SSN COLLEGE OF ENGINEERING

ASSIGNMENT 1 : LEXICAL ANALYSER USING C

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Aim:

To write a program in C that simulates a Lexical Analyser.

Code:

```
#include<stdio.h>
#include<string.h>
#include<sys/types.h>
#include<sys/stat.h>
#include<fcntl.h>
#include<unistd.h>
#include<stdlib.h>
#include<ctype.h> int main()
{
   FILE* fp;     int count
= 0;     char* line = NULL;
size_t len = 0;     ssize_t
linelen;     char
store1[10][100];     char
store2[10][100];     fp =
fopen("./in.c", "r");     int
dtype[10], cnt = 0;
   while((linelen = getline(&line, &len, fp)) != -1)
   {
      if(line[0] == '#')
      {
         for(int i = 0; i < strlen(line); i++)
         {
            if(line[i] != '\n') printf("%c", line[i]);
         }
         printf(" - preprocessor directive\n");
      }
      char* int1 = strstr(line,"int ");
      char* float1 = strstr(line,"float
      "); char* for1 = strstr(line,"for(");
      char* if1 = strstr(line,"if("); char*
      else1 = strstr(line,"else"); int
```

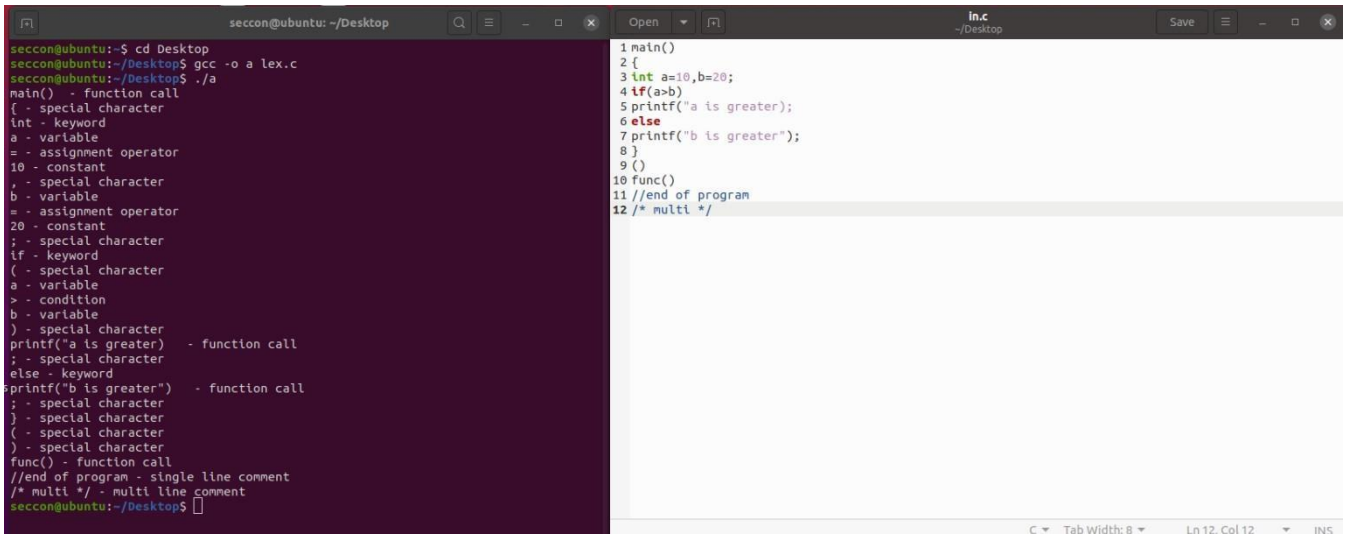
```
        declare = 0; int conditional = 0;
        if(int1 != NULL)
        {      declare = 1;
        printf("int - keyword\n");
            char* p = int1;
char str[10];             int slen = 0;
char* t = p;              int jumplen =
strlen("int ");             t = t + 4;
while(*t != '\0')            {
char c = *t;                 str[slen++]
= c;
t = t + 1;                 if(*t
== '=')
               {                    dtype[cnt++]
= 0;                    t = t + 1;
str[slen] = '\0';
strcpy(store1[count], str);
slen = 0;                    str[0] = '\0';
while(isdigit(*t) || *t == '.')
                  {
char c = *t;
str[slen++] = c;                        t
= t + 1;                   }
str[slen] = '\0';
slen = 0;
strcpy(store2[count], str);
               }
               if(*t ==',' | *t == ';')
               {                    count
= count + 1;
t = t + 1;
               }
            }
        }
        if(float1 != NULL)
        {      declare = 1;
        printf("float - keyword\n");
            char* p =
            float1; char str[10]; int slen
            = 0; char* t = p;  int jumplen
            = strlen("float ");
            t = t + 6; while(*t
            != '\0') {     char
            c = *t;
               str[slen++]=c;
t = t + 1;                 if(*t
== '=')
```

```
            {
dtype[cnt++] = 1;                   t = t +
1;                  str[slen] = '\0';
strcpy(store1[count], str);                 slen
= 0;                  str[0] = '\0';
while(isdigit(*t) || *t == '.')
                {                       char c =
*t;                      str[slen++] = c;
t = t + 1;                  }
str[slen] = '\0';                   slen = 0;
strcpy(store2[count], str);
            }
            if(*t == ',' | *t == ';')
            {                   count
= count + 1;
t = t + 1;
            }
          }
}
      if(for1 != NULL)
printf("for - keyword\n");
if(if1 != NULL)
      {           printf("if - keyword\n");
         conditional = 1;
      }
      if(else1 != NULL)           printf("else
- keyword\n"); char* templine; templine =
line; int first
= 1; if(declare == 1)
      {
         while(templine != NULL)
