# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



**LAB REPORT on**

**COMPILER DESIGN**

*Submitted by*

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***Under the Guidance of***

***Prof. Sandhya A Kulkarni***

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*in partial fulfilment for the award of the degree of*

**BACHELOR OF ENGINEERING**

in

**COMPUTER SCIENCE AND ENGINEERING**



**B.M.S. COLLEGE OF ENGINEERING**

**(Autonomous Institution under VTU)**

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**B. M. S. College of Engineering,**

**Bull Temple Road, Bangalore 560019**

**(Affiliated To Visvesvaraya Technological University, Belgaum)**

**Department of Computer Science and Engineering**



## **CERTIFICATE**

This is to certify that the Lab work entitled “**Compiler Design**” carried out by **Uday S(1BM22CS420)** , who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfilment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2023-24.

The Lab report has been approved as it satisfies the academic requirements in respect of **Compiler Design- (22CS5PCCPD)** work prescribed for the said degree.

|  |  |
| --- | --- |
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**B. M. S. COLLEGE OF ENGINEERING**

**DEPARTMENT OF COMPUTER SCIENCE AND**

**ENGINEERING**



### DECLARATION

I, Uday S (1BM22CS420), student of 5th Semester, B.E, Department of Computer Science and Engineering, B. M. S. College of Engineering, Bangalore, here by declare that, this lab report entitled " **Compiler Design**" has been carried out by me under theguidance of Prof. Latha NR, Assistant Professor, Department of CSE, B. M. S. College ofEngineering, Bangalore during the academic semester November-2023-February-2024.

I also declare that to the best of my knowledge and belief, the development reported here is not from part of any other report by any other students.

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# Lab 1

**1.1 Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuation symbols.**

**Code:**

%{

#include<stdio.h>

%} %%

printf|for|void|main|while|do|switch|case|int|char|float|double|if|else {printf(“%s-keyword\n”,yytext);

, {printf("%s-separator\n",yytext);} ; {printf("%s-delimiter\n",yytext);}

[a-zA-Z\_][a-zA-Z0-9\_]\* {printf("%s-Identifier\n",yytext);}

">"|"<"|">="|"<="|"==" {printf("%s- Relational operator\n",yytext);}

"=" {printf("%s-assignment operator\n",yytext);}

[0-9]+ {printf("%s-digit\n",yytext);}

%%

void main() {

printf("Give an input:\n"); yylex(); } int yywrap() { return 1; }

**Output**



**1.2 Write a program in LEX to count the number of characters and digits in a string.**

**Code**

%{

#include<stdio.h> int d=0,c=0;

%}

%%

[a-zA-Z] {c++;}

[0-9] {d++;}

. ;

\n {printf("No of characters and digits are %d and %d\n",c,d),c=0,d=0;}

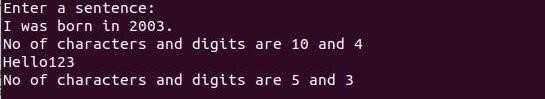
%%

void main() {

printf("Enter a sentence:\n"); yylex(); } int yywrap() { return 1;

}

**Output**



**1.3 Write a program in LEX to count the number of vowels and consonants in a string.**

**Code**

%{

#include<stdio.h> int v=0,c=0;

%}

%%

[AEIOUaeiou] {v++;}

[A-Za-z] {c++;}

\n {printf("No of vowels and consonants are %d and %d\n",v,c),v=0,c=0;}

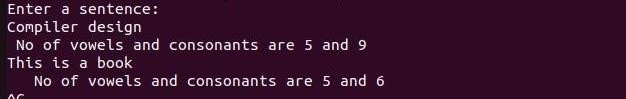
%%

void main() {

printf("Enter a sentence:\n"); yylex(); } int yywrap() { return 1;

}

**Output**



# Lab 2

**2.1Write a program in lex to count the number of words in a sentence.**

**Code**

%{

#include<stdio.h> int words;

%}

%%

[^\t\n ]+ {words++;}

\n {printf("No of words in the sentence are %d.\n",words),words=0;}

%%

void main() {

printf("Enter a sentence:\n"); yylex(); } int yywrap() { return 1;

