LAB MANUAL

COMPILER DESIGN LAB
[RCS-652]

DEPARTMENT
OF
COMPUTER SCIENCE & ENGINEERING

SHRI RAMSWAROOP MEMORIAL GROUP
OF PROFESSIONAL COLLEGES,
LUCKNOW, UP

AFFILIATED TO

Dr. A. P. J. ABDUL KALAM TECHNICAL UNIVERSITY

Lucknow UP

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RAMSWAROOP
MEMORIAL GROUP OF PROFESSIONAL COLLEGES

An ISO 9001:2008 Certified College
Governed by SRMIMCA
(Affiliated to Dr. A. P. J. Abdul Kalam Technical University, Lucknow, Approved by AICTE, New Delhi)

OUR VISION

To achieve international standards in value based professional education for the benefit of society and the nation.

OUR MISSION

- To dedicate teaching, learning, and collaborating in pursuit of frontier technologies with a spirit of innovation and excellence.
- To foster human values and ethos, compassion for ecosystem and obligation towards society and the nation.
- To provide an environment conducive to continuous learning, and all-round development of college fraternity.

Prof. (Dr.) [illegible]
Director [illegible]
Shri [illegible] Group [illegible]
[illegible]

IQAC
Shri Ramswaroop Memorial Group of Professional Colleges, Lucknow

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

To become a world class seat of learning in Computer Science to produce competent software professionals with strong values and dedication to the nation.

MISSION

M1: To produce competent Computer Science professionals through quality education.

M2: To inculcate social and ethical values in students for the wellbeing of the nation.

M3: To encourage exploration of cutting-edge technologies and pursuance of lifelong learning.

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Program Outcomes (POs)

POs describe what the students are expected to know and would be able to do upon the graduation as a professional engineer. These are various graduate attributes that relate to the skills, knowledge, competence, and behaviour that students acquire at the end of engineering programme. The POs adopted by NDA for UG Engineering Programme are given below:

PO-01 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-02 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-03 Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-04 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

PO-05 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-06 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-07 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-08 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-09 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Prof. (Col.) H.K. Jaiswal
Director General
Shri Ramswaroop Memorial Group of
Professional Colleges, Lucknow

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAMME SPECIFIC OUTCOME

PS01: Quick Learner: Ability to learn and adapt quickly in the rapidly changing and ever evolving field of computer science.

PS02: Proficiency in software: To be deft and well versed with various standard and open source software.

PROGRAM EDUCATIONAL OBJECTIVE

PE01: To have sound knowledge in mathematical, scientific and engineering concepts to formulate, design, analyze, and solve engineering problems so as to be ready for corporate world, higher education and research.

PE02: To be technically competent, and quick to adapt the technological advancements to remain current in the profession.

PE03: To be deft in working as a team player in a multidisciplinary- multifunctional environment.

PE04: To be ethical, humane and socially committed computer engineer having empathy for the society.

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Instructions for the students for conduct of Lab Practicals

1. Experiment list for the lab has been displayed. Each experiment is given a number.

2. For each day, a group of three or four students has been allotted a specific experiment, which has been shown on experiment allotment chart.

3. Students will carry out experiment shown against his/her name for the day. Change is not permitted.

4. The experiment write up will be completed on the same day and shown to faculty / lab in-charge. **Marks will be given for the experiment conducted if the write up is submitted on the same day. Marks will be deducted for delayed submission.**

5. Students may be permitted to carry out missed experiments in their own time with the approval of faculty / lab in-charge only.

6. No marks will be awarded for the experiments not done by the students.

7. Practical marks awarded at the end of semester will be strictly, according to marks allotted in the lab as per above procedure. Students are therefore advised **to ensure regular conduct of practicals and timely submission of report / writeup.**

Prof. A.K. Mehrotra
(Principal)

C:\desktop office\ins

Do's and Don't

Do's:-

1) Entry of student should be made with terminal number.
2) Student must enter the lab in uniform.
3) Properly shut down the system before leaving.
4) Student should arrange the chair after leaving.
5) Student must maintain discipline in the lab.
6) Printing schedule should be followed.
7) Student should come with proper study material in labs.

Don't:-

1) Spitting, smoking and chewing is not allowed.
2) Student should not play games in the computer.
3) Use of mobile is strictly prohibited in the lab.
4) Do not come with bags and baggage in the lab.
5) Do not install the software without permission.
6) Do not insert pen drive in computer without permission.

