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LAB REPORT
on

Compiler Design

Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**Compiler Design**" carried out by **KEERTHI P REDDY (1BM21CS090),** who is bonafide student of **B.M.S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the academic semester June-2023 to Sep-2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **Compiler Design(22CS5PCCPD)** work prescribed for the said degree.

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Part-A: Implementation of Lexical Analyzer, By using C/C++/Java/Python language and using LEX tool.

Program 1:

```
Lex program to count no. of vowels & consonants
in a ~~set~~ sentence.

[aeiouAEIOU] { vow_count ++; }
[a-zA-Z] { const_count ++; }
\n { printf("vow_count = %d , const_count = %d ",
            vow_count, const_count); }

OUTPUT:

Enter the string of vowels & consonants : Keerthi
vow_count = 3 , const_count = 4
```

Output:

```
Enter the string of vowels and consonents: KEERTHI
vow_count:  3 , const_count: 4
```

Program 2:

An program to read the following input from a file & print the valid token on the terminal.

```
%option noyywrap
%{
#include <stdio.h>
char fname[20];
%}
%%
int|float|char {printf("keywords : %s\n", yytext);}
[0-9]* {printf("number: %s\n", yytext);}
[a-zA-Z]* {printf("character: %s\n", yytext);}
%%
```

```
void main()
{
    printf("Enter the file name :");
    scanf("%s", fname);
    yyin = fopen (fname, "r");
    yylex ();
    ~~flow ();~~
    fclose (yyin);
}
```

OUTPUT:

```
Enter the file name : p.txt
keywords: float
number: 0978
character: abc.
```

Output:

```
enter the input file name
input.txt
enter the output file name
output.txt
```

```
1 int a,b;
```

```
int Keywords a Identifiers, Seperatorb Identifiers; Seperator
```

Program 3:

Lex program to recognize floating point no.'s.

```
^[+-]?[0-9]*[.][0-9]+ { printf("Floating point no."); }
^[+-]?[0-9]* { printf("Not a valid floating point no."); }
```

OUTPUT:

```
4.5
floating point no.
4
Not a valid floating point no.
+3.89
Floating point no.
-3.89
Floating point no.
.44
Floating point no
44.
Not a valid floating point no.
```

Output:

```
Enter the number: 5
Not Floating point no.
.6
Floating point no.
7.8
Floating point no.
```

Program 4:

⇒ Write a LEX program that copies a file, replacing each non empty sequence of white spaces by a single blank.

```
%{
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
char str1[200];
%}
%%
[\n] { fprintf( yyout, "%s\n", str1); str1[0]='\0'
[ ]* { fprintf ( yyout, "%s", str1; str1[0] = '\0';
       fprintf (yyout, "%s", str1);
       strcat (str1, yytext);
<<EOF>> { fprint (yyout, "%s", str1);
       return 0;
%%
```

```
int main ()
{
    extern FILE *yyin,*yyout
    char filename [100];
    printf(" Enter name of file to copy : \t");
    scanf(" %s", filename);
    yyin = fopen (filename , " r");
    if (yyin == NULL)
    {
        exit(0);
    }
    printf (" Enter the name of the file to write\t");
    scanf(" %s ", filename);
    yyout = fopen (filename, "w");
    if (yyout == NULL)
    {
        exit(1);
    }
    yylex();
int yywrap (void)
{
}
```

Output:

Open

input.txt
~/Desktop/CD LAB/Lab Programs

```
1 this is      a sample      text for        the program
```

Open

output.txt
~/Desktop/CD LAB/Lab Programs

```
1 this is a sample text for the program
```

Program 5:

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

a. The set of all strings ending in 00

```
%%
[0-9]*00 { printf("string accepted"); }
[0-9]* { printf("string rejected"); }
%%
int yywrap()
{
}
int main()
{
    yylex();
    return 0;
}
```

OUTPUT:

```
lex string_end_00.l
cc lex.yy.c
./a.out
10100
string accepted
34560
string rejected.
```

b. The set of all strings with 3 consecutive 222's

```
%%
[0-9]*222[0-9]* { printf("string contains 222"); }
[0-9]* { printf("string does not contain 222"); }
%%
```

OUTPUT:

12223

String contains 222.

