ANNAMALAI UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Bachelor of Engineering (B.E.)

CSCP-607 COMPILER DESIGN LAB

LIST OF EXPERIMENTS

Ex. No: 1

Date:

Implementation of Lexical Analyzer for 'if' Statement

Aim:

To write a C program to implement lexical analyzer for 'if' statement.

Algorithm:

Input: Programming language 'if' statement

Output: A sequence of tokens.

Tokens have to be identified and its respective attributes have to be printed.

Lexeme	**Token**
********	*******
If	<1,1>
variable-name	<2,#address>
numeric-constant	<3,#address>
;	<4,4>
(	<5,0>
)	<5,1>
{	<6,0>
}	<6,1>
>	<62,62>
>=	<620,620>
<	<60,60>
<=	<600,600>
!	<33,33>
!=	<330,330>
=	<61,61>
==	<610,610>

Program:

```
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<string.h>
char vars[100][100];
int vcnt;
char input[1000],c;
char token[50],tlen;
int state=0,pos=0,i=0,id;
```

```
char*getAddress(char str[])
{
for(i=0;i<vcnt;i++)
if(strcmp(str,vars[i])==0)
return vars[i];
strcpy(vars[vcnt],str);
return vars[vcnt++];
}
intisrelop(char c)
{
if(c=='>'||c=='<'||c=='|'||c=='=')
return 1;
else
return 0;
}
int main(void)
{
clrscr();
printf("Enter the Input String:");
gets(input);
do
{
c=input[pos];
putchar(c);
switch(state)
{
case 0:
if(c=='i')
state=1;
break;
case 1:
if(c=='f')
{
printf("\t<1,1>\n");
state =2;
}
break;
case 2:
if(isspace(c))
printf("\b");
if(isalpha(c))
{
token[0]=c;
tlen=1;
state=3;
}
if(isdigit(c))
state=4;
```

```
if(isrelop(c))
state=5;
if(c==';')printf("\t<4,4>\n");
if(c=='(')printf("\t<5,0>\n");
if(c==')')printf("\t<5,1>\n");
if(c=='{') printf("\t<6,1>\n");
if(c=='}') printf("\t<6,2>\n");
break;
case 3:
 if(!isalnum(c))
{
token[tlen]='\o';
printf("\b\t<2,%p>\n",getAddress(token));
state=2;
pos--;
}
else
token[tlen++]=c;
break;
case 4:
if(!isdigit(c))
{
printf("\b\t<3,%p>\n",&input[pos]);
state=2;
pos--;
}
break;
case 5:
id=input[pos-1];
if(c=='=')
printf("\t<%d,%d>\n",id*10,id*10);
else
{
printf("\b\t<%d,%d>\n",id,id);
pos--;
}
state=2;
break;
}
pos++;
}
while(c!=0);
getch();
return 0;
}
```

Sample Input & Output:

Enter the input string: if(a>=b) max=a;

if	<1,1>
(	<5,0>
a	<2,0960>
>=	<620,620>
b	<2,09c4>
)	<5,1>
max	<2,0A28>
=	<61,61>
a	<2,0A8c>
;	<4,4>

Result:

The above C program was successfully executed and verified.

Ex. No: 2

Date:

Implementation of Lexical Analyzer for Arithmetic Expression

Aim:

To write a C program to implement lexical analyzer for Arithmetic Expression.

Algorithm:

Input: Programming language arithmetic expression

Output: A sequence of tokens.

Tokens have to be identified and its respective attributes have to be printed.

Lexeme	**Token**
*******	******
Variable name	<1,#adddress>
Numeric constant	<2,#address>
;	<3,3>
=	<4,4>
+	<43,43>
+=	<430,430>
-	<45,45>
-=	<450,450>
*	<42,42>
*=	<420,420>
/	<47,47>
/=	<470,470>
%	<37,37>
%=	<370,370>
^	<94,94>
^=	<940,940>

Program:

```
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<string.h>
char vars[100][100];
int vcnt;
char input[1000],c;
char token[50],tlen;
int state=0,pos=0,i=0,id;
```

```
char *getAddress(char str[])
{
for(i=0;i<vcnt;i++)
if(strcmp(str,vars[i])==0)
return vars[i];
strcpy(vars[vcnt],str);
return vars[vcnt++];
}
intisrelop(char c)
{
if(c=='+'||c=='-'||c=='*'||c=='/'||c=='%'||c=='^')
return 1;
else
return 0;
}
int main(void)
{
clrscr();
printf("Enter the Input String:");
gets(input);
do
{
c=input[pos];
putchar(c);
switch(state)
{
case 0:
if(isspace(c))
printf("\b");
if(isalpha(c))
{
token[0]=c;
tlen=1;
state=1;
}
if(isdigit(c))
state=2;
if(isrelop(c))
state=3;
if(c==';')
printf("\t<3,3>\n");
if(c=='=')
printf("\t<4,4>\n");
break;
```

```
case 1:
if(!isalnum(c))
{
token[tlen]='\o';
printf("\b\t<1,%p>\n",getAddress(token));
state=0;
pos--;
}
else
token[tlen++]=c;
break;
case 2:
if(!isdigit(c))
{
printf("\b\t<2,%p>\n",&input[pos]);
state=0;
pos--;
}
break;
case 3:
id=input[pos-1];
if(c=='=')
printf("\t<%d,%d>\n",id*10,id*10);
else
{
printf("\b\t<%d,%d>\n",id,id);
pos--;
}
state=0;
break;
}
pos++;
}
while(c!=0);
getch();
return 0;
}
```

Sample Input & Output:

Enter the Input String: a=a*2+b/c;

a	<1,08CE>
=	<4,4>
a	<1,08CE>
*	<42,42>
2	<2,04E9>
+	<43,43>
b	<1,0932>
/	<47,47>
c	<1,0996>
;	<3,3>

Result:

The above C program was successfully executed and verified.

