190905104
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Lab 6, 7, 8

Recursive descent parser

Program → main () { declarations statement-list }
Declarations→ data-type identifier-list; declarations | ∈
data-type → int | char
identifier-list → id | id, identifier-list | id[number] , identifier-list | id[number]
statement_list → statement statement_list | ∈
statement → assign-stat; | decision_stat | looping-stat
assign_stat → id = expn
expn→ simple-expn eprime
eprime→relop simple-expn|∈
|simple-exp→ term seprime
seprime→addop term seprime |∈
term → factor tprime
tprime → mulop factor tprime |∈
factor → id | num
decision-stat → if (expn) {statement_list} dprime
dprime → else {statement_list} | ∈
looping-stat → while (expn) {statement_list} | for (assign_stat ; expn ; assign_stat) {statement_list}
relop → == | != | <= | >= | > | <
addop → + | -
mulop → * | / | %

Grammar 7.1

Lab 6

Program → main () { declarations assign_stat }
declarations→ data-type identifier-list; declarations | ∈
data-type → int | char
identifier-list → id | id, identifier-list
assign_stat → id=id; | id = num;

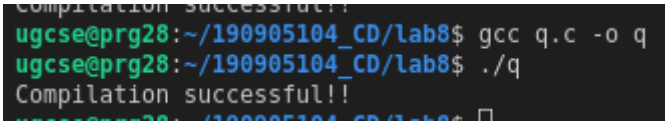
Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
        int a, b;
```

```
    char c;
    a = b;
    c = 'C';
}
```

Output

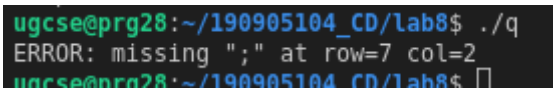


Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
    int a, b;
    char c   // missing ;
    a = b;
    c = 'C';
}
```

Output

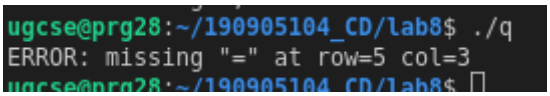


Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
    a, b;  // invalid assignment
    char c;
    a = b;
    c = 'C';
}
```

Output



Lab 7

Program → main () { declarations statement-list }

identifier-list → id | id, identifier-list | id[number] , identifier-list | id[number]

statement_list → statement statement_list | ∈

statement → assign-stat;

assign_stat → id = expn

expn→ simple-expn eprime

eprime→relop simple-expn|∈

simple-exp→ term seprime

seprime→addop term seprime |∈

term → factor tprime

tprime → mulop factor tprime |∈

factor → id | num

relop → = = | != | <= | >= | > | <

addop → + | -

mulop → * | / | %

Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
        char c;
        int first, second, third[5];

        first = second;
        first = 5*7;
        first = 5>7;
}
```

Output

```
ugcse@prg28:~/190905104_CD/lab8$ gcc q.c -o q
ugcse@prg28:~/190905104_CD/lab8$ ./q
Compilation successful!!
```

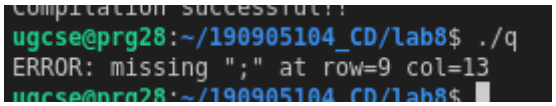
Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
        char c;
        int first, second, third[5];

        first = second;
        first = 5%%7;  // invalid operator
        first = 5>7;
}
```

Output



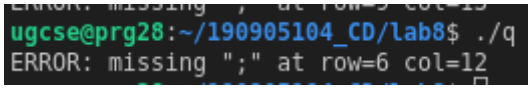
Input program

```
#include <stdio.h>
#include <stdlib.h>

int main(){
        char c;
        int first second, third[5];  // missing ,

        first = second;
        first = 5%7;
        first = 5>7;
}
```

Output



Lab 8

statement → assign-stat; | decision_stat | looping-stat

decision-stat → if (expn) {statement_list} dprime

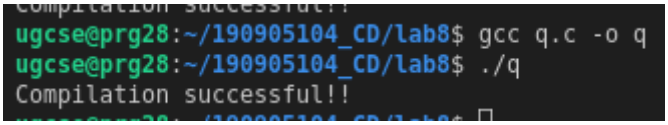
Input program

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
        int a, b;
        char c;
        int first, second, third[5];
```

```
        while (a <= b)
        {
                if (second <= 5)
                {
                        for (b = 0; b<=10; b = b + 1)
                        {
                                a = second;
                        }
                }
        }
        if (second != first)
        {
                c = 1;
        }
        else
        {
                c = 2;
        }
}
```