Lab Instructor/ Lab Incharge

SHRI RAMSWAROOP MEMORIAL GROUP OF PROFESSIONAL COLLEGES

B. TECH. (CS) VI SEM. (2019-20)

COMPILER DESIGN LAB

(RCS-652)

INDEX

Course Outcome (CO) :

At the end of this course, the student will be able to:

CO1 : Identify patterns, tokens & regular expressions for lexical analysis.
CO2 : Design Lexical analyser for given language using C and LEX /YACC tools.
CO3 : Design and analyze top down and bottom up parsers
CO4 : Generate the intermediate code.
CO5 : Generate machine code from the intermediate code forms

ASSESSMENT SHEET

S. No	Experiment Name	Date of Issue	Date of Done	Date of Check	Marks Obtained	Faculty Signature
1	Write a program to create functions for string handling					
2	Implementation of LEXICAL ANALYZER for IF STATEMENT					
3	Implementation of LEXICAL ANALYZER for ARITHMETIC EXPRESSION					
4	Construction of NFA from REGULAR EXPRESSION					
5	Construction of DFA from NFA					
6	Implementation of SHIFT REDUCE PARSING					
7	Implementation of OPERATOR PRECEDENCE PARSER					
8	Implementation of RECURSIVE DESCENT PARSER					
9	Implementation of CODE OPTIMIZATION TECHNIQUES					
10	Implementation of CODE GENERATOR					

Prepared By
Ajit Shukla

Approved By
HOD(CSE)

Introduction

Compiler is a System software that converts high level language to low level language . We human beings can't program in machine language so we program in high level language and compiler is the software which bridges the gap between user and computer.

It's a very complicated piece of software which took 18 years to make the first compiler. The main six phases of compiler are

1)lexical Analysis

2) syntax Analysis

3) Semantic Analysis

4)Intermediate code generation

5)Code optimization

6) Code generation

In this lab session students will learn implementation of lexical analyzer and code for each phase to understand compiler software and its coding in detail. This will provide deeper insight into more advance semantics aspect of programming languages, code generation, machine independent optimization and dynamic memory allocation.

LAB - 1
(STRING HANDLING FUNCTION)

Aim: Write a program to create functions for string handling

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

Theory: Strings are often needed to be manipulated by programmer according to the need of a problem. All string manipulation can be done manually by the programmer but, this makes programming complex and large. To solve this, the C supports a large number of string handling functions.

There are numerous functions defined in "string.h" header file. Few commonly used string handling functions are discussed below:

Function	Work of function
Strlen()	Calculates the length of string
Strcpy()	Copies a string to another String
Strcat()	Concatenates(joins) two strings
Strcmp()	Compares two string
Strupr()	Converts string to uppercase

In the experiment without using the header file "string.h" we have to implement the above functions in C.

Strlen()

```
#include<stdio.h>

int main() {
  char str[100];
  int length;

  printf("\nEnter the String : ");
  gets(str);

  length = 0;  // Initial Length

  while (str[length] != '\0')
    length++;

  printf("\nLength of the String is : %d", length);
  return(0);
}
```

Strcpy

```
#include<stdio.h>
void main(void)
{
  char src[25],dest[25];
  int i=0;
  printf("\nEnter the String Which is to be copied ");
  gets(src);
  do
  {
 dest[i]=src[i];
  }while(src[i++]!='\0');
  printf("\nCopied String is %s",dest);
}
```

OUTPUT

Enter the string: This is tutorialpoint.com

Output: length of string is 26

Strcmp

Enter string1 :"abcdef"

Enter string 2:"abcdef"

Output:str1 is equal to Str2 and return value is 0

EXERCISES:

1. WAP in C to implement Strlen() function
2. WAP in C to implement Strcpy() function
3. WAP in C to implement Strcat() function.
4. WAP in C to implement Strcmp () function

LAB - 2

(LEXICAL ANALYZER FOR IF STATEMENT)

Aim:

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

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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[tle
n++]=c;
break;
case 4: if(!  isdigit(c))
{
printf("\b\t<3,%p>\n",&input[pos]);
state=
2;
pos--;
}
break;
case 5:
id=input[po
s-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;
}
```

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>
```

EXERCISES:

1. WAP in C to find keywords in a C program.
2. WAP in C to find identifiers in a C program.
3. WAP in C to find special symbols in a C program.
4. WAP in C to find tokens in the following line

```
if (a==b)
 c=a;
```

LAB - 3

(LEXICAL ANALYZER FOR ARITHMETIC EXPRESSION)

Aim:

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

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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>
```

EXERCISES:

1 WAP in C to find total number of lines .
2 WAP in C to check whether a string contains arithmetic operator

LAB - 4

(CONSTRUCTION OF NFA FROM REGULAR EXPRESSION)

Aim:

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

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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);
```

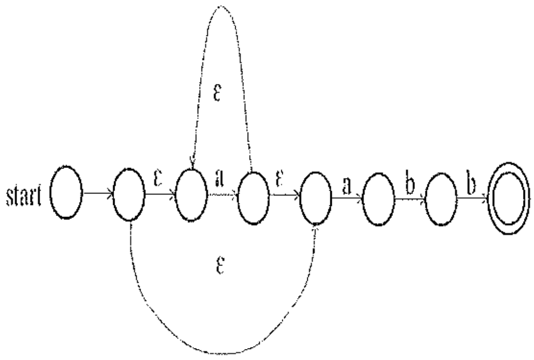
```
          outtextxy(*x2+15,*y2-9,pr);
          outtextxy(*x1-25,*y1-9,pr);
          outtextxy((*x2-*x1)/2+*x1,*y1-30,pr);
         outtextxy((*x2-*x1)/2+*x1,*y1+30,pr);
          ellipse(*x1+(*x2-*x1)/2,*y2+10,180,360,(*x2-*x1)/2+40,70);
outtextxy(*x2+37,*y2+14,"^"); if(*x1-40<minx)minx=*x1-40;
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[l];
cx2=sty[l]; par--;
if(str[i+1]=='*')

{
i++;
star1(&cx1,&cy1,&cx2,&cy2);
cx1=cx1-40;
cx2=cx2+40; stx[l]=stx[l]-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();
 }
```