Ex. No: 3

Date:

Implementation of Lexical Analyzer using Lex Tool

Aim:

To write a C program to implement Lexical Analyzer using Lex Tool.

Algorithm:

1. Start the program.
2. Lex program consists of three parts.
    a. Declaration %%
    b. Translation rules %%
    c. Auxilary procedure.
3. The declaration section includes declaration of variables, maintest, constants and regular definitions.
4. Translation rule of lex program are statements of the form
    a. P1 {action}
    b. P2 {action}
    c. …
    d. …
    e. Pn {action}
5. Write a program in the vi editor and save it with .l extension.
6. Compile the lex program with lex compiler to produce output file as
    lex.yy.c. eg $ lex filename.l
    $ cc lex.yy.c -ll
7. Compile that file with C compiler and verify the output.

Program:

Lexical.C:

```
#include<stdio.h>
#include<conio.h>
#include<ctype.h>
#include<string.h>
void main()
{
FILE  *fi,*fo,*fop,*fk;
int flag=0,i=1;
char c,t,a[15],ch[15],file[20];
clrscr();
printf("\n Enter the File Name:");
scanf("%s",&file);
fi=fopen(file,"r");
```

```
fo=fopen("inter.c","w");
fop=fopen("oper.c","r");
fk=fopen("key.c","r");
c=getc(fi);
while(!feof(fi))
{
if(isalpha(c)||isdigit(c)||(c=='['||c==']'||c=='.'==1))
fputc(c,fo);
else
{
if(c=='\n')
fprintf(fo,"\t$\t");
else
fprintf(fo,"\t%c\t",c);
}
c=getc(fi);
}
fclose(fi);
fclose(fo);
fi=fopen("inter.c","r");
printf("\n Lexical Analysis");
fscanf(fi,"%s",a);
printf("\n Line: %d\n",i++);
while(!feof(fi))
{
if(strcmp(a,"$")==0)
{
printf("\n Line: %d \n",i++);
fscanf(fi,"%s",a);
}
fscanf(fop,"%s",ch);
while(!feof(fop))
{
if(strcmp(ch,a)==0)
{
fscanf(fop,"%s",ch);
printf("\t\t%s\t:\t%s\n",a,ch);
flag=1;
}
fscanf(fop,"%s",ch);
}
rewind(fop);
fscanf(fk,"%s",ch);
while(!feof(fk))
{
if(strcmp(ch,a)==0)
{
```

```
fscanf(fk,"%k",ch);
printf("\t\t%s\t:\tKeyword\n",a);
flag=1;
}
fscanf(fk,"%s",ch);
}
rewind(fk);
if(flag==0)
{
if(isdigit(a[0]))
printf("\t\t%s\t:\tConstant\n",a);
else
printf("\t\t%s\t:\tIdentifier\n",a);
}
flag=0;
fscanf(fi,"%s",a);
}
getch();
}
```

Key.C:

```
int
void
main
char
if
for
while
else
printf
scanf
FILE
include
stdio.h
conio.h
iostream.h
```

Oper.C:

```
( open para
) closepara
{ openbrace
} closebrace
< lesser
> greater
" doublequote
' singlequote
```

: colon
; semicolon
preprocessor
= equal
== asign
% percentage
^ bitwise
& reference
* star
+ add
- sub
\ backslash
/ slash

Input.C:

```
#include  "stdio.h"
#include "conio.h"
void main()
{
int a=10,b,c;
a=b*c;
getch();
}
```

Sample Input & Output:

Enter the File Name: Input.C

Line: 1
: Preprocessor
include : keyword
< : lesser
stdio.h : keyword
> : greater

Line: 2
: Preprocessor
include : keyword
< : lesser
conio.h : keyword
> : greater

Line: 3
void : keyword

main : keyword
(: openpara
) : closepara

Line: 4
{ : openbrace

Line: 5
int : keyword
a : identifier
= : equal
10 : constant
, : identifier
b : identifier
, : identifier
c : identifier
; : semicolon

Line: 6
a : identifier
= : equal
b : identifier
* : star
c : identifier
; : semicolon

Line: 8
} : closebrace

Result:

The above C program was successfully executed and verified.

Ex. No: 4

Date:

Construction of NFA from Regular Expression

Aim:

To write a C program to construct a Non Deterministic Finite Automata (NFA) from Regular Expression.

