 2017 Fall (answers), 2016 Fall (answers), 2015 Spring (answers), 2014 (answers), 2013 (answers), 2012 (answers), 2011 on OCW	
oct 15 L15: Introduction to Program Analysis (old slides: S16, OCW) Miniquiz	oct 16 L16: Introduction to Program Analysis (old slides: S16, OCW) Miniquiz	oct 17 L17: Introduction to Data-flow Analysis (old slides: S16, OCW) Miniquiz	oct 18 L18: Introduction to Data-flow Analysis (old slides: S16, OCW) Miniquiz	oct 19 L19: Introduction to Data-flow Analysis (old slides: S16, OCW) Miniquiz	
oct 22	oct 23	oct 24	oct 25	oct 26 Project 4 info session slides Assignment: P4, Data-flow Analysis Project DUE: Project 3 "Graded"	
oct 29 L20: Loop Optimizations (old slides: S16, OCW) Miniquiz	oct 30 L21: Loop Optimizations (old slides: S16, OCW) Miniquiz	oct 31 L22: Register Allocation (old slides: S16, OCW) Miniquiz	nov 1 L23: Register Allocation Wrap-Up (old slides: S16, OCW) Miniquiz	nov 2	



为什么学编译原理（续）

- MIT的Computer Language Engineering是真正的编译课，30次的重课
- 一半编译基础——14次课
 - ▣ 正则表达式、文法；自底向上分析法、自顶向下分析、中间表示；语义分析；非优化代码的自动生成
- 一半程序分析+优化——16次课
 - ▣ 数据流分析、循环优化、寄存器分配、并行化、内存优化、指令调度



C语言编程和优化

```
/* LOOP #1 */  
for (i = 0; i < N; i++) {  
    a[i] = a[i] * 2000;  
    a[i] = a[i] / 10000;  
}
```

```
/* LOOP #2 */  
b = a;  
for (i = 0; i < N; i++) {  
    *b = *b * 2000;  
    *b = *b / 10000;  
    b++;  
}
```

- 为了获得运行更快的目标程序，你选择哪种编程方式？



实验结果

LOOP	opt. level	SPARC	MIPS	Alpha
#1 (array)	no opt	20.5	21.6	7.85
#1 (array)	opt	8.8	12.3	3.26
#1 (array)	super	7.9	11.2	2.96
#2 (ptr)	no opt	19.5	17.6	7.55
#2 (ptr)	opt	12.4	15.4	4.09
#2 (ptr)	super	10.7	12.9	3.94

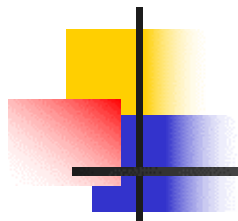
- 编译器不进行优化时——指针更优（优势微小）

但进行优化后——数组优势显著

- 告诉我们什么？

更多关注算法优化，不要沉迷“编程技巧”——反而

可能令编译器优化效果削弱



需要的先导课程

- 计算机基础
- 高级语言程序设计
- 数据结构
- 操作系统
- 汇编语言程序设计
- ...

参考书目

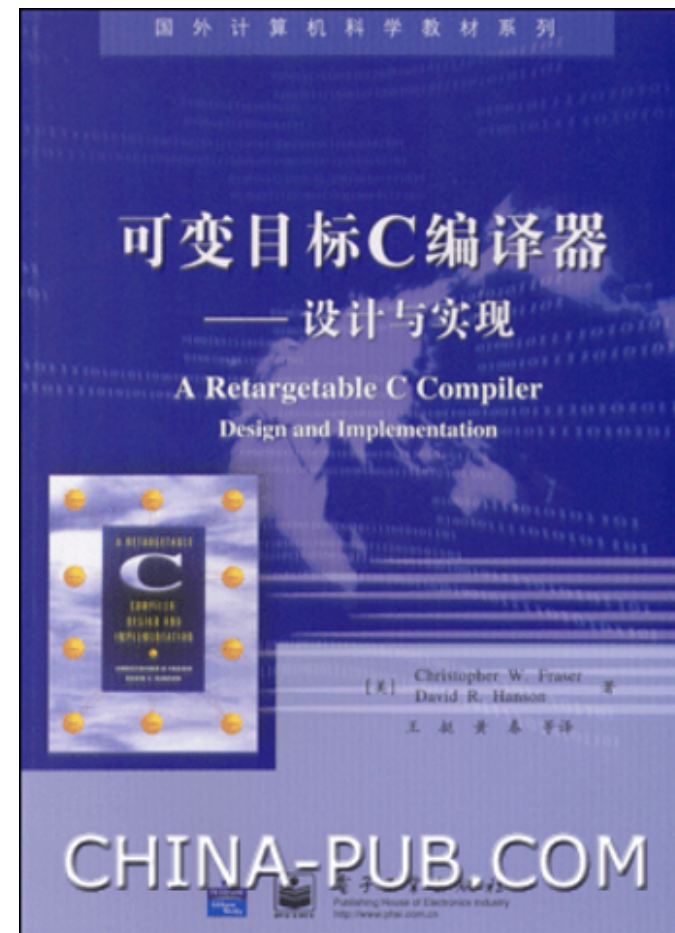
《编译原理》

(Compilers: Principles, Techniques, and Tools 中文版), 李建中、姜守旭译, 机械工业出版社, 2003



参考书目

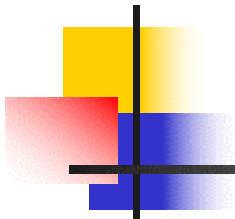
《可变目标C编译器——设计与实现》（A Retargetable C Compiler: Design and Implementation），Christopher W.Fraser等著，王挺等译，电子工业出版社，2005



参考书目

《Lex与Yacc》（第二版）
（Lex and Yacc），Levine
等著，杨作梅等译，机械
工业出版社，2003





参考资料、开发工具

- 编译器自动生成工具
 - Parser Generator 2
 - ANTLR
 - Flex、Bison
- 汇编开发包：MASM32
- 编译器构造示例
 - lcc
 - Tiny-c



成绩

- 平时作业：50%
 - ▣ 书面作业（七次）：20%
 - ▣ 上机实习（七个步骤）：30%
 - 一个简化的C语言的编译器，鼓励用辅助工具
 - ▣ 必须按时完成，期末一股脑交上来不予接受
 - ▣ 发现抄袭情况，成绩为0
- 期末考试：50%
- 上机安排：周四晚18:30~21:05，信息西楼机房，第三周开始

