ASSIGNMENT I

Problem Statement

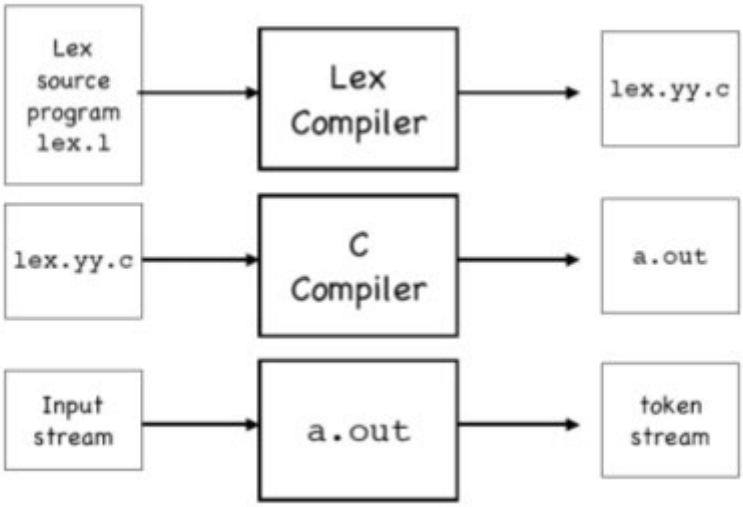
Assignment to understand basic syntax of LEX Specifications, built-in functions and Variables.

Objective

To understand the LEX syntax.

Theory

LEX format:



LEX Specification:

```
%{
        C declarations and includes
%}

declarations
%%
translation rules
%%
user subroutines
```

1. Write a program to find out whether given input is a letter or digit.

Solution: lex1.l

```
%{

%}
letter [a-zA-Z]
digit [0-9]
id2 {letter}({letter}|{digit})*
num {digit}("."({digit})+)?

%%
"if"|"else"|"while"|"for"  {printf("keyword");}
{num} {printf("num");}
{id2}    { printf("id2 "); }
%%

int main()
{
yylex();
return 0;
}
```

Execution:

1. flex lex1.l
2. cc lex.yy.c -lfl
3. ./a.out

2. Write a program to find out whether given input is a noun, pronoun,verb, adverb, adjective or preposition

Solution: lex2.l

```
%{
/*This sample demonstrates a word as a verb/ not a verb */
%}

%%
[\t]+              /*Ignore whitespaces*/;
is|
am |
are |
is|
were |
was |
be|
being |
been |
do|
does |
did|
will|
would|
should|
can|
```

```
could|
has|
have|
had|
go   {printf("%s: is a verb\n",yytext); }
[a-zA-Z]+  {printf("%s: is not a  verb\n",yytext); }
.|\n       { ECHO:}
%%
main()
{
yylex();
}
```

Execution:

1. flex lex.l
2. cc lex.yy.c -lfl
3. ./a.out

Note : Extend this program to include noun, pronoun, adverb,adjective or preposition.

ASSIGNMENT II

Problem Statement

Implement Lexical analyser for sample language using LEX with error handling. (Subset of C).

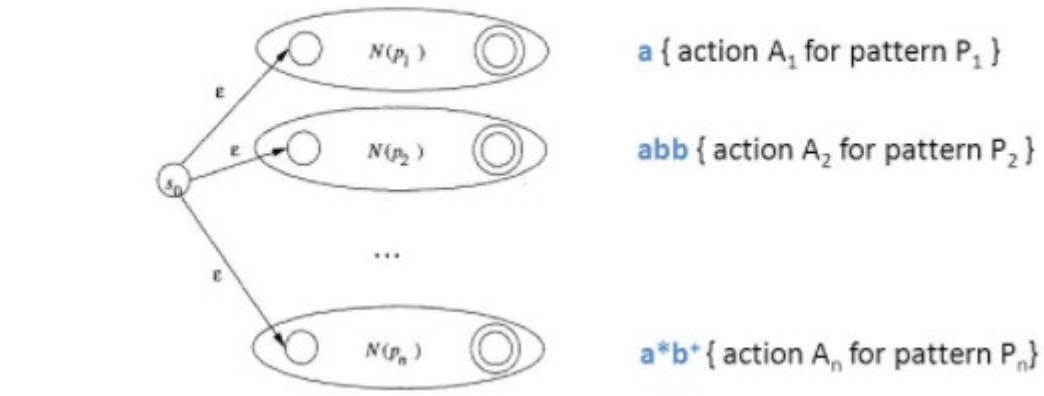
Objective

To understand how to build a Lexical Analyser.