Algorithm:

1. Start the Program.
2. Enter the regular expression R over alphabet E.
3. Decompose the regular expression R into its primitive components
4. For each component construct finite automata.
5. To construct components for the basic regular expression way that corresponding to that way compound regular expression.
6. Stop the Program.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<ctype.h>
#include<string.h>
#include<graphics.h>
#include<math.h>
#include<process.h>
int minx=1000,miny=0;
void star(int *x1,int *y1,int *x2,int *y2)
{
char pr[10];
ellipse(*x1+(*x2-*x1)/2,*y2-10,0,180,(*x2-*x1)/2,70);
outtextxy(*x1-2,*y2-17,"v");
line(*x2+10,*y2,*x2+30,*y2);
outtextxy(*x1-15,*y1-3,">");
circle(*x1-40,*y1,10);
circle(*x1-80,*y1,10);
line(*x1-30,*y2,*x1-10,*y2);
outtextxy(*x2+25,*y2-3,">");
sprintf(pr,"%c",238);
outtextxy(*x2+15,*y2-9,pr);
outtextxy(*x1-25,*y1-9,pr);
outtextxy((*x2-*x1)/2+*x1,*y1-30,pr);
```

```
outtextxy((*x2-*x1)/2+*x1,*y1+30,pr);
ellipse(*x1+(*x2-*x1)/2,*y2+10,180,360,(*x2-*x1)/2+40,70);
outtextxy(*x2+37,*y2+14,"^");
if(*x1-40<minx)minx=*x1-40;
miny=*y1;
}
void star1(int *x1,int *y1,int *x2,int *y2)
{
char pr[10];
ellipse(*x1+(*x2-*x1)/2+15,*y2-10,0,180,(*x2-*x1)/2+15,70);
outtextxy(*x1-2,*y2-17,"v");
line(*x2+40,*y2,*x2+60,*y2);
outtextxy(*x1-15,*y1-3,">");
circle(*x1-40,*y1,10);
line(*x1-30,*y2,*x1-10,*y2);
outtextxy(*x2+25,*y2-3,">");
sprintf(pr,"%c",238);
outtextxy(*x2+15,*y2-9,pr);
outtextxy(*x1-25,*y1-9,pr);
outtextxy((*x2-*x1)/2+*x1,*y1-30,pr);
outtextxy((*x2-*x1)/2+*x1,*y1+30,pr);
ellipse(*x1+(*x2-*x1)/2+15,*y2+10,180,360,(*x2-*x1)/2+50,70);
outtextxy(*x2+62,*y2+13,"^");
if(*x1-40<minx)minx=*x1-40;
miny=*y1;
}
void basis(int *x1,int *y1,char x)
{
char pr[5];
circle(*x1,*y1,10);
line(*x1+30,*y1,*x1+10,*y1);
sprintf(pr,"%c",x);
outtextxy(*x1+20,*y1-10,pr);
outtextxy(*x1+23,*y1-3,">");
circle(*x1+40,*y1,10);
if(*x1<minx)minx=*x1;
miny=*y1;
}
void slash(int *x1,int *y1,int *x2,int *y2,int *x3,int *y3,int *x4,int *y4)
{
char pr[10];
int c1,c2;
c1=*x1;
if(*x3>c1)c1=*x3;
c2=*x2;
if(*x4>c2)c2=*x4;
line(*x1-10,*y1,c1-40,(*y3-*y1)/2+*y1-10);
```

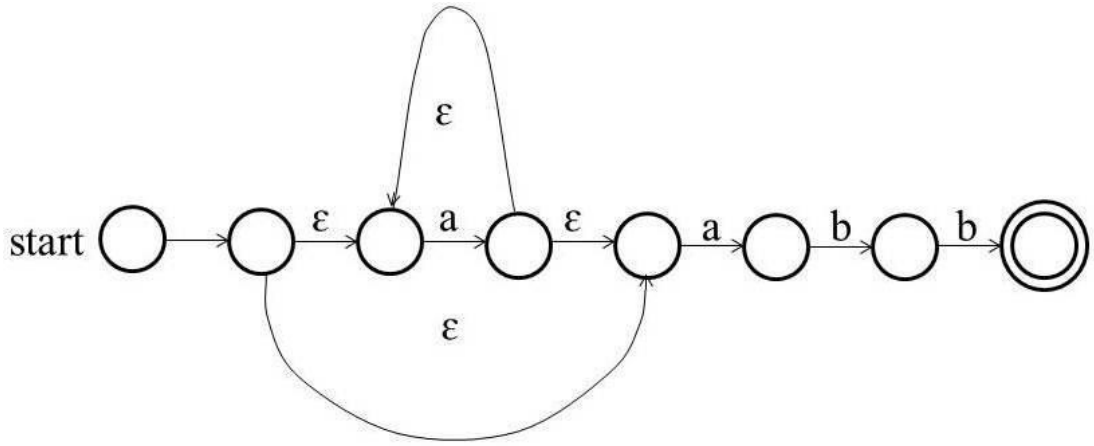
```
outtextxy(*x1-15,*y1-3,">");
outtextxy(*x3-15,*y4-3,">");
circle(c1-40,(*y4-*y2)/2+*y2,10);
sprintf(pr,"%c",238);
outtextxy(c1-40,(*y4-*y2)/2+*y2+25,pr);
outtextxy(c1-40,(*y4-*y2)/2+*y2-25,pr);
line(*x2+10,*y2,c2+40,(*y4-*y2)/2+*y2-10);
line(*x3-10,*y3,c1-40,(*y3-*y1)/2+*y2+10);
circle(c2+40,(*y4-*y2)/2+*y2,10);
outtextxy(c2+40,(*y4-*y2)/2+*y2-25,pr);
outtextxy(c2-40,(*y4-*y2)/2+*y2+25,pr);
outtextxy(c2+35,(*y4-*y2)/2+*y2-15,"^");
outtextxy(c1+35,(*y4-*y2)/2+*y2+10,"^");
line(*x4+10,*y2,c2+40,(*y4-*y2)/2+*y2+10);
minx=c1-40;
miny=(*y4-*y2)/2+*y2;
}
void main()
{
int d=0,l,x1=200,y1=200,len,par=0,op[10];
int cx1=200,cy1=200,cx2,cy2,cx3,cy3,cx4,cy4;
char str[20];
int gd=DETECT,gm;
int stx[20],endx[20],sty[20],endy[20];
int pos=0,i=0;
clrscr();
initgraph(&gd,&gm,"c:\\dosapp\\tcplus\\bgi");
printf("\n enter the regular expression:");
scanf("%s",str);
len=(strlen(str));
while(i<len)
{
if(isalpha(str[i]))
{
if(str[i+1]=='*')x1=x1+40;
basis(&x1,&y1,str[i]);
stx[pos]=x1;
endx[pos]=x1+40;
sty[pos]=y1;
endy[pos]=y1;
x1=x1+40;
pos++;
}
if(str[i]=='*')
{
star(&stx[pos-1],&sty[pos-1],&endx[pos-1],&endy[pos-1]);
stx[pos-1]=stx[pos-1]-40;
```