}

**Output**



**2.2 Write a program in lex to demonstrate regular definition.**

**Code**

%{

#include<stdio.h>

%}

alpha [a-zA-Z0-9]

%%

[a-zA-Z]+ {printf("Characters\n");}

[0-9]+ {printf("Digits");}

{alpha}+ {printf("Invalid input!\n");}

%%

void main() {

printf("Enter a string:\n"); yylex(); } int yywrap() { return 1;

}

**Output**



**2.3 identify tokens in a program by taking input from a file and printing the output on the terminal.**

**Code**

%{

#include<stdio.h>

%} %%

char|int|float {printf("%s is a keyword.\n",yytext);}

[a-zA-Z][a-zA-Z0-9]\* {printf("%s is an identifier.\n",yytext);}

, {printf("%s is a separator.\n",yytext);}

; {printf("%s is a delimiter.\n",yytext);}

"=" {printf("%s is an assignment operator.\n",yytext);}

"+"|"-"|"\*"|"/" {printf("%s is a binary operator.\n",yytext);}

[0-9]+ {printf("%s is/are digit(s).\n",yytext);}

\n ;

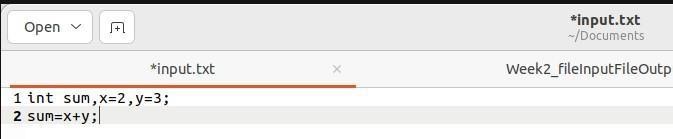
%%

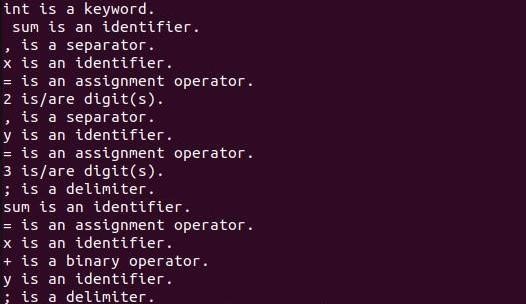
void main() {

yyin=fopen("input.txt","r"); yylex(); fclose(yyin); } int yywrap() { return 1;

}

**Output**





**2.4 identify tokens in a program by taking input from a file and printing the output in another file.**

**Code**

%{

#include<stdio.h>

%} %%

char|int|float {fprintf(yyout,"%s is a keyword.\n",yytext);}

[a-zA-Z][a-zA-Z0-9]\* {fprintf(yyout,"%s is an identifier.\n",yytext);}

, {fprintf(yyout,"%s is a separator.\n",yytext);} ; {fprintf(yyout,"%s is a delimiter.\n",yytext);}

"=" {fprintf(yyout,"%s is an assignment operator.\n",yytext);}

"+"|"-"|"\*"|"/" {fprintf(yyout,"%s is a binary operator.\n",yytext);}

[0-9]+ {fprintf(yyout,"%s is/are digit(s).\n",yytext);}

\n ;

%%

void main() {

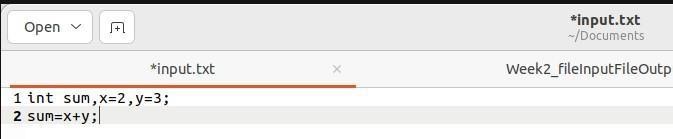
yyin=fopen("input.txt","r"); yyout=fopen("output.txt","w"); yylex();

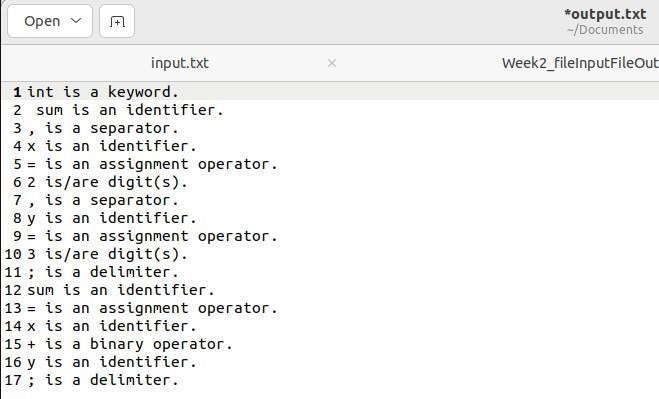
printf("Printed in output.txt\n"); fclose(yyin); fclose(yyout);