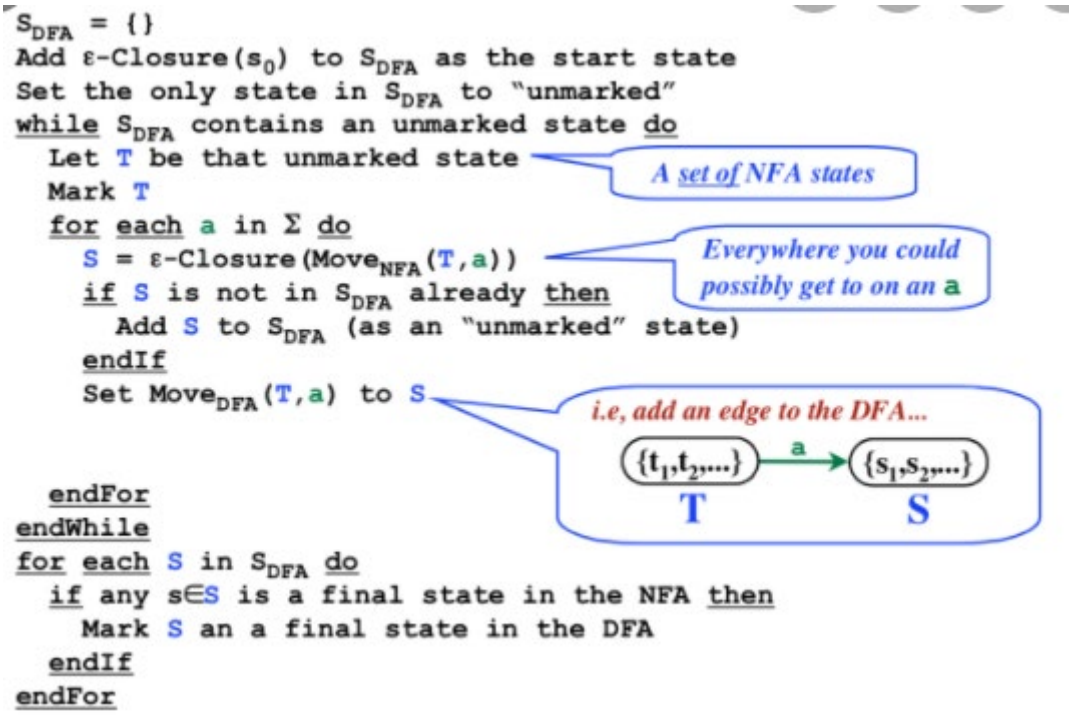
Theory

Step 1: Construct ε-NFA from the Regular Expressions

Step 2:



Convert ε-NFA to DFA using Subset Construction.



Solution:

```
//Implementation of Lexical Analyzer using Lex tool
%{
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");
if(!file)
{
printf("could not open the file");
exit(0);
}
yyin=file;
yylex();
printf("\n");
return(0);
}
int yywrap()
{
return(1);
}
```

INPUT:

```
//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:

```
l2sys29@l2sys29-Veriton-M275:~/Desktop/syedvirus$ lex exp3_lex.l
l2sys29@l2sys29-Veriton-M275:~/Desktop/syedvirus$ cc lex.yy.c
l2sys29@l2sys29-Veriton-M275:~/Desktop/syedvirus$ ./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 ;

