COMPILER AND TRANSLATOR DESIGN

Practical File

Course Code : INITC20

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1.) Write a program to implement a DFA to recognize the identifiers, keywords, constants, and comments of C language.

```c
#include <stdbool.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

// Returns 'true' if the character is a DELIMITER.
bool isDelimiter(char ch)
{
    if (ch == ' ' || ch == '+' || ch == '-' || ch == '*' ||
        ch == '/' || ch == ',' || ch == ';' || ch == '>' ||
        ch == '<' || ch == '=' || ch == '(' || ch == ')' ||
        ch == '[' || ch == ']' || ch == '{' || ch == '}')
        return (true);
    return (false);
}

// Returns 'true' if the character is an OPERATOR.
bool isOperator(char ch)
{
    if (ch == '+' || ch == '-' || ch == '*' ||
        ch == '/' || ch == '>' || ch == '<' ||
        ch == '=')
        return (true);
    return (false);
}

// Returns 'true' if the string is a VALID IDENTIFIER.
bool validIdentifier(char *str)
{
    if (str[0] == '0' || str[0] == '1' || str[0] == '2' ||
        str[0] == '3' || str[0] == '4' || str[0] == '5' ||
        str[0] == '6' || str[0] == '7' || str[0] == '8' ||
        str[0] == '9' || isDelimiter(str[0]) == true)
        return (false);
    return (true);
}

// Returns 'true' if the string is a KEYWORD.
bool isKeyword(char *str)
{
    if (!strcmp(str, "if") || !strcmp(str, "else") ||
        !strcmp(str, "while") || !strcmp(str, "do") ||
        !strcmp(str, "break") ||
```

```
        !strcmp(str, "continue") || !strcmp(str, "int") || !strcmp(str,
"double") || !strcmp(str, "float") || !strcmp(str, "return") ||
!strcmp(str, "char") || !strcmp(str, "case") || !strcmp(str, "char") ||
!strcmp(str, "sizeof") || !strcmp(str, "long") || !strcmp(str, "short")
|| !strcmp(str, "typedef") || !strcmp(str, "switch") || !strcmp(str,
"unsigned") || !strcmp(str, "void") || !strcmp(str, "static") ||
!strcmp(str, "struct") || !strcmp(str, "goto"))
        return (true);
    return (false);
}

// Returns 'true' if the string is an INTEGER.
bool isInteger(char *str)
{
    int i, len = strlen(str);

    if (len == 0)
        return (false);
    for (i = 0; i < len; i++)
    {
        if (str[i] != '0' && str[i] != '1' && str[i] != '2' && str[i]
!= '3' && str[i] != '4' && str[i] != '5' && str[i] != '6' && str[i] !=
'7' && str[i] != '8' && str[i] != '9' || (str[i] == '-' && i > 0))
            return (false);
    }
    return (true);
}

// Returns 'true' if the string is a REAL NUMBER.
bool isRealNumber(char *str)
{
    int i, len = strlen(str);
    bool hasDecimal = false;

    if (len == 0)
        return (false);
    for (i = 0; i < len; i++)
    {
        if (str[i] != '0' && str[i] != '1' && str[i] != '2' && str[i]
!= '3' && str[i] != '4' && str[i] != '5' && str[i] != '6' && str[i] !=
'7' && str[i] != '8' && str[i] != '9' && str[i] != '.' ||
            (str[i] == '-' && i > 0))
            return (false);
        if (str[i] == '.')
            hasDecimal = true;
    }
    return (hasDecimal);
}

// Extracts the SUBSTRING.
```

```
char *subString(char *str, int left, int right)
{
    int i;
    char *subStr = (char *)malloc(
        sizeof(char) * (right - left + 2));

    for (i = left; i <= right; i++)
        subStr[i - left] = str[i];
    subStr[right - left + 1] = '\0';
    return (subStr);
}

// Parsing the input STRING.
void parse(char *str)
{
    int left = 0, right = 0;
    int len = strlen(str);

    while (right <= len && left <= right)
    {
        if (isDelimiter(str[right]) == false)
            right++;

        if (isDelimiter(str[right]) == true && left == right)
        {
            if (isOperator(str[right]) == true)
                printf("'%c' IS AN OPERATOR\n", str[right]);

            right++;
            left = right;
        }
        else if (isDelimiter(str[right]) == true && left != right ||
(right == len && left != right))
        {
            char *subStr = subString(str, left, right - 1);

            if (isKeyword(subStr) == true)
                printf("'%s' IS A KEYWORD\n", subStr);

            else if (isInteger(subStr) == true)
                printf("'%s' IS AN INTEGER\n", subStr);

            else if (isRealNumber(subStr) == true)
                printf("'%s' IS A REAL NUMBER\n", subStr);

            else if (validIdentifier(subStr) == true &&
isDelimiter(str[right - 1]) == false)
                printf("'%s' IS A VALID IDENTIFIER\n", subStr);
```

```
            else if (validIdentifier(subStr) == false &&
isDelimiter(str[right - 1]) == false)
                printf("'%s' IS NOT A VALID IDENTIFIER\n", subStr);
            left = right;
        }
    }
    return;
}

// DRIVER FUNCTION
int main()
{
    // maximum length of string is 100 here
    char str[100] = "int a = b + 1c; ";

    parse(str); // calling the parse function

    return (0);
}
```