} int yywrap() { return 1;

}

**Output**





**2.5 find the length of the input string.**

**Code**

%{

#include<stdio.h>

%}

%%

[a-zA-Z0-9.,!? \t]+ {printf("Length of input string is %d.\n",yyleng);}

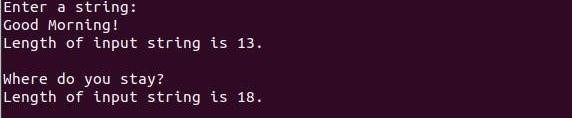
%%

void main() {

printf("Enter a string:\n"); yylex(); } int yywrap() { return 1;

}

**Output**



# Lab 3

**3.1Write a program in LEX to recognize Floating Point Numbers.**

**Code**

%{

#include<stdio.h>

%}

%%

[+-]?[0-9]\*[.][0-9][0-9]\* {printf("Floating point number!\n");};

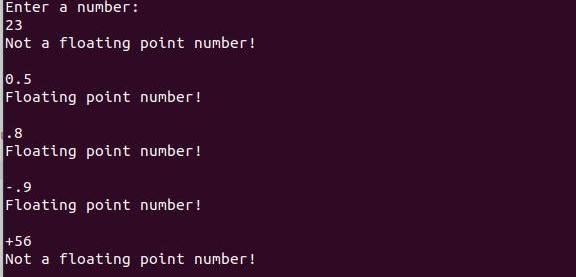
[+-]?[0-9][0-9]\* {printf("Not a floating point number!\n");};

%%

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

printf("Enter a number:\n"); yylex(); }

**Output**



**3.2 Read and input sentence, and check if it is compound or simple. If a sentence has the word- and , or ,but ,because ,if ,then ,nevertheless then it is compound else it is simple.**

**Code**

%{

#include<stdio.h> int flag=0;

%} %%

if|then|but|because|nevertheless|and|or {flag=1;}

. ;

\n {return 0;}

%%

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

printf("Enter a sentence:\n"); yylex(); if(flag==1)

printf("Compound sentence!\n"); else

printf("Simple sentence!\n");

}

**Output**

**3.3 Write a program to check if the input sentence ends with any of the following punctuation marks ( ? , fullstop , ! )**

**Code**

%{

#include<stdio.h> int flag=0;

%}

%%

.\*[?|!|.]$ {flag=1;}

.\* {flag=0;}

\n {return 0;}

%%

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

printf("Enter a sentence:\n"); yylex(); if(flag==1)

printf("Ends with a punctuation!\n"); else

printf("Does not end with punctuation!\n");

}

**Output**



**3.4 Write a program to read an input sentence and to check if the sentence begins with English articles (A, a,AN,An,THE and The).**

**Code**

%{

#include<stdio.h> int flag=0;

%}

%%

^(an|An|The|the|A|a)[" "].\* {flag=1;}

.\* {flag=0;}

\n {return 0;}

%%

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

printf("Enter a sentence:\n"); yylex(); if(flag==1)

printf("Starts with an article!\n"); else

printf("Does not start with an article!\n");

}

**Output**



**3.5 Lex program to count the number of comment lines (multi line comments or single line) in a program. Read the input from a file called input.txt and print the count in a file called output.txt.**

**Code**

%{

#include<stdio.h> int c=0;

%}

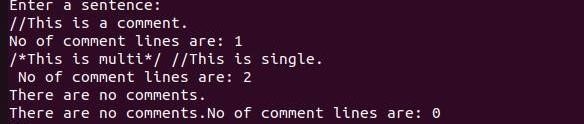
%%

"\/\\*"[^\*]\*\\*+([^/\*][^\*]\*\\*+)\*\/ {c++;}

"//".\* {c++;}

. ECHO;

%%

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

yyin=fopen("input.txt","r"); yyout=fopen("output.txt","w"); yylex();

printf("The number of comments are:%d\n",c); fclose(yyin); fclose(yyout); }

**Output**

**3.6 Write a program to read and check if the user entered number is signed or unsigned using appropriate meta character.**

