

## 北京邮电大学 2023—2024 学年第一学期

### 《编译原理与技术》期末考试试题（A 卷）

考 试 注 意 事 项	一、学生参加考试须带学生证或学院证明，未带者不准进入考场。学生必须按照监考教师指定座位就坐。 二、书本、参考资料、书包等物品一律放到考场指定位置。 三、学生不得另行携带、使用稿纸，要遵守《北京邮电大学考场规则》，有考场违纪或作弊行为者，按相应规定严肃处理。 四、学生必须将答题内容做在试题答卷上，做在草稿纸上一律无效。
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#### 一、简答题（每空 5 分，共 30 分）

1. What is the role of the symbol table in the various stages of the compiler, and what specific operations are involved? (符号表在编译器的各个阶段的作用是什么，具体涉及到哪些操作？)
2. What are the two types of attributes defined for grammar symbols to represent semantics? In practical compiler applications, what are the two commonly used attribute grammars? And please provide corresponding examples. (为表示语义我们为文法符号定义哪两类属性？实际编译器的应用中，常用的属性文法有哪两类，请给出相应的例子。)
3. Please describe the basic components of a compiler from the perspective of the front-end and the back-end. What constitutes the front-end and the back-end, and what is the purpose of distinguishing between the two? What role does intermediate code play between them? (请从前后端的角度描述一个编译器的基本组成部分。包括什么，哪些属于前端，哪些属于后端，说明这样区分前后端的目的是什么，中间代码在这之间扮演了什么样的角色？)
4. Please provide different forms of three-address instructions and explain their characteristics. (请给出三地址指令的不同表达形式，并说明其特点。)
5. Please explain the process of function call and return. (请解释函数调用过程及返回过程)
6. Please list and explain the basic code block optimization methods. (请列出并说明基本代码块的优化方法并解释)

二、计算题（每题 10 分，共 40 分）

1. Write the regular expression for the following statement: (写出下列语句的正则表达式)
  - (1) String of arbitrary length consisting of 'a' and 'b' where the third last symbol is 'a'.(倒数第 3 个符号为 a 的由 a 和 b 组成的任意长度的串)
  - (2) IPv6 address(IPv6 地址 (以冒号分隔 8 组 16 进制字符所表示的 IPv6 地址))
2. 给定正则表达式:  
 $R=(a^*|b^*)b(ba)^*$ 
  - (1) Convert the regular expressions R to NFA using the Thompson's Construction Algorithm.(请使用汤普森构建算法将 R 转换为 NFA)
  - (2) Convert the NFA in (1) to DFA using the Subset Construction Algorithm. (请使用子集构建算法将(1)的 NFA 转换为 DFA)
3. 考虑增广文法 G:  
 $S' \rightarrow S$   
 $S \rightarrow CC$   
 $C \rightarrow aC|b$ 
  - (1) Construct its LR(1) item sets, LR(1) automaton, and LR(1) parsing table.(构造它的 LR(1)项目集、LR(1)自动机和 LR(1)分析表)
  - (2) Please give the analysis procedure for the input string abaab(请对于输入串 abaab 给出分析过程)
4. For the SDDs in Table 1, provide the annotated parse tree for the following expressions and draw the dependency graph. (针对表 1 中的 SDD, 给出以下表达式的注释解析树, 并画出依赖图)
  - (1)  $(1+8)*6+7n$
  - (2)  $((9*8+8*7)+1)*9n$

PRODUCTION	SEMANTIC RULES
1) $L \rightarrow E n$	$L.val = E.val$
2) $E \rightarrow E_1 + T$	$E.val = E_1.val + T.val$
3) $E \rightarrow T$	$E.val = T.val$
4) $T \rightarrow T_1 * F$	$T.val = T_1.val * F.val$
5) $T \rightarrow F$	$T.val = F.val$
6) $F \rightarrow ( E )$	$F.val = E.val$
7) $F \rightarrow \text{digit}$	$F.val = \text{digit.lexal}$

表 1 Syntax-directed definition of a simple desk calculator

### 三、思考题（每题 10 分，共 20 分）

1. Through two major projects, Project 1 and Project 2, it is believed that you have gained a certain understanding of how to write a small-scale compiler. Building upon this knowledge, the next step is to generate a specific intermediate representation (IR) for a given source program. Following the standard form of three-address code as discussed in the class, think about how to accomplish this for the provided test cases. (Hint: Consider the translation of different types of statements in the test cases. Your answer should include considerations for grammar symbol attributes and their semantic rules. You can refer to relevant materials on intermediate code generation to explain your overall project design and provide code representations.) (通过两次大作业 Project 1 和 Project 2，相信你已经对如何编写一个小型的编译器有了一定的了解。在此基础上，进一步要做的是对于给定的源程序，产生特定的中间表示（IR）。请按照课上介绍的三地址码的规范形式，针对下面给定的测试用例，思考该如何完成。（提示：考虑测试用例中不同类型语句的翻译，你的回答应包括对文法符号属性及其语义规则的考虑。可参考关于中间代码生成的相关内容，解释你的整个项目设计，并给出代码表示）)

测试用例：

```
int main()
{
    int n;
    n = read();
    if (n > 0) write(1);
    else if (n < 0) write (-1);
    else write(0);
    return 0;
}
```

2. In the process of compilation, various techniques are used to handle programming languages, such as lexical analysis based on regular expressions. Please discuss the application of these techniques in other domains and provide relevant examples. (在编译过程中，你会使用诸如基于正则表达式的词法分析技术等各种处理程序语言的技术，请谈谈这些技术在其他地方的应用情况，给出相应的实例)

#### 四、开放题（每题 10 分，共 10 分）

In recent years, China's Internet information industry has made significant efforts in upholding independence and controllability, technological autonomy, and preventing dependency on critical core technologies. Please discuss your understanding of this situation and provide examples of achievements made by China, particularly in the field of compilers. Furthermore, based on your expertise, explain how you can contribute to the future development of the national Internet information industry in your chosen profession.(近年来，我国的网信事业在坚持自主可控,科技自主,防止在关键核心技术上被卡脖子上做了很多努力，谈谈你对此所了解的情况，列举我国所取得的成绩，特别是在编译器领域。并结合所学专业谈谈未来将如何为国家网信事业的发展做出自己的贡献)