9..Write a program using LEX Tool, to implement a lexical analyzer for parts of speech for given English language without a Symbol table.

INPUT

Dread it. Run from it.

Destiny arrives all the same.

code:

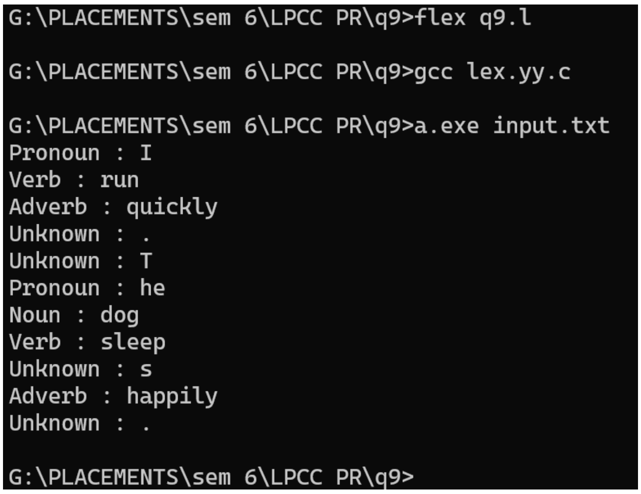
```
%{

%}

%%

"run"|"walk"|"eat"|"sleep" { printf("Verb : %s\n", yytext); }

"I"|"you"|"he"|"she"|"it"|"we"|"they" { printf("Pronoun : %s\n", yytext); }

"quickly"|"slowly"|"happily"|"sadly" { printf("Adverb : %s\n", yytext); }

"dog"|"cat"|"car"|"tree" { printf("Noun : %s\n", yytext); }

[\n\t ]+ { /* Ignore whitespace, newline, tab */ }

. { printf("Unknown : %s\n", yytext); }

%%

int yywrap() {

   return 1;

}

int main(int argc, char *argv[]) {

   ++argv, --argc;  /* skip over program name */

   if (argc > 0)

      yyin = fopen(argv[0], "r");

   else

      yyin = stdin;

   yylex();

}
```

STEPS TO RUN:

flex your_file_name.l

gcc lex.yy.c -o lexer -lfl

./lexer input.txt



```
G:\PLACEMENTS\sem 6\LPCC PR\q9>flex q9.l

G:\PLACEMENTS\sem 6\LPCC PR\q9>gcc lex.yy.c

G:\PLACEMENTS\sem 6\LPCC PR\q9>a.exe input.txt
Pronoun : I
Verb : run
Adverb : quickly
Unknown : .
Unknown : T
Pronoun : he
Noun : dog
Verb : sleep
Unknown : s
Adverb : happily
Unknown : .

G:\PLACEMENTS\sem 6\LPCC PR\q9>
```

10. Write a program using LEX Tool, to implement a lexical analyzer for given C programming language without Symbol table.

INPUT

```
{

int m=10,n=2,o;

o = m – n;

}
```

```
%{

#include <stdio.h>

%}

%option noyywrap

%%

"{"                    { printf("LEFT_BRACE\n"); }

"}"                    { printf("RIGHT_BRACE\n"); }

"int"                  { printf("INT_KEYWORD\n"); }

";"                   { printf("SEMICOLON\n"); }

[ \t]                 ; /* Skip whitespace */

\n                    ; /* Skip newline */

[a-zA-Z_][a-zA-Z0-9_]* { printf("IDENTIFIER\n"); }

[0-9]+                 { printf("NUMBER\n"); }

"+"                    { printf("PLUS\n"); }

"-"                   { printf("MINUS\n"); }

"="                    { printf("EQUALS\n"); }

","                   { printf("COMMA\n"); }

.                    ; /* Ignore other characters */

%%

int main() {

   yylex();

   return 0;

}
```

11. Write a program using LEX Tool, to implement a lexical analyzer for given C programming language without Symbol table.

INPUT

```
{
int a=3;
int b=4;
float c;
c = (a*a + b*b) *2
}
```

```
%{
#include <stdio.h>
%}
%option noyywrap
%%
"{"                 { printf("LEFT_BRACE\n"); }
"}"                 { printf("RIGHT_BRACE\n"); }
"int"               { printf("INT_KEYWORD\n"); }
"float"             { printf("FLOAT_KEYWORD\n"); }
";"                 { printf("SEMICOLON\n"); }
"="                 { printf("ASSIGNMENT\n"); }
"("                 { printf("LEFT_PAREN\n"); }
")"                 { printf("RIGHT_PAREN\n"); }
"*"                 { printf("MULTIPLICATION\n"); }
"+"                 { printf("ADDITION\n"); }
[ \t]               ; /* Skip whitespace */
\n                  ; /* Skip newline */
[a-zA-Z_][a-zA-Z0-9_]* { printf("IDENTIFIER\n"); }
[0-9]+              { printf("NUMBER\n"); }
","                 { printf("COMMA\n"); }
.                   ; /* Ignore other characters */
%%
int main() {
   yylex();
   return 0;
}
```

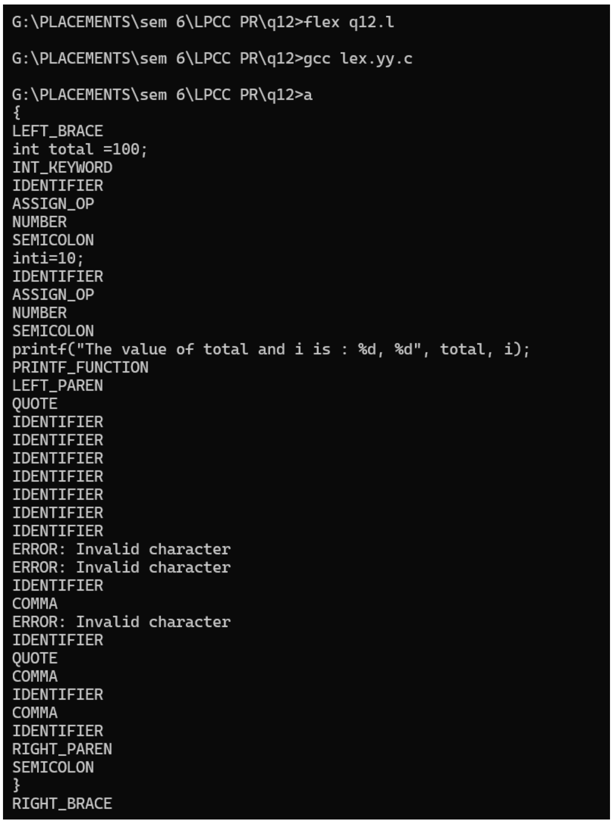
12. Write a program using LEX Tool, to implement a lexical analyzer for given C programming language without Symbol table.