OUTPUT

```
$ ./a
int a=b+c
'int' IS A KEYWORD
'a' IS A VALID IDENTIFIER
'=' IS AN OPERATOR
'b' IS A VALID IDENTIFIER
'+' IS AN OPERATOR
'c' IS A VALID IDENTIFIER
```

2. Write a program for predictive parse.

```
#include<stdio.h>
#include<ctype.h>
#include<string.h>
#include<stdlib.h>
#define SIZE 128
#define NONE -1
#define EOS '\0'
#define NUM 257
#define KEYWORD 258
#define ID 259
#define DONE 260
#define MAX 999
char lexemes[MAX];
char buffer[SIZE];
int lastchar=-1;
int lastentry=0;
int tokenval=DONE;
int lineno=1;
int lookahead;
struct entry
{
    char *lexptr;
    int token;
}
symtable[100];
struct entry
        keywords[]=
{"if",KEYWORD,"else",KEYWORD,"for",KEYWORD,"int",KEYWORD,"float",KEY
WORD,
                    "double",KEYWORD,"char",KEYWORD,"struct",KEYWOR
D,"return",KEYWORD,0,0
};
void Error_Message(char *m)
{
    fprintf(stderr,"line %d, %s \n",lineno,m);
    exit(1);
}
int look_up(char s[ ])
{
    int k;
    for(k=lastentry; k>0; k--)
        if(strcmp(symtable[k].lexptr,s)==0)
            return k;
    return 0;
}
int insert(char s[ ],int tok)
{
    int len;
```

```
    len=strlen(s);
    if(lastentry+1>=MAX)
        Error_Message("Symbpl table is full");
    if(lastchar+len+1>=MAX)
        Error_Message("Lexemes array is full");
    lastentry=lastentry+1;
    symtable[lastentry].token=tok;
    symtable[lastentry].lexptr=&lexemes[lastchar+1];
    lastchar=lastchar+len+1;
    strcpy(symtable[lastentry].lexptr,s);
    return lastentry;
}
/*void Initialize()
{
    struct entry *ptr;
    for(ptr=keywords;ptr->token;ptr+1)
        insert(ptr->lexptr,ptr->token);
}*/
int lexer()
{
    int t;
    int val,i=0;
    while(1)
    {
        t=getchar();
        if(t==' '||t=='\t');
        else if(t=='\n')
            lineno=lineno+1;
        else if(isdigit(t))
        {
            ungetc(t,stdin);
            scanf("%d",&tokenval);
            return NUM;
        }
        else if(isalpha(t))
        {
            while(isalnum(t))
            {
                buffer[i]=t;
                t=getchar();
                i=i+1;
                if(i>=SIZE)
                    Error_Message("Compiler error");
            }
            buffer[i]=EOS;
            if(t!=EOF)
                ungetc(t,stdin);
            val=look_up(buffer);
            if(val==0)
                val=insert(buffer,ID);
```

```
            tokenval=val;
            return symtable[val].token;
        }
        else if(t==EOF)
            return DONE;
        else
        {
            tokenval=NONE;
            return t;
        }
    }
}
void Match(int t)
{
    if(lookahead==t)
        lookahead=lexer();
    else
        Error_Message("Syntax error");
}
void display(int t,int tval)
{
    if(t=='+'||t=='-'||t=='*'||t=='/')
        printf("\nArithmetic Operator: %c",t);
    else if(t==NUM)
        printf("\n Number: %d",tval);
    else if(t==ID)
        printf("\n Identifier: %s",symtable[tval].lexptr);
    else
        printf("\n Token %d tokenval %d",t,tval);
}
void F()
{
    //void E();
    switch(lookahead)
    {
    case '(' :
        Match('(');
        E();
        Match(')');
        break;
    case NUM :
        display(NUM,tokenval);
        Match(NUM);
        break;
    case ID :
        display(ID,tokenval);
        Match(ID);
        break;
    default :
        Error_Message("Syntax error");
```

```
    }
}
void T()
{
    int t;
    F();
    while(1)
    {
        switch(lookahead)
        {
        case '*' :
            t=lookahead;
            Match(lookahead);
            F();
            display(t,NONE);
            continue;
        case '/' :
            t=lookahead;
            Match(lookahead);
            display(t,NONE);
            continue;
        default :
            return;
        }
    }
}
void E()
{
    int t;
    T();
    while(1)
    {
        switch(lookahead)
        {
        case '+' :
            t=lookahead;
            Match(lookahead);
            T();
            display(t,NONE);
            continue;
        case '-' :
            t=lookahead;
            Match(lookahead);
            T();
            display(t,NONE);
            continue;
        default :
            return;
        }
    }
```

```
}
void parser()
{
    lookahead=lexer();
    while(lookahead!=DONE)
    {
        E();
        Match(';');
    }
}
int main()
{
    char ans[10];
    printf("\n Program for recursive descent parsing ");
    printf("\n Enter the expression ");
    printf("And place ; at the end\n");
    printf("Press Ctrl-Z to terminate\n");
    parser();
return 0;
}
```