```
endx[pos-1]=endx[pos-1]+40;
x1=x1+40;
}
if(str[i]=='(')
{
int s;
s=i;
while(str[s]!=')')s++;
if((str[s+1]=='*')&&(pos!=0))x1=x1+40;
op[par]=pos;
par++;
}
if(str[i]==')')
{
cx2=endx[pos-1];
cy2=endy[pos-1];
l=op[par-1];
cx1=stx[1];
cx2=sty[1];
par--;
if(str[i+1]=='*')
{
i++;
star1(&cx1,&cy1,&cx2,&cy2);
cx1=cx1-40;
cx2=cx2+40;
stx[1]=stx[1]-40;
endx[pos-1]=endx[pos-1]+40;
x1=x1+40;
}
if(d==1)
{
slash(&cx3,&cy3,&cx4,&cy4,&cx1,&cy1,&cx2,&cy2);
if(cx4>cx2)x1=cx4+40;
else x1=cx2+40;
y1=(y1-cy4)/2.0+cy4;
d=0;
}
}
if(str[i]=='/')
{
cx2=endx[pos-1];
cy2=endy[pos-1];
x1=200;
y1=y1+100;
```

```
if(str[i+1]=='(')
{
d=1;
cx3=cx1;
cy3=cy1;
cx4=cx2;
cy4=cy2;
}
if(isalpha(str[i+1]))
{
i++;
basis(&x1,&y1,str[i]);
stx[pos]=x1;
endx[pos]=x1+40;
sty[pos]=y1;
endy[pos]=y1;
if(str[i+1]=='*')
{
i++;
star(&stx[pos],&sty[pos],&endx[pos],&endy[pos]);
stx[pos]=stx[pos]-40;
endx[pos]=endx[pos]+40;
}
slash(&cx1,&cy1,&cx2,&cy2,&stx[pos],&sty[pos],&endx[pos],&endy[pos]);
if(cx2>endx[pos])x1=cx2+40;
else x1=endx[pos]+40;
y1=(y1-cy2)/2.0+cy2;
cx1=cx1-40;
cy1=(sty[pos]-cy1)/2.0+cy1;
cx2=cx2+40;
cy2=(endy[pos]-cy2)/2.0+cy2;
l=op[par-1];
stx[1]=cx1;
sty[1]=cy1;
endx[pos]=cx2;
endy[pos]=cy2;
pos++;
}
}
i++;
}
circle(x1,y1,13);
line(minx-30,miny,minx-10,miny);
outtextxy(minx-100,miny-10,"start");
outtextxy(minx-15,miny-3,">");
```

