Compiler Term Project

(Syntax Analyzer)

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Date	2021.06.05

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A. CFG

0) Given CFG (non-left recursive but ambiguous)

01: CODE → VDECL CODE | FDECL CODE | CDECL CODE | ∈

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 | ∈

09: MOREARGS → comma vtype id MOREARGS | ∈

10: BLOCK → STMT BLOCK | ∈

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 | ∈

16: RETURN → return RHS semi

17: CDECL → class id lbrace ODECL rbrace

18: ODECL → VDECL ODECL | FDECL ODECL | ∈

1) Our CFG (non-ambiguous)

01: CODE → VDECL CODE | FDECL CODE | CDECL CODE | ∈

02: VDECL → vtype id semi | vtype ASSIGN semi

03: ASSIGN → id assign RHS

04: RHS → EXPR | literal | character | boolstr

05: EXPR → TERM addsub EXPR | TERM

06: TERM → FACTOR multdiv TERM | FACTOR

07: FACTOR → lparen EXPR rparen | id | num

08: FDECL → vtype id lparen ARG rparen lbrace BLOCK RETURN rbrace

09: ARG → vtype id MOREARGS | ∈

10: MOREARGS → comma vtype id MOREARGS | ∈

11: BLOCK → STMT BLOCK | ∈

12: STMT → VDECL | ASSIGN semi

13: STMT → if lparen COND rparen lbrace BLOCK rbrace ELSE

14: STMT → while lparen COND rparen lbrace BLOCK rbrace

15: COND → COND' comp COND | COND'

16: COND' → boolstr

17: ELSE → else lbrace BLOCK rbrace | ∈

18: RETURN → return RHS semi

19: CDECL → class id lbrace ODECL rbrace

20: ODECL → VDECL ODECL | FDECL ODECL | ϵ

B. SLR parsing table

Through our newly defined CFG which is non-ambiguous we constructed SLR parsing table at website : (SLR Parser Generator (sourceforge.net)).

[Input]

CODE' -> CODE

CODE -> VDECL CODE

CODE -> FDECL CODE

CODE -> CDECL CODE

CODE -> ''

VDECL -> vtype id semi

VDECL -> vtype ASSIGN semi

ASSIGN -> id assign RHS

RHS -> EXPR

RHS -> literal

RHS -> character

RHS -> boolstr

EXPR -> TERM addsub EXPR

EXPR -> TERM

TERM -> FACTOR multdiv TERM

TERM -> FACTOR

FACTOR -> lparen EXPR rparen

FACTOR -> id

FACTOR -> num

FDECL -> vtype id lparen ARG rparen lbrace BLOCK RETURN rbrace

ARG -> vtype id MOREARGS

ARG -> ''

MOREARGS -> comma vtype id MOREARGS

MOREARGS -> ''

BLOCK -> STMT BLOCK

BLOCK -> ''

STMT -> VDECL

STMT -> ASSIGN semi

STMT -> if lparen COND rparen lbrace BLOCK rbrace ELSE

STMT -> while lparen COND rparen lbrace BLOCK rbrace

COND -> COND' comp COND

COND -> COND'

COND' -> boolstr

ELSE -> else lbrace BLOCK rbrace

ELSE -> ''

