COMPILER DESIGN

19CSE401

CH.EN.U4CSE22039

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Implementation of Lexical Analyzer Using Lex Tool

Experiment No. : 1

Aim : To implement Lexical Analyzer Using Lex Tool

Algorithm :

1. Open gedit text editor from accessories in applications.
2. Specify the header files to be included inside the declaration part (i.e. between %{ and %}).
3. Define the digits i.e. 0-9 and identifiers a-z and A-Z.
4. Using translation rule, we defined the regular expression for digit, keywords, identifier, operator and header file etc. if it is matched with the given input then store and display it in yytext.
5. Inside procedure main(),use yyin() to point the current file being passed by the lexer.
6. Those specification of a lexical analyzer is prepared by creating a program lexp.l in the LEX language.
7. The Lexp.l program is run through the LEX compiler to produce an equivalent code in C language named Lex.yy.c .
8. The program lex.yy.c consists of a table constructed from the Regular Expressions of Lexp.l, together with standard routines that uses the table to recognize lexemes.
9. Finally, lex.yy.c program is run through the C Compiler to produce an object program a.out, which is the lexical analyzer that transforms an input stream into a sequence of tokens.

Code :

1. analyzer.l

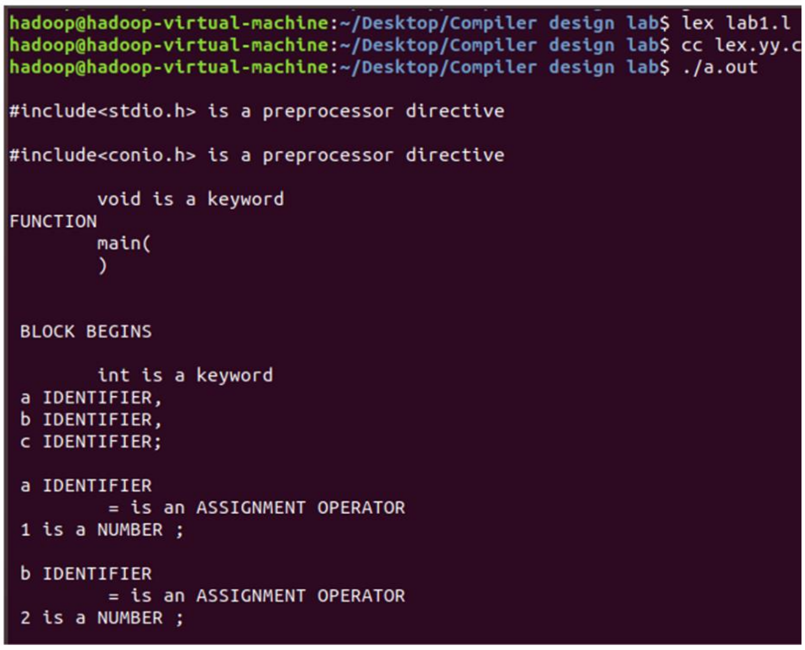
```
%{
#include<stdio.h>
int COMMENT=0;
%}
identifier [a-zA-Z][a-zA-Z0-9]*
%%
#.* {printf("\n%s is a preprocessor directive", yytext);}
int|float|char|double|while|for|struct|typedef|do|if|break|continue|void|switch|return|else|goto
{printf("\n\t%s is a keyword",yytext);}
"/*" {COMMENT=1;}{printf("\n\t%s is a COMMENT", yytext);}
{identifier}\( {if(!COMMENT)printf("\nFUNCTION \n\t%s", yytext);}
\{ {if(!COMMENT)printf("\n BLOCK BEGINS");}
\} {if(!COMMENT)printf("BLOCK ENDS ");}
{identifier}(\[[0-9]*\])? {if(!COMMENT) printf("\n %s IDENTIFIER",yytext);}
\".*\" {if(!COMMENT)printf("\n\t %s is a STRING",yytext);}
[0-9]+ {if(!COMMENT) printf("\n %s is a NUMBER ",yytext);}
```

```
\)(\:)? {if(!COMMENT)printf("\n\t");ECHO;printf("\n");}
\( ECHO;
= {if(!COMMENT)printf("\n\t %s is an ASSIGNMENT OPERATOR",yytext);}
<=|>=|==|>|< {if(!COMMENT) printf("\n\t%s is a RELATIONAL OPERATOR",yytext);}
%%
int main(int argc, char **argv)
{
   FILE *file;
   file=fopen("var.c","r"); // This program is hardcoded to read "var.c"
   if(!file)
   {
      printf("could not open the file");
      exit(0);
   }
   yyin=file;
   yylex();
   printf("\n");
   return(0);
}
int yywrap()
{
   return(1);
}
```

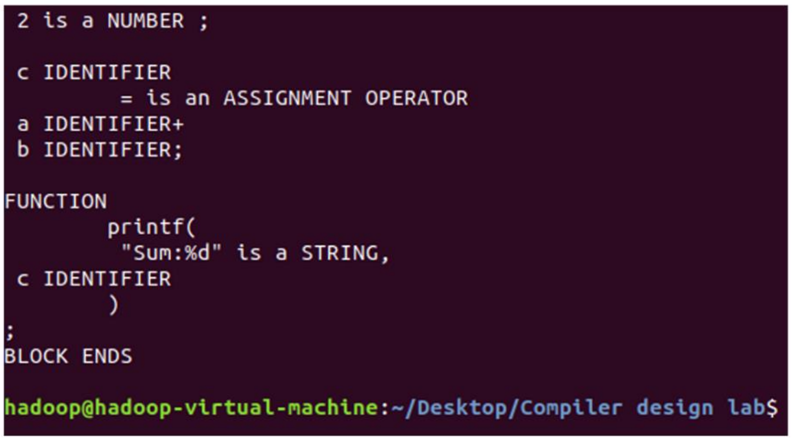
2. var.c

```
#include<stdio.h>
#include<conio.h>
void main()
{
   int a,b,c;
   a=1;
   b=2;
   c=a+b;
   printf("Sum:%d",c);
}
```