OUTPUT

```
$ ./out

Enter the expression and place ; at the end.
a*b+c;

 Identifier: a
 Identifier: b
Arithmetic Operator: *
 Identifier: c
Arithmetic Operator: +
```

3. Write a program to convert infix to postfix using Lexx and Yacc.

Main.l->

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

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

Main.y->

```
%{
#include<stdio.h>
%}
%token NUM
%left '+' '-'
%left '*' '/'
%right NEGATIVE
%%
S: E {printf("\n");}
;
E: E '+' E
{printf("+");}
| E '*' E
{printf("*");}
| E '-' E {printf("-
");}
| E '/' E
{printf("/");}
| '(' E ')'
| '-' E %prec NEGATIVE {printf("-");}
|  NUM {printf("%d", yylval);}
;
%%
 int
main()
{ yyparse
();
```

```
}

int yyerror (char *msg) {
return printf ("error YACC: %s\n", msg);
}
```

OUTPUT

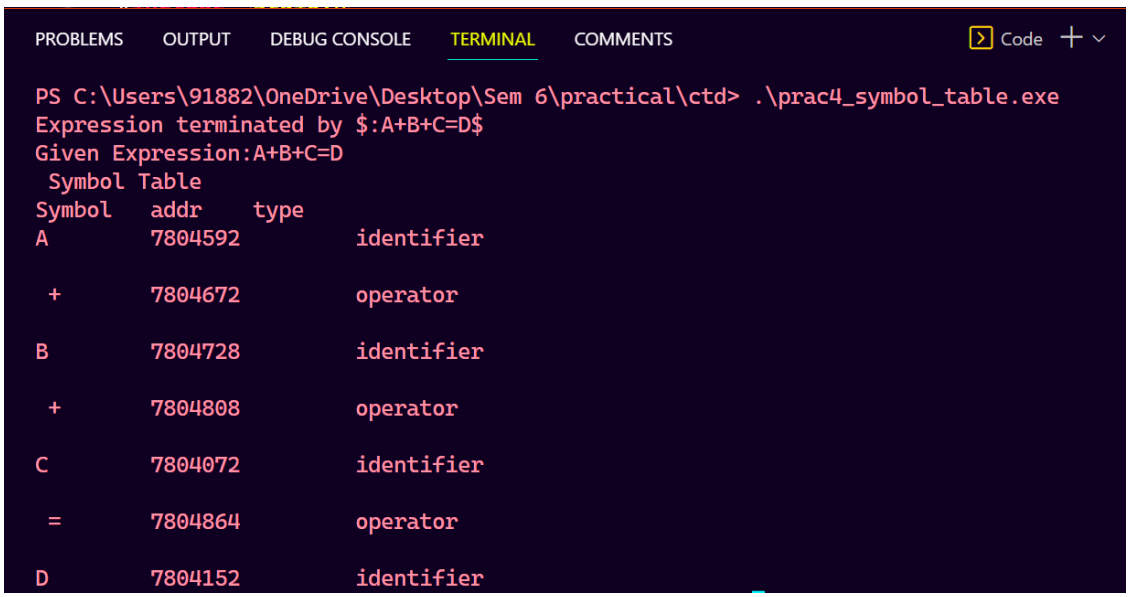
```
$ ./a
2+3/5*7-4
235/7*+4-
```

4. Write a program to implement symbols table.

```
#include <stdio.h>
#include <ctype.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
void main()
{
    int i = 0, j = 0, x = 0, n;
    void *p, *add[5];
    char ch, srch, b[15], d[15], c;
    printf("Expression terminated by $:");
    while ((c = getchar()) != '$')
    {
        b[i] = c;
        i++;
    }
    n = i - 1;
    printf("Given Expression:");
    i = 0;
    while (i <= n)
    {
        printf("%c", b[i]);
        i++;
    }
    printf("\n Symbol Table\n");
    printf("Symbol \t addr \t type");
    while (j <= n)
    {
        c = b[j];
```

```
        if (isalpha(toascii(c)))
        {
            p = malloc(c);
            add[x] = p;