INPUT

```
{
int total =100;
inti=10;
printf("The value of total and i is : %d, %d", total, i);

}
```

COde:

```
%{

#include <stdio.h>

%}

DIGIT [0-9]

LETTER [a-zA-Z]

%%

"int"       { printf("INT_KEYWORD\n"); }

"printf"    { printf("PRINTF_FUNCTION\n"); }

"="         { printf("ASSIGN_OP\n"); }

";"         { printf("SEMICOLON\n"); }

","         { printf("COMMA\n"); }

"\""        { printf("QUOTE\n"); }

"("         { printf("LEFT_PAREN\n"); }

")"         { printf("RIGHT_PAREN\n"); }

"{"         { printf("LEFT_BRACE\n"); }

"}"         { printf("RIGHT_BRACE\n"); }

{LETTER}({LETTER}|{DIGIT})*    { printf("IDENTIFIER\n"); }

{DIGIT}+    { printf("NUMBER\n"); }

[ \t\n]     ;  // skip whitespace and newlines

.           { printf("ERROR: Invalid character\n"); }

%%

int main() {

   yylex();

   return 0;

}
```



```
G:\PLACEMENTS\sem 6\LPCC PR\q12>flex q12.l

G:\PLACEMENTS\sem 6\LPCC PR\q12>gcc lex.yy.c

G:\PLACEMENTS\sem 6\LPCC PR\q12>a
{
LEFT_BRACE
int total =100;
INT_KEYWORD
IDENTIFIER
ASSIGN_OP
NUMBER
SEMICOLON
inti=10;
IDENTIFIER
ASSIGN_OP
NUMBER
SEMICOLON
printf("The value of total and i is : %d, %d", total, i);
PRINTF_FUNCTION
LEFT_PAREN
QUOTE
IDENTIFIER
IDENTIFIER
IDENTIFIER
IDENTIFIER
IDENTIFIER
IDENTIFIER
IDENTIFIER
ERROR: Invalid character
ERROR: Invalid character
IDENTIFIER
COMMA
ERROR: Invalid character
IDENTIFIER
QUOTE
COMMA
IDENTIFIER
COMMA
IDENTIFIER
RIGHT_PAREN
SEMICOLON
}
RIGHT_BRACE
```

13. Write a program to evaluate a given arithmetic expression using YACC specification.

INPUT

```
    0.33*12-4-4+(3*2)
```

final code:

LEX:

```
%{
#include "q13.tab.h"  // Include Bison-generated header for YYSTYPE and token types
%}

%%

[0-9]+(\.[0-9]+)? {
   yylval.val = atof(yytext);  // Assign the atof result to the union member 'val'
   return NUMBER;
}

[ \t]+ ;  // Ignore spaces and tabs
\n      { return 0; }  // Return 0 on a newline to signal the end of input
.      { return yytext[0]; }  // Return any other character as itself

%%

int yywrap() {
   return 1;
}
```

YACC:

```
%{
#include <stdio.h>
#include <stdlib.h>
void yyerror(const char *s);
int yylex(void);
%}

%union {
   double val;  // Define a union member for double values
}

%token <val> NUMBER  // Specify that NUMBER carries a double
%type <val> E  // The non-terminal E also returns a double

%left '+' '-'
%left '*' '/'
%left '(' ')'

%%

ArithmeticExpression:
   E { printf("\nResult = %.2f\n", $1); return 0; }
   ;

E:
   E '+' E { $$ = $1 + $3; }
```

```
 | E '-' E { $$ = $1 - $3; }
 | E '*' E { $$ = $1 * $3; }
 | E '/' E { if ($3 == 0.0) { yyerror("Division by zero"); $$ = 0.0; } else { $$ = $1 / $3; } }
 | '(' E ')' { $$ = $2; }
 | NUMBER   { $$ = $1; }
 ;

%%

void yyerror(const char *s) {
    fprintf(stderr, "Error: %s\n", s);
}

int main() {
    printf("\nEnter an Arithmetic Expression (e.g., 2.5 + 3.2 * 5):\n");
    if (!yyparse())
        printf("\nThe arithmetic expression is valid.\n");
    else
        printf("\nInvalid expression.\n");
    return 0;
}
```

commands:

```
flex calc.l
bison -d calc.y
gcc lex.yy.c calc.tab.c
./a.exe
```

14. Write a program to evaluate a given variable name using YACC specification.

SAMPLE INPUT

1) pune
2) PUNE
3) Pune1
4) pUNE_2

LEX:

```
%{
#include "varname.tab.h"
#include <string.h> // Include for strdup function
%}

%%

[a-zA-Z_][a-zA-Z0-9_]* {
   yylval.str = strdup(yytext); // Copy string to pass to Bison
   return IDENTIFIER;
}
[ \t]+ ; // Ignore spaces and tabs
\n     { return EOL; } // End of line, to process input
.     { return yytext[0]; } // Catch-all for any other character

%%

int yywrap() {
   return 1;
}
```

YACC:

```
%{
#include <stdio.h>
#include <stdlib.h>
void yyerror(const char *s);
int yylex(void);
%}

%union {
   char* str; // For storing strings
}

%token <str> IDENTIFIER
%token EOL

%%

input:
      | input line
      ;

line: IDENTIFIER EOL { printf("%s is a valid variable name.\n", $1); free($1); }
    | EOL
    | error EOL { yyerror("Invalid variable name."); }
    ;

%%

void yyerror(const char *s) {
    fprintf(stderr, "Error: %s\n", s);
}

int main() {
    printf("Enter variable names, one per line:\n");
    yyparse();
    return 0;
}
```

commands:

```
flex varname.l
bison -d varname.y
gcc lex.yy.c varname.tab.c
 ./a.exe
```

15. Write a program to evaluate a given built-in function using YACC specification.

INPUT

1.u= sqrt(36)

2. v = strlen(“pune”)

LEX:

```
%{
#include "functions.tab.h"
#include <stdlib.h>
#include <string.h>
%}
%option noyywrap
%%
[0-9]+      { yylval.ival = atoi(yytext); return NUMBER; }
\"[^\"]*\"  { yylval.sval = strdup(yytext); return STRING; }
"sqrt"      { return SQRT; }
"strlen"    { return STRLEN; }
"="         { return '='; }
[ \t\n]+    { /* ignore whitespace */ }
.           { return yytext[0]; }
%%
```

YACC:

```

%{
#include <stdio.h>
#include <math.h>
#include <string.h>
extern int yylex();
void yyerror(const char *s) { fprintf(stderr, "%s\n", s); }
%}


%union {
    int ival;
    char *sval;
}

%token <sval> STRING
%token <ival> NUMBER SQRT STRLEN
%type <ival> expr function
%type <sval> var

%%
program:
    program statement
    |
    ;

statement:
    var '=' expr { printf("%s = %d\n", $1, $3); }
    ;

var:
    'u' { $$ = strdup("u"); }
    | 'v' { $$ = strdup("v"); }
    ;

expr:
    function
    ;

function:
    SQRT '(' NUMBER ')' { $$ = (int) sqrt($3); }
    | STRLEN '(' STRING ')' { $$ = strlen($3) - 2; /* Subtract 2 for the quotes */ }
    ;
```

```
%%


int main(void) {
    printf("Enter expressions like 'u = sqrt(36)' or 'v = strlen(\"pune\")':\n");
    return yyparse();
}
```

commands:

```
flex functions.l
bison -d functions.y
gcc lex.yy.c functions.tab.c
./a.exe
```