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

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

ASSIGNMENT III

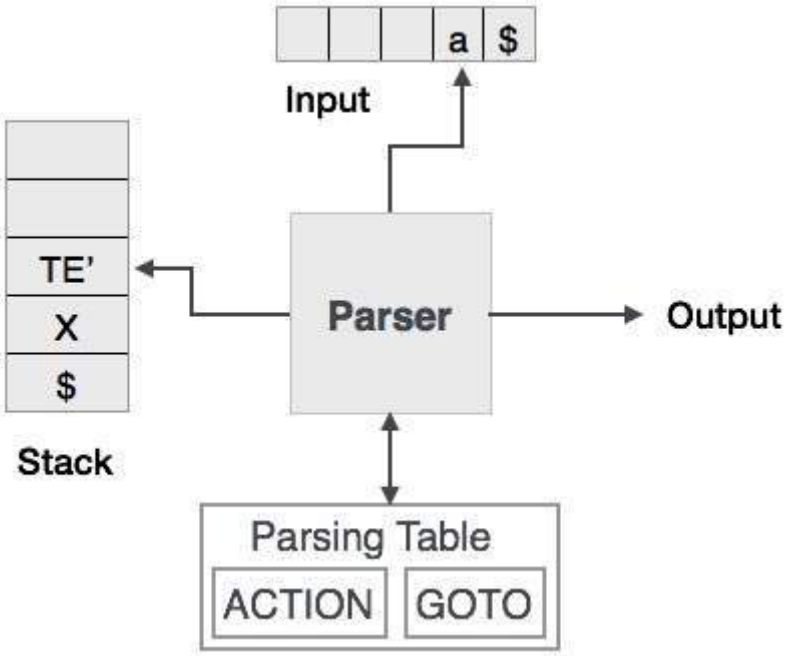
Problem Statement

Implement Recursive Descent Parser for Sample Language

Objective

To understand the working of Predictive Parser. Parse the given string using the Predictive Parser.

Theory:



Solution: Take any CFG as a input and perform the following steps.

Step 1: Remove Left Recursion from the grammar if any.

Step 2: Left Factorize the grammar if required.

Step 3: Construct FIRST set of items for every Non Terminal.

Step 4: Construct Follow set of items for every Non Terminal.

Step 5: Construct Predictive Parsing Table.

Step 6: Parse the given string using the Predictive Parsing Table.

Input: Any CFG as a input

Output: Successful / Unsuccesfull Parsing

ASSIGNMENT IV

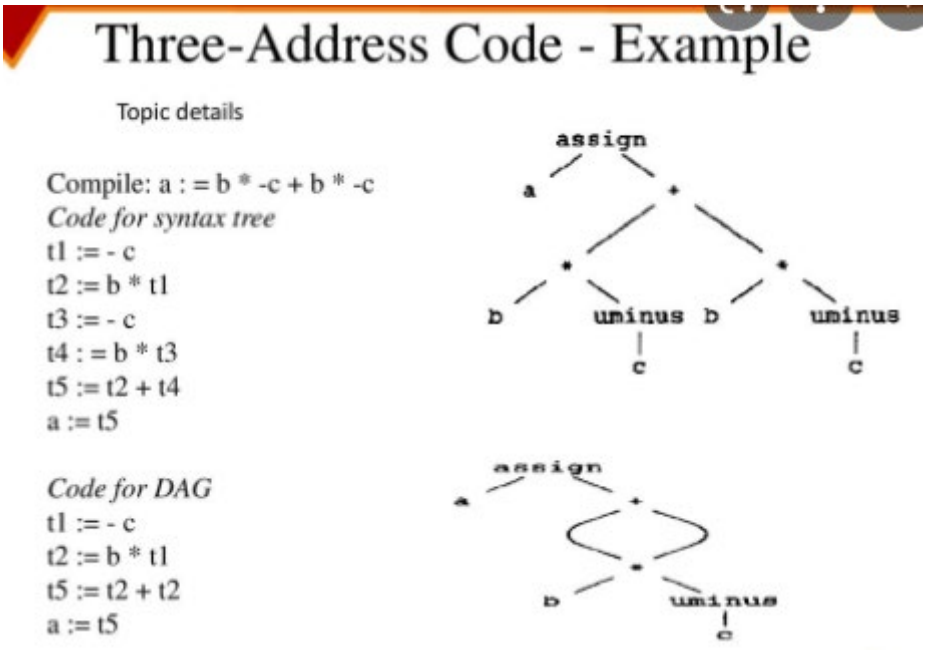
Problem Statement

Implement Intermediate Code generation

Objective

To learn the different forms of Intermediate Code generation such as Three adress forms: Quadruples, Triples, Indirect Triples, Syntax Tree, Pseudo Code etc

Theory:



Solution:

```
#include<stdio.h>
#include<string.h>
void pm();
void plus();
void div();
int i,ch,j,l,addr=100;
char ex[10], exp[10] ,exp1[10],exp2[10],id1[5],op[5],id2[5];
void main()
{
clrscr();
while(1)
{
printf("\n1.assignment\n2.arithmetic\n3.relational\n4.Exit\nEnter the choice:");
scanf("%d",&ch);
switch(ch)
{
case 1:
printf("\nEnter the expression with assignment operator:");
scanf("%s",exp);
```

```
l=strlen(exp);
exp2[0]='\0';
i=0;
while(exp[i]!='=')
{
i++;
}
strncat(exp2,exp,i);
strrev(exp);
exp1[0]='\0';
strncat(exp1,exp,l-(i+1));
strrev(exp1);
printf("Three address code:\ntemp=%s\n%s=temp\n",exp1,exp2);
break;

case 2:
printf("\nEnter the expression with arithmetic operator:");
scanf("%s",ex);
strcpy(exp,ex);
l=strlen(exp);
exp1[0]='\0';

for(i=0;i<l;i++)
{
if(exp[i]=='+'||exp[i]=='-')
{
if(exp[i+2]=='/'||exp[i+2]=='*')
{
pm();
break;
}
else
{
plus();
break;
}
}
```

```
else if(exp[i]=='/'||exp[i]=='*')
{
div();
break;
}
}
break;

case 3:
printf("Enter the expression with relational operator");
scanf("%s%s%s",&id1,&op,&id2);
if(((strcmp(op,"<")==0)||(strcmp(op,">")==0)||(strcmp(op,"<=")==0)||(strcmp(op,">=
")==0)||(strcmp(op,"==")==0)||(strcmp(op,"!=")==0))==0)
printf("Expression is error");
else
{
printf("\n%d\tif %s%s%s goto %d",addr,id1,op,id2,addr+3);
addr++;
printf("\n%d\t T:=0",addr);
addr++;
printf("\n%d\t goto %d",addr,addr+2);
addr++;
printf("\n%d\t T:=1",addr);
}
break;
case 4:
exit(0);
}
}
}
void pm()
{
strrev(exp);
j=l-i-1;
strncat(exp1,exp,j);
strrev(exp1);
printf("Three address code:\ntemp=%s\ntemp1=%c%ctemp\n",exp1,exp[j+1],exp[j]);
```

```
}
void div()
{
strncat(exp1,exp,i+2);
printf("Three address
code:\ntemp=%s\ntemp1=temp%c%c\n",exp1,exp[i+2],exp[i+3]);
}
void plus()
{
strncat(exp1,exp,i+2);
printf("Three address
code:\ntemp=%s\ntemp1=temp%c%c\n",exp1,exp[i+2],exp[i+3]);
}
```

INPUT:

A<=B

OUTPUT:

100 if a<=b goto 103
101 T:=0
102 goto 104
103 T:=1

ASSIGNMENT V

Problem Statement

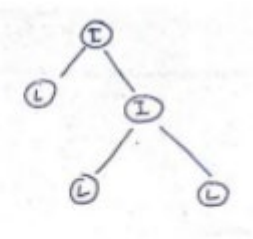
Implement Common Sub expression elimination Code optimization technique using DAG.

Objective

To learn the different techniques of Code Optimization such as Code Motion, Common Subexpression Elimination, Loop Jamming, Loop Unrolling etc. To study about DAG(Directed Acyclic Graph).

Theory:

Rules of the constructing DAG



Rule 1: In a DAG

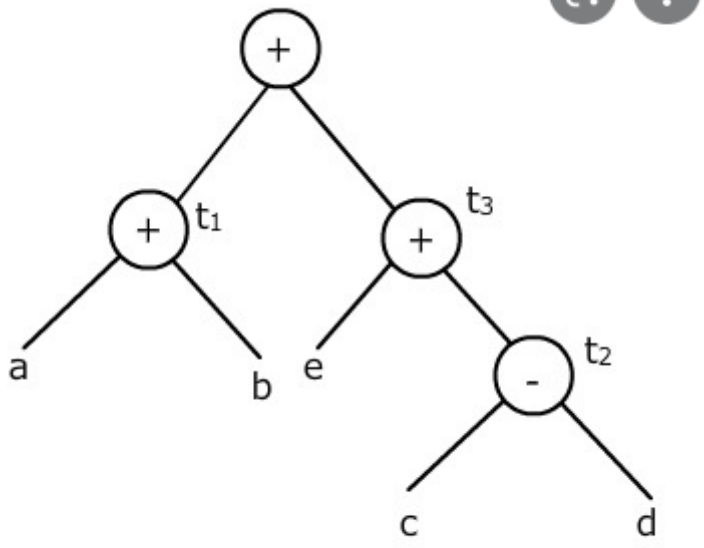
- Leaf node represent identifiers, names or constants.
- Interior node represent operators.

Rule 2:

- While constructing DAG, there is a check made to find if there is on existing node with the same children. A new node is created only when such a node doesn't exist This action allow us to detect common sub expression and eliminate the re computation of the same.

Rule 3:

- The assignment of the from x:= must not be performed until and unless it is a must.



DAG for *(a + b) + (e + (c - d))*