            d[x] = c;
            printf("\n%c \t %d \t identifier\n", c, p);
            x++;
            j++;
        }
        else
        {
            ch = c;
            if (ch == '+' || ch == '-' || ch == '*' || ch == '=')
            {
                p = malloc(ch);
                add[x] = p;
                d[x] = ch;
                printf("\n %c \t %d \t operator\n", ch, p);
                x++;
                j++;
            }
        }
    }
}
```

OUTPUT



5. Write a program to implement simple calculator using Lex and Yacc.

Main.l->

```
%{
#include<stdlib.h> #include "y.tab.h" extern int yylval;
%}

%%

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

">=" return GE;
"<=" return LE;
"!=" return NE;
"==" return EQ;
[\n] return 0;
[\t];
 . return yytext[0];

%%
```

Main.y->

```
%{
#include<stdio.h>
%}

%token NAME NUMBER  // Declaration of Names token
%left GE LE NE EQ '<' '>' '%'   // Asscociativity
%left '-' '+'
%left '*' '/'
%nonassoc UMINUS

%%
 statement : NAME '=' exp

|exp {printf("=%d\n",$1);}
;

exp : NUMBER {$$ == $1;}
|exp '+' exp {$$ = $1 + $3 ;}
|exp '-' exp {$$ = $1 - $3 ;}
|exp '*' exp {$$ = $1 * $3 ;}
|exp '/' exp {$$ = $1 / $3 ;}
|exp '<' exp {$$ = $1 < $3 ;}
|exp '>' exp {$$ = $1 > $3 ;}
|exp '%' exp {$$ = $1 % $3 ;}
```

```
|exp GE exp {$$ = $1 >= $3 ;}
|exp LE exp {$$ = $1 <= $3 ;}
|exp EQ exp {$$ = $1 == $3 ;}
|exp NE exp {$$ = $1 != $3 ;}
|exp '-' exp %prec UMINUS {$$ = -$2 ;}
|'(' exp ')' {$$ = $2 ;}
;

%%

int main()
{ yyparse();
}
int yyerror()
{
}  int yywrap()
{ return 1;
}
```