Output



Input program

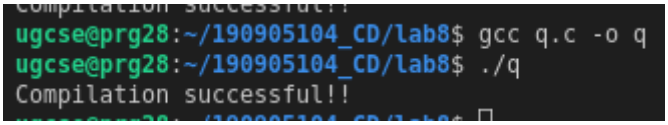
```
#include <stdio.h>
#include <stdlib.h>

int main()
{
        int a, b;
        char c;
        int first, second, third[5];

        while (a <= b)
        {
                if (second <= 5)
                {
                        for (b = 0; b<=10; b = b + 1)
                        {
                                a = second;
                        }
                }
        }
        if (second != first)
        {
                c = 1;
        }
        else
        {
```

```
            c = 2;
        }
        for(i = 0; i < b; i=i+1)
        {
            if(i < a)
            {
                a = i;
            }
        }
}
```

Output



Input program

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
        int a, b;
        char c;
        int first, second, third[5];

        while (a <= b)
        {
            if (second <= 5)
            {
                for (b = 0; b<=10; b = b + 1)
                {
                    a = second;
                }
            // missing }
        }
        if (second != first)
        {
            c = 1;
        }
        else
        {
            c = 2;
        }
        for(i = 0; i < b; i=i+1)
        {
            if(i < a)
            {
                a = i;
            }
        }
}
```

Output

```
ugcse@prg28:~/190905104_CD/lab8$ ./q
ERROR: missing "}" at row=-1 col=0
```

Input program

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
	int a, b;
	char c;
	int first, second, third[5];

	while (a <= b)
	{
		if (second <= 5)
		{
			for (b = 0; b<=10; b = b + 1)
			{
				a = second;
			}
		}
	}
	if (second != first)
	{
		c = 1;
	}
	else
	// missing {
		c = 2;
	}
	for(i = 0; i < b; i=i+1)
	{
		if(i < a)
		{
			a = i;
		}
	}
}
```

Output

```
ugcse@prg28:~/190905104_CD/lab8$ ./q
ERROR: missing "{" at row=26 col=3
ugcse@prg28:~/190905104_CD/lab8$
```