```
getch();
closegraph();
}
```

Sample Input & Output:



Result:

The above C program was successfully executed and verified.

Ex.No: 5

Date:

Construction of DFA from NFA

Aim:

To write a C program to construct a DFA from the given NFA.

Algorithm:

1. Start the program.
2. Accept the number of state A and B.
3. Find the E-closure for node and name if as A.
4. Find v(a,a) and (a,b) and find a state.
5. Check whether a number new state is obtained.
6. Display all the state corresponding A and B.
7. Stop the program.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<ctype.h>
#include<process.h>
typedef struct
{
int num[10],top;
}
stack;
stack s;
int mark[16][31],e_close[16][31],n,st=0;
char data[15][15];
void push(int a)
{
s.num[s.top]=a;
s.top=s.top+1;
}
int pop()
{
int a;
if(s.top==0)
return(-1);
s.top=s.top-1;
a=s.num[s.top];
```

```
return(a);
}
void epi_close(int s1,int s2,int c)
{
int i,k,f;
for(i=1;i<=n;i++)
{
if(data[s2][i]=='e')
{
f=0;
for(k=1;k<=c;k++)
if(e_close[s1][k]==i)
f=1;
if(f==0)
{
c++;
e_close[s1][c]=i;
push(i);
}
}
}
while(s.top!=0) epi_close(s1,pop(),c);
}
int move(int sta,char c)
{
int i;
for(i=1;i<=n;i++)
{
if(data[sta][i]==c)
return(i);
}
return(0);
}
void e_union(int m,int n)
{
int i=0,j,t;
for(j=1;mark[m][i]!=-1;j++)
{
while((mark[m][i]!=e_close[n][j])&&(mark[m][i]!=-1))
i++;
if(mark[m][i]==-1)mark[m][i]=e_close[n][j];
}
}
void main()
{
int i,j,k,Lo,m,p,q,t,f;
clrscr();
```

```
printf("\n enter the NFA state table entries:");
scanf("%d",&n);
printf("\n");
for(i=0;i<=n;i++)
printf("%d",i);
printf("\n");
for(i=0;i<=n;i++)
printf(" ----- ");
printf("\n");
for(i=1;i<=n;i++)
{
printf("%d|",i);
fflush(stdin);
for(j=1;j<=n;j++)
scanf("%c",&data[i][j]);
}
for(i=1;i<=15;i++)
for(j=1;j<=30;j++)
{
e_close[i][j]=-1;
mark[i][j]=-1;
}
for(i=1;i<=n;i++)
{
e_close[i][1]=i;
s.top=0;
epi_close(i,i,1);
}
for(i=1;i<=n;i++)
{
for(j=1;e_close[i][j]!=-1;j++)
for(k=2;e_close[i][k]!=-1;k++)
if(e_close[i][k-1]>e_close[i][k])
{
t=e_close[i][k-1];
e_close[i][k-1]=e_close[i][k];
e_close[i][k]=t;
}
}
printf("\n the epsilon closures are:");
for(i=1;i<=n;i++)
{
printf("\n E(%d)={",i);
for(j=1;e_close[i][j]!=-1;j++)
printf("%d",e_close[i][j]);
printf("}");
}
```

```
j=1;
while(e_close[1][j]!=-1)
{
mark[1][j]=e_close[1][j];
j++;
}
st=1;
printf("\n DFA Table is:");
printf("\n              a              b      ");
printf("\n----------------------------------------------");
for(i=1;i<=st;i++)
{
printf("\n{");
for(j=1;mark[i][j]!=-1;j++)
printf("%d",mark[i][j]);
printf("}");
while(j<7)
{
printf(" ");
j++;
}
for(Lo=1;Lo<=2;Lo++)
{
for(j=1;mark[i][j]!=-1;j++)
{
if(Lo==1)
t=move(mark[i][j],'a');
if(Lo==2)
t=move(mark[i][j],'b');
if(t!=0)
e_union(st+1,t);
}
for(p=1;mark[st+1][p]!=-1;p++)
for(q=2;mark[st+1][q]!=-1;q++)
{
if(mark[st+1][q-1]>mark[st+1][q])
{
t=mark[st+1][q];
mark[st+1][q]=mark[st+1][q-1];
mark[st+1][q-1]=t;
}
}
f=1;
for(p=1;p<=st;p++)
{
j=1;
```

```
while((mark[st+1][j]==mark[p][j])&&(mark[st+1][j]!=-1))
j++;
if(mark[st+1][j]==-1 && mark[p][j]==-1)
f=0;
}
if(mark[st+1][1]==-1)
f=0;
printf("\t{");
for(j=1;mark[st+1][j]!=-1;j++)
{
printf("%d",mark[st+1][j]);
}
printf("}\t");
if(Lo==1)
printf(" ");
if(f==1)
st++;
if(f==0)
{
for(p=1;p<=30;p++)
mark[st+1][p]=-1;
}
}
}
getch();
}
```

Sample Input & Output:

Enter the NFA state table entries: 11

(**Note:** *Instead of* '-' *symbol use blank spaces in the output window*)

```
0  1  2  3  4  5  6  7  8  9  10  11
-----------------------------------------------
1 -  e -  -  -  - -  e  -  -  -
2 -  -  e -  e -  - -  -  -  -
3 -  -  - a  - -  -  -  -  -  -
4 -  -  -  -  - -  e  -  -  -  -
5 -  -  -  -  - b -  -  -  -  -
6 -  -  -  -  -  -  e - -  -  -
7 -  e  -  -  -  -  - e -  -  -
8 -  -  -  -  -  -  -  - e  -  -
9 -  -  -  -  -  -  -  -  - e  -
10 ---------------------------------e
11 - -  -  -  -  -  -  -  -  -  -
```

The Epsilon Closures Are:

```
E(1)={12358}
E(2)={235}
E(3)={3}
E(4)={234578}
E(5)={5}
E(6)={235678}
E(7)={23578}
E(8)={8}
E(9)={9}
E(10)={10}
E(11)={11}
```

DFA Table is:

```
            a            b
-----------------------------------
{12358}      {2345789}        {235678}
{2345789}    {2345789}        {23567810}
{235678}     {2345789}        {235678}
{23567810}   {2345789}        {23567811}
{23567811}   {2345789}        {235678}
```

Result:

The above C program was successfully executed and verified.

Ex.No: 6

Date:

Implementation of Shift Reduce Parsing Algorithm

Aim:

To write a C program to implement the shift-reduce parsing algorithm.