OUTPUT

```
$ ./a
2+10/5*3-4
=4
```

6. Write a program to implement lexical analyzer for C language.

Main.l->

```
%{
int COMMENT=0;
%}
identi1er [a-zA-Z][a-zA-Z0-9]*
%%
#.*\n {printf("%sThis is a PREPROCESSOR DIRECTIVE\n",yytext);}
auto|break|case|char|const|continue|default|do|double|else|enum|exte
rn|Roat|for|goto|if|int|long|register|return|short|signed|sizeof|
static|struct|switch|typedef|union|unsigned|void|volatile|while
{printf("\n%s is a KEYWORD",yytext);}
"/*" {COMMENT = 1;}
"*/" {COMMENT = 0;}
{identi1er}\( {if(!COMMENT)printf("\nFUNCTION: \n%s",yytext);}
```

```
{identi1er}(\[[0-9]*\])? {if(!COMMENT) printf("\n%s is an
IDENTIFIER",yytext);}
\".*\" {if(!COMMENT)printf("\n%s is a STRING",yytext);}
[0-9]+ {if(!COMMENT) printf("\n%s is a NUMBER ",yytext);}
\{ {if(!COMMENT) printf("\nBLOCK BEGINS");}
\} {if(!COMMENT) printf("\nBLOCK ENDS");}
\) {if(!COMMENT);printf("\n)");}
= {if(!COMMENT) printf("\n%s is an ASSIGNMENT OPERATOR",yytext);}
\<= | \>= | \< | \== | \!= | \> {if(!COMMENT) printf("\n%s is a
RELATIONAL
OPERATOR",yytext);}
\, | \; {if(!COMMENT) printf("\n%s is a SEPERATOR",yytext);}
%%
int main(int argc, char **argv)
{
FILE *1le;
1le=fopen("c_lex_analyser.txt","r"); if(!1le) { printf("could not
open the 1le"); exit(0);
}
yyin=1le; yylex(); printf("\n"); return(0);
} int yywrap()
{ return(1);
}
```

OUTPUT

```
$ ./a

void is a KEYWORD
FUNCTION:
main(
int is a KEYWORD
a is an IDENTIFIER
)

BLOCK BEGINS


int is a KEYWORD
a is an IDENTIFIER,
b is an IDENTIFIER,
c is an IDENTIFIER;

a is an IDENTIFIER
= is an ASSIGNMENT OPERATOR
1 is a NUMBER ;

b is an IDENTIFIER
= is an ASSIGNMENT OPERATOR
2 is a NUMBER ;

if is a KEYWORD (
a is an IDENTIFIER >
b is an IDENTIFIER
)

c is an IDENTIFIER
= is an ASSIGNMENT OPERATOR
0 is a NUMBER ;

else is a KEYWORD

c is an IDENTIFIER
```

```
FUNCTION:
printf(
"The value of c: %d" is a STRING,
c is an IDENTIFIER
);

for is a KEYWORD (
int is a KEYWORD
i is an IDENTIFIER
= is an ASSIGNMENT OPERATOR
0 is a NUMBER ;
i is an IDENTIFIER <
5 is a NUMBER ;
i is an IDENTIFIER++
)

i is an IDENTIFIER++;

return is a KEYWORD
0 is a NUMBER ;

BLOCK ENDS
```

