

编译原理概述

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2020 年 11 月 8 日



2 个月 = 8 周 = 16 次课



期末测试 (40 分): 考试周统一安排; 时长 2 小时; 闭卷

作业 (15 分): 7 次必做作业 + 1 次选做报告 (+3 分)

实验 (45 分): 4 次必做实验 + 1 次选做实验 (+5 分)



Moodle

<http://219.219.120.72>

选课密码: grade18

每周二布置作业

下周四提交作业

$$45 = 0 + 5 + 15 + 15 + 10 + 5$$

<http://problemoverflow.cn/compiler/>

L0 : 环境配置已经开放



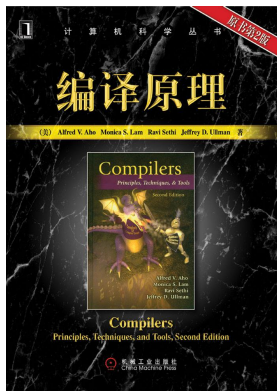
QQ 群号: 587330269



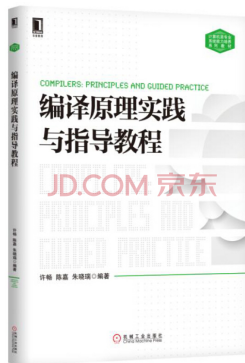
作业助教: 王腾、田汶哲、郑立铨

实验助教: 张灵毓、何伟

外援: 张天昀、唐瑞泽

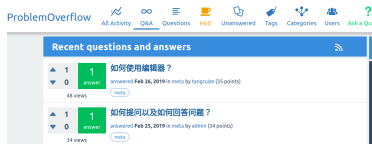


也可使用“本科教学版”



https://cs.nju.edu.cn/changxu/2_compiler/index.html

- ☐ 4 repositories selected...
- ☐ **courses-at-nju-by-hfwei/compiler-book** updated on Sep 15
- ☒ **courses-at-nju-by-hfwei/compiler-lab** Private updated 2 days ago
- ☒ **courses-at-nju-by-hfwei/compiler-lectures** updated 12 hours ago
- ☐ **courses-at-nju-by-hfwei/compiler-papers-we-love** updated on Aug 14
- ☒ **courses-at-nju-by-hfwei/compiler-problem-set** updated on Aug 10
- ☐ **courses-at-nju-by-hfwei/compiler-resources** updated 17 hours ago
- ☒ **courses-at-nju-by-hfwei/compiler-tutorials** updated on Aug 10

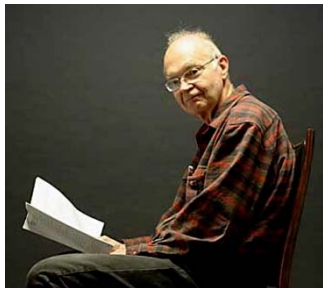


<http://problemoverflow.cn/>

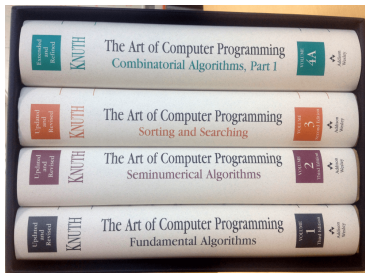
<https://github.com/orgs/courses-at-nju-by-hfwei/teams/compiler-course-at-nju-software/repositories>



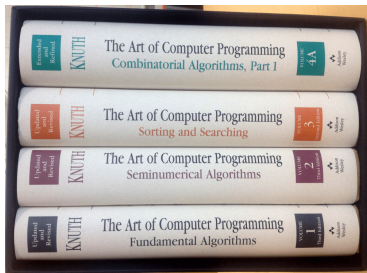
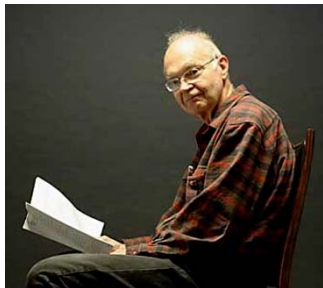
the “father of the analysis of algorithms”



Donald E. Knuth (1938 ~)



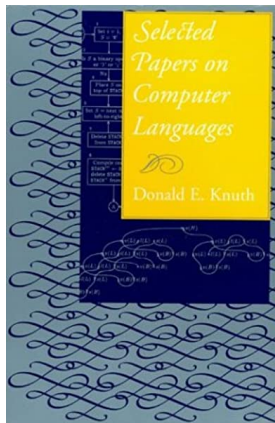
the “father of the analysis of algorithms”



Donald E. Knuth (1938 ~)

“For his major contributions to the analysis of algorithms and the design of programming languages, and in particular for his contributions to “The Art of Computer Programming” through his well-known books in a continuous series by this title.”