RETURN -> return RHS semi

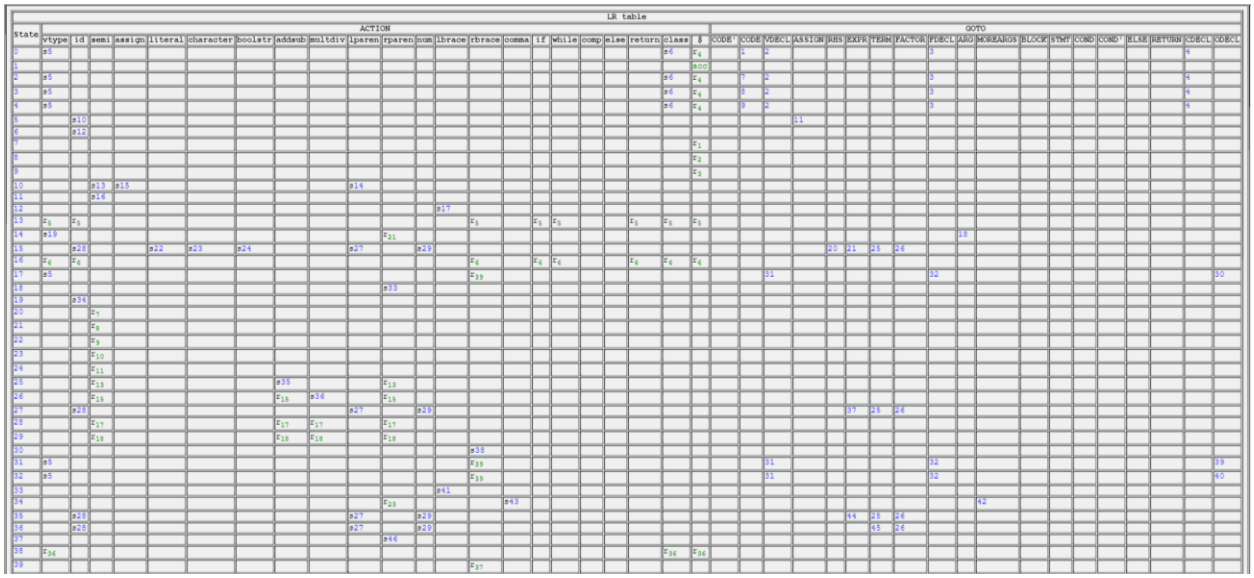
CDECL -> class id lbrace ODECL rbrace

ODECL -> VDECL ODECL

ODECL -> FDECL ODECL

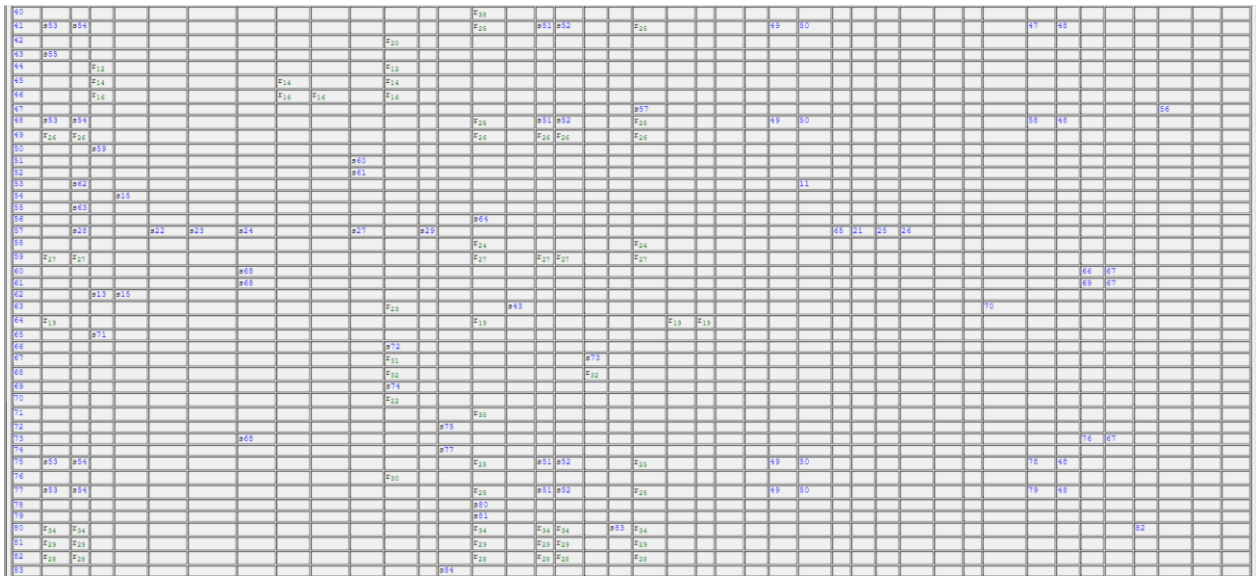
ODECL -> ''

[Output]

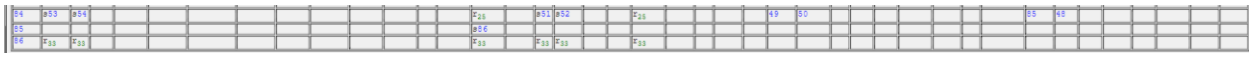


LR table

State	ACTION																				GOTO														
	vtype	id	semi	assign	literal	character	boolstr	addsub	multdiv	lparen	rparen	num	lbrace	rbrace	comma	if	while	comp	else	return	class	$	CODE'	CODE	VDECL	ASSIGN	RHS	EXPR	TERM	FACTOR	FDECL	ARG	MOREARGS	BLOCK	STMT	COND	COND'	ELSE	RETURN	CDECL	ODECL
0	s5																			r6	r4		1	2						3									4	
1																					acc																				
2	s5																			r6	r4		7	2						3									4	
3	s5																			r6	r4		8	2						3									4	
4	s5																			r6	r4		9	2						3									4	
5		s10																			r1					11															
6		s12																			r2																				
7																					r3																				
8																																								
9																																								
10			s13	s15						s14																															
11			s16																																						
12													s17																												
13	r5	r5												r5		r5	r5			r5	r5	r5																			
14	s19										r21																					18										
15		s28			s22	s23	s24			s27		s29															20	21	25	26												
16	r6	r6												r6		r6	r6			r6	r6	r6																			
17	s5													r39												31					32										30
18											s33																														
19		s34																																							
20			r7																																						
21			r8																																						
22			r9																																						
23			r10																																						
24			r11																																						
25			r13					s35			r13																														
26			r15					r15	s36		r15																														
27		s28								s27		s29															37	25	26												
28			r17					r17	r17		r17																														
29			r18					r18	r18		r18																														
30														r38																											
31	s5													r39												31					32										39
32	s5													r39												31					32										40
33													s41																												
34											r23				s43																		s42								
35		s28								s27		s29															44	25	26												
36		s28								s27		s29																45	26												
37											s46																														
38	r36																			r36	r34																			
39														r37																											



