Synthetic : Grammar Checking

Credit

Synthetic is built upon the works of `ezaquraii` , with his beautiful work for Flex, GNU Bison integration and the ability to change file streams to make testing go by MUCH faster. If this project did not exist, we would not be here at this point. Here is the link to the original work, all other work is original.

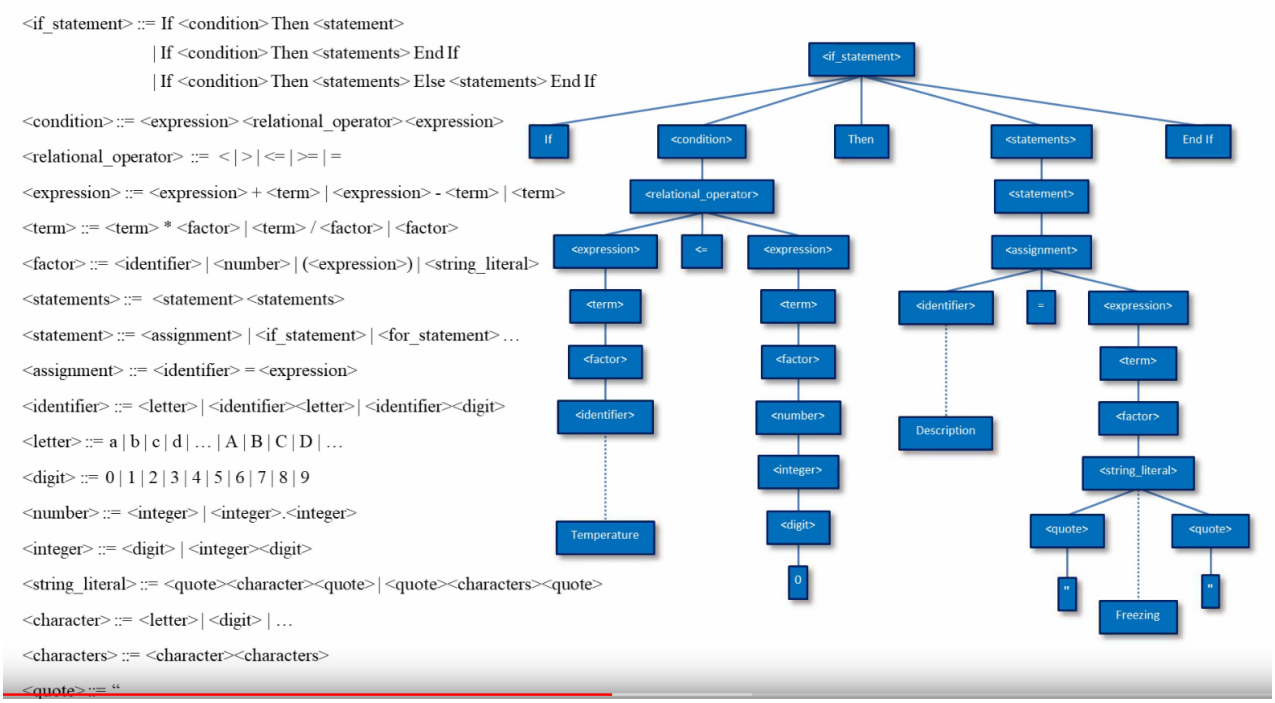
NOTES AND CAVEATS

- Given that there are so many different parse trees for each individual grammar rule, GNU Bison was used to generate these trees.
- Since this project is so interlaced with Flex (Fast Lexer), the use of `lexi` , our previous lexer build could not be used.
- Even though we did not write the parse trees by hand, the learning curve for this component was....dense to say the least

TODO

- [ ] Parse tree for simple example
- [ ] Diagrams of the program flow
- [ ] LaTeX rendition
- [ ] Note that each statement is a rule provided by the *statements* rule, it is recursively defined to encompass one or more repetitions!
  - [ ] Optional Tokens
  - [ ] More than one
  - [ ] TL;DR : Bison is a LALR parser, therefore cannot support extended BNF
  - [ ] Also I am sleep deprived so please ask me what the absolute $@$@ I was thinking during this time of writing...English sucks
- [ ] Variable retrieval for addition, subtraction, multiplication, division
- [ ] We used GNU Bison for parse tree generation