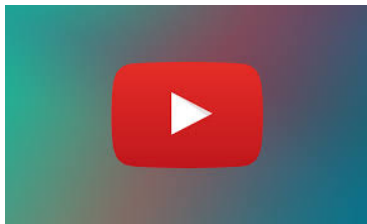
— Turing Award, 1974



ALGOL 58 Compiler

LR Parser

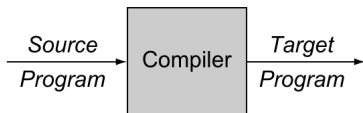
Attribute Grammar



“I got a job at the end of my senior year
to write a compiler for Burroughs”

“高级”语言 \implies (通常) “低级”语言 (如, 汇编语言)

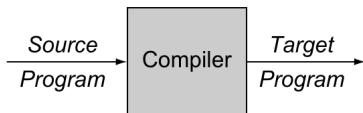
汇编语言经过**汇编器**生成机器语言



Q : 机器语言是如何跑起来的?

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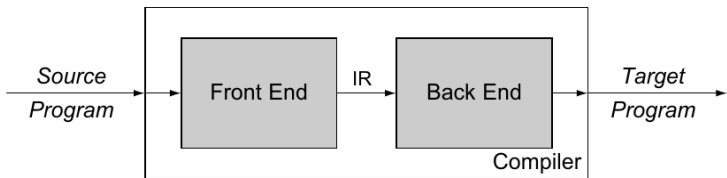
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<https://www.bilibili.com/video/BV1EW411u7th>

两个月的“编译器设计原理”之旅

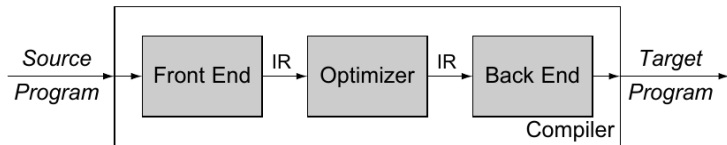


IR: Intermediate Representation (中间表示)



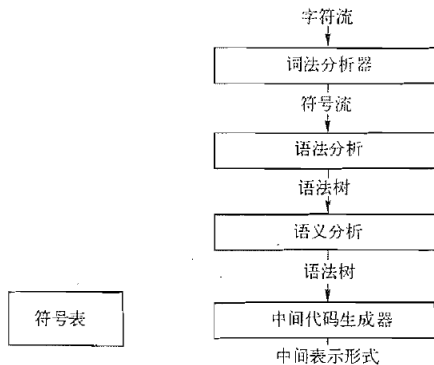
前端 (分析阶段): 分析源语言程序, 收集所有必要的信息

后端 (综合阶段): 利用收集到的信息, 生成目标语言程序



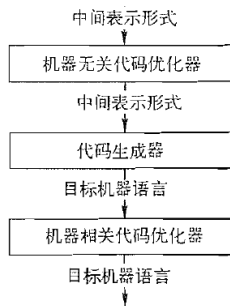
机器无关的中间表示优化

编译器前端：分析阶段



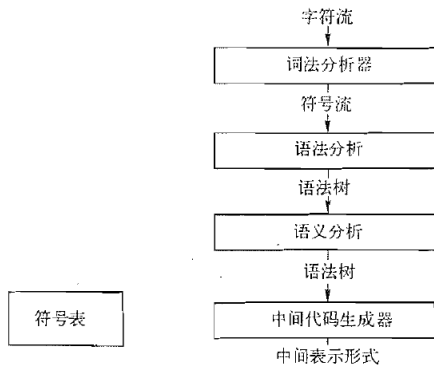
前四次必做实验

编译器后端：综合阶段



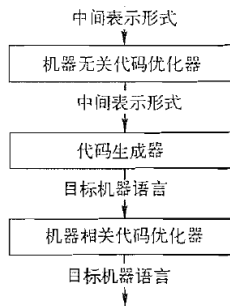
第五次选做实验

编译器前端：分析阶段



前四次必做实验

编译器后端：综合阶段



第五次选做实验

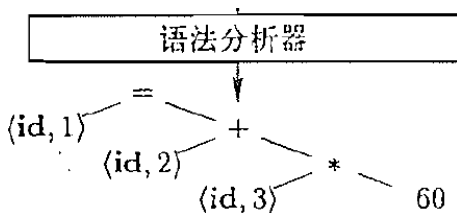
`position = initial + rate * 60`

词法分析器 (Lexer/Scanner): 将字符流转化为词法单元 (token) 流。

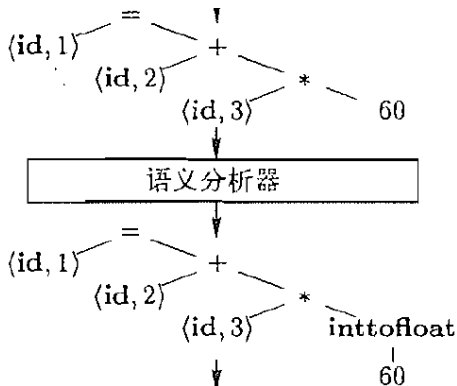
token : $\langle \text{token-class}, \text{attribute-value} \rangle$