40														r30																											
41	s53	s54												r25		s51	s52			r25					49	50									47	48					
42											r20																														
43	s55																																								
44			r12								r12																														
45			r14					r14			r14																														
46			r16					r16	r16		r16																														
47																				s57																			r56		
48	s53	s54												r26		s51	s52			r26					49	50									58	48					
49	r26	r26												r26		r26	r26			r26																					
50			s59																																						
51										s60																															
52										s61																															
53		s62																								11															
54				s15																																					
55		s63																																							
56														r64																											
57		s28			s22	s23	s24			s27		s29															r65	r21	r25	r26												
58														r24						r24																					
59	r27	r27												r27		r27	r27			r27																					
60							s65																															r66	r67			
61							s68																															r69	r67			
62			s13	s15																																					
63											r23				s43																s70										
64	r19													r19							r19	r19																			
65			s71																																						
66											r72																														
67											r31							s73																							
68											r32							r32																							
69											s74																														
70											r22																														
71														r35																											
72													s75																												
73							s65																															r76	r67			
74													s77																												
75	s53	s54												r25		s51	s52			r25					49	50									78	48					
76											r30																														
77	s53	s54												r25		s51	s52			r25					49	50									79	48					
78														r80																											
79														r81																											
80	r34	r34												r34		r34	r34		s83	r34																			r82		
81	r29	r29												r29		r29	r29			r29																					
82	r28	r28												r28		r28	r28			r28																					
83													s84																												



84	s53	s54												r25		s51	s52			r25					49	50									85	48					
85														r26																												
86	r33	r33												r33		r33	r33			r33																						

C. Code Implementation

1) lexical_analyzer.py (Revised)

```
40              if token == '$':                                # finish when meeting end of string
41                  break
```

[Line 40~41]

: Case for end symbol ($) is added to finish lexical analyzing.

2) SLR.py

```
class SLRGrammar:
    def __init__(self, grammar):
        self.grammar = grammar
```

Class for CFG is defined. Our non-ambiguous CFG is added in form of 2D-list at self.grammar.

```
class SLRTable:
    def __init__(self, action, goto):
        self.action = action
        self.goto = goto
```

Class for SLR parsing table is defined. We used the table through website : (SLR Parser Generator (sourceforge.net)) (image of SLR parsing table is at ***B. SLR parsing table.***) We used two variables for action table and goto table.

```
slr_grammar = SLRGrammar([["CODE'", 'CODE'],
                          ['CODE', 'VDECL CODE'],
                          ['CODE', 'FDECL CODE'],
                          ['CODE', 'CDECL CODE'],
                          ['CODE', ''],
                          ['VDECL', 'VTYPE ID SEMI'],
                          ['VDECL', 'VTYPE GOTO_ASSIGN SEMI'],
                          ['GOTO_ASSIGN', 'ID ASSIGN RHS'],
                          ['RHS', 'EXPR'],
                          ['RHS', 'STRING'],
                          ['RHS', 'CHAR'],
                          ['RHS', 'BOOL'],
                          ['EXPR', 'TERM ADDSUB EXPR'],
                          ['EXPR', 'TERM'],
                          ['TERM', 'FACTOR MULTDIV TERM'],
                          ['TERM', 'FACTOR'],
                          ['FACTOR', 'LPAREN EXPR RPAREN'],
                          ['FACTOR', 'ID'],
                          ['FACTOR', 'INTEGER'],
                          ['FDECL', 'VTYPE ID LPAREN ARG RPAREN LBRACE BLOCK GOTO_RETURN RBRACE'],
                          ['ARG', 'VTYPE ID MOREARGS'],
                          ['ARG', ''],
                          ['MOREARGS', 'COMMA VTYPE ID MOREARGS'],
                          ['MOREARGS', ''],
                          ['BLOCK', 'STMT BLOCK'],
                          ['BLOCK', ''],
                          ['STMT', 'VDECL'],
                          ['STMT', 'GOTO_ASSIGN SEMI'],
                          ['STMT', 'IF LPAREN COND RPAREN LBRACE BLOCK RBRACE GOTO_ELSE'],
                          ['STMT', 'WHILE LPAREN COND RPAREN LBRACE BLOCK RBRACE'],
                          ['COND', "COND' COMP COND"],
                          ['COND', "COND'"],
                          ["COND'", 'BOOL'],
                          ['GOTO_ELSE', 'ELSE LBRACE BLOCK RBRACE'],
                          ['GOTO_ELSE', ''],
                          ['GOTO_RETURN', 'RETURN RHS SEMI'],
                          ['CDECL', 'CLASS ID LBRACE ODECL RBRACE'],
                          ['ODECL', 'VDECL ODECL'],
                          ['ODECL', 'FDECL ODECL'],
                          ['ODECL', '']])
```

