Logo Parser / Translator

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Class I2a, Group #8

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Table of Contents

[Introduction 2](#_Toc421826714)

[Grammar 3](#_Toc421826715)

[Solution 4](#_Toc421826716)

[REPCOUNT 4](#_Toc421826717)

[Warning: Choice Conflict 4](#_Toc421826718)

[Test 5](#_Toc421826719)

[Limitations 8](#_Toc421826720)

Table of Figures

[Figure 1: square logo file 2](#_Toc421826721)

[Figure 2: result of square logo file 2](#_Toc421826722)

[Figure 3: lovely little house 7](file:///C:\Users\ThS\Documents\fachhochschule\AutLg\13_project\dist\doc\report.docx#_Toc421826723)

# Introduction

We were tasked with writing a parser/translator in JavaCC (Logo.jj), which parses given Logo (\*.logo) source code files matching an EBNF grammar which was provided, and parses it to Java. Which, when executed, drew the described picture in the “.logo” file.

For example:

The “square.logo” file (see figure 1) will be output as beautiful square (see figure 2)

|  |  |
| --- | --- |
| Figure 1: square logo file | Figure 2: result of square logo file |

In order for the parser to successfully interpret and parse the given “.logo” our parser needed to understand the used grammar and commands. Therein lay the challenge of this “mini-project”. For example: Commands like REPEAT :SIDES [ FD :SIZE LT 360/:SIDES ] needed to be understood as well as parsed into a normal Java class as:

for (int i = 1; i <= sides; i++) {

logo.fd(size);

logo.lt(360 / sides);

}

# Grammar

We slightly altered the provided grammar to complete our project. The changes that were made are highlighted in bold.

Program = "LOGO" Identifier { Subroutine } { Statement } "END"

Subroutine = "TO" Identifier { Parameter } { Statement } "END"

Statement = "CS" | "PD" | "PU" | "HT" | "ST"

| "FD" NExpr | "BK" NExpr | "LT" NExpr | "RT" NExpr

| "WAIT" NExpr

| "REPEAT" NExpr "[" { Statement } "]"

| "IF" BExpr "[" { Statement } "]"

| "IFELSE" BExpr "[" { Statement } "]" "[" { Statement } "]"

| Identifier { NExpr }

NExpr = NTerm { ( "+" | "-" ) NTerm }

We eliminated the redundancy in the “NFactor” routine and created a second one called “NFactorPos“

NTerm = NFactor { ( "\*" | "/" ) NFactor }

NFactor = "-" NFactorPos | NFactorPos

**NFactorPos = Number | REPCOUNT | Parameter | "(" NExpr ")"**

BExpr = BTerm { "OR" BTerm }

BTerm = BFactor { "AND" BFactor }

BFactor = "TRUE" | "FALSE" | "NOT" "(" BExpr ")"

| NExpr ( "==" | "!=" | "<" | ">" | "<=" | ">=" ) NExpr

Comments start with "#" with scope until the newline

Numbers are real numbers

Identifiers start with a letter followed by letters or digits

Parameters are ":" followed by Identifier

Identifiers, parameters, keywords in uppercase only

# Solution

We did a quite straightforward implementation by implementing both the parser and the translator combined in one file (Logo.jj). The implementation follows the rules as laid out in the grammar provided.

## REPCOUNT

To implement the REPCOUNT identifier, we directly use the loop counter of the Java for loops.

Whenever we enter a REPEAT body, we increment a depth counter. When leaving it, we decrement it again. This counter can then be used to determine a unique variable name for up to 18 levels (characters i to z).

c = Character.toChars('i' + ++numRepeat)[0];  
// no handling for more than 18 repetition levels

if (c > 'z')

throw new ParseException("No more than " + ('z' - 'i' + 1)  
+ " repetition levels allowed.");

indent();

pw.println("for (int " + c + " = 1; " + c + " <= " + n + ";  
" + c + "++) {");

This variable can then be used to represent the value of the REPCOUNT identifier.

<REPCOUNT> { // use innermost repeat counter

return Character.toString(Character.toChars('i' + numRepeat)[0]);

}

## Warning: Choice Conflict

A choice conflict warning is shown because when calling a subroutine, only the first parameter can be negative. If an additional value starts with a - (minus) it is considered to be part of a numeric expression.