Algorithm:

Grammar:

E->E+E

E->E*E

E->E/E

E->a/b

Method:

Stack	Input Symbol	Action
$	id1*id2$	shift
$id1	*id2 $	shift *
$*	id2$	shift id2
$id2	$	shift
$	$	accept

Shift: Shifts the next input symbol onto the stack.

Reduce: Right end of the string to be reduced must be at the top of the stack.

Accept: Announce successful completion of parsing.

Error: Discovers a syntax error and call an error recovery routine.

Program:

```
#include<conio.h>
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
char ip_sym[15],stack[15];
int ip_ptr=0,st_ptr=0,len,i;
char temp[2],temp2[2];
char act[15];
void check();
void main()
{
clrscr();
printf("\n\n\t Shift Reduce Parser\n");
printf("\n\t****** ****** ******");
printf("\n Grammar\n\n");
printf("E->E+E\nE->E/E\n");
printf("E->E*E\nE->a/b");
printf("\n Enter the Input Symbol:\t");
gets(ip_sym);
printf("\n\n\t Stack Implementation Table");
printf("\n Stack\t\t Input Symbol\t\t Action");
printf("\n $\t\t %s$\t\t\t --",ip_sym);
strcpy(act,"shift");
temp[0]=ip_sym[ip_ptr];
temp[1]='\0';
strcat(act,temp);
len=strlen(ip_sym);
for(i=0;i<=len-1;i++)
{
stack[st_ptr]=ip_sym[ip_ptr];
stack[st_ptr+1]='\0';
ip_sym[ip_ptr]=' ';
ip_ptr++;
printf("\n$%s\t\t%s$\t\t\t%s",stack,ip_sym,act);
strcpy(act,"shift");
temp[0]=ip_sym[ip_ptr];
temp[1]='\0';
strcat(act,temp);
check();
st_ptr++;
}
st_ptr++;
check();
getch();
}
```

```
void check()
{
int flag=0;
temp2[0]=stack[st_ptr];
temp[1]='\0';
if((!strcmpi(temp2,"a"))||(!strcmpi(temp2,"b")))
{
stack[st_ptr]='E';
if(!strcmpi(temp2,"a"))
printf("\n$%s\t\t%s$\t\t\tE->a",stack,ip_sym);
else
printf("\n$%s\t\t%s$\t\t\tE->a",stack,ip_sym);
flag=1;
}
if((!strcmpi(temp2,"+"))||(strcmpi(temp2,"*"))||(!strcmpi(temp2,"/")))
{
flag=1;
}
if((!strcmpi(stack,"E+E"))||(!strcmpi(stack,"E/E"))||(!strcmpi(stack,"E*E")))
{
strcpy(stack,"E");
st_ptr=0;
if(!strcmpi(stack,"E+E"))
printf("\n$%s\t\t%s$\t\t\tE->E+E",stack,ip_sym);
else
if(!strcmpi(stack,"E/E"))
printf("\n$%s\t\t\t%s$\t\tE->E/E",stack,ip_sym);
else
printf("\n$%s\t\t%s$\t\t\tE->E*E",stack,ip_sym);
flag=1;
}
if(!strcmpi(stack,"E")&&ip_ptr==len)
{
printf("\n$%s\t\t%s$\t\t\tAccept",ip_sym);
getch();
exit(0);
}
if(flag==0)
{
printf("\n %s \t\t\t %s \t\t Reject",stack,ip_sym);
}
return;
}
```

Sample Input & Output:

Shift Reduce Parser
***** ****** *****
Grammar

E->E+E
E->E/E
E->E*E
E->a/b

Enter the input symbol: if(a*b)

Stack Implementation Table

Stack	Input Symbol	Action
$	if(a*b)$	--
$i	f(a*b)$	shift i
$if	(a*b)$	shift f
$if(	a*b)$	shift (
$if(a	*b)$	shift a
$if(E	*b)$	E->a
$if(E*	b)$	shift *
if(E*	b)	reject

Press any key to continue...

Result:

The above C program was successfully executed and verified.

Ex.No: 7

Date:

Implementation of Operator Precedence Parser

Aim:

To write a C program to implement Operator Precedence Parser.

Algorithm:

Input: String of terminals from the operator grammar

Output: Sequence of shift reduce step1

Method:

1- Let the input string to be initially the stack contains, when the reduce action takes place we have to reach create parent child relationship.

2- See IP to pointer to the first symbol of input string and repeat forever if only $ is on the input accept and break else begin.

3- Let 'd' be the top most terminal on the stack and 'b' be current input IF(a<b) or a=b then Begin push 'b' onto the stack.

4- Advance Input to the stack to the next Input symbol

end;

else if(a>b)

5- Repeat pop the stack until the top most terminal is related by < to the terminal most recently popped else error value routine

end;

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<ctype.h>
char q[9][9]={
{'>','>','<','<','<','<','>','<','>' },
{'>','>','<','<','<','<','>','<','>' },
{'>','>','>','>','<','<','>','<','>' },
{'>','>','>','>','<','<','>','<','>' },
{'>','>','<','<','<','<','>','<','>' },
```