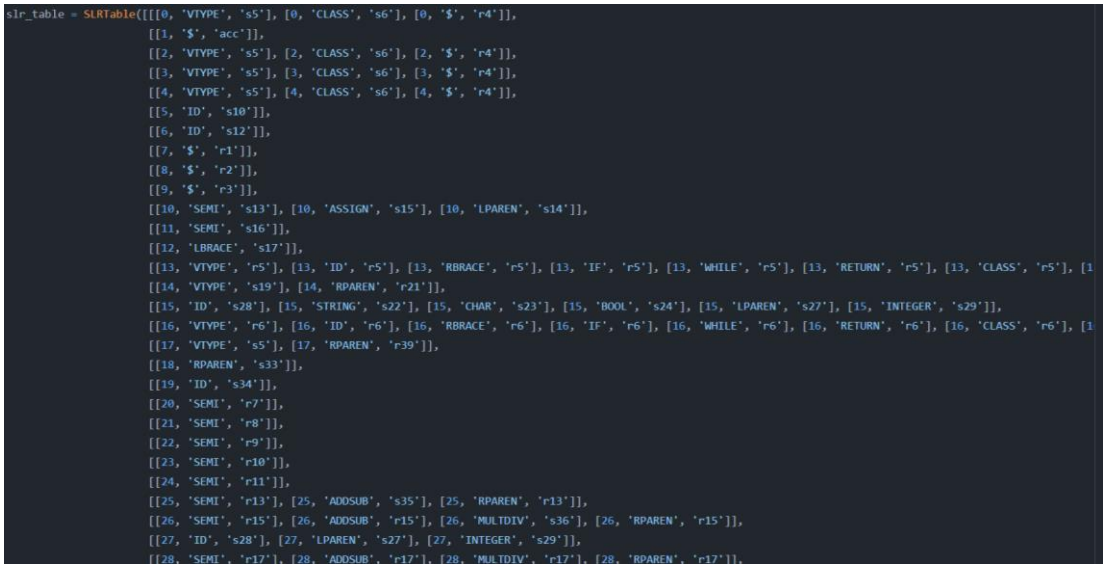
Our CFG is added in form of 2D list. Derivation and derivative are initialized as string value.

(※ ASSIGN, ELSE, RETURN non-terminal are included in both action table and goto table. Thus we named GOTO_ASSIGN, GOTO_ELSE, GOTO_RETURN for goto table non-terminals and ASSIGN, ELSE, RETURN for action table non-terminals.)

Form : [['Derivation', 'Derivative']]

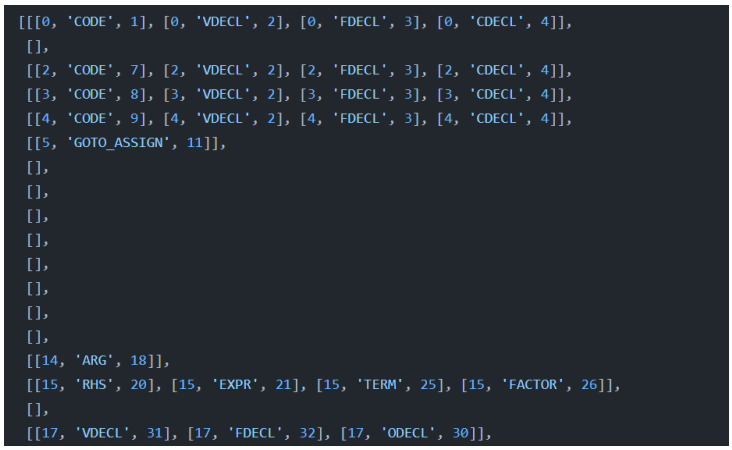
EX) CODE -> CDECL CODE : [['CODE', 'CDECL CODE']]