         { if(first == 1)
            {    templine = strstr(templine,"
          ");       first = 0;
            }    else
            {                   printf(", - special character\n");
            }
int equindex;
            for(int z = 0; z < strlen(templine); z++)               {
               if(*(templine + z) == '=')
               {                       equindex
= z;
break;
               }
            }
            for(int j = 1; j < equindex; j++)
            {
               printf("%c", *(templine + j));
```

```
            }
            printf(" - variable\n");            printf("=
- assignment operator\n");
templine = strstr(templine, "=");            int
commaindex;
            for(int z = 0; z < strlen(templine); z++)
            {
                if(*(templine + z) == ',')
                {
commaindex = z;
break;
                }
            }
            for(int j = 1; j < commaindex; j++)
            {
                printf("%c", *(templine + j));
            }
            printf(" - constant\n");
            templine = strstr(templine, ",");
        }
    }
    char* main1 = strstr(line, "main(");
    char* printf1 = strstr(line, "printf(");
    if(main1 != NULL || printf1 != NULL)
    {   for(int i = 0; i < strlen(line);
    i++)
        {   if(line[i]=='\t' || line[i]==';' || line[i] ==
        '\n')
            {   printf("
            ");
            }
            else
            {       printf("%c",
        line[i]);
            }
        }           printf(" - function
call\n");
    }
    char* popen = strstr(line, "{");        if(popen !=
NULL) printf("{ - special character\n");
char* semicolon = strstr(line, ";");
    if(semicolon != NULL) printf("; - special character\n");
char* pclose = strstr(line, "}");
    if(pclose != NULL) printf("} - special character\n");
char* bracket_open = strstr(line, "(");
    if(bracket_open != NULL && main1 == NULL && printf1 == NULL) printf("( -
special character\n");       char* tempvar;
    if(conditional == 1)
```

```
        {               tempvar =
strstr(line, "(");
int i;              int condition;
            for(int z = 0; z < strlen(tempvar); z++)
            {
                if(*(tempvar + z) == '<' || *(tempvar + z) == '>')
                {
condition = z;
break;
                }
            }
            for(int j = 1; j < condition; j++)
            {
                printf("%c", *(tempvar + j));
            }
            printf(" - variable\n");               char*
tempvar1 = strstr(tempvar, "<");
char* tempvar2 = strstr(tempvar, ">");              if(tempvar1
!= NULL) tempvar = tempvar1;              if(tempvar2 !=
NULL) tempvar = tempvar2;              printf("%c -
condition\n", *(tempvar));
            for(int z = 1; z < strlen(tempvar); z++)
            {
                if(*(tempvar + z) == ')')
                {
        condition = z;
                    break;
                }
             else
                {
                    printf("%c", *(tempvar + z));
                }
            }
            printf(" - variable\n");
        }         char* bracket_close = strstr(line,
")");
        if(bracket_close != NULL && main1 == NULL && printf1 == NULL) printf(") -
special character\n");
    }
fclose(fp);
    return 0;
}
```