7. Write a program to implement parser for C language.

Main.l->

```
%option yylineno

%{
#include<stdio.h>
#include"y.tab.h"
%}


%%
"#include"[ ]+<[a-zA-z_][a-zA-z_0-9.]*>     {return HEADER;}
"#de1ne"[ ]+[a-zA-z_][a-zA-z_0-9]* {return DEFINE;}
"auto"|"register"|"static"|"extern"|"typedef" {return
storage_const;}
"void"|"char"|"short"|"int"|"long"|"Roat"|"double"|"signed"|"unsigne
d" {return type_const;}
"const"|"volatile" {return qual_const;}
"enum" {return enum_const;}
"struct"|"union" {return struct_const;}
"case" {return CASE;}
"default" {return DEFAULT;}
"if" {return IF;}
"switch" {return SWITCH;}
```

```
"else" {return ELSE;}
"for" {return FOR;}
"do" {return DO;}
"while" {return WHILE;}
"goto" {return GOTO;}
"continue" {return CONTINUE;}
"break" {return BREAK;}
"return" {return RETURN;}
"sizeof" {return SIZEOF;}
"||" {return or_const;}
"&&" {return and_const;}
"=="|"!=" {return eq_const;}
"<="|">=" {return rel_const;}
">>"|"<<" {return shift_const;}
"++"|"--" {return inc_const;}
"->" {return point_const;}
"*="|"/="|"+="|"%="|">>="|"-="|"<<="|"&="|"^="|"|=" {return PUNC;}
[0-9]+ {return int_const;}
[0-9]+"."[0-9]+ {return Roat_const;}
"'"."'" {return char_const;}
[a-zA-z_][a-zA-z_0-9]* {return id;}
\".*\" {return string;}
"//"(\\.|[^\n])*[\n]
;
[/][*]([^*]|[*]*[^*/])*[*]+[/]  ;
[ \t\n]

;
";"|"="|","|"{"|"}"|"("|")"|"["|"]"|"*"|"+"|"-
"|"/"|"?"|":"|"&"|"|"|"^"|"!"|"~"|"%"|"<"|">" {return yytext[0];}
%%

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

Main.y->

```
%{
#include<stdio.h> int yylex(void); int yyerror(const char *s); int
success = 1;
%}

%token int_const char_const Roat_const id string storage_const
type_const qual_const struct_const enum_const DEFINE
%token IF FOR DO WHILE BREAK SWITCH CONTINUE RETURN CASE DEFAULT
GOTO SIZEOF PUNC or_const and_const eq_const shift_const rel_const
inc_const
%token point_const ELSE HEADER
```

```
%left '+' '-'
%left '*' '/'
%right UMINUS
%nonassoc "then" %nonassoc ELSE

%start program_unit
%%
program_unit

    : HEADER program_unit
| DEFINE primary_exp program_unit
| translation_unit
;
translation_unit

    : external_decl
| translation_unit external_decl
;
external_decl   : function_de1nition
| decl
;
function_de1nition
    : decl_specs declarator decl_list compound_stat
| declarator decl_list compound_stat
| decl_specs declarator compound_stat
| declarator compound_stat
;
decl
    : decl_specs init_declarator_list ';'

 decl_list  | decl_specs ';'
;
: decl
| decl_list decl
;

decl_specs

    : storage_class_spec decl_specs
| storage_class_spec
| type_spec decl_specs
| type_spec


 storage_class_spec     | type_quali1er decl_specs
| type_quali1er
;
: storage_const
;
type_spec
```

```
    : type_const


 type_quali1er  | struct_or_union_spec
| enum_spec
;
: qual_const
;
struct_or_union_spec    : struct_or_union id '{' struct_decl_list
'}' ';'
| struct_or_union id
;
struct_or_union     : struct_const
;
struct_decl_list

 init_declarator_list

 init_declarator    : struct_decl
| struct_decl_list struct_decl
;
: init_declarator
| init_declarator_list ',' init_declarator
;
: declarator
| declarator '=' initializer
;
struct_decl     : spec_quali1er_list struct_declarator_list ';'
;
spec_quali1er_list  : type_spec spec_quali1er_list
| type_spec
    | type_quali1er spec_quali1er_list
    | type_quali1er
    ; struct_declarator_list    : struct_declarator
    | struct_declarator_list ',' struct_declarator
    ; struct_declarator     : declarator
| declarator ':' conditional_exp
| ':' conditional_exp
;
enum_spec   : enum_const id '{' enumerator_list '}'
| enum_const '{' enumerator_list '}'
| enum_const id
;
enumerator_list     : enumerator
| enumerator_list ',' enumerator
;
enumerator  : id
| id '=' conditional_exp
;
declarator  : pointer direct_declarator
```