CODE -> ε : [['CODE', '']]



```
slr_table = SLRTable([[[0, 'VTYPE', 's5'], [0, 'CLASS', 's6'], [0, '$', 'r4']],
                      [[1, '$', 'acc']],
                      [[2, 'VTYPE', 's5'], [2, 'CLASS', 's6'], [2, '$', 'r4']],
                      [[3, 'VTYPE', 's5'], [3, 'CLASS', 's6'], [3, '$', 'r4']],
                      [[4, 'VTYPE', 's5'], [4, 'CLASS', 's6'], [4, '$', 'r4']],
                      [[5, 'ID', 's10']],
                      [[6, 'ID', 's12']],
                      [[7, '$', 'r1']],
                      [[8, '$', 'r2']],
                      [[9, '$', 'r3']],
                      [[10, 'SEMI', 's13'], [10, 'ASSIGN', 's15'], [10, 'LPAREN', 's14']],
                      [[11, 'SEMI', 's16']],
                      [[12, 'LBRACE', 's17']],
                      [[13, 'VTYPE', 'r5'], [13, 'ID', 'r5'], [13, 'RBRACE', 'r5'], [13, 'IF', 'r5'], [13, 'WHILE', 'r5'], [13, 'RETURN', 'r5'], [13, 'CLASS', 'r5'], [1
                      [[14, 'VTYPE', 's19'], [14, 'RPAREN', 'r21']],
                      [[15, 'ID', 's28'], [15, 'STRING', 's22'], [15, 'CHAR', 's23'], [15, 'BOOL', 's24'], [15, 'LPAREN', 's27'], [15, 'INTEGER', 's29']],
                      [[16, 'VTYPE', 'r6'], [16, 'ID', 'r6'], [16, 'RBRACE', 'r6'], [16, 'IF', 'r6'], [16, 'WHILE', 'r6'], [16, 'RETURN', 'r6'], [16, 'CLASS', 'r6'], [1
                      [[17, 'VTYPE', 's5'], [17, 'RPAREN', 'r39']],
                      [[18, 'RPAREN', 's33']],
                      [[19, 'ID', 's34']],
                      [[20, 'SEMI', 'r7']],
                      [[21, 'SEMI', 'r8']],
                      [[22, 'SEMI', 'r9']],
                      [[23, 'SEMI', 'r10']],
                      [[24, 'SEMI', 'r11']],
                      [[25, 'SEMI', 'r13'], [25, 'ADDSUB', 's35'], [25, 'RPAREN', 'r13']],
                      [[26, 'SEMI', 'r15'], [26, 'ADDSUB', 'r15'], [26, 'MULTDIV', 's36'], [26, 'RPAREN', 'r15']],
                      [[27, 'ID', 's28'], [27, 'LPAREN', 's27'], [27, 'INTEGER', 's29']],
                      [[28, 'SEMI', 'r17'], [28, 'ADDSUB', 'r17'], [28, 'MULTDIV', 'r17'], [28, 'RPAREN', 'r17']],
```

SLR parsing table (Action table)



```
[[[0, 'CODE', 1], [0, 'VDECL', 2], [0, 'FDECL', 3], [0, 'CDECL', 4]],
 [],
 [[2, 'CODE', 7], [2, 'VDECL', 2], [2, 'FDECL', 3], [2, 'CDECL', 4]],
 [[3, 'CODE', 8], [3, 'VDECL', 2], [3, 'FDECL', 3], [3, 'CDECL', 4]],
 [[4, 'CODE', 9], [4, 'VDECL', 2], [4, 'FDECL', 3], [4, 'CDECL', 4]],
 [[5, 'GOTO_ASSIGN', 11]],
 [],
 [],
 [],
 [],
 [],
 [],
 [],
 [],
 [[14, 'ARG', 18]],
 [[15, 'RHS', 20], [15, 'EXPR', 21], [15, 'TERM', 25], [15, 'FACTOR', 26]],
 [],
 [[17, 'VDECL', 31], [17, 'FDECL', 32], [17, 'ODECL', 30]],
```

SLR parsing table (Goto table)

SLR parsing table has lots of value so we captured it partially. We used 3D list to initialize value of SLRTable.

Action table Form : [[[State_num, 'State', 'Action']]]

EX)

State	
	vtype
0	s5

: [[[0, 'VTYPE', 's5']]]

Goto table Form : [[[State_num, 'State', goto_state]]]

EX) (row at state '0')

GOTO		
FDECL	ARG	MORE
3		

: [[[0, 'FDECL', 3]]]

