实验报告

一、实验目的

- 熟悉C语言的词法规则，了解编译器词法分析器的主要功能和实现技术，掌握典型词法分析器构造方法，设计并实现C语言词法分析器
- 了解Flex工作原理和基本思想，学习使用工具自动生成词法分析器
- 掌握编译器从前端到后端各个模块的工作原理，词法分析模块与其他模块之间的交互过程。

二、实验内容

- 根据C语言的词法规则，设计并实现C语言词法分析器
- 词法分析器的输入为C语言源程序，输出为属性字流
- 可以选择编码实现，也可以选择使用自动生成工具

三、实验过程

- 实验环境
  - jflex-1.8.2
  - jdk-17.0.2
- 实验步骤
  - 将需要识别的单词分为7类：Keyword, Identifier, Operator, Delimiter, IntergerConstant, FloatConstant, CharacterConstant, StringListeral
  - 写出匹配这7类单词的正则表达式

```
Keyword="auto"|"break"|"case"|"char"|"const"|"continue"|"default"|"do"|"double"|"else"|"enum"|"extern"|"float"|"for"|"goto"|"if"|"inline"|"int"|"long"|"register"|"restrict"|"return"|"short"|"signed"|"sizeof"|"static"|"struct"|"switch"|"typedef"|"union"|"unsigned"|"void"|"volatile"|"while"

Identifier=[:jletter:] [:jletterdigit:]*

IntegerConstant=0|[1-9][0-9]*

FloatConstant=[0-9]+(\.[0-9]+)
```

```
Operator="+"|"-"|"*"|"/"|"%"|"++"|"--"|">"|"<"|"=="|">="|"
<="|"!="|"&&"|"||"|"!"|"&"|"|"|"~"|"^"|"<<"|">>"|"="|"+="|"-
="|"*="|"/="|"%="|"&="|"|="|"^="|"<<="|">>="|"?"|":"|"."

Delimiter=","|";"|"\""|"'"|"("|")"|"["|"]"|"{"|"}"|"#"

CharacterConstant=\'((\\\S)|[^'])\'

StringLiteral=\"\S*[^\\]\"
```

- 写出匹配空白符、换行符和注释的正则表达式

```
Comment = {TraditionalComment} | {EndOfLineComment} |
{DocumentationComment}

WhiteSpace=\ |\t|\f|\b

LineTerminator=\r|\n|\r\n

CommentContent       = ( [^*] | \*+ [^/*] )*
TraditionalComment   = "/*" [^*] ~"*/" | "/*" "*"+ "/"
EndOfLineComment     = "//" [^\r\n]* {LineTerminator}?
DocumentationComment = "/**" {CommentContent} "*"+ "/"
```

- 写出匹配成功后所要执行的函数

```
%{
    private int count = 0;

    public void genToken(char[] zzBuffer, int type, int count,
int startPos, int endPos) throws IOException{
        FileWriter writer = new FileWriter("test.txt", true);
        String s = String.valueOf(zzBuffer, startPos, endPos -
startPos);
        switch(type) {
            // Keyword
            case 0: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',<'" + s
+ "'>," + yyline + ":" + yycolumn +"]\n"); break;
            // Identifier
            case 1: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',
<Identifier>," + yyline + ":" + yycolumn +"]\n"); break;
            // Operator
```

```
            case 2: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',<'" + s
+ "'>," + yyline + ":" + yycolumn +"]\n"); break;
            // Delimiter
            case 3: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',<'" + s
+ "'>," + yyline + ":" + yycolumn +"]\n"); break;
            // IntegerConstant
            case 4: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',
<IntegerConstant>," + yyline + ":" + yycolumn +"]\n"); break;
            // FloatConstant
            case 5: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',
<FloatConstant>," + yyline + ":" + yycolumn +"]\n"); break;
            // CharacterConstant
            case 6: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',
<CharacterConstant>," + yyline + ":" + yycolumn +"]\n");
break;
            // StringLiteral
            case 7: writer.write("[@" + count + "," + yycolumn
+ ":" + (yycolumn + endPos - startPos) + "='" + s + "',
<StringLiteral>," + yyline + ":" + yycolumn +"]\n"); break;
        }
        writer.flush();
        writer.close();
    }
%}
```

- 在词法规则部分对整体进行匹配

```
<YYINITIAL> {
    {Keyword}     { count++; genToken(zzBuffer, 0, count,
zzCurrentPos, zzMarkedPos); }
    {Identifier}  { count++; genToken(zzBuffer, 1, count,
zzCurrentPos, zzMarkedPos); }
    {Operator}    { count++; genToken(zzBuffer, 2, count,
zzCurrentPos, zzMarkedPos); }
    {Delimiter}   { count++; genToken(zzBuffer, 3, count,
zzCurrentPos, zzMarkedPos); }
    {IntegerConstant}   { count++; genToken(zzBuffer, 4,
count, zzCurrentPos, zzMarkedPos); }
    {FloatConstant}     { count++; genToken(zzBuffer, 5,
count, zzCurrentPos, zzMarkedPos); }
    {CharacterConstant} { count++; genToken(zzBuffer, 6,
count, zzCurrentPos, zzMarkedPos); }
    {StringLiteral}     { count++; genToken(zzBuffer, 7,
count, zzCurrentPos, zzMarkedPos); }
    {Comment}     {}
}

{LineTerminator}|{WhiteSpace} {}
```