**Code**

%{

#include<stdio.h>

%}

%%

[+|-][0-9]+ {printf("Signed number!\n");}

[0-9]+ {printf("Unsigned number!\n");}

%%

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

printf("Enter a number:\n"); yylex(); }

**Output**



# Lab 4

**4.1 Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a single blank.**

**Code**

%{

#include<stdio.h>

%}

%%

[ \t]+ {fprintf(yyout," ");}

.|\n {fprintf(yyout,"%s",yytext);}

%%

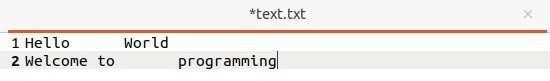
void main() {

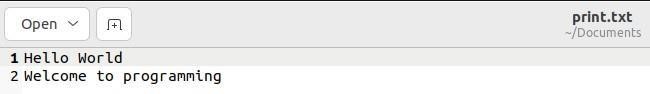
yyin=fopen("text.txt","r"); yyout=fopen("print.txt","w"); yylex(); fclose(yyin); fclose(yyout); printf("Printed!\n");

} int yywrap() { return 1;

}

**Output**





**4.2 Write a LEX program to recognize the following tokens over the alphabets {0,1,..,9}**

**4.2.1 The set of all string ending in 00.**

**Code**

%{

#include<stdio.h> int flag=0;

%}

%%

[0-9]+[00] {flag=1;}

. ;

\n {return 0;}

%%

void main() {

printf("Enter a string:\n"); yylex(); if(flag==1) printf("Ends with 0.\n"); else

printf("Does not end with 0.\n");

} int yywrap() { return 1; }

**Output**

**4.2.2 The set of all strings with three consecutive 222’s.**

**Code**

%{

#include<stdio.h> int flag=0;

%}

%%

[0-9]\*[2][2][2][0-9]\* {flag=1;}

. ;

\n {return 0;}

%%

void main() {

printf("Enter a string:\n"); yylex(); if(flag==1) printf("Has 3 consecutive 2's.\n"); else

printf("Does not have 3 consecutive 2's.\n");

} int yywrap() { return 1; }

**Output**

**4.2.3 string such that every block of five consecutive symbols contains at least two 5’s.**

**Code**

%{

#include<stdio.h> int i,count=0,flag;

%}

%%

.{1,5} {flag=0; for(i=0;i<5;i++)

{

int c=yytext[i]-'0'; if(c==5)

{ count++; if(count==2)

{ flag=1; break;

}

} } count=0;

printf("yytext:%s,flag(1 if no of 5 is atleast 2):%d\n",yytext,flag); if(flag!=1)

{

printf("Not a valid string!\n");

return 0;

}

}

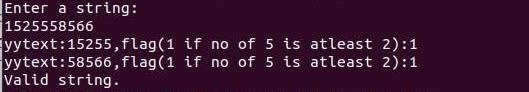
\n {return 0;}

%%

void main()

{ printf("Enter a string:\n"); yylex(); if(flag==1) printf("Valid string.\n"); } int yywrap() { return 1; }

**Output**



**4.2.4 strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.**

**Code**

%{

#include<stdio.h> int c,i,flag=1,sum=0,power=1;

%}

%%

^1[01]\* {for(i=yyleng-1;i>=0;i--)

{

c=yytext[i]-'0';

sum+=c\*power; power\*=2;

} printf("Decimal representation:%d\n",sum); if(sum%5!=0) {

printf("Not congruent to modulo 5.\n"); sum=0; power=1; } else {

printf("Congruent to modulo 5.\n"); sum=0; power=1;

}

}

.\* {printf("Not a binary number.\n");}

\n {return 0;}

%%

void main() {

printf("Enter a string:\n");

yylex(); } int yywrap() { return 1; }

**Output**



**4.2.5 strings such that the 10th symbol from the right end is 1.**

**Code**

%{

#include<stdio.h> int flag=0;

%}

%%

[0-9]\*1[0-9][0-9][0-9][0-9][0-9][0-9][0-9][0-9][0-9] {flag=1;}

. ;