```
| direct_declarator
;
direct_declarator   : id

| '(' declarator ')'

| direct_declarator '[' conditional_exp ']'

| direct_declarator '['     ']' | direct_declarator '(' param_list
')'

| direct_declarator '(' id_list ')'

    | direct_declarator '('     ')'
;
pointer     : '*' type_quali1er_list
| '*'
| '*' type_quali1er_list pointer
| '*' pointer
;
type_quali1er_list  : type_quali1er
| type_quali1er_list type_quali1er
;
param_list  : param_decl
| param_list ',' param_decl
;
param_decl  : decl_specs declarator
| decl_specs abstract_declarator
| decl_specs
;
id_list     : id
| id_list ',' id ;
initializer     : assignment_exp
| '{' initializer_list '}'
| '{' initializer_list ',' '}' ;
initializer_list    : initializer
| initializer_list ',' initializer
;
type_name   : spec_quali1er_list abstract_declarator
| spec_quali1er_list
;
abstract_declarator     : pointer
| pointer direct_abstract_declarator
    |   direct_abstract_declarator
;
direct_abstract_declarator  : '(' abstract_declarator ')'
| direct_abstract_declarator '['
conditional_exp ']'
| '[' conditional_exp ']'
| direct_abstract_declarator '[' ']'
```

```
| '[' ']'
| direct_abstract_declarator '(' param_list ')'
| '(' param_list ')'
| direct_abstract_declarator '(' ')'
| '(' ')' ;
stat    : labeled_stat

| exp_stat

| compound_stat

| selection_stat
    | iteration_stat
    | jump_stat
    ;
labeled_stat    : id ':' stat
    | CASE int_const ':' stat
    | DEFAULT ':' stat
    ; exp_stat  : exp ';'
| ';' ;
compound_stat   : '{' decl_list stat_list '}'

| '{' stat_list '}'

    | '{' decl_list     '}'

| '{' '}'

;

stat_list

    : stat
| stat_list stat
;
selection_stat  : IF '(' exp ')' stat
%prec "then"
| IF '(' exp ')' stat ELSE stat
| SWITCH '(' exp ')' stat
;
iteration_stat  : WHILE '(' exp ')' stat
| DO stat WHILE '(' exp ')' ';'
| FOR '(' exp ';' exp ';' exp ')' stat
    | FOR '(' exp ';' exp ';'   ')' stat
| FOR '(' exp ';' ';' exp ')' stat | FOR '(' exp ';' ';' ')' stat
| FOR '(' ';' exp ';' exp ')' stat
| FOR '(' ';' exp ';' ')' stat
| FOR '(' ';' ';' exp ')' stat
| FOR '(' ';' ';' ')' stat ;
jump_stat   : GOTO id ';'
```

```
| CONTINUE ';'
| BREAK ';'
| RETURN exp ';'
| RETURN ';'
;
exp     : assignment_exp
| exp ',' assignment_exp
;
assignment_exp  : conditional_exp
| unary_exp assignment_operator
assignment_exp
 assignment_operator
;
    : PUNC
| '='

    ;
conditional_exp     : logical_or_exp
| logical_or_exp '?' exp ':' conditional_exp
;
logical_or_exp  : logical_and_exp
| logical_or_exp or_const logical_and_exp
;
logical_and_exp     : inclusive_or_exp
| logical_and_exp and_const inclusive_or_exp
;
inclusive_or_exp    : exclusive_or_exp
| inclusive_or_exp '|' exclusive_or_exp
;
exclusive_or_exp    : and_exp
| exclusive_or_exp '^' and_exp
;
and_exp     : equality_exp
| and_exp '&' equality_exp
;
equality_exp    : relational_exp
| equality_exp eq_const relational_exp
;
relational_exp  : shift_expression
| relational_exp '<' shift_expression
| relational_exp '>' shift_expression
| relational_exp rel_const shift_expression
;
shift_expression

 additive_exp   : additive_exp
| shift_expression shift_const additive_exp
;
: mult_exp
| additive_exp '+' mult_exp
```