Output :



```
hadoop@hadoop-virtual-machine:~/Desktop/Compiler design lab$ lex lab1.l
hadoop@hadoop-virtual-machine:~/Desktop/Compiler design lab$ cc lex.yy.c
hadoop@hadoop-virtual-machine:~/Desktop/Compiler design lab$ ./a.out

#include<stdio.h> is a preprocessor directive

#include<conio.h> is a preprocessor directive

        void is a keyword
FUNCTION
        main(
        )


 BLOCK BEGINS

        int is a keyword
 a IDENTIFIER,
 b IDENTIFIER,
 c IDENTIFIER;

 a IDENTIFIER
         = is an ASSIGNMENT OPERATOR
 1 is a NUMBER ;

 b IDENTIFIER
         = is an ASSIGNMENT OPERATOR
 2 is a NUMBER ;
```



```
 2 is a NUMBER ;

 c IDENTIFIER
         = is an ASSIGNMENT OPERATOR
 a IDENTIFIER+
 b IDENTIFIER;

FUNCTION
        printf(
         "Sum:%d" is a STRING,
 c IDENTIFIER
        )
;
BLOCK ENDS

hadoop@hadoop-virtual-machine:~/Desktop/Compiler design lab$
```

Result : The code has been executed and output displayed successfully.

Program to eliminate left recursion and factoring from the given grammar

Experiment No. : 2

Aim : To implement eliminate left recursion and left factoring from the given grammar using C program.

Algorithm :

Left Factoring :

- Start the processes by getting the grammar and assigning it to the appropriate variables
- Find the common terminal and non-terminal elements and assign them in a separate grammar
- Display the new and modified grammar.

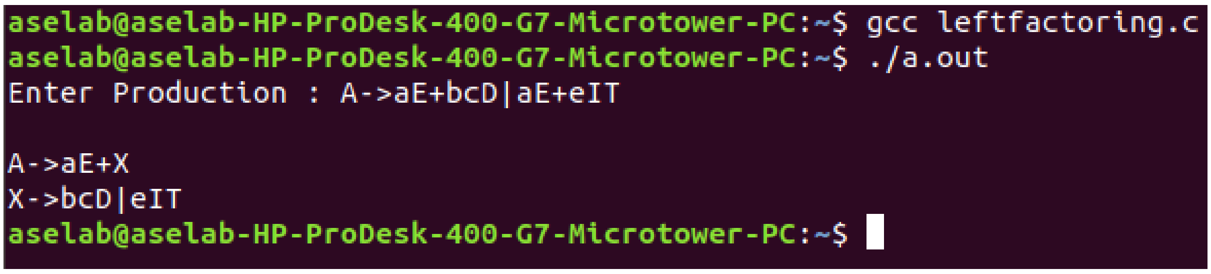
Code :

leftfactoring.c

```
#include <stdio.h>
#include <string.h>
int main() {
   char gram[100], part1[50], part2[50], modifiedGram[50], newGram[50];
   int i, j = 0, k = 0, pos = 0;
   printf("Enter Production : A->");
   if (fgets(gram, sizeof(gram), stdin) == NULL) {
      printf("Error reading input.\n");
      return 1;
   }
   gram[strcspn(gram, "\n")] = '\0';
   char *pipe_pos = strchr(gram, '|');
   if (pipe_pos == NULL) {
      printf("No '|' found in production.\n");
      return 1;
   }
   int pipe_index = pipe_pos - gram;
   strncpy(part1, gram, pipe_index);
   part1[pipe_index] = '\0';
   strcpy(part2, gram + pipe_index + 1);
   for (i = 0; i < (int)strlen(part1) && i < (int)strlen(part2); i++) {
      if (part1[i] == part2[i]) {
         modifiedGram[k++] = part1[i];
         pos = i + 1;
      } else {
         break;
      }
```

```
    }
    modifiedGram[k++] = 'X';  // New non-terminal
    modifiedGram[k] = '\0';
    j = 0;
    for (i = pos; i < (int)strlen(part1); i++) {
        newGram[j++] = part1[i];
    }
    newGram[j++] = '|';
    for (i = pos; i < (int)strlen(part2); i++) {
        newGram[j++] = part2[i];
    }
    newGram[j] = '\0';
    printf("\nA->%s\n", modifiedGram);
    printf("X->%s\n", newGram);
    return 0;
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc leftfactoring.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out
Enter Production : A->aE+bcD|aE+eIT

A->aE+X
X->bcD|eIT
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ 
```

Left Recursion.c

Aim : To implement left recursion using C.

Algorithm :

- Start the processes by getting the grammar and assigning it to the appropriate variables.
- Check if the given grammar has left recursion.
- Identify the alpha and beta elements in the production.
- Print the output according to the formula to remove left recursion

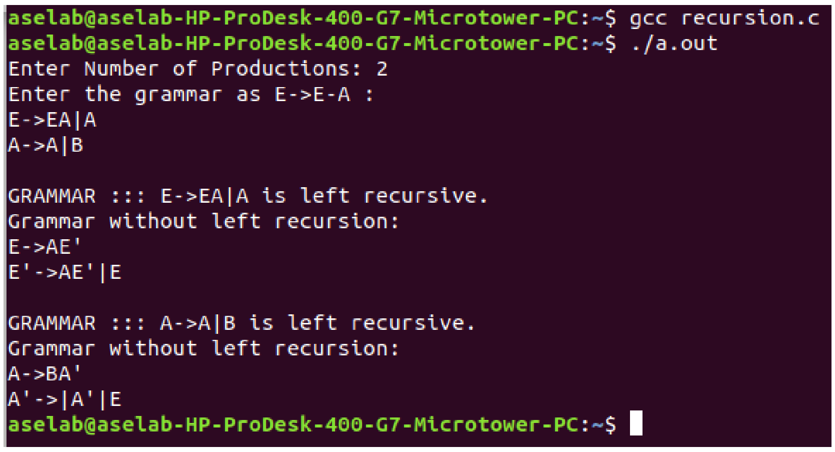
Code :