\n {return 0;}

%%

void main() {

printf("Enter a string:\n"); yylex(); if(flag==1)

printf("10th symbol from right is 1.\n"); else

printf("10th symbol from right is not 1.\n");

} int yywrap() { return 1; }

**Output**



**4.2.6 The set of all four digits numbers whose sum is 9.**

**Code**

%{

#include<stdio.h> int sum=0,i,flag=0;

%}

%%

[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng;i++)

{ sum+=yytext[i]-'0';

} if(sum==9)

{ flag=1; sum=0; } else { flag=0; sum=0; }

}

\n {return 0;}

%%

void main() {

printf("Enter a string:\n"); yylex(); if(flag==1) printf("The sum of digits is 9.\n"); else

printf("The sum of digits is not 9.\n");

} int yywrap()

{ return 1; }

**Output**



**4.2.7 The set of all four digital numbers, whose individual digits are in ascending order from left to right.**

**Code**

%{

#include<stdio.h> int c,i,flag=1;

%}

%%

[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng-1;i++)

{ if(yytext[i]>=yytext[i+1])

{ flag=0; break;

}

}

}

\n {return 0;}

%%

void main() {

printf("Enter a string:\n"); yylex(); if(flag==1)

printf("The digits are in ascending order.\n"); else

printf("The digits are not in ascending order.\n");

} int yywrap() { return 1;

}

**Output**



# Lab 5

**Write a C program to design lexical analysis to recognize any five keywords, identifiers, numbers, operators and punctuations.**

**Code**

#include <stdio.h>

#include <string.h> #include <ctype.h>

void lexicalAnalyzer(char input\_code[]) {

char \*keywords[] = {"if", "else", "while", "for", "return"}; char \*operators[] = {"+", "-", "\*", "/", "=", "==", "<", ">", "<=", ">="}; char \*punctuations[] = {",", ";", "(", ")", "{", "}"};

char \*token = strtok(input\_code, " \t\n");

while (token != NULL)

{if (isdigit(token[0]))

{ printf("Number: %s\n", token);

} else if (isalpha(token[0]) || token[0] == '\_')

{int isKeyword = 0;

for (int i = 0; i < sizeof(keywords) / sizeof(keywords[0]); i++)

{if (strcmp(token, keywords[i]) == 0) { printf("Keyword: %s\n", token); isKeyword = 1; break;

}

} if (!isKeyword)

{ printf("Identifier: %s\n", token);

}

} else if (strchr("+-\*/=<>(){}[]", token[0]) != NULL)

{printf("Operator: %s\n", token);

} else if(strchr(",;", token[0]) != NULL)

{ printf("Punctuation:%s\n",token);

}

token = strtok(NULL, " \t\n");

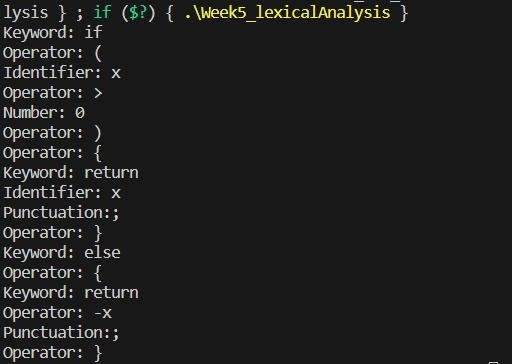
} }

int main() {

char input\_code[] = "if ( x > 0 ) { return x ; } else { return -x ; }"; lexicalAnalyzer(input\_code); return 0;

}

**Output**



# Lab 6

**Write a program to perform recursive descent parsing on the following grammar:**

**S->cAd**

**A->ab | a**

**Code**

#include <stdio.h> #include<stdlib.h> char input[100]; int ind = 0; void match(char expected)

{ if (input[ind] == expected)

{ ind++;

} } void A(); void S()

{

match('c'); A(); match('d'); } void A()

{ if (input[ind] == 'a')

{ printf("Hello\n"); match('a'); match('b');

} /\*else if (input[ind] == 'a')

{ printf("Hi!\n"); match('a'); }\*/ else

{ printf("Parsing failed.\n", ind); exit(1);