Output:



Learning Outcome:

- The role and operation of Lexical Analyser was understood.
- Implementation of Regular Expression has been learnt.
- Learnt to parse the program and token identification.
- Understood the role of a Lexical Analyser in compilation.
- Understood the significance of keywords and general structure of a C program.

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ASSIGNMENT 2: LEXICAL ANALYSER USING LEX TOOL

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Aim:

To write a program using Lex to perform the basic functionalities of a Lexical Analyser, and to form a symbol table on the parsed program.

Code:

```
 %{
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
struct symbol{     char
type[10];     char name[20];
char value[100]; };  //For
Symbol Table

typedef struct symbol sym;
sym sym_table[1000];
int cur_size = -1; char current_type[10];
%}  number_const [-+]?[0-9]+(\.[0-9]+)?
char_const \'.\' string_const \".*\"  identifier [a-
zA-Z_][a-zA-Z0-9_]* function [a-zAZ_][a-zA-
Z0-9]*[(].*[)] keyword
(int|float|char|unsigned|typedef|struct|return|continue|break|if|else|for|while|do|e
xtern|auto|case|switch|enum|goto|long|double|sizeof|void|default|register) pp_dir ^[#].*[>]$
rel_ops ("<"|">"|"<="|">="|"=="|"!=") assign_ops
("="|"+="|"-="|"%="|"/="|"*=") arith_ops ("+"|"-
"|"%"|"/"|"*") single_cmt [/][/].*  multi_cmt
([/][/].*)|([/][*](.|[\n\r])*[*][/]) spl_chars [{}(),;\[\]]
/*Rules*/

%%

{pp_dir} {     printf("PPDIR
");
    strcpy(current_type, "INVALID");
}

{keyword} {     printf("KW
");
     if(strcmp(yytext, "int") == 0){         strcpy(current_type,
       "int");
    }
    else if(strcmp(yytext, "float") == 0){         strcpy(current_type, "float");
```

```
    }
    else if(strcmp(yytext, "double") == 0){
strcpy(current_type, "double");
    }
    else if(strcmp(yytext, "char") == 0){         strcpy(current_type,
"char");
    }     else{
        strcpy(current_type, "INVALID");
    }
}
 {function} {     printf("FUNCT
");
}

{identifier} {     printf("ID ");

    if(strcmp(current_type, "INVALID") != 0){         cur_size++;
strcpy(sym_table[cur_size].name, yytext);         strcpy(sym_table[cur_size].type,
current_type);
         if(strcmp(current_type, "char") == 0){
strcpy(sym_table[cur_size].value, "NULL");
        }
        else if(strcmp(current_type, "int") == 0){
strcpy(sym_table[cur_size].value, "0");
        }         else{
            strcpy(sym_table[cur_size].value, "0.0");
        }
    }
}

{single_cmt} {     printf("SCMT
");
}
 {multi_cmt} {     printf("MCMT
");
}

{number_const} {     printf("NUM_CONST
");
 if(strcmp(current_type,      "INVALID")    !=        0){         strcpy(sym_table[cur_size].value,
       yytext);
    }
}
 {char_const} {     printf("CHAR_CONST
");
     if(strcmp(current_type, "char") == 0){
strcpy(sym_table[cur_size].value, yytext);
    }
```

```
}

{string_const} {     printf("STR_CONST
");
}
 {rel_ops} {     printf("REL_OP
");
}
 {arith_ops} {
printf("ARITH_OP ");
}
 {assign_ops} {
printf("ASSIGN_OP ");
}
 {spl_chars} {     if(strcmp(yytext, ";") == 0){
strcpy(current_type, "INVALID");
    }

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

[ \t] { }


%%           int
yywrap(void)
{     return 1;
}

int main(int argc, char *argv[]){ int i = 0;


    yyin = fopen(argv[1], "r");     yylex();
      printf("\n\t----------------------------------------
\n");       printf("\n\t\t\tSYMBOL TABLE");
printf("\n\t\tNAME\tTYPE\tVALUE\n");     for(i
= 0; i <= cur_size; i++){          printf("\t\t%s\t%s\t%s\n", sym_table[i].name,
sym_table[i].type, sym_table[i].value);      }       printf("\t----------------------------------------
\n");

    return 0;
}
```