recursion.c

```
#include <stdio.h>
#include <string.h>
#define SIZE 10
int main() {
   char non_terminal;
   char beta, alpha;
   int num;
   char production[10][SIZE];
   int index = 3;  // Starting index after "->"
   printf("Enter Number of Productions: ");
   scanf("%d", &num);
   printf("Enter the grammar as E->E-A :\n");
   for (int i = 0; i < num; i++) {
      scanf("%s", production[i]);
   }
   for (int i = 0; i < num; i++) {
      printf("\nGRAMMAR ::: %s", production[i]);
      non_terminal = production[i][0];
      if (non_terminal == production[i][index]) {
         alpha = production[i][index + 1];
         printf(" is left recursive.\n");
         while (production[i][index] != 0 && production[i][index] != '|') {
            index++;
         }
         if (production[i][index] != 0) {
            beta = production[i][index + 1];
            printf("Grammar without left recursion:\n");
            printf("%c->%c%c\'", non_terminal, beta, non_terminal);
            printf("\n%c\'->%c%c\'|E\n", non_terminal, alpha, non_terminal);
         } else {
            printf(" can't be reduced\n");
         }
      } else {
         printf(" is not left recursive.\n");
```

```
        }
        index = 3;  // Reset index for next production
    }
    return 0;
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc recursion.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out
Enter Number of Productions: 2
Enter the grammar as E->E-A :
E->EA|A
A->A|B

GRAMMAR ::: E->EA|A is left recursive.
Grammar without left recursion:
E->AE'
E'->AE'|E

GRAMMAR ::: A->A|B is left recursive.
Grammar without left recursion:
A->BA'
A'->|A'|E
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ 
```

Result : The program to implement left factoring and left recursion has been successfully executed.

Implementation of LL(1) parsing

Experiment No. : 3

Aim : To implement LL(1) parsing using C program.

Algorithm :

- Read the input string.
- Using predictive parsing table parse the given input using stack.
- If stack [i] matches with token input string pop the token else shift it repeat the process until it reaches to $.

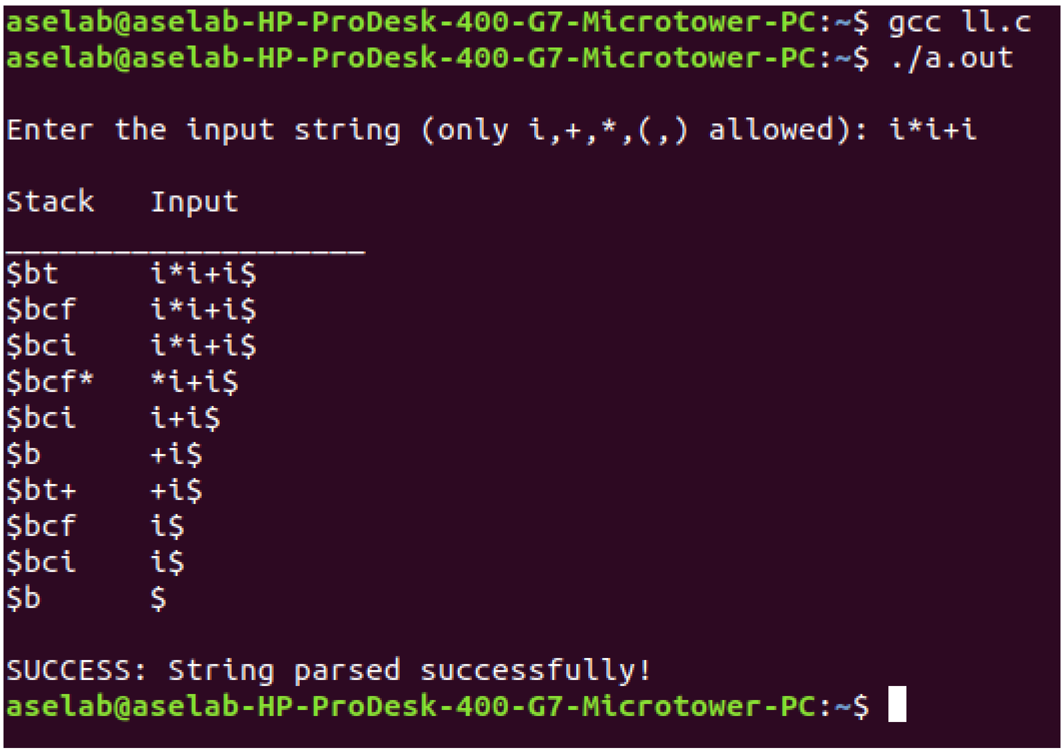
Code :

ll.c

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
char s[50], stack[50];
int main() {
   char m[5][6][5] = {
      {"tb",  "",    "",    "tb",  "",    ""},   // E
      {"",    "+tb", "",    "",    "n",   "n"},  // B
      {"fc",  "",    "",    "fc",  "",    ""},   // T
      {"",    "n",   "*fc", "n",   "n",   "n"},  // C
      {"i",   "",    "",    "(e)", "",    ""}    // F
   };
   int size[5][6] = {
      {2,0,0,2,0,0},
      {0,3,0,0,1,1},
      {2,0,0,2,0,0},
      {0,1,3,1,1,1},
      {1,0,0,3,0,0}
   };
   int i = 1, j = 0, k, n, str1 = 0, str2 = 0;
   printf("\nEnter the input string (only i,+,*,(,) allowed): ");
   scanf("%s", s);
   strcat(s, "$");
   n = strlen(s);
   stack[0] = '$';
   stack[1] = 'e';
   printf("\nStack\tInput\n");
   printf("____________________\n");
   while (stack[i] != '$' && s[j] != '$') {
      if (stack[i] == s[j]) {  // Terminal match
         i--;
         j++;
      }
      switch (stack[i]) {
         case 'e': str1 = 0; break;
```