} } int main() {

printf("Enter the input string:\n"); scanf("%s", input); S();

if (input[ind] == '$') { printf("Parsing successful.\n");

} else { printf("Parsing failed. Extra characters found.\n");

}

return 0;

}

**Output**



# Lab 7

**7.1Write a program in YACC to design a suitable grammar for evaluation of arithmetic expression having +, -, \* and /.**

**Code**

## LEX

%{

#include<stdio.h>

#include<stdlib.h> #include "y.tab.h" extern int yylval;

%}

%%

[0-9]+ {yylval=atoi(yytext);return num;}

[\t ] ;

\n {return 0;}

. {return yytext[0];}

%%

int yywrap()

{

}

## YACC

%{

#include<stdio.h> #include<stdlib.h> int yyerror(const char \*s); int yylex(void);

%}

%token num;

%left '+' '-'

%left '\*' '/'

%left ')' %left '(' %%

s:e {printf("Valid expression!\n");

printf("Result:%d\n",$$); exit(0);

}

;

e:e'+'e {$$=$1+$3;} |e'-'e {$$=$1-$3;}

|e'\*'e {$$=$1\*$3;}

|e'/'e {$$=$1/$3;}

|'('e')' {$$=$2;}

|num {$$=$1;}

;

%%

void main() {

printf("Enter an arithmetic expression:\n"); yyparse(); } int yyerror(const char \*s) { printf("Invalid expression!\n"); return 0; }

**Output**



**7.2 Write a program in YACC to recognize strings of the form {(a^n)b , n>=5}.**

**Code**

## LEX

%{

#include<stdio.h>

#include<stdlib.h> #include "y.tab.h" extern int yylval;

%}

%%

[aA] {yylval=yytext[0];return A;} [bB] {yylval=yytext[0];return B;}

\n {return NL;}

. {return yytext[0];}

%%

int yywrap() { return 1; }

## YACC

%{

#include<stdio.h> #include<stdlib.h> int yyerror(char \*s); int yylex(void);

%}

%token A

%token B

%token NL

%%

smtr:A A A A A S B NL {printf("Parsed using the rule (a^n)b, n>=5.\nValid String!\n");}

;

S:S A

|

;

%%

void main() { printf("Enter a string!\n"); yyparse(); } int yyerror(char \*s) { printf("Invalid String!\n"); return 0; }

**Output**



**7.3 Write a program in YACC to generate syntax tree for a given arithmetic expression.**

**Code**

## LEX

%{

#include<stdio.h>

#include<stdlib.h> #include "y.tab.h" extern int yylval;

%}

%%

[0-9]+ {yylval=atoi(yytext);return digit;}

[\t] ;

[\n] return 0;

. return yytext[0];

%%

int yywrap() { return 1; }

## YACC

%{

#include <math.h>

#include<ctype.h>

#include<stdio.h>

#include<stdlib.h> #include<string.h> int yyerror(char \*s); int yylex(void); struct tree\_node

{ char val[10]; int lc; int rc; };

int ind; struct tree\_node syn\_tree[100]; void my\_print\_tree(int cur\_ind); int mknode(int lc,int rc,char \*val);

%}

%token digit

%%

S:E {my\_print\_tree($1);}

;

E:E'+'T {$$=mknode($1,$3,"+");}

|T {$$=$1;}

;

T:T'\*'F {$$= mknode($1,$3,"\*");}

|F {$$=$1;}

;

F:'('E')' {$$=$2;}

|digit {char buf[10];sprintf(buf,"%d", yylval);$$ = mknode(-1,-1,buf);}

;

%%

int main() { ind=0;

printf("Enter an expression:\n"); yyparse(); return 0; } int yyerror(char \*s) { printf("NITW Error\n"); return 0; }

int mknode(int lc,int rc,char val[10])

{

strcpy(syn\_tree[ind].val,val);

syn\_tree[ind].lc = lc; syn\_tree[ind].rc = rc; ind++; return ind-1;

}

/\*my\_print\_tree function to print the syntax tree in DLR fashion\*/ void my\_print\_tree(int cur\_ind)

{

if(cur\_ind==-1) return;