OutPUT



EXERCISES:

1 WAP in C to design a NFA from ab*.
2 WAP in C to design a NFA from abc.
3 WAP in C to design a NFA from a+b+c.

4 WAP in C to design a NFA from a*b.

LAB - 5

(Construction of DFA from NFA)

Aim:

To write a C program to construct a DFA from the given NFA.
TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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<pr
ocess.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();
        }
```

EXERCISES:

Sample Input & Output:

Enter the NFA state table entries: 11

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

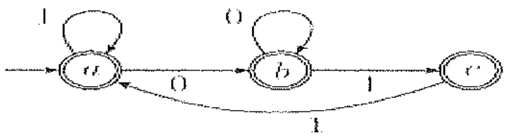
```
0 1 2 3 4 5  6 7 8 9 10 11
----------------------------------------------------------------------
1   -e- - - - - e -  -  -
2   -- e- e- - - - -  -  -
3   -- -a -- - - - -  -
4   -- - - --e - - -  -
5   -- - - -b- - - -  -
6   -- - - - - e -- -  -
7   -e - - - - - e- -  -
8   -- - - - - - - e - 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

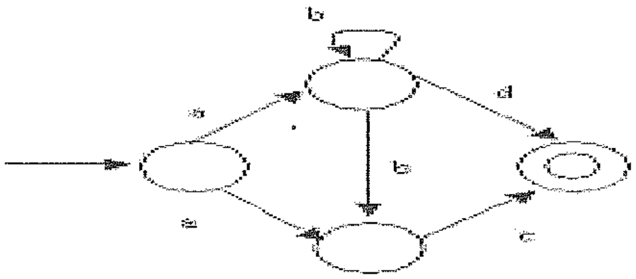
EXERCISES

1 WAP in C to design a DFA from the following NFA

(a)



(b)



LAB - 6

(Implementation of Shift Reduce Parsing Algorithm)

Aim:

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

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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[1
5]; int
ip_ptr=0,st_ptr=0,l
en,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
```

EXERCISES:

1 WAP in C to implement shift reduce parsing algorithm on the following production rules

E -> E + E | E * E | id| a| b

2 WAP in C to perform shift reduce parsing on the following string
(a*b)

3 WAP in C to perform shift reduce parsing on the following string
a+b*a

4 WAP in C to perform shift reduce parsing on the following string
(a*b) +(a)

LAB - 7

(Implementation of Operator Precedence Parser)

Aim:

To write a C program to implement Operator Precedence Parser.
TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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
```

EXERCISES:

1 .WAP in C to construct a operator precedence table for the following grammar

E -> E + E | E * E | id| a| b

2. WAP in C to parse the following string
   id1+id2*id3

3 . WAP in C to parse the following string
   id2*(id2+id3)

4. WAP in C to parse the following string
   (id1+id2)*(id3)

LAB - 8

(Implementation of Recursive Descent Parser)

._**Aim:**

To write a C program to implement Recursive Descent Parser.

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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

prime():
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
        advanc
        e();
        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'

EXERCISES:

1 Write a program to implement recursive descent parser

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

2 WAP in C to remove left recursion

E →E+T/ T , T→T*F/F , F→ (E)/id

3 WAP in C to remove left recursion

S→Sb/a

LAB - 9

(Implementation of Code Optimization Techniques)

Aim:

To write a C program to implement Code Optimization Techniques.
TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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
```

EXERCISES:

1 WAP in C to optimize the following code

```
a=9
b=c+d
e=c+d
f=b+e
r=:f
```

2 Write any left factoring grammar and remove left factoring from the grammar

LAB - 10

(Implementation of Code Generator)

Aim:

To write a C program to implement Simple Code Generator.

TOOLS/APPARATUS: Turbo C or gcc / gprof compiler in linux.

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
```

EXERCISES:

1 WAP in C to generate a code for the following sequence

a=b+c
c=a*c

2 WAP in C to generate a code for the following sequence
$A + B * C$

3 WAP in C to generate a code for the following sequence
a=b+c
d=a+e

4 WAP in C to generate a code for the following sequence
a=b-c
d=a*e

References:-

1. Alfred V. Aho, and Jeffrey D. Ullman, "Principles of Compiler Design", Addison-Wesley, 2th Edition, 2006.
2. Raghvan, "Principles of Compiler Design", TMH, 1st Ed., 2010.
3. O.G. Kakde," Compiler Design", Laxmi publication, 2006