$\langle \text{id}, 1 \rangle$ $\langle \text{ws} \rangle$ $\langle \text{assign} \rangle$ $\langle \text{ws} \rangle$ $\langle \text{id}, 2 \rangle$ $\langle \text{ws} \rangle$
 $\langle + \rangle$ $\langle \text{ws} \rangle$ $\langle \text{id}, 3 \rangle$ $\langle \text{ws} \rangle$ $\langle * \rangle$ $\langle \text{ws} \rangle$ $\langle \text{num}, 4 \rangle$

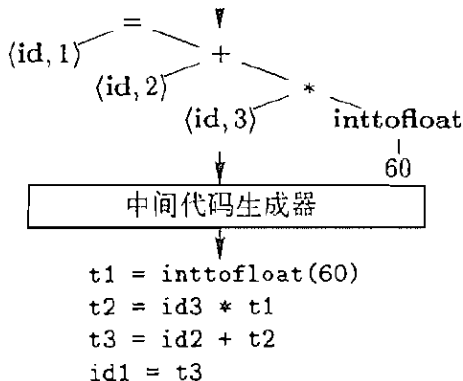
语法分析器 (Parser): 构建词法单元之间的语法结构, 生成语法树



语义分析器: 语义检查, 如类型检查、“先声明后使用”约束检查



中间代码生成器：生成中间代码，如“三地址代码”



中间代码优化器

```
t1 = inttofloat(60)
t2 = id3 * t1
t3 = id2 + t2
id1 = t3
```



```
t1 = id3 * 60.0
id1 = id2 + t1
```

代码生成器: 生成目标代码, 主要任务包括指令选择、寄存器分配

```
t1 = id3 * 60.0  
id1 = id2 + t1
```



代码生成器

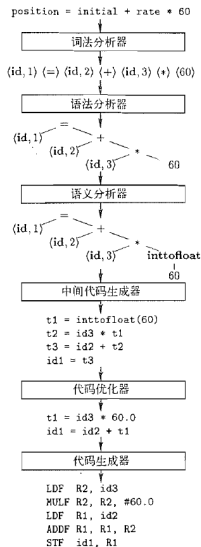


```
LDF  R2, id3  
MULF R2, R2, #60.0  
LDF  R1, id2  
ADDF R1, R1, R2  
STF  id1, R1
```

符号表: 收集并管理变量名/函数名相关的信息

1	position	...
2	initial	...
3	rate	...

符号表

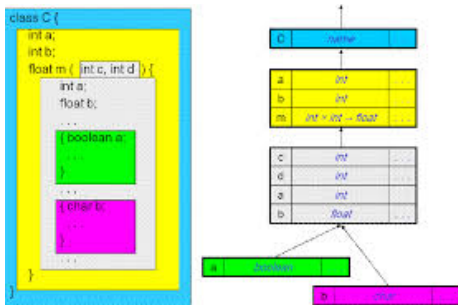


```
public class ST<Key extends Comparable<Key>, Value>
```

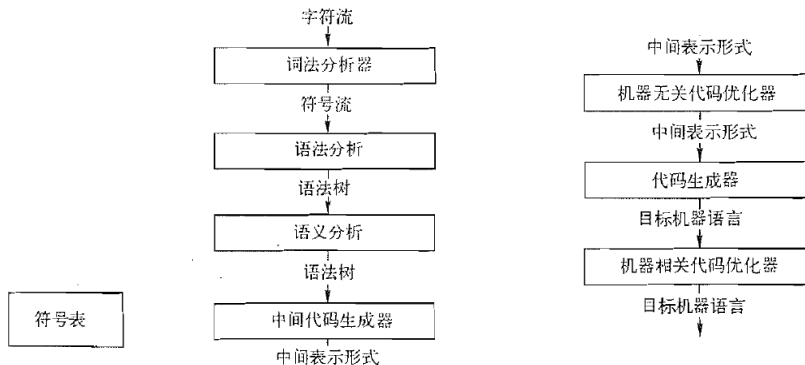
ST()	<i>create an empty symbol table</i>
void put(Key key, Value val)	<i>associate val with key</i>
Value get(Key key)	<i>value associated with key</i>
void remove(Key key)	<i>remove key (and its associated value)</i>
boolean contains(Key key)	<i>is there a value associated with key?</i>
int size()	<i>number of key-value pairs</i>
Iterable<Key> keys()	<i>all keys in the symbol table</i>

红黑树 (RB-Tree)、哈希表 (Hashtable)

为了方便表达嵌套结构与作用域, 可能需要维护多个符号表

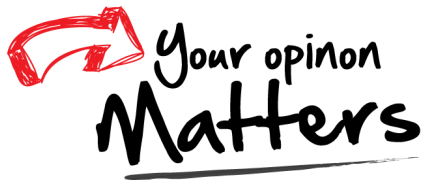


时间苦短，来不及优化



但是, 在设计实际生产环境中的编译器时, **优化**通常占用了大多数时间

Thank
You!



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