```
            case 'b': str1 = 1; break;
            case 't': str1 = 2; break;
            case 'c': str1 = 3; break;
            case 'f': str1 = 4; break;
            default: str1 = -1; break;
        }
        switch (s[j]) {
            case 'i': str2 = 0; break;
            case '+': str2 = 1; break;
            case '*': str2 = 2; break;
            case '(': str2 = 3; break;
            case ')': str2 = 4; break;
            case '$': str2 = 5; break;
            default: str2 = -1; break;
        }
        if (str1 == -1 || str2 == -1 || m[str1][str2][0] == '\0') {
            printf("\nERROR: Invalid string\n");
            exit(0);
        } else if (m[str1][str2][0] == 'n') {  // ε-production
            i--;
        } else {  // Expand production
            i--; // Pop non-terminal
            for (k = size[str1][str2] - 1; k >= 0; k--) {
                stack[++i] = m[str1][str2][k];
            }
        }
        for (k = 0; k <= i; k++) printf("%c", stack[k]);
        printf("\t");
        for (k = j; k < n; k++) printf("%c", s[k]);
        printf("\n");
    }
        printf("\nSUCCESS: String parsed successfully!\n");
    return 0;
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc ll.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out

Enter the input string (only i,+,*,(,) allowed): i*i+i

Stack   Input
____________________
$bt     i*i+i$
$bcf    i*i+i$
$bci    i*i+i$
$bcf*   *i+i$
$bci    i+i$
$b      +i$
$bt+    +i$
$bcf    i$
$bci    i$
$b      $

SUCCESS: String parsed successfully!
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus, the program to implement LL(1) has been successfully executed.

Parser Generation using YACC

Experiment No. : 4

Aim : To write a program in YACC for parser generation.

Algorithm :

1) Get the input from the user and Parse it token by token.
2) First identify the valid inputs that can be given for a program.
3) Define the precedence and the associativity of various operators like +,-,/,* etc.
4) Write codes for saving the answer into memory and displaying the result on the screen.
5) Write codes for performing various arithmetic operations.
6) Display the possible Error message that can be associated with this calculation.
7) Display the output on the screen else display the error message on the screen

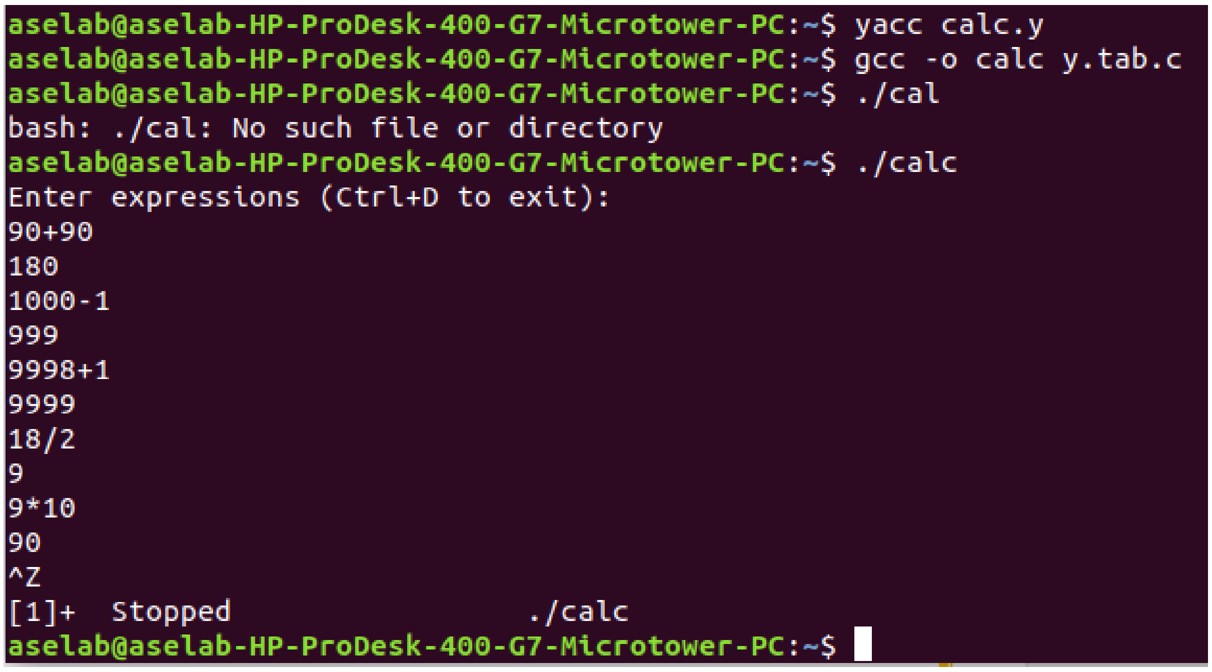
Code :