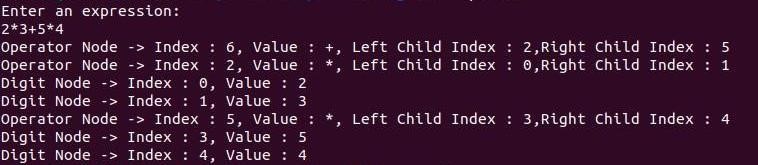
if(syn\_tree[cur\_ind].lc==-1&&syn\_tree[cur\_ind].rc==-1)

printf("Digit Node -> Index : %d, Value : %s\n",cur\_ind,syn\_tree[cur\_ind].val); else printf("Operator Node -> Index : %d, Value : %s, Left Child Index : %d,Right Child Index :

%d\n",cur\_ind,syn\_tree[cur\_ind].val, syn\_tree[cur\_ind].lc,syn\_tree[cur\_ind].rc); my\_print\_tree(syn\_tree[cur\_ind].lc); my\_print\_tree(syn\_tree[cur\_ind].rc);

}

**Output**



# Lab 8

**8.1Write a program in YACC to convert infix to postfix expression.**

**Code**

## LEX

%{

#include<stdio.h>

#include<stdlib.h> #include "y.tab.h" extern int yylval;

%}

%%

[0-9]+ {yylval=atoi(yytext);return num;}

[\t ] ;

\n {return 0;}

. {return yytext[0];}

%%

int yywrap()

{

}

## YACC

%{

#include<stdio.h> #include<stdlib.h> int yyerror(const char \*s); int yylex(void);

%}

%token num

%left '+' '-'

%left '\*' '/'

%left ')' %left '('

%right '^'

%%

s:e {printf("\n");}

;

e:e'+'t {printf("+");}

|e'-'t {printf("-");}

|t

;

t:t'\*'h {printf("\*");}

|t'/'h {printf("/");}

|h

;

h:f'^'h {printf("^");}

|f ; f:'('e')'

|num {printf("%d",$1);}

;

%%

void main() { printf("Enter an infix expression:\n"); yyparse(); } int yyerror(const char \*s) { printf("Invalid infix expression!\n"); return 0; }

**Output**



[[

# Lab 9

**9.1Write a program in YACC to generate three address code for a given expression.**

**Code**

## LEX

%{

#include<stdio.h>

#include<stdlib.h> #include"y.tab.h" extern int yylval; extern char iden[20];

%}

d [0-9]+ a [a-zA-Z]+

%%

{d} { yylval=atoi(yytext); return digit; }

{a} { strcpy(iden,yytext); yylval=1; return id;}

[ \t] {;}

\n return 0;

. return yytext[0];

%%

int yywrap() { return 1; }

## YACC

%{

#include <math.h>

#include<ctype.h> #include<stdio.h> int yyerror(char \*s); int yylex(void); int var\_cnt=0; char iden[20];

%}

%token id

%token digit

%%

S:id '=' E {printf("%s=t%d\n",iden,var\_cnt-1);}

E:E '+' T {$$=var\_cnt; var\_cnt++; printf("t%d = t%d + t%d;\n", $$, $1, $3 );}

|E '-' T { $$=var\_cnt; var\_cnt++; printf("t%d = t%d - t%d;\n", $$, $1, $3 );}

|T {$$=$1;}

;

T:T '\*' F {$$=var\_cnt; var\_cnt++; printf("t%d = t%d \* t%d;\n", $$, $1, $3 );}

|T '/' F {$$=var\_cnt; var\_cnt++; printf("t%d = t%d / t%d;\n", $$, $1, $3 );}

|F {$$=$1;}

;

F:P '^' F {$$=var\_cnt; var\_cnt++; printf("t%d = t%d ^ t%d;\n", $$, $1, $3 );}

|P {$$ = $1;}

;

P: '(' E ')' {$$=$2;}

|digit {$$=var\_cnt; var\_cnt++; printf("t%d = %d;\n",$$,$1);}

;

%%

int main() { var\_cnt=0;

printf("Enter an expression:\n"); yyparse(); return 0; } int yyerror(char \*s)

{

printf("Invalid expression!"); return 0; }

**Output**