q.c

```
#include "lex_analyser.h"

void program();
void declarations();
void datatype();
void idList();
void idListprime();
void idListprimePrime();
void stmtList();
void stmt();
void assignStat();
void expn();
void eprime();
void simpleExpn();
void seprime();
void term();
void tprime();
void factor();
void relop();
void addop();
void mulop();
void decStat();
void dPrime();
void loopStat();

struct token tkn;
FILE *f1;

void program()
{
   if (strcmp(tkn.lexeme, "main") == 0)
   {
      tkn = getNextToken(f1);
      if (strcmp(tkn.lexeme, "(") == 0)
      {
         tkn = getNextToken(f1);
         if (strcmp(tkn.lexeme, ")") == 0)
         {
            tkn = getNextToken(f1);
            if (strcmp(tkn.lexeme, "{") == 0)
            {
               tkn = getNextToken(f1);
               declarations();
               stmtList();
               if (strcmp(tkn.lexeme, "}") == 0)
               {
                  printf("Compilation successful!!\n");
                  return;
               }
               else
```

```
                {
                    printf("ERROR: missing \"}\" at row=%d col=%d\n", tkn.row, tkn.col);
                    exit(1);
                }
            }
            else
            {
                printf("ERROR: missing \"{\" at row=%d col=%d\n", tkn.row, tkn.col);
                exit(1);
            }
        }
        else
        {
            printf("ERROR: missing \")\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else
    {
        printf("ERROR: missing \"(\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}
else
{
    printf("ERROR: missing \"main\" at row=%d col=%d\n", tkn.row, tkn.col);
    exit(1);
}
}

void declarations()
{
    if (isdtype(tkn.lexeme) == 0)
        return;
    datatype();
    idList();
    if (strcmp(tkn.lexeme, ";") == 0)
    {
        tkn = getNextToken(f1);
        declarations();
    }
    else
    {
        printf("ERROR: missing \";\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void datatype()
{
    if (strcmp(tkn.lexeme, "int") == 0)
    {
```

```
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "char") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else
    {
        printf("ERROR: missing datatype(int or char) at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void idList()
{
    if (strcmp(tkn.type, "IDENTIFIER") == 0)
    {
        tkn = getNextToken(f1);
        idListprime();
    }
    else
    {
        printf("ERROR: missing IDENTIFIER at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void idListprime()
{
    if (strcmp(tkn.lexeme, ",") == 0)
    {
        tkn = getNextToken(f1);
        idList();
    }
    else if (strcmp(tkn.lexeme, "[") == 0)
    {
        tkn = getNextToken(f1);
        if (strcmp(tkn.type, "NUMBER") == 0)
        {
            tkn = getNextToken(f1);
            if (strcmp(tkn.lexeme, "]") == 0)
            {
                tkn = getNextToken(f1);
                idListprimePrime();
            }
            else
            {
                printf("ERROR: missing \"]\" at row=%d col=%d\n", tkn.row, tkn.col);
                exit(1);
            }
```

```
        }
        else
        {
            printf("ERROR: missing NUMBER at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
}

void idListprimePrime()
{
    if (strcmp(tkn.lexeme, ",") == 0)
    {
        tkn = getNextToken(f1);
        idList();
    }
    else
        return;
}

void stmtList()
{
    if (strcmp(tkn.type, "IDENTIFIER") == 0 || strcmp(tkn.lexeme, "if") == 0 || strcmp(tkn.lexeme,
"for") == 0 || strcmp(tkn.lexeme, "while") == 0)
    {
        stmt();
        stmtList();
    }
    return;
}

void stmt()
{
    if (strcmp(tkn.type, "IDENTIFIER") == 0)
    {
        assignStat();
        if (strcmp(tkn.lexeme, ";") == 0)
        {
            tkn = getNextToken(f1);
            return;
        }
        else
        {
            printf("ERROR: missing \";\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else if (strcmp(tkn.lexeme, "if") == 0)
        decStat();
    else if ((strcmp(tkn.lexeme, "while") == 0) || (strcmp(tkn.lexeme, "for") == 0))
        loopStat();
    else
```

```
    {
        printf("%d.%d : Expected \" statement \"\n", tkn.row, tkn.col);
        exit(0);
    }
}

void assignStat()
{
    if (strcmp(tkn.type, "IDENTIFIER") == 0)
    {
        tkn = getNextToken(f1);
        if (strcmp(tkn.lexeme, "=") == 0)
        {
            tkn = getNextToken(f1);
            expn();
        }
        else
        {
            printf("ERROR: missing \"=\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else
    {