calc.y

```
%{
#include <stdio.h>
#include <ctype.h>
int yylex(void);
void yyerror(const char *s);
#define YYSTYPE double
%}
%token NUMBER
%left '+' '-'
%left '*' '/'
%right UMINUS
%%
lines:
     lines expr '\n'   { printf("Result: %g\n", $2); }
   | lines '\n'
   | /* empty */
   ;

expr:
     expr '+' expr     { $$ = $1 + $3; }
   | expr '-' expr     { $$ = $1 - $3; }
   | expr '*' expr     { $$ = $1 * $3; }
   | expr '/' expr     {
                     if ($3 == 0) {
                        yyerror("Division by zero");
                        $$ = 0;
                     } else {
                        $$ = $1 / $3;
```

```
                           }
                        }
    | '(' expr ')'      { $$ = $2; }
    | '-' expr %prec UMINUS { $$ = -$2; }
    | NUMBER
    ;
%%

// Simple lexer
int yylex(void) {
    int c;

    // Skip whitespace
    while ((c = getchar()) == ' ' || c == '\t');

    // Handle numbers
    if (c == '.' || isdigit(c)) {
        ungetc(c, stdin);
        scanf("%lf", &yylval);
        return NUMBER;
    }

    return c;
}

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

int yywrap() {
    return 1;
}

int main() {
    printf("Enter expressions (CTRL+D to quit):\n");
    yyparse();
    return 0;
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ yacc calc.y
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc -o calc y.tab.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./cal
bash: ./cal: No such file or directory
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./calc
Enter expressions (Ctrl+D to exit):
90+90
180
1000-1
999
9998+1
9999
18/2
9
9*10
90
^Z
[1]+  Stopped                 ./calc
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus the program in YACC for parser generation has been executed successfully.

Implementation of Symbol Table

Experiment No. : 5

Aim : To implement Symbol Table.

Algorithm :

1) Start the Program.
2) Get the input from the user with the terminating symbol '$'.
3) Allocate memory for the variable by dynamic memory allocation function.
4) If the next character of the symbol is an operator then only the memory is allocated.
5) While reading, the input symbol is inserted into symbol table along with its memory address.
6) The steps are repeated till "$" is reached.
7) To reach a variable, enter the variable to the searched and symbol table has been.
8) Checked for corresponding variable, the variable along its address is displayed as result.
9) Stop the program

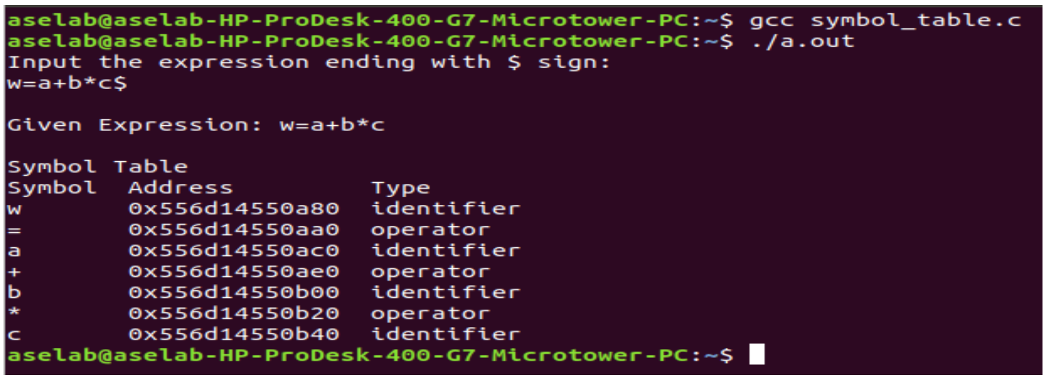
Code :

symbol_table.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>

void main() {
   int x = 0, n, i = 0, j = 0;
   void *mypointer, *symbol_address[100];
   char ch, search_char, input_expr[100], symbol_list[100], c;

   printf("Input the expression ending with $ sign:\n");

   // Read characters until '$'
   while ((c = getchar()) != '$') {
      input_expr[i++] = c;
   }
   n = i - 1;

   // Display given expression
   printf("\nGiven Expression: ");
   for (i = 0; i <= n; i++) {
      printf("%c", input_expr[i]);
   }

   // Display symbol table
   printf("\n\nSymbol Table\n");
   printf("Symbol\tAddress\t\tType\n");
```

```
    while (j <= n) {
        c = input_expr[j];

        // If it's an alphabet, it's an identifier
        if (isalpha(c)) {
            mypointer = malloc(sizeof(char)); // allocate 1 byte
            symbol_address[x] = mypointer;
            symbol_list[x] = c;
            printf("%c\t%p\tidentifier\n", c, mypointer);
            x++;
        }

        // If it's an operator
        else if (c == '+' || c == '-' || c == '*' || c == '=') {
            mypointer = malloc(sizeof(char)); // allocate 1 byte
            symbol_address[x] = mypointer;
            symbol_list[x] = c;
            printf("%c\t%p\toperator\n", c, mypointer);
            x++;
        }

        j++;
    }
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc symbol_table.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out