16. Write a program to evaluate a given built-in function using YACC specification.

INPUT

u= sin(12)+cos(12)

LEX:

filename: lexer.l

Code:

```
%{

#include "lexer.tab.h" // make sure this matches your Bison-generated header

#include <math.h>

#include <string.h>

%}


%option noyywrap

%option yylineno


%%


[uU][a-zA-Z_]*          { yylval.var = strdup(yytext); return VARIABLE; }

[0-9]+(\.[0-9]+)?       { yylval.num = atof(yytext); return NUMBER; }

"sin"                   { return SIN; }

"cos"                   { return COS; }

"+"                     { return PLUS; }

"-"                     { return MINUS; }

"*"                     { return TIMES; }

"/"                     { return DIVIDE; }

"("                     { return LPAREN; }

")"                     { return RPAREN; }

"="                     { return EQUALS; }
```

```
";"                   { return SEMICOLON; }
[ \t]+                ; // Ignore whitespace
.                   { return yytext[0]; } // Handle other characters

%%
```

YACC:

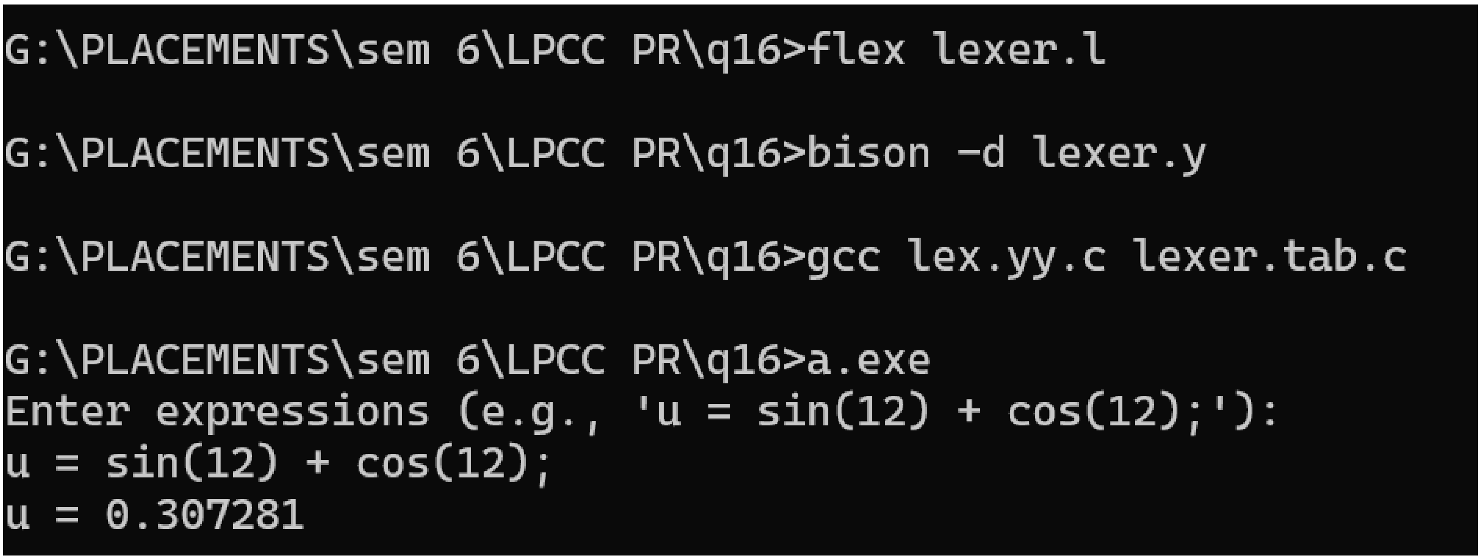
file name: lexer.y

Code:

```
%{
#include <stdio.h>
#include <stdlib.h>
#include <math.h>        // Include for math functions
#include "lexer.tab.h"   // Ensure this is the header generated by Flex

void yyerror(const char *s);
int yylex(void);
extern int yylineno;    // External declaration if using %option yylineno in Flex

double vars[256];       // Simple variable storage based on ASCII index
%}

%union {
    double num;         // For numerical values
    char* var;          // For variable names
}

%token <var> VARIABLE
%token <num> NUMBER
```

```
%token SIN COS
%token PLUS MINUS TIMES DIVIDE
%token LPAREN RPAREN
%token EQUALS SEMICOLON

%type <num> expression term factor
%type <var> assignment

%%
input:
     | input line
     ;

line:
     assignment SEMICOLON { printf("%s = %f\n", $1, vars[$1[0]]); }
   | error SEMICOLON      { yyerror("syntax error"); }
   ;

assignment:
     VARIABLE EQUALS expression { vars[$1[0]] = $3; $$ = $1; }
   ;

expression:
     expression PLUS term   { $$ = $1 + $3; }
   | expression MINUS term  { $$ = $1 - $3; }
   | term                   { $$ = $1; }
   ;

term:
     term TIMES factor      { $$ = $1 * $3; }
   | term DIVIDE factor     { $$ = $1 / $3; }
```

```
    | factor                { $$ = $1; }
    ;

factor:
      NUMBER                { $$ = $1; }
    | VARIABLE              { $$ = vars[$1[0]]; }
    | LPAREN expression RPAREN { $$ = $2; }
    | SIN LPAREN expression RPAREN { $$ = sin($3); }
    | COS LPAREN expression RPAREN { $$ = cos($3); }
    ;

%%
void yyerror(const char *s) {
    fprintf(stderr, "Error near line %d: %s\n", yylineno, s);
}

int main(void) {
    printf("Enter expressions (e.g., 'u = sin(12) + cos(12);'):\n");
    yyparse();
    return 0;
}
```



```
G:\PLACEMENTS\sem 6\LPCC PR\q16>flex lexer.l

G:\PLACEMENTS\sem 6\LPCC PR\q16>bison -d lexer.y

G:\PLACEMENTS\sem 6\LPCC PR\q16>gcc lex.yy.c lexer.tab.c

G:\PLACEMENTS\sem 6\LPCC PR\q16>a.exe
Enter expressions (e.g., 'u = sin(12) + cos(12);'):
u = sin(12) + cos(12);
u = 0.307281
```

