

# SUPRALGOL<sup>2016</sup>

## Introduction to language theory and compiling

### Project – Part 1

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*No proper program contains an indication which as an operator-applied occurrence identifies an operator-defining occurrence which as an indication-applied occurrence identifies an indication-defining occurrence different from the one identified by the given indication as an indication-applied occurrence.*

ALGOL 68 Report

## 1 Introduction

In this project, you are requested to design and write a compiler for SUPRALGOL<sup>2016</sup>, a variant of the classical Algol68 language. The grammar of the language is given in Figure 1, where reserved keywords have been typeset using `typewriter` font. In addition, `[VarName]` and `[Number]` are lexical units, which are defined as follows. A `[VarName]` identifies a variables, which is a string of digits and letters, starting with a letter (this is case sensitive). A `[Number]` represents a numerical constant, and is made up of a string of digits only. The minus sign can be generated using rule [16].

Finally, comments are allowed in SUPRALGOL<sup>2016</sup>: they are all the symbols occurring between a pair of `co` keywords. Observe that comments do not occur in the rules of the grammar: they must be ignored by the scanner, and will not be transmitted to the parser.

Figure 2 shows an example of SUPRALGOL<sup>2016</sup> program.

## 2 Assignment - Part 1

In this first part of the assignment, you must produce the *lexical analyser* of your compiler, using the JFlex tool reviewed during the practicals. *Please adhere strictly to the instructions given below, otherwise we might be unable to grade your project, as automatic testing procedures will be applied.*

The lexical analyzer will be implemented in JAVA 1.6. It must recognise the different lexical units of the language, and maintain a symbol table. To help you, several JAVA classes are provided on the Moodle platform:

- The `LexicalUnit` class contains an enumeration of all the possible lexical units;
- The `Symbol` class implements the notion of token. Each object of the class can be used to associate a value (a generic Java Object) to a `LexicalUnit`, and a line and column number (position in the file). The code should be self-explanatory. If not, do not hesitate to ask questions to the teacher, or to the teaching assistants.

[1]	<Program>	→ begin <Code> end
[2]	<Code>	→ $\epsilon$
[3]		→ <InstList>
[4]	<InstList>	→ <Instruction>
[5]		→ <Instruction> ; <InstList>
[6]	<Instruction>	→ <Assign>
[7]		→ <If>
[8]		→ <While>
[9]		→ <For>
[10]		→ <Print>
[11]		→ <Read>
[12]	<Assign>	→ [VarName] := <ExprArith>
[13]	<ExprArith>	→ [VarName]
[14]		→ [Number]
[15]		→ ( <ExprArith> )
[16]		→ - <ExprArith>
[17]		→ <ExprArith> <Op> <ExprArith>
[18]	<Op>	→ +
[19]		→ -
[20]		→ *
[21]		→ /
[22]	<If>	→ if <Cond> then <Code> fi
[23]		→ if <Cond> then <Code> else <Code> fi
[24]	<Cond>	→ <Cond> <BinOp> <Cond>
[25]		→ not <SimpleCond>
[26]		→ <SimpleCond>
[27]	<SimpleCond>	→ <ExprArith> <Comp> <ExprArith>
[28]	<BinOp>	→ and
[29]		→ or
[30]	<Comp>	→ =
[31]		→ >=
[32]		→ >
[33]		→ <=
[34]		→ <
[35]		→ /=
[36]	<While>	→ while <Cond> do <Code> od
[37]	<For>	→ for [VarName] from <ExprArith> by <ExprArith> to <ExprArith> do <Code> od
[38]	<Print>	→ print ([VarName])
[39]	<Read>	→ read ([VarName])

Figure 1: The SUPRALGOL<sup>2016</sup> grammar.

```

co Euclid's algorithm co

begin
  read(a) ;
  read(b) ;
  while b /= 0 do
    c := b ;
    while a >= b do      co computation of modulo co
      a := a-b
    od ;
    b := a ;
    a := c
  od ;
  print(a)
end

```

Figure 2: An example SUPRALGOL<sup>2016</sup> program implementing Euclid's algorithm. The inner loop computes  $a \bmod b$ . Note the use of semicolons as *instruction separators* and not *instruction terminators* as in C. That is, semicolon *separate consecutive instructions* but they are not present after the last instruction of each block.

You must hand in:

- A PDF report containing all REs, and presenting your work, with all the necessary justifications, choices and hypothesis
- The source code of your lexical analyzer in a JFlex source file called `LexicalAnalyzer.flex`;
- The SUPRALGOL<sup>2016</sup> example files you have used to test your analyser;
- All required files to evaluate your work (like a `Main.java` file calling the lexical analyser, etc).

You must structure your files in four folders:

- `doc` contains the JAVADOC and the PDF report;
- `test` contains all your example files;
- `dist` contains an executable JAR;
- `more` contains all other files.

Your implementation must contain:

1. the provided classes `LexicalUnit` and `Symbol`, *without modification*;
2. an executable public class `Main` that reads the file given as argument and writes on the standard output stream the sequence of matched lexical units and the content of the symbol table. More precisely, the format of the output must be:
  - (a) First, the sequence of matched lexical units. You must use the `toString()` method of the provided `Symbol` class to print individual tokens;
  - (b) Then, the word *Identifiers*, to clearly separate the symbol table from the sequence of tokens;

- (c) Finally, the content of the symbol table, formatted as the sequence of all recognised identifiers, in lexicographical (alphabetical) order. There must be one identifier per line, together with the number of the line of the input file where this identifier has been encountered for the first time (the identifier and the line number must be separated by at least one space).

The command for running your executable must be:

```
java -jar yourJarFile.jar Main sourceFile
```

For instance, on the following input:

```
read(b)
while(b) do
```

your executable must produce exactly, using the `toString()` method of the `Symbol` class, the following output for the sequence of tokens (an example for the symbol table is given hereunder):

```
token: read      lexical unit: READ
token: (         lexical unit: LEFT_PARENTHESIS
token: b         lexical unit: VARNAME
token: )         lexical unit: RIGHT_PARENTHESIS
token: while     lexical unit: WHILE
token: (         lexical unit: LEFT_PARENTHESIS
token: b         lexical unit: VARNAME
token: )         lexical unit: RIGHT_PARENTHESIS
token: do        lexical unit: DO
```

Note that the *token* is the matched input string (for instance `b` for the third token) while the *lexical unit* is the name of the matched element from the `LexicalUnit` enumeration (`VARNAME` for the third token).

Also, for the example in Figure 2, the symbol table must be displayed as:

```
Identifiers
a 2
b 3
c 5
```

An example input file with the expected output are available on Moodle to test your program. You will compress your folder (in the *zip* format—no *rar* or other format) and you will submit it on the Université Virtuelle before **October, 30th**. A printed copy of your report only will be handed in to the Secrétariat étudiants (Mrs. Maryka Peetroons, NO8.104) for the same date. You are allowed to work in group of maximum two students.