Input the expression ending with $ sign:
w=a+b*c$

Given Expression: w=a+b*c

Symbol Table
Symbol   Address          Type
w        0x556d14550a80   identifier
=        0x556d14550aa0   operator
a        0x556d14550ac0   identifier
+        0x556d14550ae0   operator
b        0x556d14550b00   identifier
*        0x556d14550b20   operator
c        0x556d14550b40   identifier
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus the program to implement symbol table has been executed successfully.

Implementation of Intermediate Code Generation

Experiment No. : 6

Aim : To implementation of intermediate code generation.

Algorithm :

1) Take the parse tree tokens from the syntax analyser.
2) Generate intermediate code using temp variable
3) Assign the final temp variable to initial variable

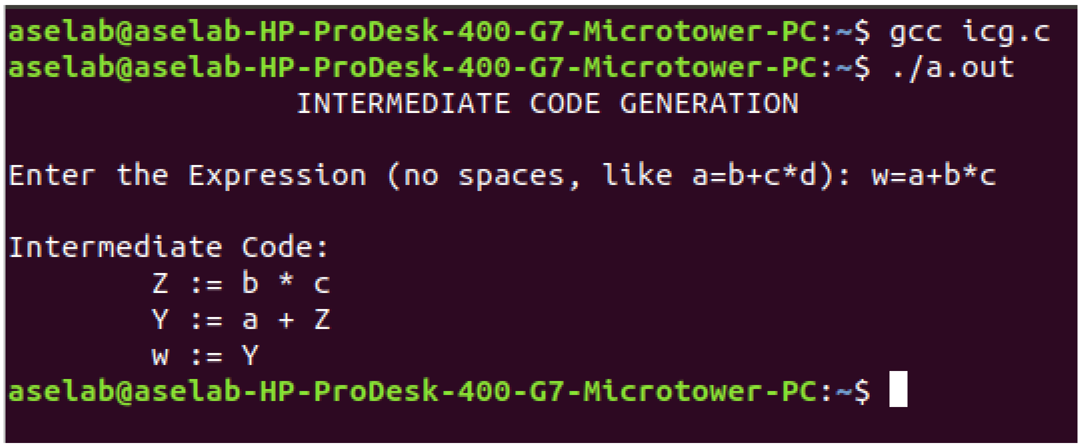
Code :

icg.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int i = 1, j = 0, no = 0, tmpch = 'Z';
char str[100], left[15], right[15];

struct exp {
   int pos;
   char op;
} k[15];

void findopr();
void explore();
void fleft(int);
void fright(int);

void main() {
   printf("\t\tINTERMEDIATE CODE GENERATION\n\n");
   printf("Enter the Expression (no spaces, like a=b+c*d): ");
   scanf("%s", str);
   printf("\nIntermediate Code:\n");
   findopr();
   explore();
}

void findopr() {
   for (i = 0; str[i] != '\0'; i++) {
      if (str[i] == '=') {
         k[j].pos = i;
         k[j++].op = '=';
      }
   }
   for (i = 0; str[i] != '\0'; i++) {
      if (str[i] == '/' || str[i] == '*') {
         k[j].pos = i;
         k[j++].op = str[i];
      }
   }
   for (i = 0; str[i] != '\0'; i++) {
        if (str[i] == '+' || str[i] == '-') {
            k[j].pos = i;
            k[j++].op = str[i];
        }
    }
}

void explore() {
    i = 1;
    while (k[i].op != '\0') {
        fleft(k[i].pos);
        fright(k[i].pos);
        str[k[i].pos] = tmpch;
        printf("\t%c := %s %c %s\n", tmpch, left, k[i].op, right);
        tmpch--;
        i++;
    }

    fright(-1);
    if (no == 0) {
        fleft(strlen(str));
        printf("\t%s := %s\n", right, left);
        exit(0);
    }

    printf("\t%s := %c\n", right, str[k[--i].pos]);
}

void fleft(int x) {
    int w = 0, flag = 0;
    x--;
    while (x != -1 && str[x] != '+' && str[x] != '-' && str[x] != '*' &&
           str[x] != '/' && str[x] != '=' && str[x] != '\0') {
        if (str[x] != '$' && flag == 0) {
            left[w++] = str[x];
            left[w] = '\0';
            str[x] = '$';
            flag = 1;
        }
        x--;
    }
}

void fright(int x) {
    int w = 0, flag = 0;
    x++;
    while (x != -1 && str[x] != '+' && str[x] != '-' && str[x] != '*' &&
           str[x] != '/' && str[x] != '=' && str[x] != '\0') {
```

```
        if (str[x] != '$' && flag == 0) {
            right[w++] = str[x];
            right[w] = '\0';
            str[x] = '$';
            flag = 1;
        }
        x++;
    }
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc icg.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out
                INTERMEDIATE CODE GENERATION

Enter the Expression (no spaces, like a=b+c*d): w=a+b*c

Intermediate Code:
        Z := b * c
        Y := a + Z
        w := Y
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus, the program to implement intermediate code generation has been executed successfully.

Implementation of Code Optimization Techniques

Experiment No. : 7

Aim : To implementation of Code Optimization Techniques

Algorithm :

1. Start the program
2. Declare the variables and functions.
3. Enter the expression and state it in the variable a, b, c. 24
4. Calculate the variables b & c with ‘temp’ and store it in f1 and f2.
5. If(f1=null && f2=null) then expression could not be optimized.
6. Print the results.
7. Stop the program.

Code :

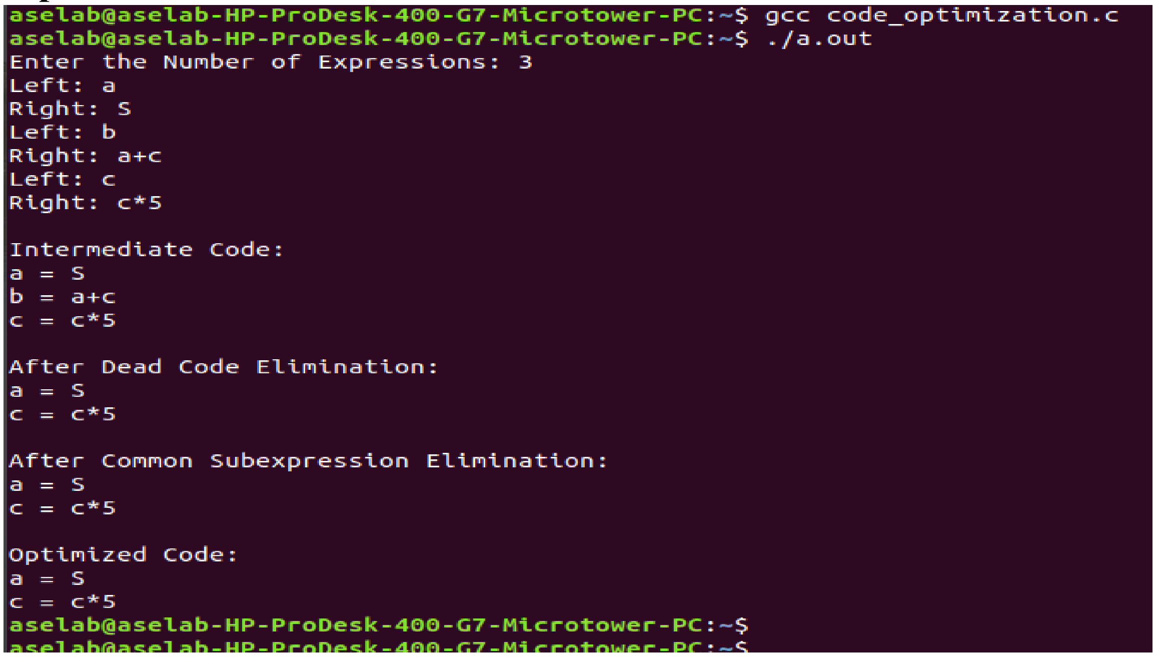
code_optimization.c