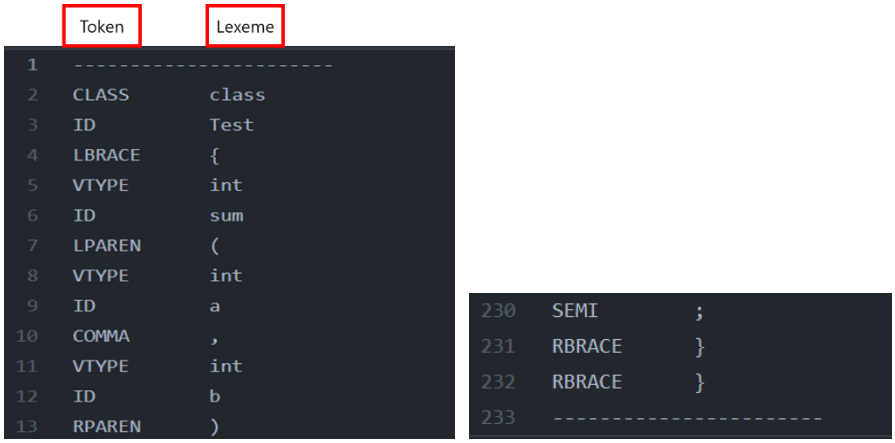
3) syntax_analyzer.py

```
import argparse
from SLR import *


def syntax_analyzer(data):
    data = data.split()                         # split output of lexical analyzer by blank and reset to analyze easier
    del data[-1]
    data.append('$')
    data.append('$')
    index = 1                                   # initialize index of starting token
    state_stack = [0]                           # stack that stores states and last element is current state
    left_substring = []                         # store left substring that already shifted before
    while True:
        if data[index] == 'OP':                 # distinguish +, - and *, / operators
            if data[index + 1] == '+' or data[index + 1] == '-':
                data[index] = 'ADDSUB'
            else:
                data[index] = 'MULTDIV'
        for action in slr_table.action[state_stack[-1]]:
            if data[index] == action[1]:                # find action corresponding to terminal value
                if action[2][0] == 's':                 # shift and goto decision
                    state_stack.append(int(action[2][1:]))
                    left_substring.append(data[index])
                    index += 2
                elif action[2][0] == 'r':               # reduce decision
                    for non_terminal in reversed(slr_grammar.grammar[int(action[2][1:])][1].split()):
                        if non_terminal == left_substring[-1]:
                            del left_substring[-1]
                            state_stack.pop()
                        else:
                            print(f"There's no goto at state {state_stack[-1]} for {left_substring}")
                            return
                    left_substring.append(slr_grammar.grammar[int(action[2][1:])][0])
                    for goto in slr_table.goto[state_stack[-1]]:        # find goto corresponding to non-terminal value
                        if left_substring[-1] == goto[1]:
                            state_stack.append(goto[2])
                else:
                    print("Accept")
                    return
                break
        else:
            print("reject")
            print(f"There's no action at state {state_stack[-1]} for {data[index]}")
            return


parser = argparse.ArgumentParser()
parser.add_argument("input_file_name", help="file name of your input code")
args = parser.parse_args()
fr = open(args.input_file_name, 'r')
lexical_output = fr.read()
syntax_analyzer(lexical_output)
```

```
5   def syntax_analyzer(data):
6       data = data.split()                    # split output of lexical analyzer by blank and reset to analyze easier
7       del data[-1]
8       data.append('$')
9       data.append('$')
10      index = 1                              # initialize index of starting token
11      state_stack = [0]                      # stack that stores states and last element is current state
12      left_substring = []                    # store left substring that already shifted before
```

Syntax_analyzer function gets ***data*** argument, a result of ***lexical_analyzer.py***.

First, let's see example of ***lexical_analyzer.py*** result.



This is result of lexical_analyzer.py. Therefore if we use data.split() data will have following value.

data[0] = ----------

data[1] = CLASS

data[2] = class

data[3] = ID

data[4] = Test

……..

data[-1] = ----------

Therefore, we deleted value at data[-1] at line 7.

Then we appended '$' twice, one for token and one for lexeme.

Finally we initialized index variable, stack list, which will be used for bottom-up parsing, and left substring list.

```
13      while True:
14          if data[index] == 'OP':                 # distinguish +, - and *, / operators
15              if data[index + 1] == '+' or data[index + 1] == '-':
16                  data[index] = 'ADDSUB'
17              else:
18                  data[index] = 'MULTDIV'
```

Now we start bottom-up parsing from line 13. First, we check whether token is 'OP' or not. Our lexical analyzer determines every +, -, *, / operators as 'OP'. Therefore, we need additional process to distinguish +,- operator and *,/ operator to determine operator priority. To do this, after 'OP' is checked, we check lexeme value(data[index+1]) to distinguish whether it is 'ADDSUB' or 'MULTDIV'.

```
19          for action in slr_table.action[state_stack[-1]]:
20              if data[index] == action[1]:                # find action corresponding to terminal value
21                  if action[2][0] == 's':                 # shift and goto decision
22                      state_stack.append(int(action[2][1:]))
23                      left_substring.append(data[index])
24                      index += 2
25                  elif action[2][0] == 'r':               # reduce decision
26                      for non_terminal in reversed(slr_grammar.grammar[int(action[2][1:])][1].split()):
27                          if non_terminal == left_substring[-1]:
28                              del left_substring[-1]
29                              state_stack.pop()
30                          else:
31                              print(f"There's no goto at state {state_stack[-1]} for {left_substring}")
32                              return
33                      left_substring.append(slr_grammar.grammar[int(action[2][1:])][0])
34                      for goto in slr_table.goto[state_stack[-1]]:        # find goto corresponding to non-terminal value
35                          if left_substring[-1] == goto[1]:
36                              state_stack.append(goto[2])
37                  else:
38                      print("Accept")
39                      return
40                  break
41          else:
42              print("reject")
43              print(f"There's no action at state {state_stack[-1]} for {data[index]}")
44              return
```

[Line 19~44]

We check the last value of state_stack list and find it at slr_table's action table.
At first, state_stack[-1] is 0, so it checks state 0 of action table.

[Line 20~40]

If data[index] value (terminal value) is same with action[1], such as `[0, 'VTYPE', 's5']` this value, we check action[2][0] `[0, 'VTYPE', 's5']` to determine whether to shift or reduce.

[Line 21~24]

If a[2][0] is 's', it means 'shift'. Therefore we append a[2][1] `[0, 'VTYPE', 's5']` at state_stack list and append current token at left_substring list. Then increase index value by 2 to skip current lexeme and check next token.