17. Write a program to evaluate a given built-in function using YACC specification.

INPUT

p= pow(3,2) / log (24);

lex:

filename: q17.l

code:

```
%{
#include "q17.tab.h"
#include <math.h>
#include <string.h>
extern void yyerror(const char *);
%}

%option noyywrap

%%

[ \t\n]+                { /* Ignore whitespace */ }
[a-zA-Z_][a-zA-Z0-9_]*    {
   if (strcmp(yytext, "pow") == 0) return POW;
   if (strcmp(yytext, "log") == 0) return LOG;
   yylval.str = strdup(yytext);
   return IDENTIFIER;
}
[0-9]+(\.[0-9]+)?        { yylval.num = atof(yytext); return NUMBER; }
"="                     { return '='; }
";"                     { return ';'; }
"("                     { return '('; }
")"                     { return ')'; }
```

```
","                    { return ','; }
"+"                     { return '+'; }
"-"                    { return '-'; }
""                    { return ''; }
"/"                    { return '/'; }
.                    { yyerror("Invalid character"); }

%%
```

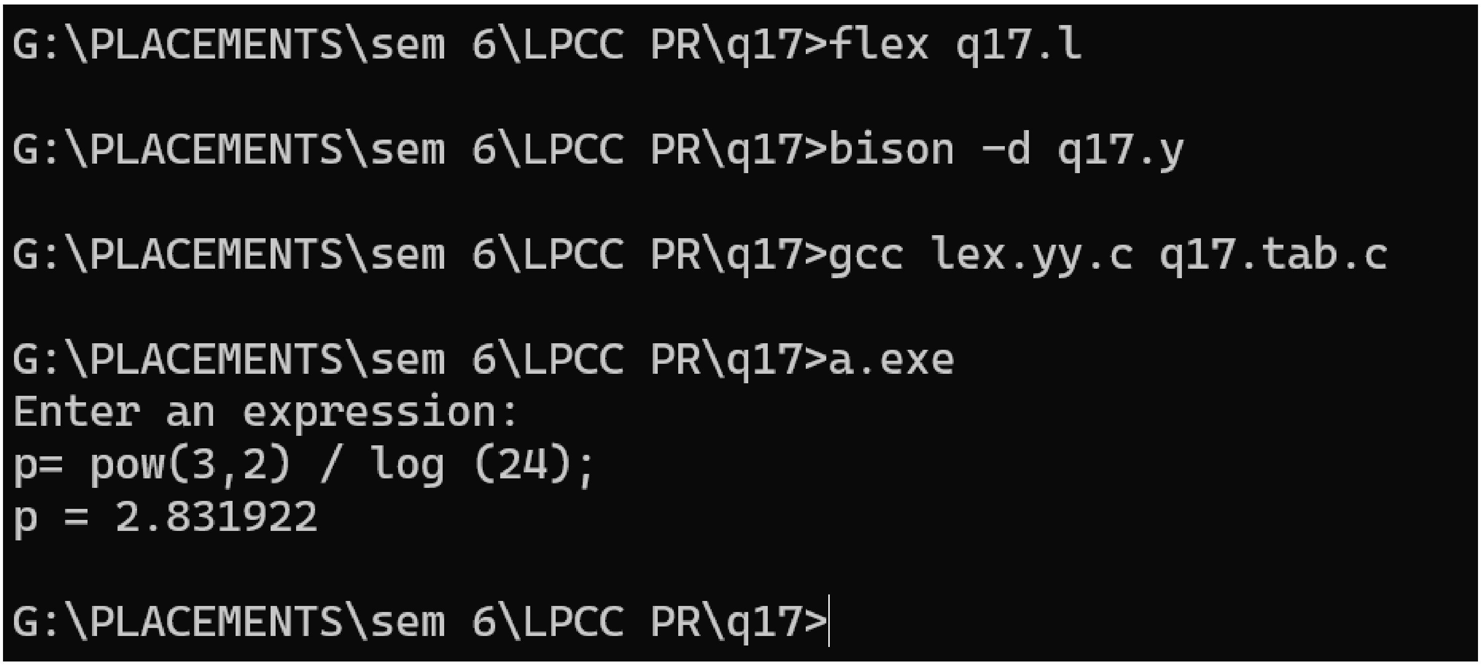
yacc:

filename: q17.y

code:

```
%{
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include <string.h>

void yyerror(const char *s);
extern int yylex();
%}

%union {
    double num;        // For numerical values
    char* str;         // For string values (e.g., identifiers)
}

%token <str> IDENTIFIER
```

```
%token <num> NUMBER
%token POW LOG
%type <num> expr     // Expressions return a numeric value
%type <num> statement  // Statements return a numeric value (for expression statements)

%left '+' '-'
%left '*' '/'
%right NEG

%%

program:
    | program statement
    ;

statement:
      expr ';' { printf("Result = %lf\n", $1); }
    | IDENTIFIER '=' expr ';' {
        printf("%s = %lf\n", $1, $3);
        free($1);
    }
    ;

expr:
      NUMBER                    { $$ = $1; }
    | IDENTIFIER                { printf("Variable [%s] used, but not defined in this scope.\n", $1); free($1); $$ = 0; }
    | expr '+' expr           { $$ = $1 + $3; }
    | expr '-' expr           { $$ = $1 - $3; }
    | expr '*' expr           { $$ = $1 * $3; }
    | expr '/' expr           { $$ = $1 / $3; }
    | '-' expr %prec NEG       { $$ = -$2; }
    | '(' expr ')'            { $$ = $2; }

    | POW '(' expr ',' expr ')' { $$ = pow($3, $5); }

    | LOG '(' expr ')'        { $$ = log($3); }

    ;


%%


void yyerror(const char *s) {

    fprintf(stderr, "Error: %s\n", s);

}


int main(void) {

    printf("Enter an expression:\n");

    yyparse();

    return 0;

}
```



```
G:\PLACEMENTS\sem 6\LPCC PR\q17>flex q17.l

G:\PLACEMENTS\sem 6\LPCC PR\q17>bison -d q17.y

G:\PLACEMENTS\sem 6\LPCC PR\q17>gcc lex.yy.c q17.tab.c

G:\PLACEMENTS\sem 6\LPCC PR\q17>a.exe
Enter an expression:
p= pow(3,2) / log (24);
p = 2.831922

G:\PLACEMENTS\sem 6\LPCC PR\q17>
```

1. Write a program to generate a Symbol table of a two-pass Assembler for the given Assembly language source code.

INPUT/CODE

```
         START 180
         READ M
         READ N
LOOP      MOVER AREG, M
          MOVER BREG, N
         COMP BREG, =’200’
          BC GT, LOOP
BACK SUB AREG, M
      COMP AREG, =’500’
          BC  LT, BACK
         STOP
M         DS      1
N         DS      1
          END
```