        printf("ERROR: missing IDENTIFIER at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void expn()
{
    simpleExpn();
    eprime();
}

void eprime()
{
    if (strcmp(tkn.type, "RELATIONALOPERATOR") != 0)
        return;
    relop();
    simpleExpn();
}

void simpleExpn()
{
    term();
    seprime();
}

void seprime()
{
    if ((strcmp(tkn.lexeme, "+") != 0) && (strcmp(tkn.lexeme, "-") != 0))
```

```
        return;
    addop();
    term();
    seprime();
}

void term()
{
    factor();
    tprime();
}

void tprime()
{
    if ((strcmp(tkn.lexeme, "*") != 0) && (strcmp(tkn.lexeme, "/") != 0) && (strcmp(tkn.lexeme,
"%") != 0))
        return;
    mulop();
    factor();
    tprime();
}

void factor()
{
    if (strcmp(tkn.type, "IDENTIFIER") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.type, "NUMBER") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else
    {
        printf("ERROR: Expected IDENTIFIER or NUMBER at row=%d col=%d\n", tkn.row,
tkn.col);
        exit(1);
    }
}

void relop()
{
    if (strcmp(tkn.lexeme, "==") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "!=") == 0)
    {
        tkn = getNextToken(f1);
```

```
        return;
    }
    else if (strcmp(tkn.lexeme, "<=") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, ">=") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "<") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, ">") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else
    {
        printf("ERROR: Expected RELATIONAL OPERATOR or NUMBER at row=%d col=%d\n",
tkn.row, tkn.col);
        exit(1);
    }
}

void addop()
{
    if (strcmp(tkn.lexeme, "+") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "-") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else
    {
        printf("ERROR: Expected \"+\" or \"-\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void mulop()
{
    if (strcmp(tkn.lexeme, "*") == 0)
```

```
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "/") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else if (strcmp(tkn.lexeme, "*") == 0)
    {
        tkn = getNextToken(f1);
        return;
    }
    else
    {
        printf("ERROR: Expected \"*\" or \"/\" or \"%%\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}

void decStat()
{
    if (strcmp(tkn.lexeme, "if") == 0)
    {
        tkn = getNextToken(f1);
        if (strcmp(tkn.lexeme, "(") == 0)
        {
            tkn = getNextToken(f1);
            expn();
            if (strcmp(tkn.lexeme, ")") == 0)
            {
                tkn = getNextToken(f1);
                if (strcmp(tkn.lexeme, "{") == 0)
                {
                    tkn = getNextToken(f1);
                    stmtList();
                    if (strcmp(tkn.lexeme, "}") == 0)
                    {
                        tkn = getNextToken(f1);
                        dPrime();
                        return;
                    }
                    else
                    {
                        printf("ERROR: missing \"}\" at row=%d col=%d\n", tkn.row, tkn.col);
                        exit(1);
                    }
                }
                else
                {
                    printf("ERROR: missing \"{\" at row=%d col=%d\n", tkn.row, tkn.col);
```

```
                exit(1);
            }
        }
        else
        {
            printf("ERROR: missing \")\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else
    {
        printf("ERROR: missing \"(\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}
else
{
    printf("ERROR: missing \"keyword\" at row=%d col=%d\n", tkn.row, tkn.col);
    exit(1);
}
}

void dPrime()
{
    if (strcmp(tkn.lexeme, "else") == 0)
    {
        tkn = getNextToken(f1);
        if (strcmp(tkn.lexeme, "{") == 0)
        {
            tkn = getNextToken(f1);
            stmtList();
            if (strcmp(tkn.lexeme, "}") == 0)
            {
                tkn = getNextToken(f1);
                return;
            }
            else
            {
                printf("ERROR: missing \"}\" at row=%d col=%d\n", tkn.row, tkn.col);
                exit(1);
            }
        }
        else
        {
            printf("ERROR: missing \"{\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else
        return;
}
void loopStat()
```

```
{
   if (strcmp(tkn.lexeme, "while") == 0)
   {
      tkn = getNextToken(f1);
      if (strcmp(tkn.lexeme, "(") == 0)
      {
         tkn = getNextToken(f1);
         expn();
         if (strcmp(tkn.lexeme, ")") == 0)
         {
            tkn = getNextToken(f1);
            if (strcmp(tkn.lexeme, "{") == 0)
            {
               tkn = getNextToken(f1);
               stmtList();