[Line 25~36]

If a[2][0] is 'r', it means 'reduce'. Therefore we get value of int(action[2][1:]) `[20, 'SEMI', 'r7']` and check slr_grammar.grammar[int(action[2][1:])][1].split(), derivatives of CFG such as `['CODE', 'VDECL CODE'],`.

[Line 27~29]

If last value of left substring is in chosen derivatives, we delete last value of left substring and pop value of state stack. This process will be repeated as the length of derivatives.

[Line 30~32]

If last value of left substring are not in chosen derivatives, it prints error report that there are no corresponding states and stops parsing.

[Line 33]

Finally we append the reduced non-terminal value such as `['CODE', 'VDECL CODE'],`.

[Line 34~36]

Finally we check goto table at state_stack's last value and check if last value of left_substring is in goto[1] such as `[0, 'CODE', 1]`. And if it is true we append the value of goto[2] such as `[0, 'CODE', 1]` at state_stack list.

[Line 37~39]

If action[2][0] is neither 's' or 'r', it means case such as `[1, '$', 'acc']` which means "Accept".

[Line 41~44]

If there is no corresponding action table, it prints reject error.

D. Result Screenshots

[Every possible test case without any error]

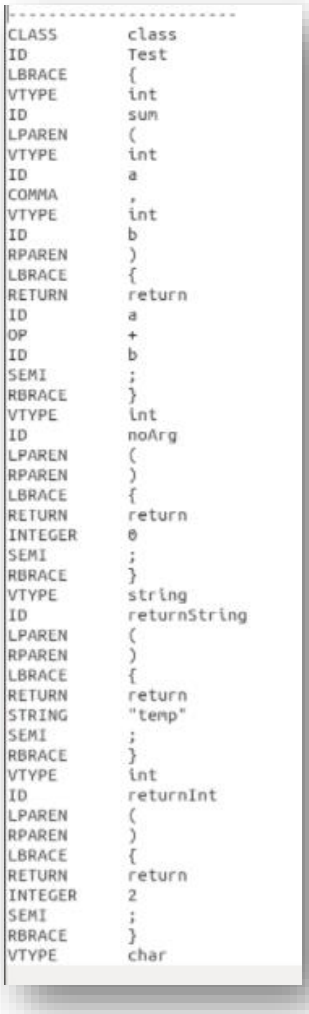
Command Line

```
os161@ubuntu:~/compiler_term_project/compiler-main$ python3 lexical_analyzer.py input.txt
os161@ubuntu:~/compiler_term_project/compiler-main$ python3 syntax_analyzer.py input.txt_output.txt
Accept
```

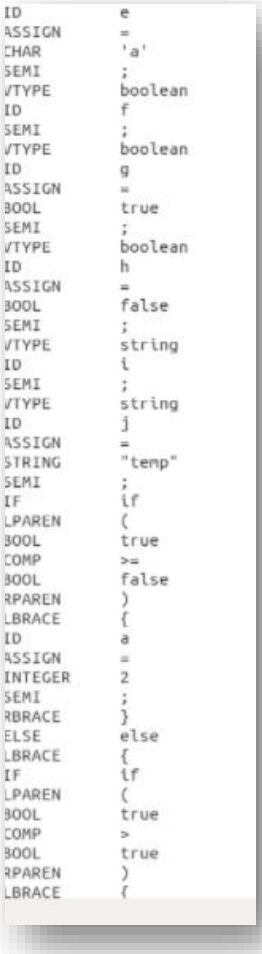
Input File (Input.txt)

```
class Test {
    int sum(int a, int b) {
        return a+b;
    }
    int noArg(){
        return 0;
    }
    string returnString(){
        return "temp";
    }
    int returnInt(){
        return 2;
    }
    char returnChar(){
        return 'a';
    }
    boolean returnTrue(){
        return true;
    }
    boolean returnFalse(){
        return false;
    }


    int main(string s) {
        int a = 3;
        int b = 4;
        int c;
        char d;
        char e = 'a';
        boolean f;
        boolean g = true;
        boolean h = false;
        string i;
        string j = "temp";
        if (true >= false){
           a = 2;
        }
        else{
            if(true > true){
                b=3;
            }
            else{

            }
        }

        if(true==false){
        }
        if(true!=false){
        }
        if(true<false){
        }
        if(true<=false){
        }
        c = a+b;
        c = a-b;
        c = a/b;
        c = a*b;
        while(true){

        }
        while(false<true){
            c = 2;
        }

        return 'a';
    }
}
```