2. Write a program to generate a Literal table of a two-pass Assembler for the given Assembly language source code.

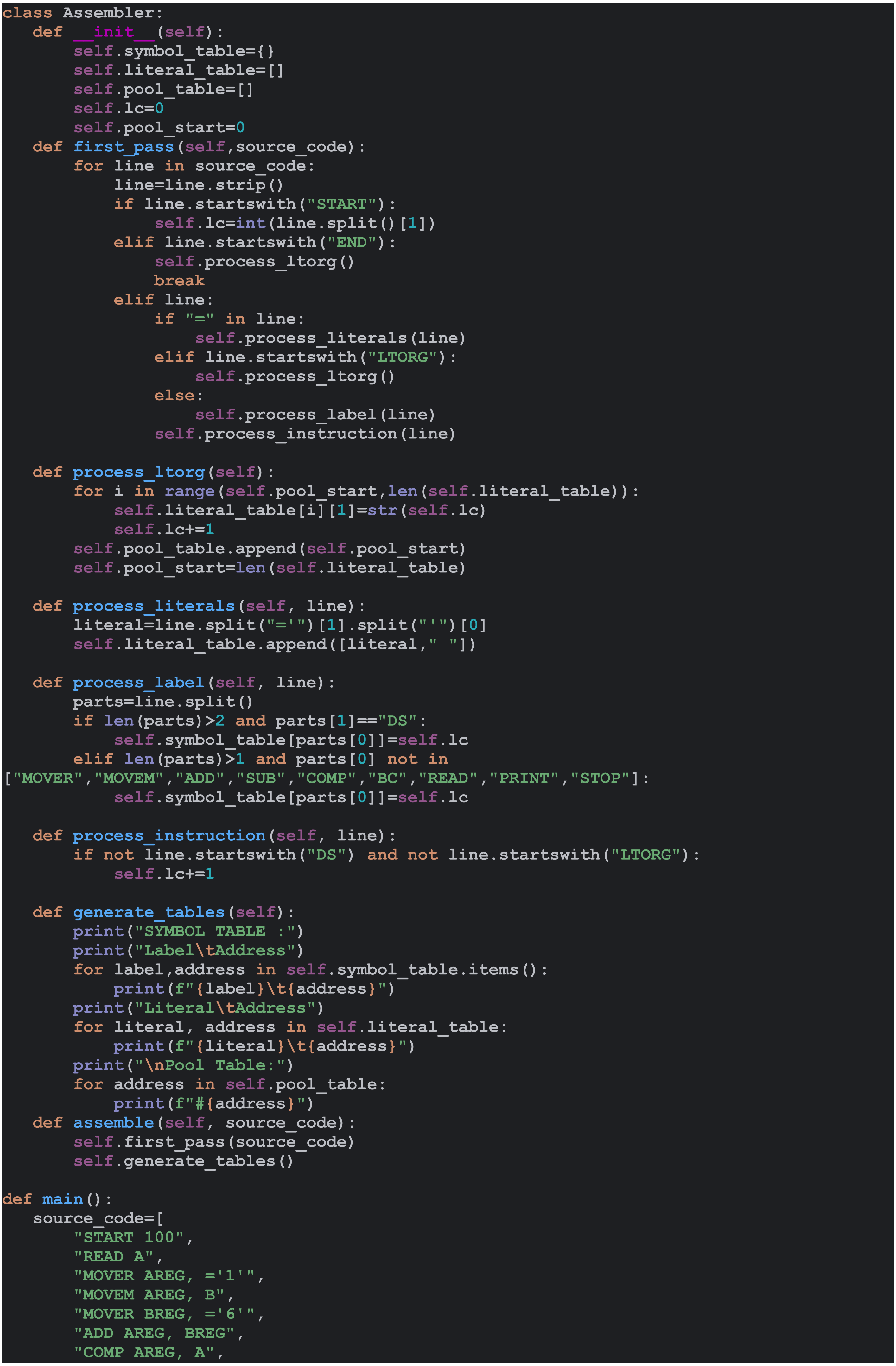
INPUT/CODE

```
        START 100
                READ A
                READ B
        MOVER AREG, =’50'
                MOVER BREG, =’60’
            ADD AREG, BREG
LOOP    MOVER CREG, A
                ADD  CREG, ='10'
                COMP CREG, B
                BC LT, LOOP
NEXT    SUB AREG, ='10'
                COMP AREG, B
                BC  GT, NEXT
                STOP
A               DS       1
B               DS       1
                END
```

3.Write a program to generate a Pool table of a two-pass Assembler for the given Assembly language source code.

INPUT/CODE

```
                START 100
                READ A
        MOVER AREG, ='1'
                MOVEM AREG, B
                MOVER BREG, ='6'
                ADD AREG, BREG
                COMP AREG, A
                BC GT, LAST
                LTORG
  NEXT SUB AREG, ='1'
                MOVER CREG, B
                ADD   CREG, ='8'
            MOVEM CREG, B
            PRINT B
LAST      STOP
        A       DS      1
        B       DS      1
                END
```