```
#include <stdio.h>
#include <string.h>

struct op {
    char l;       // Left side of assignment
    char r[20];   // Right side expression
} op[10], pr[10];

void main() {
    int i, j, k, m, n, z = 0, a, q;
    char temp, t;
    char *p, *l, *tem;

    printf("Enter the Number of Expressions: ");
    scanf("%d", &n);

    for (i = 0; i < n; i++) {
        printf("Left: ");
        scanf(" %c", &op[i].l);
        printf("Right: ");
        scanf(" %s", op[i].r);
    }

    printf("\nIntermediate Code:\n");
    for (i = 0; i < n; i++) {
        printf("%c = %s\n", op[i].l, op[i].r);
    }

    // Dead Code Elimination
    for (i = 0; i < n - 1; i++) {
        temp = op[i].l;
        for (j = 0; j < n; j++) {
```

```
        p = strchr(op[j].r, temp);
        if (p) {
            pr[z].l = op[i].l;
            strcpy(pr[z].r, op[i].r);
            z++;
            break;
        }
    }
}

// Always keep the last instruction
pr[z].l = op[n - 1].l;
strcpy(pr[z].r, op[n - 1].r);
z++;

printf("\nAfter Dead Code Elimination:\n");
for (k = 0; k < z; k++) {
    printf("%c = %s\n", pr[k].l, pr[k].r);
}

// Common Subexpression Elimination
for (m = 0; m < z; m++) {
    tem = pr[m].r;
    for (j = m + 1; j < z; j++) {
        p = strstr(tem, pr[j].r);
        if (p) {
            t = pr[j].l;
            pr[j].l = pr[m].l;
            for (i = 0; i < z; i++) {
                l = strchr(pr[i].r, t);
                if (l) {
                    a = l - pr[i].r;
                    pr[i].r[a] = pr[m].l;
                }
            }
        }
    }
}

printf("\nAfter Common Subexpression Elimination:\n");
for (i = 0; i < z; i++) {
    printf("%c = %s\n", pr[i].l, pr[i].r);
}

// Remove duplicates
for (i = 0; i < z; i++) {
    for (j = i + 1; j < z; j++) {
        q = strcmp(pr[i].r, pr[j].r);
```

```
            if ((pr[i].l == pr[j].l) && !q) {
                pr[i].l = '\0'; // Mark for deletion
            }
        }
    }

    printf("\nOptimized Code:\n");
    for (i = 0; i < z; i++) {
        if (pr[i].l != '\0') {
            printf("%c = %s\n", pr[i].l, pr[i].r);
        }
    }
}
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc code_optimization.c
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./a.out
Enter the Number of Expressions: 3
Left: a
Right: S
Left: b
Right: a+c
Left: c
Right: c*5

Intermediate Code:
a = S
b = a+c
c = c*5

After Dead Code Elimination:
a = S
c = c*5

After Common Subexpression Elimination:
a = S
c = c*5

Optimized Code:
a = S
c = c*5
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus, the program to implement code optimization has been executed successfully.

Implementation of Symbol Table

Experiment No. : 8

Aim : To write a program that implements the target code generation

Algorithm :

1. Read input string

2. Consider each input string and convert it to machine code instructions using switch case

3. Load the input variables into new variables as operands and display them using “load”

4. With the help of arithmetic operation, we will display arithmetic operations like add, sub, div, mul for the respective operations in switch case

5. Generate 3 address code for each input variable.

6. If ‘=‘ is seen as arithmetic operation, then store the result in a variable and display it with “store”.

7. Repeat this for each line in the input string.

8. Display the output which gives a transformed input string of assembly language code.

Code :

1. target.c

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>

int label[20];
int no=0;

int check_label(int k)
{
   int i;
   for(i=0;i<no;i++)
   {
      if(k==label[i]) return 1;
   }
   return 0;
}

int main()
{
   FILE *fp1,*fp2;
   char fname[10],op[10],ch;
   char operand1[8],operand2[8],result[8];
   int i=0,j=0;

   printf("\n Enter filename of the intermediate code: ");
   scanf("%s",fname);

   fp1=fopen(fname,"r");
   fp2=fopen("target.txt","w");
```

```
if(fp1==NULL || fp2==NULL)
{
   printf("\n Error opening the file");
   exit(0);
}

while(!feof(fp1))
{
   fprintf(fp2,"\n");
   fscanf(fp1,"%s",op);
   i++;

   if(check_label(i))
      fprintf(fp2,"\nlabel#%d",i);

   if(strcmp(op,"print")==0)
   {
      fscanf(fp1,"%s",result);
      fprintf(fp2,"\n\t OUT %s",result);
   }

   if(strcmp(op,"goto")==0)
   {
      fscanf(fp1,"%s %s",operand1,operand2);
      fprintf(fp2,"\n\t JMP %s,label#%s",operand1,operand2);
      label[no++]=atoi(operand2);
   }

   if(strcmp(op,"[]=")==0)
   {
      fscanf(fp1,"%s %s %s",operand1,operand2,result);
      fprintf(fp2,"\n\t STORE %s[%s],%s",operand1,operand2,result);
   }

   if(strcmp(op,"uminus")==0)
   {
      fscanf(fp1,"%s %s",operand1,result);
      fprintf(fp2,"\n\t LOAD -%s,R1",operand1);
      fprintf(fp2,"\n\t STORE R1,%s",result);
   }