- 添加生成选项

```
%public
%class MyScanner
%function scan
%type void

%char
%line
%column
%unicode
```

- 使用Jflex生成词法分析器并添加调用函数

```
import java.io.FileReader;
import java.io.FileWriter;
import java.io.IOException;

public class Main {
    public static void main(String[] args) throws IOException
{
        if (args[0].equals("")) {
```

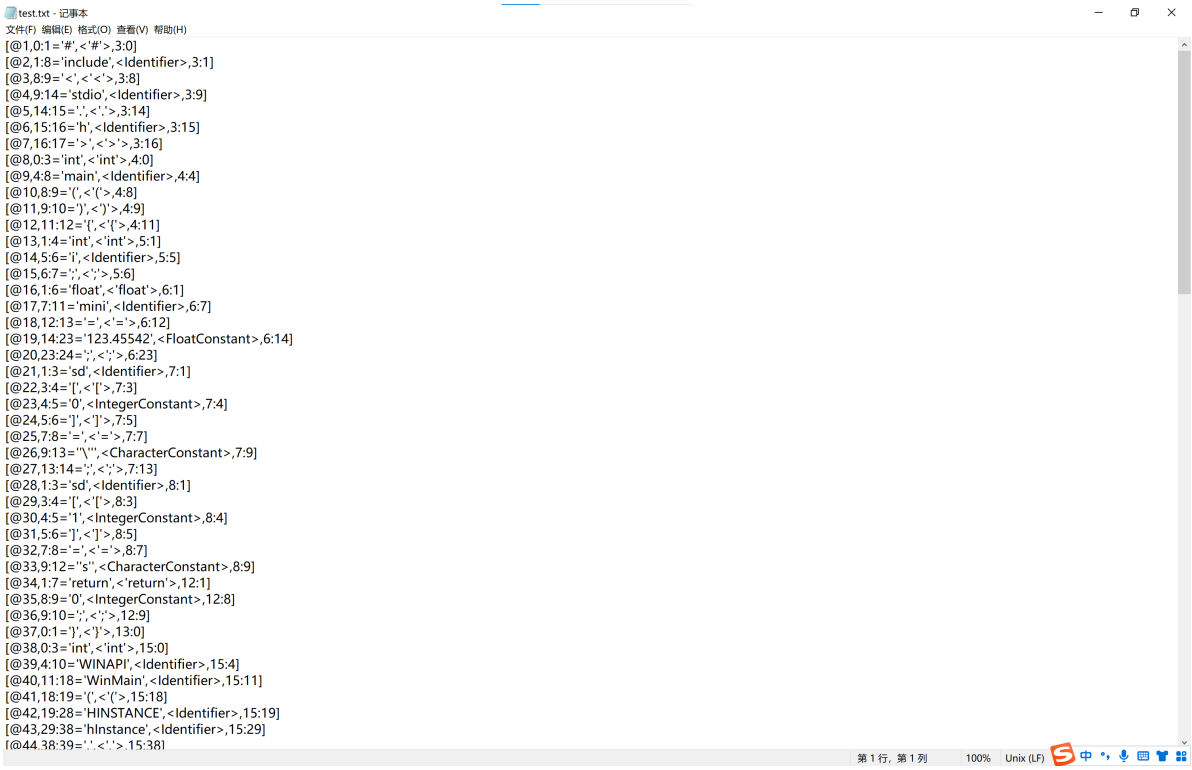
```
            System.out.println("Need parameter.");
            return;
        }

        FileWriter writer = new FileWriter("out.txt", false);
        writer.write("");
        writer.flush();
        writer.close();
        MyScanner scanner = new MyScanner(new
FileReader(args[0]));
        System.out.println("Start...");
        scanner.scan();
        System.out.println("Finish...");
    }
}
```

四、运行效果截图

- C语言源代码

```c
/*jhgkhjkh
kljlkjlj
*/
#include<stdio.h>
int main() {
    int i;
    float mini = 123.45542;
    sd[0] = '\'';
    sd[1] = 's'

    // kljlkj

    return 0;
}

int WINAPI WinMain(HINSTANCE hInstance, HINSTANCE hPrevInstance, LPSTR lpCmdLine, int nCmdShow){
    LPSTR msg;
    UINT opt;

    if(checkVbox()){
        msg = "Virtual box detected !!!";
        opt = MB_ICONEXCLAMATION;
    } else {
        msg = "Virtual box not detected !!!";
        opt = MB_OK;
    }

    MessageBox(NULL, msg, "Virtual Box", opt);

    return 0;
}
```

- 输出属性字流（部分）



五、实验心得体会

由于对正则表达式的使用不够熟练，大部分时间都花费在了写正则表达式上，并且被一些细节问题纠缠了很久。另一个时间开销比较大的方面是学习Jflex的使用方法。由于使用手册是全英文的，网上的中文翻译水平参差不齐，导致花费了较多时间。