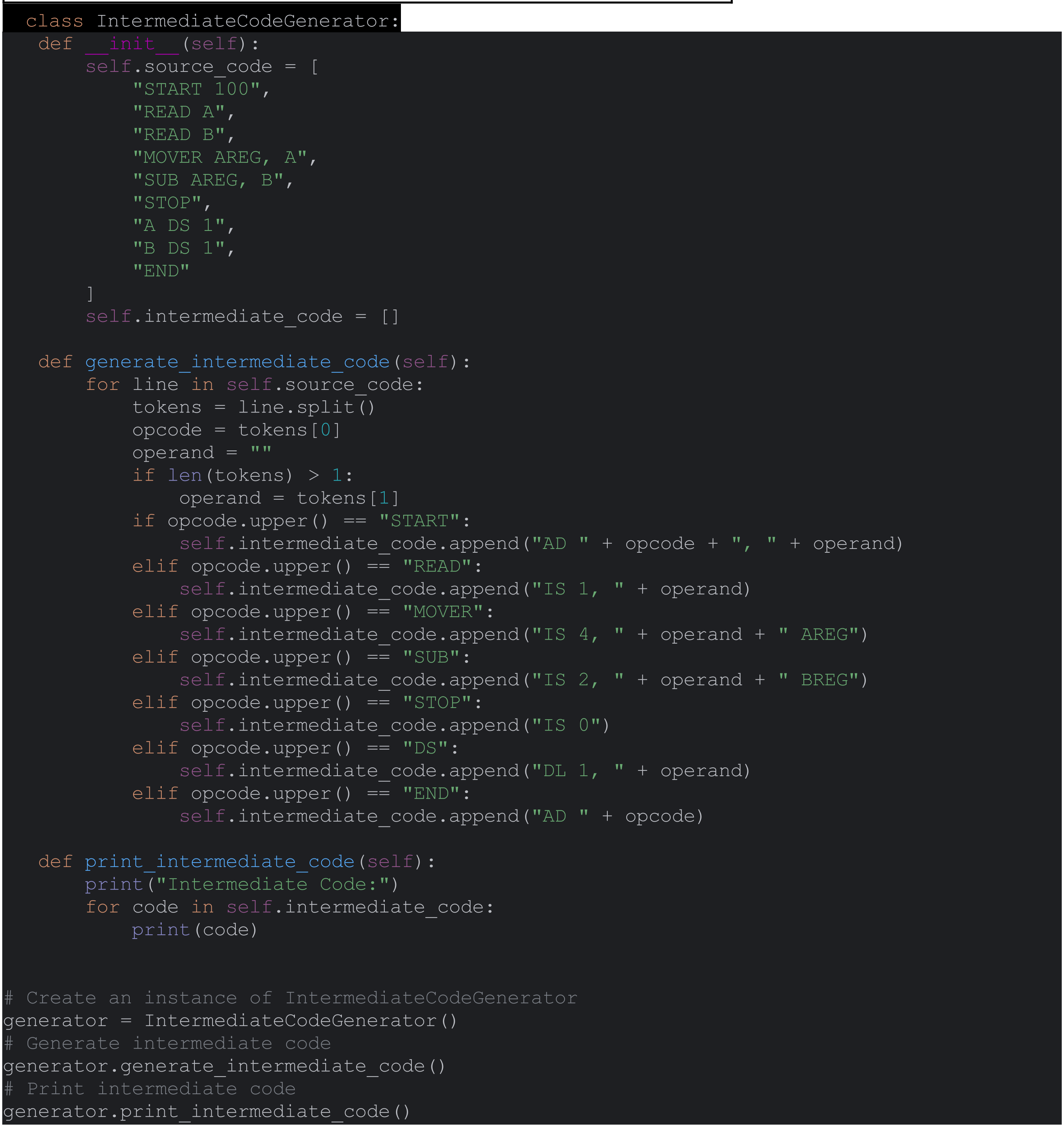


```
class Assembler:
   def __init__(self):
       self.symbol_table={}
       self.literal_table=[]
       self.pool_table=[]
       self.lc=0
       self.pool_start=0
   def first_pass(self,source_code):
       for line in source_code:
           line=line.strip()
           if line.startswith("START"):
               self.lc=int(line.split()[1])
           elif line.startswith("END"):
               self.process_ltorg()
               break
           elif line:
               if "=" in line:
                   self.process_literals(line)
               elif line.startswith("LTORG"):
                   self.process_ltorg()
               else:
                   self.process_label(line)
               self.process_instruction(line)

   def process_ltorg(self):
       for i in range(self.pool_start,len(self.literal_table)):
           self.literal_table[i][1]=str(self.lc)
           self.lc+=1
       self.pool_table.append(self.pool_start)
       self.pool_start=len(self.literal_table)

   def process_literals(self, line):
       literal=line.split("='")[1].split("'")[0]
       self.literal_table.append([literal," "])

   def process_label(self, line):
       parts=line.split()
       if len(parts)>2 and parts[1]=="DS":
           self.symbol_table[parts[0]]=self.lc
       elif len(parts)>1 and parts[0] not in
["MOVER","MOVEM","ADD","SUB","COMP","BC","READ","PRINT","STOP"]:
           self.symbol_table[parts[0]]=self.lc

   def process_instruction(self, line):
       if not line.startswith("DS") and not line.startswith("LTORG"):
           self.lc+=1

   def generate_tables(self):
       print("SYMBOL TABLE :")
       print("Label\tAddress")
       for label,address in self.symbol_table.items():
           print(f"{label}\t{address}")
       print("Literal\tAddress")
       for literal, address in self.literal_table:
           print(f"{literal}\t{address}")
       print("\nPool Table:")
       for address in self.pool_table:
           print(f"#{address}")
   def assemble(self, source_code):
       self.first_pass(source_code)
       self.generate_tables()

def main():
   source_code=[
       "START 100",
       "READ A",
       "MOVER AREG, ='1'",
       "MOVEM AREG, B",
       "MOVER BREG, ='6'",
       "ADD AREG, BREG",
       "COMP AREG, A",
       "BC GT, LAST",
       "LTORG",
       "NEXT SUB AREG, ='1'",
       "MOVER CREG, B",
       "ADD CREG, ='8'",
       "MOVEM CREG, B",
       "PRINT B",
       "LAST STOP",
       "A DS 1",
       "B DS 1",
       "END"
   ]
   assembler=Assembler()
   assembler.assemble(source_code)

if __name__=="__main__":
   main()
```

4.Write a program to generate Intermediate code of a two-pass Assembler for the given Assembly language source code.

INPUT/CODE

```
            START 100
            READ A
            READ B
            MOVER AREG, A
            SUB AREG, B
            STOP
A           DS    1
B           DS    1
            END
```



```python
class IntermediateCodeGenerator:
    def __init__(self):
        self.source_code = [
            "START 100",
            "READ A",
            "READ B",
            "MOVER AREG, A",
            "SUB AREG, B",
            "STOP",
            "A DS 1",
            "B DS 1",
            "END"
        ]
        self.intermediate_code = []

    def generate_intermediate_code(self):
        for line in self.source_code:
            tokens = line.split()
            opcode = tokens[0]
            operand = ""
            if len(tokens) > 1:
                operand = tokens[1]
            if opcode.upper() == "START":
                self.intermediate_code.append("AD " + opcode + ", " + operand)
            elif opcode.upper() == "READ":
                self.intermediate_code.append("IS 1, " + operand)
            elif opcode.upper() == "MOVER":
                self.intermediate_code.append("IS 4, " + operand + " AREG")
            elif opcode.upper() == "SUB":
                self.intermediate_code.append("IS 2, " + operand + " BREG")
            elif opcode.upper() == "STOP":
                self.intermediate_code.append("IS 0")
            elif opcode.upper() == "DS":
                self.intermediate_code.append("DL 1, " + operand)
            elif opcode.upper() == "END":
                self.intermediate_code.append("AD " + opcode)

    def print_intermediate_code(self):
        print("Intermediate Code:")
        for code in self.intermediate_code:
            print(code)


# Create an instance of IntermediateCodeGenerator
generator = IntermediateCodeGenerator()
# Generate intermediate code
generator.generate_intermediate_code()
# Print intermediate code
generator.print_intermediate_code()
```

5.Write a program to generate Intermediate code of a two-pass Macro processor.

INPUT/CODE	…continued…
LOAD A MACRO ABC LOAD p SUB q MEND STORE B MULT D MACRO ADD1 ARG LOAD X STORE ARG MEND …continued…	LOAD B MACRO ADD5 A1, A2, A3 STORE A2 ADD1 5 ADD1 10 LOAD A1 LOAD A3 MEND ADD1 t ABC ADD5 D1, D2, D3 END

6.Write a program to generateIntermediate code of a two-pass Macro processor.