```
{'<','<','<','<','<','<','=','<','E' },
{'>','>','>','>','>','E','>','E','>' },
{'>','>','>','>','>','E','>','E','>' },
{'<','<','<','<','<','<','E','<','A' }
};
char s[30],st[30],qs[30];
int top=-1,r=-1,p=0;
void push(char a)
{
top++;
st[top]=a;
}
char pop()
{
char a;
a=st[top];
top--;
return a;
}
int find(char a)
{
switch(a)
{
case '+':return 0;
case '-':return 1;
case '*':return 2;
case '/':return 3;
case '^':return 4;
case '(':return 5;
case ')':return 6;
case 'a':return 7;
case '$':return 8;
default :return -1;
}
}
void display(char a)
{
printf("\n Shift %c",a);
}
void display1(char a)
{
if(isalpha(a))
printf("\n Reduce E->%c",a);
else if((a=='+')||(a=='-')||(a=='*')||(a=='/')||(a=='^'))
printf("\n Reduce E->E%cE",a);
else if(a==')')

printf("\n Reduce E->(E)");
```

```
}
intrel(char a,char b,char d)
{
if(isalpha(a)!=0)
a='a';
if(isalpha(b)!=0)
b='a';
if(q[find(a)][find(b)]==d)
return 1;
else
return 0;
}
void main()
{
char s[100];
int i=-1;
clrscr();
printf("\n\t Operator Preceding Parser\n");
printf("\n Enter the Arithmetic Expression End with $..");
gets(s);
push('$');
while(i)
{
if((s[p]=='$')&&(st[top]=='$'))
{
printf("\n\nAccepted");
break;
}
else if(rel(st[top],s[p],'<')||rel(st[top],s[p],'='))
{
display(s[p]);
push(s[p]);
p++;
}
else if(rel(st[top],s[p],'>'))
{
do
{
r++;
qs[r]=pop();
display1(qs[r]);
}
while(!rel(st[top],qs[r],'<'));
}
}
getch();
}
```

Sample Input & Output:

Enter the Arithmetic Expression End with $: a-(b*c)^d$

Shift a
Reduce E->a
Shift -
Shift (
Shift b
Reduce E->b
Shift *
Shift c
Reduce E->c
Reduce E->E*E
Shift)
Reduce E->(E)
Shift ^
Shift d
Reduce E->d
Reduce E->E^E
Reduce E->E-E
Accepted

Result:

The above C program was successfully executed and verified.

Ex.No: 8

Date:

Implementation of Recursive Descent Parser

Aim:

To write a C program to implement Recursive Descent Parser.

Algorithm:

Input: Context Free Grammar without last recursion and an input string from the grammar.

Output: Sequence of productions rules used to derive the sentence.

Method:

Consider the grammar
E->TE
E'->+TE'/e
T->FT
T->*FT/e
F->(E)/Id

To recursive decent parser for the above grammar is given below

Procedure:

```
Begin
T()
E_prime();
print E-> TE'
end

procedureeprime():
ifip_sym+='+' then
begin
advance();
T();
eprime();
prime E'->TE'
end
else
print E'->e

procedure T();
begin
e();
```

```
Tprime();
print T->FT';
end;

procedureTprime();
ifip_sym='*' then
begin
advance();
F();
Tprime()
print T'->T*FT'
end
else print T'->e

procedure F()
ifip_sym =id then
begin
advance();
print->id
end
else
Error();
end;
else
Error();
```

Program:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#include<string.h>
char ip_sym[15],ip_ptr=0;
void e_prime();
void t();
void e();
void t_prime();
void f();
void advance();
void e()
{
printf("\n\t\tE' ------ >TE'");
t();
e_prime();
}
void e_prime()
{
```

```
if(ip_sym[ip_ptr]=='+')
{
printf("\n\t\tE' ------>+TE'");
advance();
t();
e_prime();
}
else
printf("\n\t\tE' ---->e'");
}
void t()
{
printf("\n\t\tT' ------>FT'"); f();
t_prime();
}
void t_prime()
{
if(ip_sym[ip_ptr]=='*')
{
printf("\n\t\tT----- >*FT'"); advance();
f();
t_prime();
}
else
{
printf("\n\t\tT' ---->e");
}
}
void f()
{
if((ip_sym[ip_ptr]=='i')||(ip_sym[ip_ptr]=='j'))
{
printf("\n\t\tF----- >i"); advance();
}
else
{
if(ip_sym[ip_ptr]=='(')
{
advance();
e();
if(ip_sym[ip_ptr]==')')
{
advance();
printf("\n\t\tF---- >(E)");
}
```

```
else
{
printf("\n\t\tSyntax Error");
getch();
exit(1);
}
}
}
}
void advance()
{
ip_ptr++;
}
void main()
{
int i;
clrscr();
printf("\n\t\tGRAMMER WITHOUT RECURSION");
printf("\n\t\tE------>TE'\n\t\tE'/e\r\t\tT----->FT");
printf("\n\t\tT------>*FT/e\n\t\tF ----->(E)/id");
printf("\n\t\tEnter the Input Symbol: ");
gets(ip_sym);
printf("\n\t\tSequence of Production Rules");
e();
getch();
}
```

Sample Input & Output:

```
GRAMMER WITHOUT RECURSION
E ----->TE'
T ---->FT
T ----->*FT/e
F ----->(E)/id

Enter the Input Symbol: T

Sequence of Production Rules
E'------ >TE'
T'------ >FT'
T'---- >e
E'---- >e'
```

Result:

The above C program was successfully executed and verified.

Ex.No: 9

Date:

Implementation of Code Optimization Techniques

Aim:

To write a C program to implement Code Optimization Techniques.