1234

String does not contain 222.

c. The set of all string such that every block of five consecutive symbols contains at least two 5's.

```
%%
[0-9]*
{
    int i, c=0;
    if (yyleng < 5)
    {
        printf("%s doesn't match any such \n", yytext
    }
    else
    {
        for (i=0; i<5; i++)
        {
            if (yytext[i] == '5')
            {
                c++;
            }
            if (c==2)
            {
                for (i < yyleng ; i++)
            {
```

```
        if (yytext[i-5] == '5') { c--; }
        if (yytext[i] == '5') { c++; }
    }
    if (c < 2)
    {
        printf("%s doesn't match any rule\n", yytext);
        break;
    }
    }
    else
    {
        printf("%s doesn't match any rule\n", yytext);
    }
    }
%%
```

d. The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer is congruent to zero modulo 5.

```
%%
(1 (0)*(11|01)(01*01|01*10(0)*(11|1)*0)
 (1|10(0)*(11|01)(01*01|00*10(0)*(11|1)*10)
printf("The set of all strings beginning with
        a 1 is interpolated as the binary
        representation of an integer");
}
%%
```

e. The set of all strings such that the 10th symbol from ~~from~~ the right end is 1.

```
%%
({a})* 1 {a}{a}{a}
    printf("The set of all strings such that
            the 10th symbol from the right
            end is 1");
}
%%
```

OUTPUT

1011100010

The set of all string such that the 10th symbol from right end is 1.

f. The set of all 4 digit no.'s whose individual digits are in ascending order from left to right.

```
%%
{d}{a}
int sum = 0, i;
for (i= 0; i<4; i++)
{
    sum = sum + yytext [i] - 48;
}
if (sum == 9)
{
  printf("The sum of digits whose sum is 9");
}
```

```
}
}
% %
```

OUTPUT:

0 2 3 4

The sum is 9.

9. The set of all 4 digit no.'s whose individual digits are in ascending order from left to right:

```
% %
{d}{U}{
    for (i=0; i<3; i++)
    {
        if (gytext[i] > gytext[i+1])
        {
            sum = 0;
            break;
        }
    }
    if (sum==1)
    {
        printf("ascending order from left to right
    }
    else
    {
        printf("%s doesnt match any rule\n",
    }
}
% %
```

OUTPUT:

4 5 6 7

in ascending order.

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Output:

```
Enter text
1200
1200 -> string ending in 00

122299
122299 -> string with three consecutive 222's

10
10 doesn't match any rule

157495
157495 doesn't match any rule
```

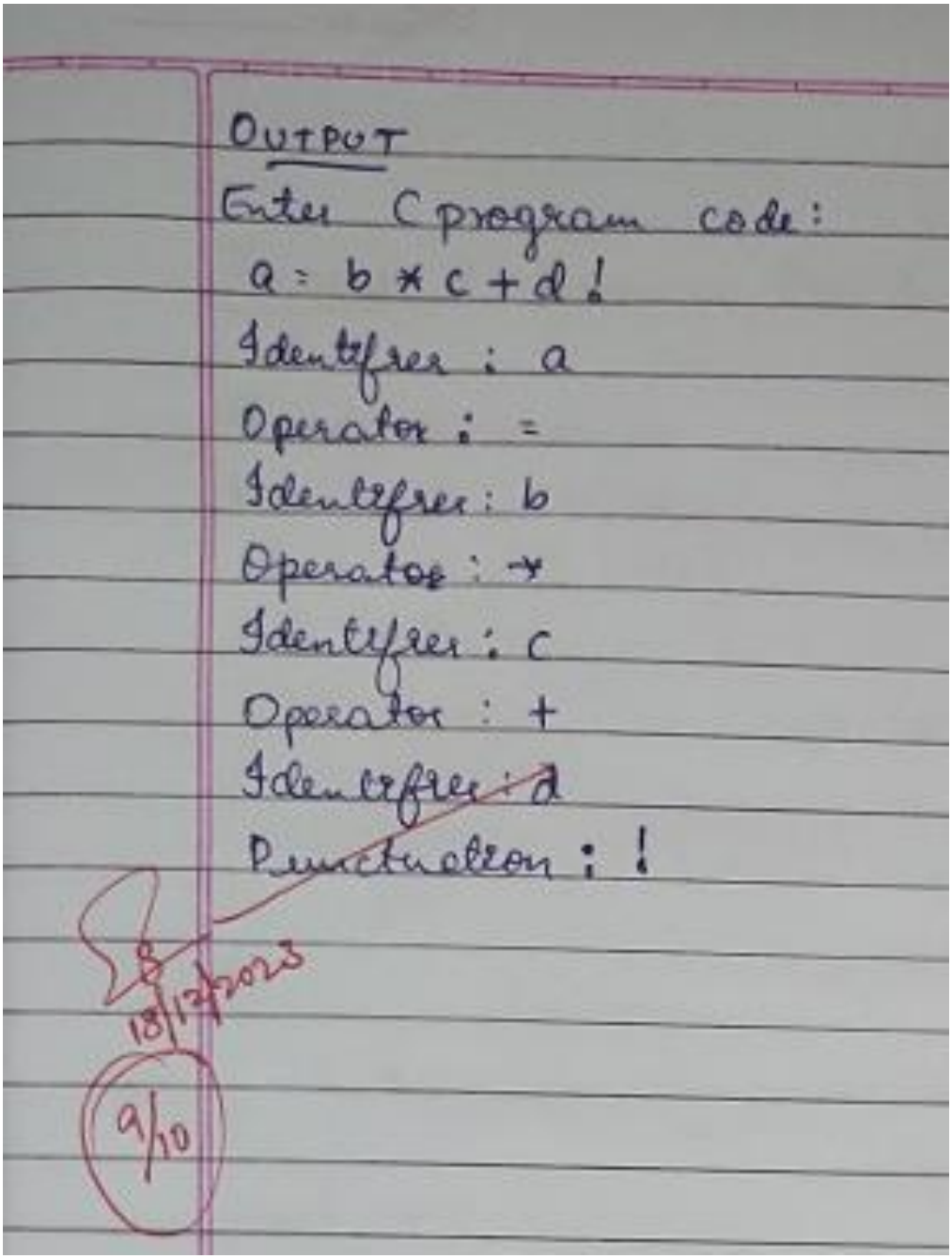
Program 6:

WAP to design a Lexical Analyzer to recognize any 5 keywords, identifiers, no's, operators & punctuations.

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

#define KEYWORD 1
#define IDENTIFIER 2
#define NUMBER 3
#define OPERATOR 4
#define PUNCTUATION 5
#define INVALID 6

int isKeyword(char* str)
{
    int i;
    char keywords[5][10]={"if", "else", "while", "int",
                          "return"};
    for (i=0; i<5; ++i)
    {
        if(strcmp(str, keyword[i])==0)
        {
            return KEYWORD;
        }
    }
    return 0;
}
```

```
void analyzeToken(char *token)
{
    if (isKeyword(token) == KEYWORD)
    {
        printf("KEYWORD: %s \n", token);
    }
    else if (isdigit(token[0]))
    {
        printf("Number: %s \n", token);
    }
    else if (isalpha(token[0]) || token[0] == '_')
    {
        printf("Op Identifier: %s \n", token);
    }
    else if (strch("+-*/=", token[0]) != NULL)
    {
        printf("Operator: %s \n", token);
    }
    else
    {
        printf("Invalid Token: %s \n", token);
    }
}

int main()
{
    char input[500];
    char token[100];
    int tokenIndex = 0;
    int i;
```

```
printf("Enter the C program code: \n");
fget(input, size(input), stdin);
for (i=0; i<=strlen(input); ++i)
{
    if(isalnum(input)|| ~~strlen~~; input[i]=='_')
    {
        token[tokenIndex++] = input[i];
    }
    else
    {
        if(tokenIndex>0)
        {
            token[tokenIndex] = '\0';
            analyzeToken(token);
            tokenIndex=0;
        }
        if(input[i]!=' ' && input[i]!='\n'
                && input[i]!='\t')
        {
            token[0] = input[i];
            token[1] = '\0';
            analyzeToken(token);
        }
    }
}
return 0;
}
```



OUTPUT

Enter C program code:

a = b * c + d !

Identifier : a

Operator : =

Identifier : b

Operator : *

Identifier : c

Operator : +

Identifier : d

Punctuation : !

18/12/2023

9/10

Output:

```
Enter the sentence: int
Keyword
abc
Identifiers
+
Operator
!
Punctuator
123
Constants
```

Part-B: Part-B: Implementation of Parsers (Syntax Analyzers) Using C/C++/Java/Python language)

Program 1:

PROGRAM 18: Recursive Decent

```
#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
        {
            printf("Parsing Failed.\n", end);
            exit(1);
        }
}
int main()
{
    printf("Enter the input string:\n");
    scanf("%s", input);
    s();
    if (input[end] == '$')
    {
        printf("Parsing successful.\n");
    }  ~~scanf("~~
    else
    {
        printf("Parsing Failed. Extra character
                                    found");
    }
    return 0;
}
```

OUTPUT:

Enter the input string: cabd$
Parsing Successful.

Enter the input string: caac$
Parsing Failed. Extra characters found.

Output:

```
Enter the input string: cabd
Parsing successful! Input belongs to the given grammar.
```

```
Enter the input string: caab
Parsing failed! Input does not belong to the given grammar.
```

Part-C: Syntax Directed Translation using YACC tool

Program 1:

String match $a^n b$ where $n > 5$

```
%{
#include <stdio.h>
#include <stdlib.h>
#include "y.tab.h"
extern int yylval;
%}
%%
[a A]   { yylval = yytext[0];   return A; }
[b B]   { yylval = yytext[0];   return B; }
\n      { return NL; }
        { return yytext[0]; }
%%
int yywrap()
{
    return 1;
}

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

%token A
%token B
%token NL
```

```
%%
Sinta: AAAAA SBB    NL {printf(" Parsed using
                        the rule (a^n b) b,
                        n >=5 \n Valid string \n");}

;
S: S A
|
;

%%

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

Output

```
Enter a string
a a a a a b
Parsed using the rule (a^n)b, n >=5
valid string

a a b b b
Invalid String!
```

Output:

```
Enter the string : aaaaab$
Parsed using the rule(a^n)b, n>5
Valid string!
```

```
Enter the string : aabb$
Invalid string!
```

Program 2:

PROGRAM -19 : Desk Calculator

```
%option noyywrap
%{
#include "y.tab.h"
%}
%%
[0-9]+  {yylval = atoi(yytext); return NUM;}
[\t];
\n  return 0;
.  return yytext[0]
%%


%{
#include<stdio.h>
%}
%token NUM
%left '+'
%right '-'
%%
exp : e { printf("Valid expression\n");
          printf("Result : %d\n", $$); return 0;}
e : e '+' e  { $$ = $1 + $3;}
| e '-' e  { $$ = $1 - $3;}
| NUM  { $$ = $1 }
;
%%
int main()
{
printf("\n Enter an arithmetic expression");
```

```
yyparse();
return 0;
}
int yyerror()
{
printf("In Invalid expression\n");
return 0;
}
```

OUTPUT

```
>lex prog1.l
>yacc -d prog1.y
>gcc lex.yy.c y.tab.c
> ./a.out
Enter an arithmetic expression
5+6-3-6
Valid expression
Result: 14
```

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Output:

```
Enter an arithmetic expression:
1+2*3%1^2
Valid expression
Result: 1
```

Program 3:

Date :
Page No :

Write a Yacc program to generate syntax tree for a given arithmetic expression

p1.y

```
%{
#include <math.h>
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

struct tree_node
{
   char val[10];
   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[10]);
%}

% token digit
%%
S: E  { my_print_tree ($1); }
;

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

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

F: '(' E ')'  { $$ = $2; }
| digit  { char buf[10]; sprintf(buf, "%d", yyle
           $$ = mknode(-1, -1, buf); }
%%

int main()
{
    ind = 0;
    printf("Enter an expression");
    yyparse();
    return 0;
}

int yyerror()
{
    printf("NITW Error \n");
}

int mknode(int lc, int rc, char val[10])
{
    strcpy(syn_tree[ind].val, val);
    syn_tree[ind].lc = ;
    syn_tree[ind].rc = rc;
    ind ++;
    return ind - 1;
}
```

```
void my-print-tree (int cur-ind)
{
        if (cur-ind == -1) return;
        if (sym-tree[cur-ind].lc == -1 && sym-tree
                                [cur-ind].rc == -1)
        printf (" Digit Node -> Index : %d, Value : %d",
                cur-ind, sym-tree [cur-ind].val);
        else
        printf (" Operator Node -> Index : %d, Value : %c
                Left Child Index : %d, Right Child Index : %d
                \n sym-tree[cur-ind].lc. sym-tree
                                [cur-ind]. );
    my-print-tree (sym-tree[cur-ind].lc);
    my-print-tree( sym-tree( cur-ind].rc);
}
```

P.l

```
%{
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+   { yylval = atoi (yytext); return digit; }
[ ;t];
[\n]    return 0;
.       return yylex(0);
%%
int yywrap()
{
}
```