OUTPUT:

```
KW FUNCT
KW ID ASSIGN_OP NUM_CONST ID
KW ID ASSIGN_OP NUM_CONST
KW ID ID ASSIGN_OP CHAR_CONST
KW ID ASSIGN_OP NUM_CONST

FUNCT

ID ASSIGN_OP ID ARITH_OP NUM_CONST

KW ID REL_OP NUM_CONST
FUNCT


KW ID REL_OP NUM_CONST
FUNCT
ID ASSIGN_OP NUM_CONST



SCMT
MCMT

KW NUM_CONST


        ----------------------------------------

                        SYMBOL TABLE
                NAME    TYPE    VALUE
                a       int     1
                b       int     0
                c       int     2
                d       char    NULL
                e       char    'Z'
                f       float   1.23
        ----------------------------------------
```

Learning Outcome:

- Learnt the basics of Lex tool.
- Implement recognition for regular expressions using Lex terminology.
- Learnt to implement a basic symbol table using Lex on the parsed C program.
- Realized that Lex tool is more powerful and easy-to-use for Lexical Analysis.

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ASSIGNMENT 3: ELIMINATION OF LEFT RECURSION USING C

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Aim:

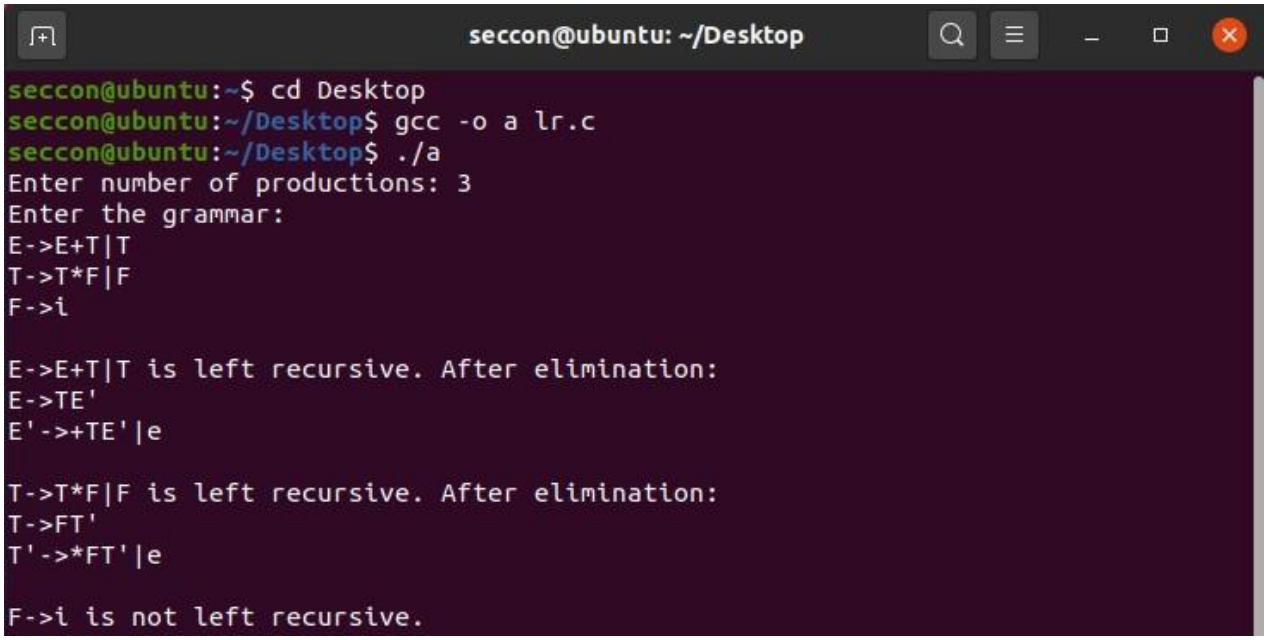
Write a program in C to find whether the given grammar is Left Recursive or not. If it is found to be left recursive, convert the grammar in such a way that the left recursion is removed.