```
| additive_exp '-' mult_exp
;
mult_exp    : cast_exp
| mult_exp '*' cast_exp

    | mult_exp '/' cast_exp
| mult_exp '%' cast_exp
;
cast_exp    : unary_exp
| '(' type_name ')' cast_exp
;
unary_exp   : post1x_exp
| inc_const unary_exp
| unary_operator cast_exp
| SIZEOF unary_exp
| SIZEOF '(' type_name ')'
;
unary_operator      : '&' | '*' | '+' | '-' | '~' | '!'
;
post1x_exp
    : primary_exp









primary_exp


    : id    | post1x_exp '[' exp ']'
| post1x_exp '(' argument_exp_list ')'
| post1x_exp '(' ')'
| post1x_exp '.' id
| post1x_exp point_const id
| post1x_exp inc_const
;
| consts
| string
| '(' exp ')'
;
argument_exp_list   : assignment_exp
| argument_exp_list ',' assignment_exp
;
consts  : int_const

    | char_const    | Roat_const
    | enum_const
    ;
```

```
%%

int main()
{ yyparse(); if(success) printf("Parsing Successfull\n");
return 0;
}

int yyerror(const char *msg)
{ extern int yylineno; printf("Parsing Failed\nLine Number: %d
%s\n",yylineno,msg); success = 0; return 0;
}
```

OUTPUT

```
$ ./a
int a=b+c;
^Z
Parsing Successfull
```

8. Generate three address code for selected C statements.

Main.l->

```
%{
#include"y.tab.h"
extern char yyval;
%}
%%
[0-9]+ {yylval.symbol=(char)(yytext[0]);return NUMBER;}
[a-z] {yylval.symbol= (char)(yytext[0]);return LETTER;}
. {return yytext[0];}
\n {return 0;}
%%
```

Main.y->

```
%{
#include"y.tab.h"
#include<stdio.h>
char addtotable(char,char,char);
int index1=0;
char temp = 'A'-1;
struct expr{
char operand1;
char operand2;
char operator;
char result;
};
%}
%union{
char symbol;
}
%left '+' '-'
%left '/' '*'
%token <symbol> LETTER NUMBER
%type <symbol> exp
%%
statement: LETTER '=' exp ';' {addtotable((char)$1,(char)$3,'=');};
exp: exp '+' exp {$$ = addtotable((char)$1,(char)$3,'+');}
|exp '-' exp {$$ = addtotable((char)$1,(char)$3,'-');}
|exp '/' exp {$$ = addtotable((char)$1,(char)$3,'/');}
|exp '*' exp {$$ = addtotable((char)$1,(char)$3,'*');}
|'(' exp ')' {$$= (char)$2;}
|NUMBER {$$ = (char)$1;}
|LETTER {(char)$1;};
%%
struct expr arr[20];
```

```
void yyerror(char *s){
printf("Errror %s",s);
}
char addtotable(char a, char b, char o){
temp++;
arr[index1].operand1 =a;
arr[index1].operand2 = b;
arr[index1].operator = o;
arr[index1].result=temp;
index1++;
return temp;
}
void threeAdd(){
int i=0;
char temp='A';
while(i<index1){
printf("%c:=\t",arr[i].result);
printf("%c\t",arr[i].operand1);
printf("%c\t",arr[i].operator);
printf("%c\t",arr[i].operand2);
i++;
temp++;
printf("\n");
}
}
int yywrap(){
return 1;
}
int main(){
printf("Enter the expression: ");
yyparse();
printf("\n");
threeAdd();
printf("\n");
return 0;
}
```

OUTPUT

```
$ ./a
Enter the expression: a=b+c;

A:=     b       +       c
B:=     a       =       A
```