   switch(op[0])
   {
      case '*': fscanf(fp1,"%s %s %s",operand1,operand2,result);
             fprintf(fp2,"\n \t LOAD %s,R0",operand1);
             fprintf(fp2,"\n \t LOAD %s,R1",operand2);
             fprintf(fp2,"\n \t MUL R1,R0");
             fprintf(fp2,"\n \t STORE R0,%s",result);
```

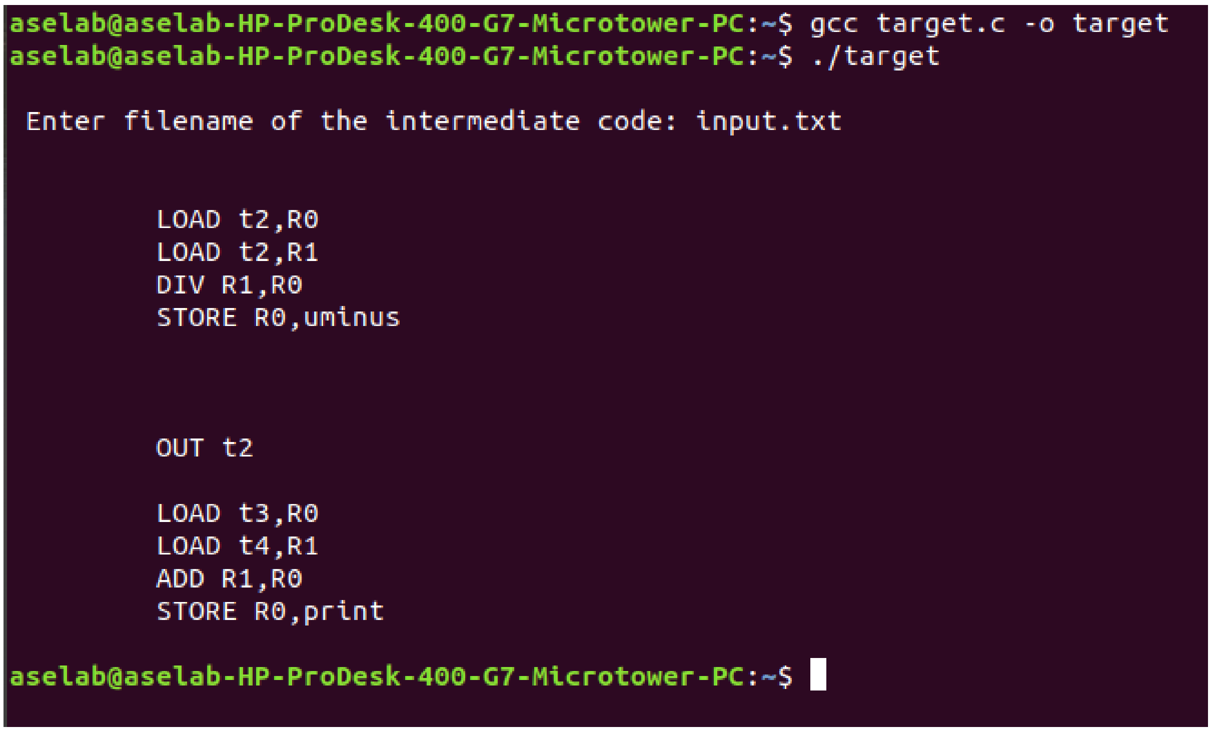
```
            break;

        case '+': fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n \t LOAD %s,R0",operand1);
            fprintf(fp2,"\n \t LOAD %s,R1",operand2);
            fprintf(fp2,"\n \t ADD R1,R0");
            fprintf(fp2,"\n \t STORE R0,%s",result);
            break;

        case '-': fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n\t LOAD %s,R0",operand1);
            fprintf(fp2,"\n \t LOAD %s,R1",operand2);
            fprintf(fp2,"\n \t SUB R1,R0");
            fprintf(fp2,"\n \t STORE R0,%s",result);
            break;

        case '/': fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n \t LOAD %s,R0",operand1);
            fprintf(fp2,"\n \t LOAD %s,R1",operand2);
            fprintf(fp2,"\n \t DIV R1,R0");
            fprintf(fp2,"\n \t STORE R0,%s",result);
            break;

        case '%': fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n \t LOAD %s,R0",operand1);
            fprintf(fp2,"\n \t LOAD %s,R1",operand2);
            fprintf(fp2,"\n \t DIV R1,R0");
            fprintf(fp2,"\n \t STORE R0,%s",result);
            break;

        case '=': fscanf(fp1,"%s %s",operand1,result);
            fprintf(fp2,"\n\t STORE %s %s",operand1,result);
            break;

        case '>': j++;
            fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n \t LOAD %s,R0",operand1);
            fprintf(fp2,"\n\t JGT %s,label#%s",operand2,result);
            label[no++]=atoi(result);
            break;

        case '<': fscanf(fp1,"%s %s %s",operand1,operand2,result);
            fprintf(fp2,"\n \t LOAD %s,R0",operand1);
            fprintf(fp2,"\n\t JLT %s,label#%s",operand2,result);
            label[no++]=atoi(result);
            break;
    }
}
```

```
    fclose(fp2);
    fclose(fp1);

    fp2=fopen("target.txt","r");
    if(fp2==NULL)
    {
        printf("Error opening the file\n");
        exit(0);
    }

    do
    {
        ch=fgetc(fp2);
        printf("%c",ch);
    }while(ch!=EOF);

    fclose(fp2);
    return 0;
}
```

2. Input.txt

```
/t3 t2 t2
uminus t2 t2
print t2
+t1 t3 t4
print t4
```

Output :



```
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ gcc target.c -o target
aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$ ./target

 Enter filename of the intermediate code: input.txt


         LOAD t2,R0
         LOAD t2,R1
         DIV R1,R0
         STORE R0,uminus



         OUT t2

         LOAD t3,R0
         LOAD t4,R1
         ADD R1,R0
         STORE R0,print

aselab@aselab-HP-ProDesk-400-G7-Microtower-PC:~$
```

Result : Thus, the program to implement target code generation has been successfully executed.