Code:

```
#include<stdio.h> #include<string.h>
int main()
{
   char non_terminal, productions[10][100], splits[10][10];
int num;
   printf("Enter number of productions: ");
scanf("%d", &num);     printf("Enter the
grammar:\n");
   for(int i = 0; i < num; i++)
   {
      scanf("%s", productions[i]);
   }
   for(int i = 0; i < num; i++)
   {
      printf("\n%s", productions[i]);
non_terminal = productions[i][0];
      char production[100], *token;         int j,
flag = 0;         for(j = 0; productions[i][j + 3]
!= '\0'; j++)             production[j] =
productions[i][j + 3];         production[j] = '\0';
      j = 0;
      token = strtok(production, "|");
      while(token != NULL)
      {
         strcpy(splits[j], token);
         if(token[0] == non_terminal && flag == 0) flag = 1;
else if(token[0] != non_terminal && flag == 1) flag = 2;
j++;
         token = strtok(NULL, "|");
      }
      if(flag == 0) printf(" is not left recursive.\n");
      else if(flag == 1) printf(" is left recursive, cannot reduce.\n");
else
      {
```

```
            printf(" is left recursive. After elimination:\n");
flag = 0;
            for(int k = 0; k < j; k++)
            {
                if(splits[k][0] != non_terminal) {
                    if(flag != 0)
                    {
                        printf("|%s%c\'", splits[k], non_terminal);
                    }
else                        {
flag = 1;
                        printf("%c->%s%c\'", non_terminal, splits[k], non_terminal);
                    }
                }
}
printf("\n");
flag = 0;
            for(int k = 0; k < j; k++)
            {
                if(splits[k][0] == non_terminal) {
                    if(flag != 0)
                    {
                        printf("|%s%c\'", splits[k] + 1, non_terminal);
                    }
else                        {
flag = 1;
                        printf("%c\'->%s%c\'", non_terminal, splits[k] + 1, non_terminal);
                    }
                }
}
            printf("|e\n");
        }
    }
}
```

OUTPUT:



Learning Outcome:

- Learnt about left recursive grammars.
- Learnt to check if a grammar is left recursive using C.
- Successfully implemented a conversion in C which converts left recursive grammar to non left recursive grammar.

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ASSIGNMENT 4: Recursive Descent Parser using C

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Aim:

To implement a recursive descent parser using C

Code:

```
#include<stdio.h>
#include<stdlib.h>
void E();
void Eprime();
void T();
void Tprime();
void F();
char s;
int pos = 0;
void parse(char c)
{
    if(s == c) {
        s = getchar();
    }
    else {
        printf("Error at position %d!\n", pos);
        exit(0);
    }
}
void E()
{
    T();
    Eprime();
}
void Eprime()
{
    if(s == '+') {
        pos++;
        parse('+');
        T();
        Eprime();
    }
}
void T()
{
    F();
    Tprime();
}
```

```
void Tprime()
{
    if(s == '*') {
        pos++;
        parse('*');
        F();
        Tprime();
    }
}
void F()
{
    if(s == '(') {
        pos++;
        parse('(');
        E();
        pos++;
        parse(')');
    }
    else if(s == 'i') {
        pos++;
        parse('i');
        parse('d');
    }
    else {
        printf("Error at position %d!\n", pos);
        exit(0);
    }
}
int main()
{
    printf("Enter string to parse: ");
    s = getchar();
    E();
    printf("Parse Success!\n");
    return 0;
}
```

OUTPUT:

```
seccon@ubuntu:~/Desktop$ gcc -o a dp.c
seccon@ubuntu:~/Desktop$ ./a

Enter a string to parse: ((i+i)

Error parsing at Position 6!
seccon@ubuntu:~/Desktop$ gcc -o a dp.c
seccon@ubuntu:~/Desktop$ ./a

Enter a string to parse: ((i+i))

Parse Success!
seccon@ubuntu:~/Desktop$
```

Learning Outcome:

- Learnt the working of Recursive Descent Parser
- Understood why it doesn't support Left Recursive Grammars
- Successfully implemented a Recursive Descent Parser using c using return handling and recursion.