               if (strcmp(tkn.lexeme, "}") == 0)
               {
                  tkn = getNextToken(f1);
                  return;
               }
               else
               {
                  printf("ERROR: missing \"}\" at row=%d col=%d\n", tkn.row, tkn.col);
                  exit(1);
               }
            }
            else
            {
               printf("ERROR: missing \"{\" at row=%d col=%d\n", tkn.row, tkn.col);
               exit(1);
            }
         }
         else
         {
            printf("ERROR: missing \")\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
         }
      }
      else
      {
         printf("ERROR: missing \"(\" at row=%d col=%d\n", tkn.row, tkn.col);
         exit(1);
      }
   }
   else if (strcmp(tkn.lexeme, "for") == 0)
   {
      tkn = getNextToken(f1);
      if (strcmp(tkn.lexeme, "(") == 0)
      {
         tkn = getNextToken(f1);
         assignStat();
         if (strcmp(tkn.lexeme, ";") == 0)
```

```
    {
        tkn = getNextToken(f1);
        expn();
        if (strcmp(tkn.lexeme, ";") == 0)
        {
            tkn = getNextToken(f1);
            assignStat();
            if (strcmp(tkn.lexeme, ")") == 0)
            {
                tkn = getNextToken(f1);
                if (strcmp(tkn.lexeme, "{") == 0)
                {
                    tkn = getNextToken(f1);
                    stmtList();
                    if (strcmp(tkn.lexeme, "}") == 0)
                    {
                        tkn = getNextToken(f1);
                        return;
                    }
                    else
                    {
                        printf("ERROR: missing \"}\" at row=%d col=%d\n", tkn.row, tkn.col);
                        exit(1);
                    }
                }
                else
                {
                    printf("ERROR: missing \"{\" at row=%d col=%d\n", tkn.row, tkn.col);
                    exit(1);
                }
            }
            else
            {
                printf("ERROR: missing \")\" at row=%d col=%d\n", tkn.row, tkn.col);
                exit(1);
            }
        }
        else
        {
            printf("ERROR: missing \";\" at row=%d col=%d\n", tkn.row, tkn.col);
            exit(1);
        }
    }
    else
    {
        printf("ERROR: missing \";\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}
else
{
    printf("ERROR: missing \"(\" at row=%d col=%d\n", tkn.row, tkn.col);
```

```
            exit(1);
        }
    }
    else
    {
        printf("ERROR: missing \"keyword\" at row=%d col=%d\n", tkn.row, tkn.col);
        exit(1);
    }
}


int main()
{
    FILE *fa, *fb;
    int ca, cb;
    fa = fopen("sample.c", "r");
    if (fa == NULL)
    {
        printf("Cannot open file \n");
        exit(0);
    }
    fb = fopen("output.c", "w+");
    ca = getc(fa);
    while (ca != EOF)
    {
        if (ca == ' ')
        {
            putc(ca, fb);
            while (ca == ' ')
                ca = getc(fa);
        }
        if (ca == '/')
        {
            cb = getc(fa);
            if (cb == '/')
            {
                while (ca != '\n')
                    ca = getc(fa);
            }
            else if (cb == '*')
            {
                do
                {
                    while (ca != '*')
                        ca = getc(fa);
                    ca = getc(fa);
                } while (ca != '/');
            }
            else
            {
                putc(ca, fb);
                putc(cb, fb);
```

```
        }
    }
    else
        putc(ca, fb);
    ca = getc(fa);
}
fclose(fa);
fclose(fb);
fa = fopen("output.c", "r");
if (fa == NULL)
{
    printf("Cannot open file");
    return 0;
}
fb = fopen("temp.c", "w+");
ca = getc(fa);
while (ca != EOF)
{
    if (ca == "")
    {
        putc(ca, fb);
        ca = getc(fa);
        while (ca != "")
        {
            putc(ca, fb);
            ca = getc(fa);
        }
    }
    else if (ca == '#')
    {
        while (ca != '\n')
            ca = getc(fa);
    }
    putc(ca, fb);
    ca = getc(fa);
}
fclose(fa);
fclose(fb);
fa = fopen("temp.c", "r");
fb = fopen("output.c", "w");
ca = getc(fa);
while (ca != EOF)
{
    putc(ca, fb);
    ca = getc(fa);
}
fclose(fa);
fclose(fb);
remove("temp.c");
f1 = fopen("output.c", "r");
if (f1 == NULL)
{
```

```
        printf("Error! File cannot be opened!\n");
        return 0;
    }
    while ((tkn = getNextToken(f1)).row != -1)
    {
        // printf("%s\n", tkn.lexeme);
        if (strcmp(tkn.lexeme, "main") == 0)
        {
            program();
            break;
        }
    }
    fclose(f1);
}
```