We did not handle this warning because this is a problem with the grammar provided. It is simply impossible to determine the difference between an expression and a negative factor. As long as all whitespace is skipped, we can only pass 0 - <NUM> as a workaround.

# Test

We wrote a “master.logo” file, which tests all the required functions:

# master test program

LOGO MASTER

TO WINDOWRECT :WIDTH :HEIGHT # rectangular window

REPEAT 2 [

FD :HEIGHT

RT 90

FD :WIDTH

RT 90

]

END

TO WINDOWOCTA :LENGTH # octagonal window

REPEAT 8 [

IFELSE NOT (REPCOUNT <= 3 AND REPCOUNT >= 3  
OR REPCOUNT < 8 AND REPCOUNT > 6) [

FD :LENGTH

] [

FD :LENGTH / 2

RT 90

FD :LENGTH / 3

BK :LENGTH / 3

LT 90

FD :LENGTH / 2

]

RT 45

]

END

REPEAT 3 [ # show 'ellipsis' to simulate 'calculation'

FD (REPCOUNT + 1) \* 2.5

PU

FD 5

PD

IF REPCOUNT != 3 OR FALSE [

WAIT 125

]

IF TRUE AND REPCOUNT == 3 [

WAIT 250

CS

]

]

ST # show initial turtle position

HT

PU # move to initial position (bottom-left corner)

FD -150

LT 90

BK 200

PD

FD 300 # draw a simple house

RT 45

FD 212

RT 90

FD 212

RT 45

FD 300

RT 90

FD 300

RT 90

PU # draw door

RT 90

FD 50

LT 90

PD

FD 50

RT 90

FD 25

RT 90

FD 10

BK 10

LT 90

BK 25

LT 90

FD 50

RT 90

FD 50

RT 90

FD 100

PU

LT 90

BK 100

LT 90

PD

PU # draw 'rectangular' windows

RT 90

FD 150

LT 90

FD 50

PD

WINDOWRECT 50 50

PU

RT 90

FD 75

LT 90

PD

WINDOWRECT 25 50

PU

RT 90

FD 25

LT 90

PD

WINDOWRECT 25 50

PU

BK 50

RT 90

BK 150 + 75 + 25

LT 90

PD

PU # draw 'round' window

FD 300 - 25

RT 90

FD 165

RT 180

PD

WINDOWOCTA 30

PU

RT 180

BK 165

LT 90

BK 300 - 25

PD

ST # show final turtle position

END

The result draws a lovely little house (see Figure 3).

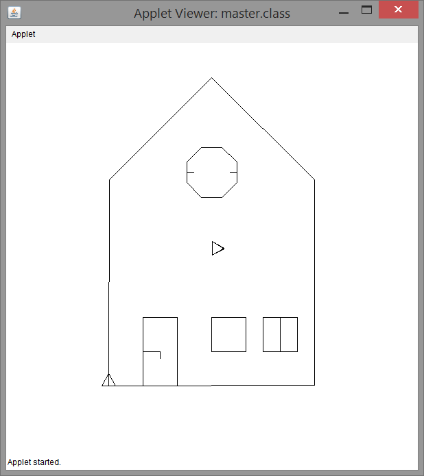


Figure 3: lovely little house

# Limitations

Although our solution works with all of your provided examples and our own (hopefully) complete test program, there are certain limitations to it. As already discussed above, no more than 18 levels of nested REPEATs are supported, which should not significantly limit the solution’s applicability.

As for the software engineering principles, it is clear we do violate some of them: Our Logo.jj file is responsible for both parsing and translating the LOGO files which is not generally desirable. These two different activities should be separated from each other and preferably not (directly) rely on each other.

Also, mixing the code fragments for these two activities in one file significantly reduces extensibility. The JavaCC syntax is already complicated on itself, but including the logic for both parsing and translating the LOGO language files further complicates reading and understanding the code.

In our opinion, the translation should be segregated from the parser by means of abstraction. It should be possible to use the same parser for different tasks. At least translation into multiple target languages should be supported. Ideally, the files should be executed directly, maybe analysed or even optimised and so on.