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ASSIGNMENT 5: Implementation of Desk Calculator using Yacc Tool

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Aim:

To implement a Desk Calculator using Yacc Tool

Code:

Calculator.l

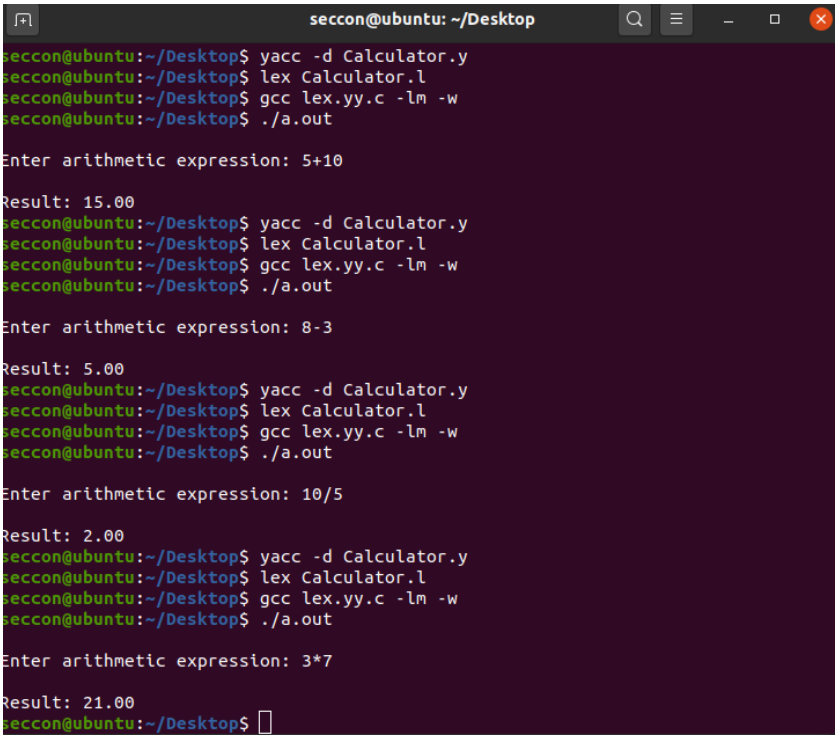
```
%{
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+ {
  yylval = atoi(yytext);
  return INTEGER;
}
(" "|"\t") { }
("+"|"-"|"*"|"/"|"^"|"("|")"|"\n") { return *yytext; }
. {
  char err[25];
  sprintf(err, "Invalid character: %s\n", yytext);
  yyerror(err);
}
```

Calculator.y

```
%{
#include<stdio.h>
#include<stdlib.h>
#include<math.h>
int yylex(void);
#include "y.tab.h"
%}
%token INTEGER
%%
program: line program
       | line
line: expr '\n' { printf("%d\n", $1); }
expr: expr '+' mulex { $$ = $1 + $3; }
    | expr '-' mulex { $$ = $1 - $3; }
    | mulex { $$ = $1; }
mulex: mulex '*' powex { $$ = $1 * $3; }
```

```
      | mulex '/' powex { $$ = $1 / $3; }
      | powex { $$ = $1; }
powex: powex '^' term { $$ = pow($1, $3); }
      | term { $$ = $1; }
term: '(' expr ')' { $$ = $2; }
    | INTEGER { $$ = $1; }
%%
int yyerror(char* s)
{
  fprintf(stderr, "%s\n", s);
  return 0;
}
int yywrap()
{
  return 1;
}
int main()
{
  yyparse();
  return 0;
}
```

OUTPUT:



Learning Outcome:

- Learnt about Yacc Parser Generator and that it is LALR(1) parser.
- Learnt to visualize parser's working using scanner.
- Learnt to integrate Yacc and Lex in one file.

- Successfully implemented a basic calculator using Yacc tool, understanding it’s syntax.