# COMPILER PROJECT II 2021

The goal of the second term-project is to implement a bottom-up syntax analyzer (a.k.a., parser) as we've learned. More specifically, you will implement the syntax analyzer for a simplified Java programming language with the following context free grammar G;

**CFG G:**

01: CODE → VDECL CODE | FDECL CODE | CDECL CODE| ϵ
02: VDECL → vtype id semi | vtype ASSIGN semi
03: ASSIGN → id assign RHS
04: RHS → EXPR | literal | character | boolstr
05: EXPR → EXPR addsub EXPR | EXPR multdiv EXPR
06: EXPR → lparen EXPR rparen | id | num
07: FDECL → vtype id lparen ARG rparen lbrace BLOCK RETURN rbrace
08: ARG → vtype id MOREARGS | ϵ
09: MOREARGS → comma vtype id MOREARGS | ϵ
10: BLOCK → STMT BLOCK | ϵ
11: STMT → VDECL | ASSIGN semi
12: STMT → if lparen COND rparen lbrace BLOCK rbrace ELSE
13: STMT → while lparen COND rparen lbrace BLOCK rbrace
14: COND → COND comp COND | boolstr
15: ELSE → else lbrace BLOCK rbrace | ϵ
16: RETURN → return RHS semi
17: CDECL → class id lbrace ODECL rbrace
18: ODECL → VDECL ODECL | FDECL ODECL | ϵ

✓ **Terminals (21)**

1. **vtype** for the types of variables and functions
2. **num** for signed integers
3. **character** for a single character
4. **boolstr** for Boolean strings
5. **literal** for literal strings

6. **id** for the identifiers of variables and functions
7. **if, else, while,** and **return** for if, else, while, and return statements respectively
8. **class** for class declarations
9. **addsub** for + and - arithmetic operators
10. **multdiv** for * and / arithmetic operators
11. **assign** for assignment operators
12. **comp** for comparison operators
13. **semi** and **comma** for semicolons and commas respectively
14. **lparen, rparen, lbrace,** and **rbrace** for (, ), {, and } respectively

✓ **Non-terminals (15)**

CODE, VDECL, ASSIGN, RHS, EXPR, FDECL, ARG, MOREARGS, BLOCK, STMT, COND, ELSE, RETURN, CDECL, ODECL

✓ **Start symbol:** CODE

**Descriptions**

✓ The given CFG G is non-left recursive, but **ambiguous**.

✓ Codes include zero or more declarations of functions, variables, and classes (CFG line 1)

✓ Variables are declared with or without initialization (CFG line 2 ~ 3)

✓ The right hand side of assignment operations can be classified into four types; 1) arithmetic operations (expressions), 2) literal strings (CFG line 13), 3) a single character, and 4) Boolean strings (CFG 4)

✓ Arithmetic operations are the combinations of +, -, *, / operators (CFG line 5 ~ 7)

✓ Functions can have zero or more input arguments (CFG line 8 ~ 10)

✓ Function blocks include zero or more statements (CFG line 11)

✓ There are four types of statements: 1) variable declarations, 2) assignment operations, 3) if-else statements, and 4) while statements (CFG line 12 ~ 14)

- ✓ if and while statements include a conditional operation which consists of Boolean strings and an condition operator (CFG line 13 ~ 15)
- ✓ if statements can be used with or without an else statement (CFG line 13 & 16)
- ✓ return statements return 1) the computation result of arithmetic operations, 2) literal strings, 3) a single character, or 4) Boolean strings (CFG line 17)
- ✓ class is declared with zero or more declarations of functions and variables (CFG line 18 ~ 19)

Based on this CFG, you should implement a bottom-up parser as follows:

- ✓ Discard an ambiguity in the CFG
- ✓ Construct a SLR parsing table for the non-ambiguous CFG through the following website: http://jsmachines.sourceforge.net/machines/slr.html
- ✓ Implement a SLR parsing program for the simplified Java programming language by using the constructed table.

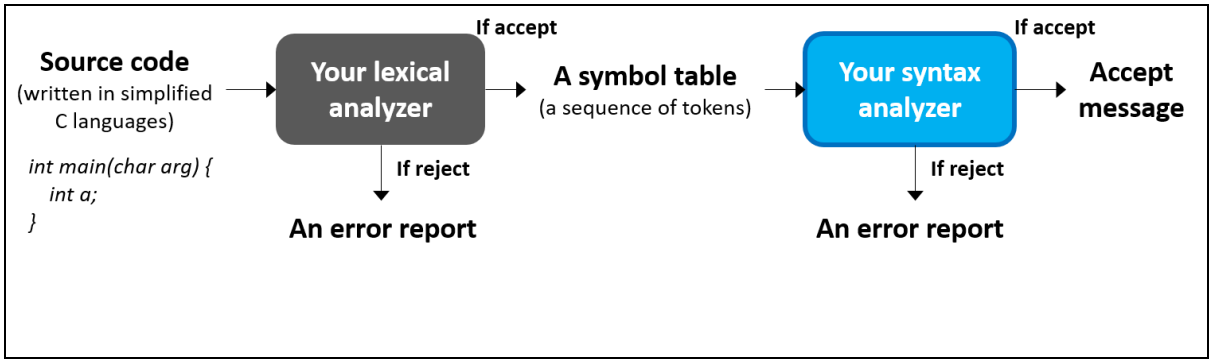
For the implementation, you can use C, C++, JAVA, or Python as you want. However, your syntax analyzer must run on Linux or Unix-like OS without any error.

**Your syntax analyzer should work as follows:**

- ✓ **The execution flow of your syntax analyzer:**

  lexical_analyzer <input_file_name>

  syntax_analyzer <output_of_your_lexical_analyzer>
- ✓ **Input:** An output of your lexical analyzer program
- ✓ **Output:** just an acceptance message
  - ■ (If an output is "reject") please make an error report which explains why and where the error occurred (e.g., line number)




**Term-project schedule and submission**

- ✓ **Deadline: 6/5, 23:59 (through an e-class system)**
  - For a delayed submission, you will lose 0.1 * your original project score per each delayed day
- ✓ Submission file: team_<your_team_number>.zip or .tar.gz
  - The compressed file should contain
    - The source code of **your syntax and lexical analyzer** with detailed comments
    - The executable binary file of **your syntax analyzer + lexical analyzer**
    - Documentation (the most important thing!)
      - It must include 1) your non-ambiguous CFG G and 2) your SLR parsing table
      - It must also include any change in the CFG G and all about how your syntax analyzer works for validating token sequences (for example, overall procedures, implementation details like algorithms and data structures, working examples, and so on)
    - Test input files and outputs which you used in this project
      - The test input files are not given. You should make the test files, by yourself, which can examine all the syntax grammars.
- ✓ If there exist any error in the given CFG, please send an e-mail to hskimhello@cau.ac.kr