lex_analyser.c

```
#include <stdlib.h>
#include <stdio.h>
#include <ctype.h>
#include <string.h>
static int row = 1, col = 1;
char buf[2048];
char dbuf[128];
int ind = 0;
const char specialsymbols[] = {'?', ';', ':', ','};
const char arithmeticsymbols[] = {'*'};
const char *keywords[] = {"auto", "double", "int", "struct", "break", "else", "long", "switch", "case",
"enum", "register", "typedef", "char", "extern", "return", "union", "continue", "for", "signed",
"void", "do", "if", "static", "while", "default", "goto", "sizeof", "volatile", "const", "short",
"unsigned", "printf", "scanf", "true", "false", "bool"};
const char *datypes[] = {"int", "char", "void", "float", "bool", "double"};
struct token
{
        char lexeme[128];
        unsigned int row, col;
        char type[64];
};
struct sttable
{
        int sno;
        char lexeme[128];
        char dtype[64];
        char type[64];
        int size;
};

int isKeyword(char *w)
{
        for (int i = 0; i < sizeof(keywords) / sizeof(char *); i++)
                if (strcmp(w, keywords[i]) == 0)
```

```
                        return 1;
        return 0;
}
int isdtype(char *w)
{
        for (int i = 0; i < sizeof(datypes) / sizeof(char *); i++)
                if (strcmp(w, datypes[i]) == 0)
                        return 1;
        return 0;
}
void newLine()
{
        row++;
        col = 1;
}
void printTable(struct sttable *tab, int n)
{
        for (int i = 0; i < n; i++)
                printf("%d %s %s %s %d\n", tab[i].sno, tab[i].lexeme, tab[i].dtype, tab[i].type,
tab[i].size);
}
int findTable(struct sttable *tab, char *nam, int n)
{
        for (int i = 0; i < n; i++)
                if (strcmp(tab[i].lexeme, nam) == 0)
                        return 1;
        return 0;
}
struct sttable fillTable(int sno, char *lexn, char *dt, char *t, int s)
{
        struct sttable tab;
        tab.sno = sno;
        strcpy(tab.lexeme, lexn);
        strcpy(tab.dtype, dt);
        strcpy(tab.type, t);
        tab.size = s;
        return tab;
}
void fillToken(struct token *tkn, char c, int row, int col, char *type)
{
        tkn->row = row;
        tkn->col = col;
        strcpy(tkn->type, type);
        tkn->lexeme[0] = c;
        tkn->lexeme[1] = '\0';
}
int charIs(int c, const char *arr)
{
        int len;
        if (arr == specialsymbols)
                len = sizeof(specialsymbols) / sizeof(char);
```

```
	else if (arr == arithmeticsymbols)
		len = sizeof(arithmeticsymbols) / sizeof(char);

	for (int i = 0; i < len; i++)
		if (c == arr[i])
			return 1;
	return 0;
}
int sz(char *w)
{
	if (strcmp(w, "int") == 0)
		return sizeof(int);
	if (strcmp(w, "char") == 0)
		return sizeof(char);
	if (strcmp(w, "void") == 0)
		return 0;
	if (strcmp(w, "float") == 0)
		return sizeof(float);
	if (strcmp(w, "bool") == 0)
		return 1;
}
struct token getNextToken(FILE *fa)
{
	int c;
	struct token tkn =
		{
			.row = -1
		};
	int gotToken = 0;
	while (!gotToken && (c = fgetc(fa)) != EOF)
	{
		if (charIs(c, specialsymbols))
		{
			fillToken(&tkn, c, row, col, "SS");
			gotToken = 1;
			col++;
		}
		else if (charIs(c, arithmeticsymbols))
		{
			fseek(fa, -1, SEEK_CUR);
			c = getc(fa);
			if (isalnum(c))
			{
				fillToken(&tkn, c, row, col, "ARITHMETICOPERATOR");
				gotToken = 1;
				col++;
			}
			fseek(fa, 1, SEEK_CUR);
		}
		else if (c == '(')
		{
			fillToken(&tkn, c, row, col, "LB");
```

```
		gotToken = 1;
		col++;
	}
	else if (c == ')')
	{
		fillToken(&tkn, c, row, col, "RB");
		gotToken = 1;
		col++;
	}
	else if (c == '{')
	{
		fillToken(&tkn, c, row, col, "LC");
		gotToken = 1;
		col++;
	}
	else if (c == '}')
	{
		fillToken(&tkn, c, row, col, "RC");
		gotToken = 1;
		col++;
	}
	else if (c == '[')
	{
		fillToken(&tkn, c, row, col, "LS");
		gotToken = 1;
		col++;
	}
	else if (c == ']')
	{
		fillToken(&tkn, c, row, col, "RS");
		gotToken = 1;
		col++;
	}
	else if (c == '+')
	{
		int x = fgetc(fa);