- [ ] Redirect all `std::cout` produced in `yylex` in `src/parser.y` to another filestream
- [ ] More intermediate code generation



Types

- `bool`
- `long long int`
- `float`

Rules

- `assignment`
- `statements -> statement`
  - `if_statement`
  - `for_statement`
  - `while_statement`

Process

- source file read in

- Gets lexxed (Flex) -> probably MUCH faster than lexi
- token stream is fed into GNU Bison
- Token stream is then checked against grammar rules (GNU Bison) -> semantical analysis can be completed here too
- AST Generated for object code generation and further semantic analysis
- All tests can be found in `inputs/`

Control Flow

If Else Branching

Notation:

```
<if_statement> ::= IF <condition> THEN <statement>
                   | IF <condition> THEN <statements> ENDIF
                   | IF <condition> THEN <statements> ELSE <statement> ENDIF
```

Example code:

```
! Depth one (do the parse tree of this one for simplicitity) !

if (1 < 2) then
    int v = 100;
endif


! Depth two or more statements (recursive) !

if (1 < 2) then
    int v = 100;
    int c = 1000;
else
    int v = 1000;
endif

! Nested if's !

if (1 > 100) then
    if (100 > 99) then
        int val = 10;
        int c = 100;
    endif
endif
```

```
! Nested if's with other statements !

if(1 > 100) then
    int value = 100;
    int another = 1000;
else
    if (100 < 0) then
        int something = 10;
    endif
    int another = 1000;
endif

! if condition with literal true and false !

if (true) then
    int value = 100;
endif

if (false) then
    int value = 100;
endif
```

While Loop

Notation:

```
while_condition ::= WHILE condition statements WHILEEND
                    | DO statement WHILE condition DOEND
                    | DO statements WHILE condition DOEND
```

Example code:

```
! Traditional while loop that makes no sense (infinite loop)!

while (1 < 2)
    int value = 100;
whileend

! Do while loop that is absolutely fuckered !

do
  int value = 1;
while (1 < 2)
doend
```

For Loop

Notation:

```
for_statement ::= FOR LEFTPAR PRIMITIVE_TYPE ID ASSIGN expression SEMICOLON
                  | FOR LEFTPAR PRIMITIVE_TYPE ID ASSIGN expression SEMICOL(
```

Example code:

```
for (int i = 0; i < 10; i++)
    int first = 0;
    for (int i = 0; i < 10; i++)
        int second = 0;
    forend
forend
```

```
for (int i = 0; i < 10; ++i)
    int first = 0;
    for (int i = 0; i < 10; ++i)
        int second = 0;
    forend
forend
```

```
for (int i = 0; i < 10; --i)
    int first = 0;
    for (int i = 0; i < 10; --i)
        int second = 0;
    forend
forend
```

Statements

Addition and Subtraction

Notation:

```
expression ::= <expression> + <expression>
               | <expression> - <expression>
               | <term>
```

Example code:

```
! Evaluates to 2 !
1 + 1
(1 + 1)

(3232 + 213322)
```

Note

- expression is defined as a long long int, therefore operations only work for non floating point numbers.
- The symbol table is a string -> float, so converting long long int (unsigned 64 bit integer) to float loses no information

Multiplication and Division

Notation:

```
term := <term> * <factor>
        | <term> / <factor>
        | <factor>
```

Example code:

```
5 * 10 * 80
(5 * 9 * 190)
int value = 1 * 2 * 3;
int another = 1 / 3 / 3;
value = 1 / 2;
another = 1 * 10;
! Currently variable retrieval is broken therefore this would thrown an erro
a * 10
```

Assignment

Notation:

```
assignment : PRIMITIVE_TYPE ID SEMICOLON
             | PRIMITIVE_TYPE ID ASSIGN expression SEMICOLON
             | ID ASSIGN expression SEMICOLON
```

```
              | PRIMITIVE_TYPE ID ASSIGN term SEMICOLON
              | ID ASSIGN term SEMICOLON
```

Example code:

```
int value = 1 * 2 * 3;
int another = 1 / 3 / 3;
value = 1 / 2;
another = 1 * 10;
```

Note:

- recursively defined as a statement too
- therefore can be used in mutliple lines of statements