INPUT/CODE	…continued….
LOAD J STORE M MACRO EST LOAD e ADD d MEND LOAD S MACRO SUB4 ABC LOAD U STORE ABC MEND	LOAD P ADD V MACRO ADD7 P4, P5, P6 LOAD P5 SUB4 XYZ SUB 8 SUB 2 STORE P4 STORE P6 MEND EST ADD7 C4, C5, C6 SUB4 z END

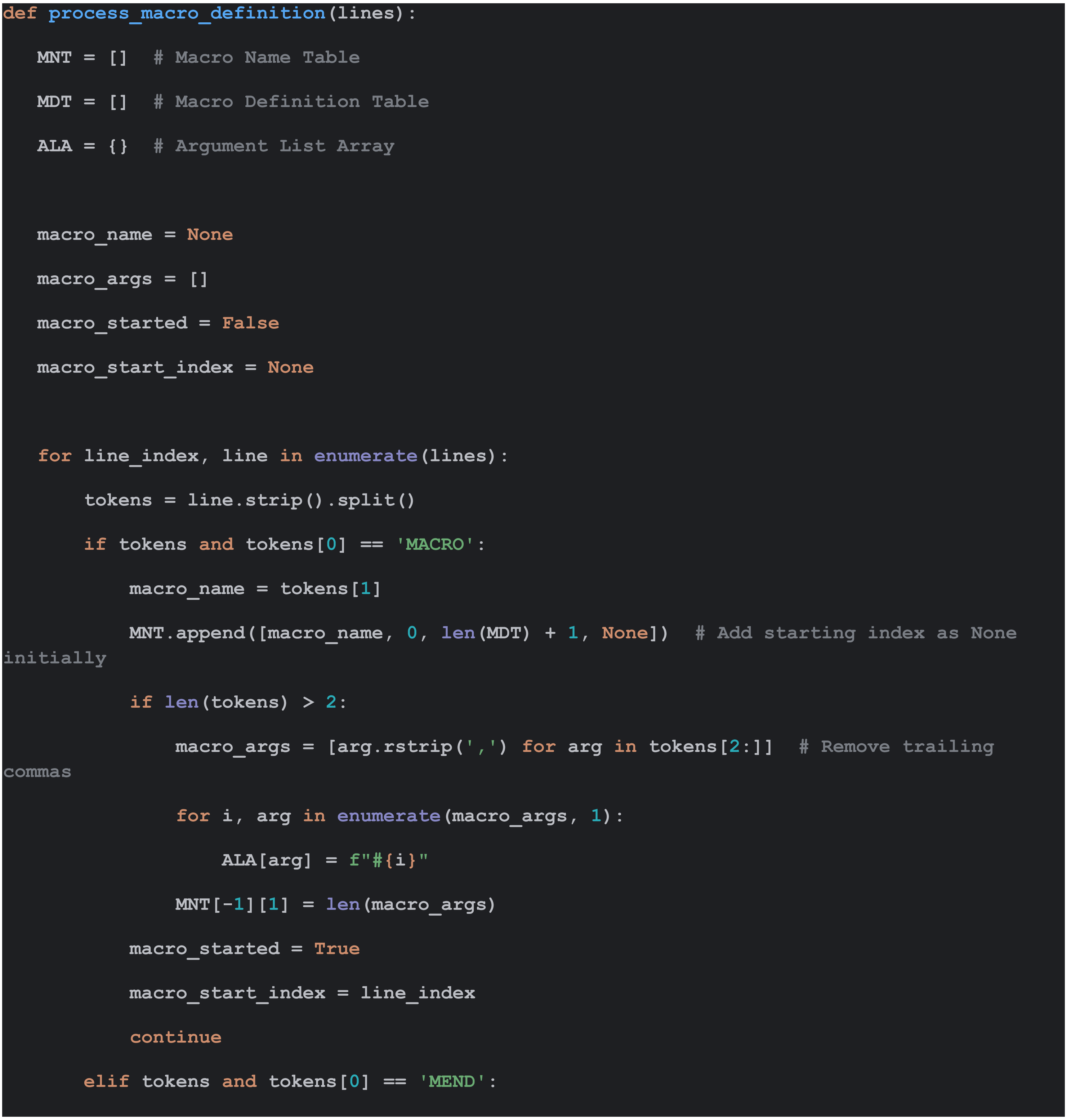
7.Write a program to generate MDT MNT(Macro Definition Table) of a two-pass Macro processor.

INPUT/CODE	…continued….
LOAD A STORE B MACRO ABC LOAD p SUB q MEND MACRO ADD1 ARG LOAD X STORE ARG MEND ….Continued….	MACRO ADD5 A1, A2, A3 STORE A2 ADD1 5 ADD1 10 LOAD A1 LOAD A3 MEND ABC ADD5 D1, D2, D3 END

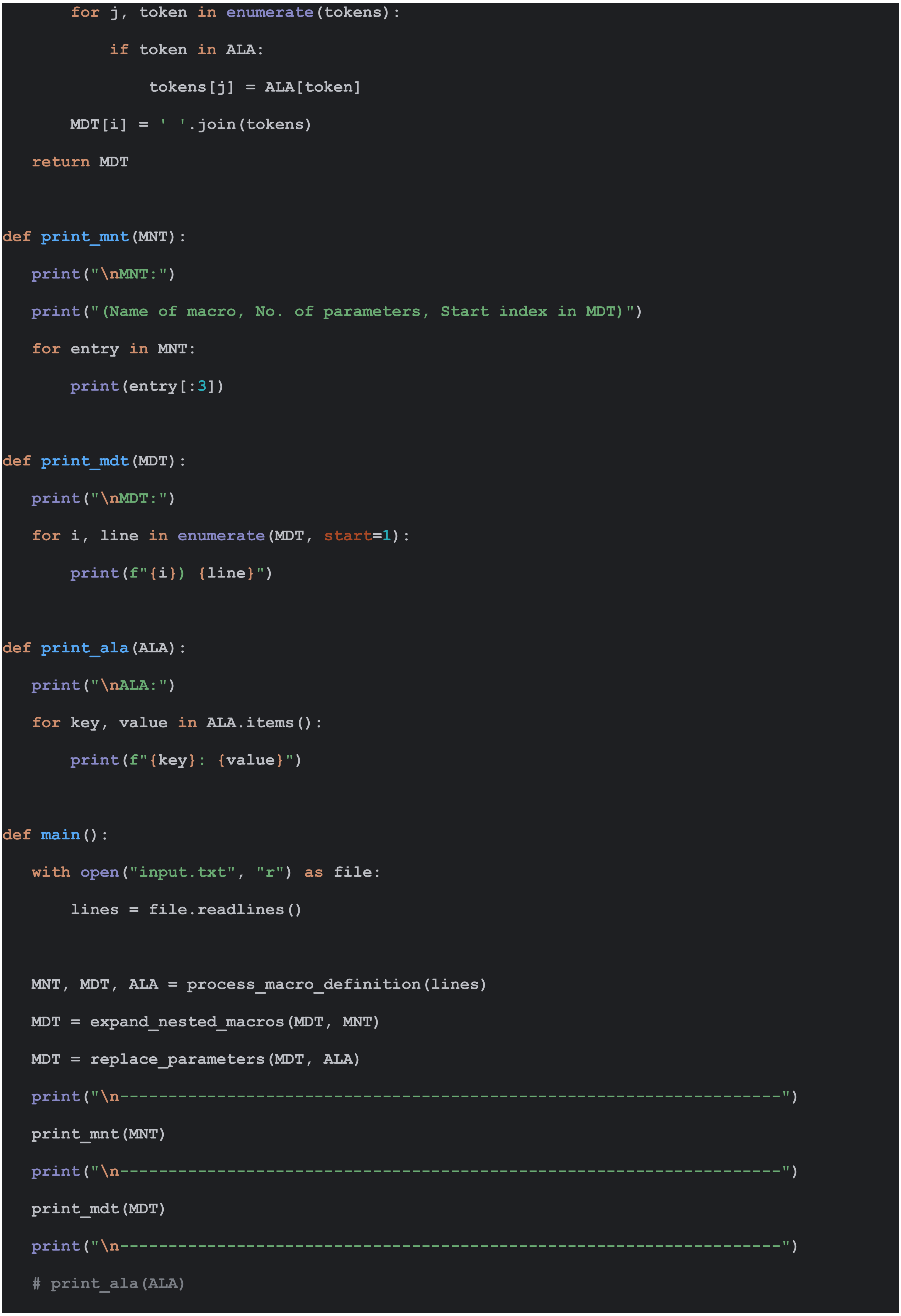
8.Write a program to generate MDT MNT(Macro Name Table) of a two-pass Macro processor.