		if (x != '+')
		{
			fillToken(&tkn, c, row, col, "ARITHMETICOPERATOR");
			gotToken = 1;
			col++;
			fseek(fa, -1, SEEK_CUR);
		}
		else
		{
			fillToken(&tkn, c, row, col, "UNARYOPERATOR");
			strcpy(tkn.lexeme, "++");
			gotToken = 1;
			col += 2;
		}
	}
	else if (c == '-')
```

```
{
	int x = fgetc(fa);
	if (x != '-')
	{
		fillToken(&tkn, c, row, col, "ARITHMETICOPERATOR");
		gotToken = 1;
		col++;
		fseek(fa, -1, SEEK_CUR);
	}
	else
	{
		fillToken(&tkn, c, row, col, "UNARYOPERATOR");
		strcpy(tkn.lexeme, "++");
		gotToken = 1;
		col += 2;
	}
}
else if (c == '=')
{
	int x = fgetc(fa);
	if (x != '=')
	{
		fillToken(&tkn, c, row, col, "ASSIGNMENTOPERATOR");
		gotToken = 1;
		col++;
		fseek(fa, -1, SEEK_CUR);
	}
	else
	{
		fillToken(&tkn, c, row, col, "RELATIONALOPERATOR");
		strcpy(tkn.lexeme, "++");
		gotToken = 1;
		col += 2;
	}
}
else if (isdigit(c))
{
	fillToken(&tkn, c, row, col++, "NUMBER");
	int j = 1;
	while ((c = fgetc(fa)) != EOF && isdigit(c))
	{
		tkn.lexeme[j++] = c;
		col++;
	}
	tkn.lexeme[j] = '\0';
	gotToken = 1;
	fseek(fa, -1, SEEK_CUR);
}
else if (c == '#')
{
	while ((c = fgetc(fa)) != EOF && c != '\n')
		;
```

```
		newLine();
	}
	else if (c == '\n')
	{
		newLine();
		c = fgetc(fa);
		if (c == '#')
		{
			while ((c = fgetc(fa)) != EOF && c != '\n')
				;
			newLine();
		}
		else if (c != EOF)
			fseek(fa, -1, SEEK_CUR);
	}
	else if (isspace(c))
		col++;
	else if (isalpha(c) || c == '_')
	{
		tkn.row = row;
		tkn.col = col++;
		tkn.lexeme[0] = c;
		int j = 1;
		while ((c = fgetc(fa)) != EOF && isalnum(c))
		{
			tkn.lexeme[j++] = c;
			col++;
		}
		tkn.lexeme[j] = '\0';
		if (isKeyword(tkn.lexeme))
			strcpy(tkn.type, "KEYWORD");
		else
			strcpy(tkn.type, "IDENTIFIER");
		gotToken = 1;
		fseek(fa, -1, SEEK_CUR);
	}
	else if (c == '/')
	{
		int d = fgetc(fa);
		col++;
		if (d == '/')
		{
			while ((c = fgetc(fa)) != EOF && c != '\n')
				col++;
			if (c == '\n')
				newLine();
		}
		else if (d == '*')
		{
			do
			{
				if (d == '\n')
```

```
                        newLine();
                    while ((c == fgetc(fa)) != EOF && c != '*')
                    {
                        col++;
                        if (c == '\n')
                            newLine();
                    }
                    col++;
                } while ((d == fgetc(fa)) != EOF && d != '/' && (col++));
                col++;
            }
            else
            {
                fillToken(&tkn, c, row, --col, "ARITHMETIC OPERATOR");
                gotToken = 1;
                fseek(fa, -1, SEEK_CUR);
            }
        }
        else if (c == '"')
        {
            tkn.row = row;
            tkn.col = col;
            strcpy(tkn.type, "STRING LITERAL");
            int k = 1;
            tkn.lexeme[0] = '"';
            while ((c = fgetc(fa)) != EOF && c != '"')
            {
                tkn.lexeme[k++] = c;
                col++;
            }
            tkn.lexeme[k] = '"';
            gotToken = 1;
        }
        else if (c == '<' || c == '>' || c == '!')
        {
            fillToken(&tkn, c, row, col, "RELATIONALOPERATOR");
            col++;
            int d = fgetc(fa);
            if (d == '=')
            {
                col++;
                strcat(tkn.lexeme, "=");
            }
            else
            {
                if (c == '!')
                    strcpy(tkn.type, "LOGICALOPERATOR");
                fseek(fa, -1, SEEK_CUR);
            }
            gotToken = 1;
        }
        else if (c == '&' || c == '|')
```

```
		{
			int d = fgetc(fa);
			if (c == d)
			{
				tkn.lexeme[0] = tkn.lexeme[1] = c;
				tkn.lexeme[2] = '\0';
				tkn.row = row;
				tkn.col = col;
				col++;
				gotToken = 1;
				strcpy(tkn.type, "LOGICALOPERATOR");
			}
			else
				fseek(fa, -1, SEEK_CUR);
			col++;
		}
		else
			col++;
	}
  // printf("%s\n", tkn.lexeme);
	return tkn;
}
```