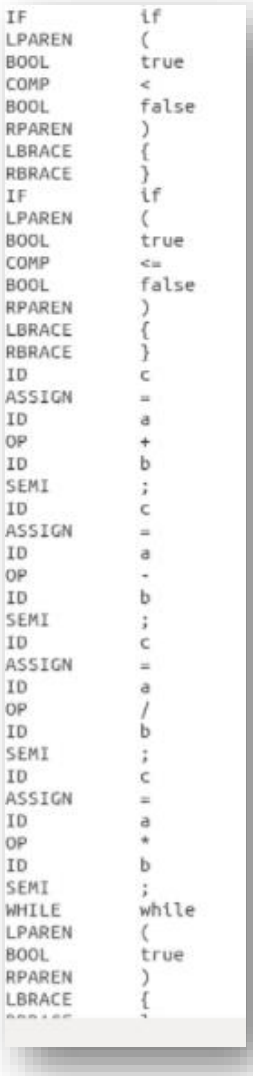
Output File (input.txt_output.txt)



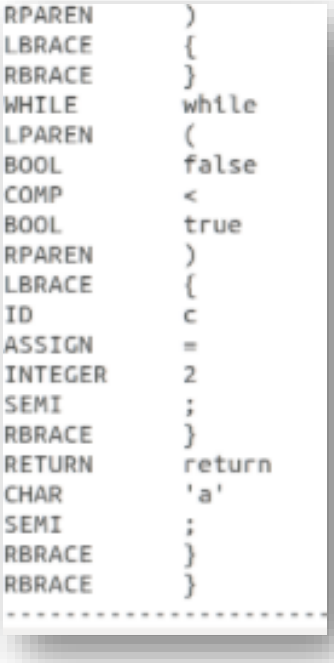
```
----------------------
CLASS       class
ID          Test
LBRACE      {
VTYPE       int
ID          sum
LPAREN      (
VTYPE       int
ID          a
COMMA       ,
VTYPE       int
ID          b
RPAREN      )
LBRACE      {
RETURN      return
ID          a
OP          +
ID          b
SEMI        ;
RBRACE      }
VTYPE       int
ID          noArg
LPAREN      (
RPAREN      )
LBRACE      {
RETURN      return
INTEGER     0
SEMI        ;
RBRACE      }
VTYPE       string
ID          returnString
LPAREN      (
RPAREN      )
LBRACE      {
RETURN      return
STRING      "temp"
SEMI        ;
RBRACE      }
VTYPE       int
ID          returnInt
LPAREN      (
RPAREN      )
LBRACE      {
RETURN      return
INTEGER     2
SEMI        ;
RBRACE      }
VTYPE       char
```



```
ID          e
ASSIGN      =
CHAR        'a'
SEMI        ;
VTYPE       boolean
ID          f
SEMI        ;
VTYPE       boolean
ID          g
ASSIGN      =
BOOL        true
SEMI        ;
VTYPE       boolean
ID          h
ASSIGN      =
BOOL        false
SEMI        ;
VTYPE       string
ID          i
SEMI        ;
VTYPE       string
ID          j
ASSIGN      =
STRING      "temp"
SEMI        ;
IF          if
LPAREN      (
BOOL        true
COMP        >=
BOOL        false
RPAREN      )
LBRACE      {
ID          a
ASSIGN      =
INTEGER     2
SEMI        ;
RBRACE      }
ELSE        else
LBRACE      {
IF          if
LPAREN      (
BOOL        true
COMP        >
BOOL        true
RPAREN      )
LBRACE      {
```



```
IF          if
LPAREN      (
BOOL        true
COMP        <
BOOL        false
RPAREN      )
LBRACE      {
RBRACE      }
IF          if
LPAREN      (
BOOL        true
COMP        <=
BOOL        false
RPAREN      )
LBRACE      {
RBRACE      }
ID          c
ASSIGN      =
ID          a
OP          +
ID          b
SEMI        ;
ID          c
ASSIGN      =
ID          a
OP          -
ID          b
SEMI        ;
ID          c
ASSIGN      =
ID          a
OP          /
ID          b
SEMI        ;
ID          c
ASSIGN      =
ID          a
OP          *
ID          b
SEMI        ;
WHILE       while
LPAREN      (
BOOL        true
RPAREN      )
LBRACE      {
```


RPAREN)
LBRACE {
RBRACE }
WHILE while
LPAREN (
BOOL false
COMP <
BOOL true
RPAREN)
LBRACE {
ID c
ASSIGN =
INTEGER 2
SEMI ;
RBRACE }
RETURN return
CHAR 'a'
SEMI ;
RBRACE }
RBRACE }

[Input with an error]

Command Line

```
os161@ubuntu:~/compiler_term_project/compiler-main$ python3 lexical_analyzer.py wrong_input.txt
os161@ubuntu:~/compiler_term_project/compiler-main$ python3 syntax_analyzer.py wrong_input.txt_output.txt
reject
There's no action at state 41 for BOOL
```

Input File (input.txt)

```
int main(){
    false = false+1;
    }
```

Output File (input.txt_output.txt)

```
-----------------------
VTYPE       int
ID          main
LPAREN      (
RPAREN      )
LBRACE      {
BOOL        false
ASSIGN      =
BOOL        false
OP          +
INTEGER     1
SEMI        ;
RBRACE      }
-----------------------
```