INPUT/CODE

```
LOAD J
STORE M
MACRO EST1
LOAD e
ADD d
MEND
MACRO EST ABC
EST1
STORE ABC
MEND
MACRO ADD7 P4, P5, P6
LOAD P5
EST 8
SUB4 2
STORE P4
STORE P6
MEND
EST
ADD7 C4, C5, C6
END
```



```python
def process_macro_definition(lines):

   MNT = []  # Macro Name Table

   MDT = []  # Macro Definition Table

   ALA = {}  # Argument List Array


   macro_name = None

   macro_args = []

   macro_started = False

   macro_start_index = None


   for line_index, line in enumerate(lines):

       tokens = line.strip().split()

       if tokens and tokens[0] == 'MACRO':

           macro_name = tokens[1]

           MNT.append([macro_name, 0, len(MDT) + 1, None])  # Add starting index as None initially

           if len(tokens) > 2:

               macro_args = [arg.rstrip(',') for arg in tokens[2:]]  # Remove trailing commas

               for i, arg in enumerate(macro_args, 1):

                   ALA[arg] = f"#{i}"

               MNT[-1][1] = len(macro_args)

           macro_started = True

           macro_start_index = line_index

           continue

       elif tokens and tokens[0] == 'MEND':
           MDT.append(line.strip())
           MNT[-1][3] = len(MDT) - 1  # Update the starting index in MNT
           macro_started = False
           continue

       if macro_started:
           formatted_line = []
           for token in tokens:
               if token in ALA:
                   token = ALA[token]  # Replace macro arguments with positional parameters
               formatted_line.append(token)
           MDT.append(' '.join(formatted_line))
       else:
           print(line.strip())  # Print intermediate code

   return MNT, MDT, ALA


def expand_nested_macros(MDT, MNT):
   for i, line in enumerate(MDT):
       tokens = line.strip().split()
       if tokens[0] in [entry[0] for entry in MNT]:  # Check if it's a macro call
           macro_index = [entry[0] for entry in MNT].index(tokens[0])
           macro_start_index = MNT[macro_index][2]
           macro_end_index = MNT[macro_index][3]
           if macro_end_index is None:
               print("Error: MEND not found for nested macro")
               continue
           macro_definition = MDT[macro_start_index-1:macro_end_index]
           MDT = MDT[:i] + macro_definition + MDT[i+1:]
   return MDT

def replace_parameters(MDT, ALA):
   for i, line in enumerate(MDT):
       tokens = line.strip().split()
```



```python
        for j, token in enumerate(tokens):
            if token in ALA:
                tokens[j] = ALA[token]
        MDT[i] = ' '.join(tokens)
    return MDT

def print_mnt(MNT):
    print("\nMNT:")
    print("(Name of macro, No. of parameters, Start index in MDT)")
    for entry in MNT:
        print(entry[:3])

def print_mdt(MDT):
    print("\nMDT:")
    for i, line in enumerate(MDT, start=1):
        print(f"{i}) {line}")

def print_ala(ALA):
    print("\nALA:")
    for key, value in ALA.items():
        print(f"{key}: {value}")

def main():
    with open("input.txt", "r") as file:
        lines = file.readlines()

    MNT, MDT, ALA = process_macro_definition(lines)
    MDT = expand_nested_macros(MDT, MNT)
    MDT = replace_parameters(MDT, ALA)
    print("\n--------------------------------------------------------------------")
    print_mnt(MNT)
    print("\n--------------------------------------------------------------------")
    print_mdt(MDT)
    print("\n--------------------------------------------------------------------")
    # print_ala(ALA)
```

```
if __name__ == "__main__":
    main()
```

18. Write a program to generate three address codes for the given simple expression.

INPUT

w = u*u - u*v+ v*v

```
class generate_TAC:
    temp_count = 1

    @staticmethod
    def precedence(op):
        if op in ['+', '-']:
            return 1
        elif op in ['*', '/']:
            return 2
        return -1

    @staticmethod
    def apply_op(op, a, b):
        result = "t" + str(generate_TAC.temp_count)
        generate_TAC.temp_count += 1
        print(f"{result} = {a} {op} {b}")
        return result

    @staticmethod
    def infix_to_tac(exp):
        operators = []
        values = []

        i = 0
        while i < len(exp):
            c = exp[i]
            if c == ' ':
                i += 1
                continue


            if c.isalnum():

                sbuf = ''

                while i < len(exp) and (exp[i].isalnum() or exp[i] == '_'):

                    sbuf += exp[i]

                    i += 1

                values.append(sbuf)

                i -= 1

            elif c == '(':

                operators.append(c)

            elif c == ')':

                while operators and operators[-1] != '(':

                    val2 = values.pop()

                    val1 = values.pop()

                    op = operators.pop()

                    values.append(generate_TAC.apply_op(op, val1, val2))

                operators.pop()

            else:

                while operators and generate_TAC.precedence(operators[-1]) >=
generate_TAC.precedence(c):

                    val2 = values.pop()

                    val1 = values.pop()

                    op = operators.pop()

                    values.append(generate_TAC.apply_op(op, val1, val2))

                operators.append(c)

            i += 1


        while operators:

            val2 = values.pop()

            val1 = values.pop()

            op = operators.pop()

            values.append(generate_TAC.apply_op(op, val1, val2))


        print("Result =", values.pop())
```

```python
    @staticmethod
    def main():
        exp = input("Enter an infix expression: ")
        print("Infix Expression:", exp)
        print("Generated Three Address Code:")
        generate_TAC.infix_to_tac(exp)


if __name__ == "__main__":
    generate_TAC.main()
```