Algorithm:

Input: Set of 'L' values with corresponding 'R' values.

Output: Intermediate code & Optimized code after eliminating common expressions.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
struct op
{
char l;
char r[20];
}
op[10],pr[10];
void main()
{
int a,i,k,j,n,z=0,m,q;
char *p,*l;
char temp,t;
char *tem;
clrscr();
printf("Enter the Number of Values:");
scanf("%d",&n);
for(i=0;i<n;i++)
{
printf("left:  ");
op[i].l=getche();
printf("\tright: ");
scanf("%s",op[i].r);
}
printf("Intermediate Code\n") ;
for(i=0;i<n;i++)
{
printf("%c=",op[i].l);
printf("%s\n",op[i].r);
}
```

```
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++;
}
}
}
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\t=",pr[k].l);
printf("%s\n",pr[k].r);
}
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;
printf("pos: %d",a);
pr[i].r[a]=pr[m].l;
}
}
}
}
}
```

```
printf("Eliminate Common Expression\n");
for(i=0;i<z;i++)
{
printf("%c\t=",pr[i].l);
printf("%s\n",pr[i].r);
}
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';
strcpy(pr[i].r,'\0');
}
}
}
printf("Optimized Code\n");
for(i=0;i<z;i++)
{
if(pr[i].l!='\0')
{
printf("%c=",pr[i].l);
printf("%s\n",pr[i].r);
}
}
getch();
}
```

Sample Input & Output:

```
Enter the Number of Values: 5
Left:  a        right: 9
Left:  b        right:  c+d
Left:  e        right:  c+d
Left:  f        right:  b+e
Left:  r        right:  f

Intermediate Code
a=9
b=c+d
e=c+d
f=b+e
r=:f

After Dead Code Elimination
b     =c+d
e     =c+d
f     =b+e
r     =:f

Eliminate Common Expression
b     =c+d
b     =c+d
f     =b+b
r     =:f

Optimized Code
b=c+d
f=b+b
r=:f
```

Result:

The above C program was successfully executed and verified.

Ex.No: 10

Date:

Implementation of Code Generator

Aim:

To write a C program to implement Simple Code Generator.

Algorithm:

Input: Set of three address code sequence.

Output: Assembly code sequence for three address codes (opd1=opd2, op, opd3).

Method:

1- Start
2- Get address code sequence.
3- Determine current location of 3 using address (for 1st operand).
4- If current location not already exist generate move (B,O).
5- Update address of A(for 2nd operand).
6- If current value of B and () is null,exist.
7- If they generate operator () A,3 ADPR.
8- Store the move instruction in memory
9- Stop.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<ctype.h>
#include<graphics.h>
typedef struct
{
char var[10];
int alive;
}
regist;
regist preg[10];
void substring(char exp[],int st,int end)
{
int i,j=0;
char dup[10]="";
for(i=st;i<end;i++)
dup[j++]=exp[i];
dup[j]='0';
```

```
strcpy(exp,dup);
}
int getregister(char var[])
{
int i;
for(i=0;i<10;i++)
{
if(preg[i].alive==0)
{
strcpy(preg[i].var,var);
break;
}
}
return(i);
}
void getvar(char exp[],char v[])
{
int i,j=0;
char var[10]="";
for(i=0;exp[i]!='\0';i++)
if(isalpha(exp[i]))
var[j++]=exp[i];
else
break;
strcpy(v,var);
}
void main()
{
char basic[10][10],var[10][10],fstr[10],op;
int i,j,k,reg,vc,flag=0;
clrscr();
printf("\nEnter the Three Address Code:\n");
for(i=0;;i++)
{
gets(basic[i]);
if(strcmp(basic[i],"exit")==0)
break;
}
printf("\nThe Equivalent Assembly Code is:\n");
for(j=0;j<i;j++)
{
getvar(basic[j],var[vc++]);
strcpy(fstr,var[vc-1]);
substring(basic[j],strlen(var[vc-1])+1,strlen(basic[j]));
getvar(basic[j],var[vc++]);
reg=getregister(var[vc-1]);
```

```
if(preg[reg].alive==0)
{
printf("\nMov R%d,%s",reg,var[vc-1]);
preg[reg].alive=1;
}
op=basic[j][strlen(var[vc-1])];
substring(basic[j],strlen(var[vc-1])+1,strlen(basic[j]));
getvar(basic[j],var[vc++]);
switch(op)
{
case '+': printf("\nAdd"); break;
case '-': printf("\nSub"); break;
case '*': printf("\nMul"); break;
case '/': printf("\nDiv"); break;
}
flag=1;
for(k=0;k<=reg;k++)
{
if(strcmp(preg[k].var,var[vc-1])==0)
{
printf("R%d, R%d",k,reg);
preg[k].alive=0;
flag=0;
break;
}
}
if(flag)
{
printf(" %s,R%d",var[vc-1],reg);
printf("\nMov %s,R%d",fstr,reg);
}
strcpy(preg[reg].var,var[vc-3]);
getch();
}
}
```

Sample Input & Output:

Enter the Three Address Code:
a=b+c
c=a*c
exit

The Equivalent Assembly Code is:

```
Mov R0,b
Add  c,R0
Mov a,R0
Mov R1,a
Mul  c,R1
Mov c,R1
```

Result:

The above C program was successfully executed and verified.