Output

Enter an expression

2 +4

Operation Node -> Index:2, Value: +, left Child Index:0

Right Child Index:1

Digit Node -> Index:0, Value:2

Digit Node -> Index:1, Value:4

Output:

```
Enter an expression
4+6*9
Operator Node -> Index : 4, Value : +, Left Child Index : 0,Right Child Index : 3
Digit Node -> Index : 0, Value : 4
Operator Node -> Index : 3, Value : *, Left Child Index : 1,Right Child Index : 2
Digit Node -> Index : 1, Value : 6
Digit Node -> Index : 2, Value : 9
```

Program 4:

```
Infix Postfix
%{
#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()
{
}


Infix Postfix
%{
#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, $t");}
;

%%
void main()
{
        printf(" Enter an infix expression: \n");
        yyparse();
}
int yyerror(const char *s)
{
```

```
    printf("Invalid infix expression!\n");
    return 0;
}
```

Output:

```
Enter an infix expression
3+9*8
398*+

Enter an infix expression
3+9*6/5+*+
396*5/+ Invalid expression!
```

Output:

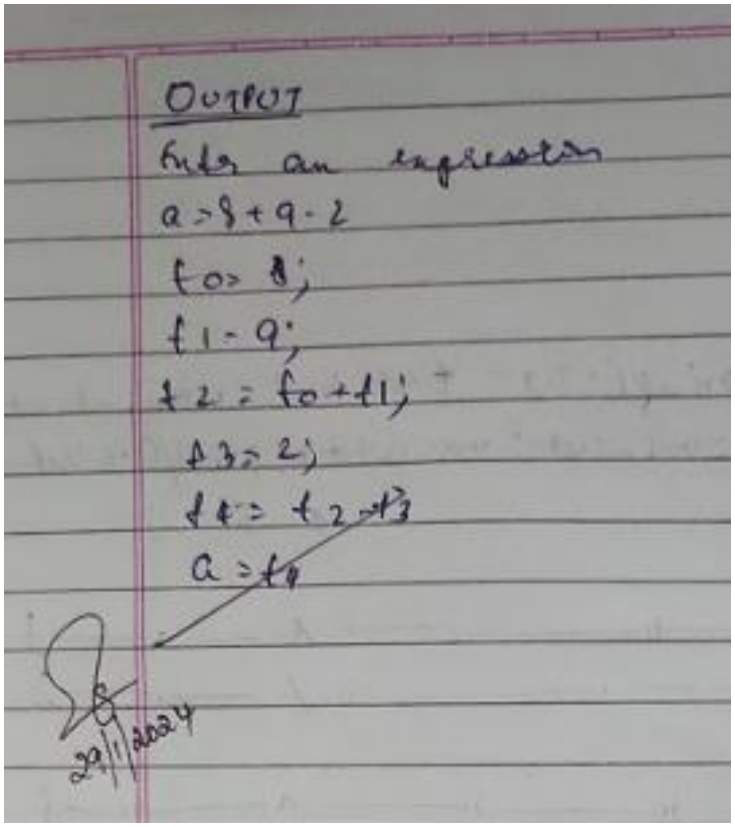
```
Enter an infix expression:
3+6*2-1/3
362*+13/-
```

```
Enter infix expression:  2+3*4
234*+
```

Program 5:

```
Address Code.l
%{
#include <stdio.h>
#include <stdlib.h>
#include "y.tab.h"
extern int yylval;
extern char iden[20];
%}
d [0-9]+
a [a-z A-Z]+
%%
{d}   {yylval = atoi(yytext); digit ;}
{a}   { strcpy (iden, yytext); yylval = 1; return id;
[\t]  { ; }
\n    return 0;
      return yytext[0];

%%
int yywrap()
{
    return 1;
}

Address & Copy.y

%{
#include<math.h>
#include <ctype.h>
#include <stdio.h>

int yyerror(char *s);
```

```
char Iden[20];
%
%token id
%token digit
%%
S: id '=' E {printf("%s = %d \n", Iden, val_cut);}
E: E '+' T {$$ = val_cut; val_cut++; printf("%d
                                    , $$);}

T: T '*' F {  ———— " ———— " ———— * ———— " ———— }
| T '/' F {  ———— " ———— " ———— / ———— " ———— };
| F { $$ = $1; }
F: P '^' F { ———— " ———— " ———— ^ ———— " ———— };

int main()
{
   val_cut = 0;
   printf("Enter an expression :\n");
   yyparse();
   return 0;
}


int yyerror(char *s)
{
   return 0;
}
```



Output:

```
Enter an expression:
a=8+9-2
t0 = 8;
t1 = 9;
t2 = t0 + t1;
t3 = 2
t4 = t2 - t3;
a = t4;
```