Lab Manual

OF

Compiler Design

Bachelor of Technology(CSE)

By

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1. Write a program to recognize the string starting from ‘a’ over {a,b}.

Code:

```
#include<stdio.h>
int main()
{
char string[100]; printf("Enter the string: "); scanf("%s", string);
int i=0, state=0; while(string[i]!='\0')
{
switch(state)
{
case 0: if(string[i]=='a') state=1; else if(string[i]=='b')state=2; else state=3;
break;
case 1: if(string[i]=='a') state=1;
else if(string[i]=='b') state=1;
else
state=3; break;
case 2: if(string[i]=='a') state=2;
else if(string[i]=='b') state=2;
else
state=3; break;
case 3: break;
}
i++;
}
if(state==1)
printf("String accepted\n"); else if(state==2)
printf("String not accepted\n"); else
printf("String not recognized\n");

return 0;
}
```

Output:

```
Enter the string: abbaab
String accepted
```

```
Enter the string: baab
String not accepted
```

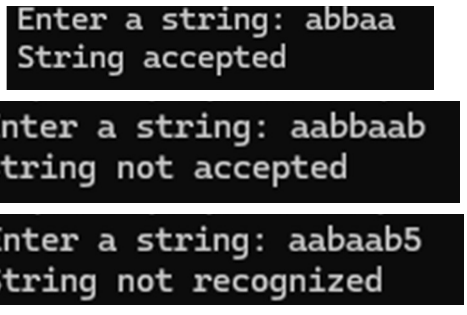
```
Enter the string: aab4aab
String not recognized
```

2. Write a program to recognize the string ending on ‘a’ over {a,b}.

Code:

```
#include<stdio.h>
int main()
{
char string[100]; int state=0, i=0;
printf("Enter a string: "); scanf("%s", string);

while (string[i]!='\0')
{
switch(state)
{
case 0:
if(string[i]=='a') state=1;
else if(string[i]=='b') state=0; else state=2;
break; case 1:
if(string[i]=='a') state=1;
else if(string[i]=='b') state=0; else state=2;
break; case 2:
break;


} i++;
}
if(state==1)
printf("String accepted\n"); else if(state==0)
printf("String not accepted\n"); else
printf("String not recognized\n");

return 0;
}
```

Output:

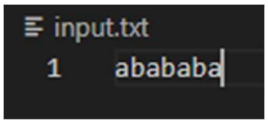


3. Write a program to recognize strings end with ‘ab’. Take the input from text file.

Code:

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

int main() {
char string[100];
FILE *file = fopen("input.txt", "r"); if (file == NULL) {

printf("Could not open file input.txt\n"); return 1;
}
while (fgets(string, sizeof(string), file))
{
int i = 0, state = 0; while (string[i] != '\0')
{
switch (state) { case 0:
if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 0; else state = 3;
break; case 1:
if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 2; else state = 3;
break; case 2:
if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 0; else state = 3;
break; case 3:

state = 3; break;
} i++;
}
if (state == 2)
printf("String accepted: %s\n", string); else if (state == 0 || state == 1)
printf("String not accepted: %s\n", string); else
printf("String not recognized: %s\n", string);
}
fclose(file); return 0;
}
```

Input:



Output:

```
String not accepted: abababa
```

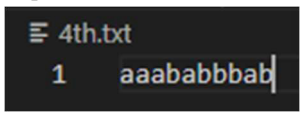
```
String accepted: abababab
```

4. Write a program to recognize strings contains ‘ab’. Take the input from text file.

Code:

```
#include<stdio.h>
int main()
{
char string[100];
FILE *file = fopen("4th.txt", "r"); if (file == NULL) {
printf("Could not open file input.txt\n"); return 1;
}
while(fgets(string, sizeof(string), file))
{
int i=0, state=0; while(string[i]!='\0')
{
switch(state)
{
case 0:
if(string[i]=='a') state=1;
else if(string[i]=='b') state=0; break;
case 1:
if(string[i]=='a') state=1;
else if(string[i]=='b') state=2; break;
case 2:
if(string[i]=='a') state=1;
else if(string[i]=='b') state=2; break;
}
i++;
}
if(state==2)
printf("String accepted: %s\n", string); else if(state==0 || state==1)
printf("String not accepted: %s\n", string); else
printf("String not recognized: %s\n", string);
}

}
```

Input:



Output:

```
String accepted: aaababbbab
```

5. Single line

   comment

Code:

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

int main()
{
char string[100];
FILE *file = fopen("comment.txt", "r"); if (file == NULL) {
printf("Could not open file input.txt\n"); return 1;
}
while (fgets(string, sizeof(string), file))
{
int i=0, state=0; while(string[i]!='\0')
{
switch(state)
{
case 0:
if(string[i]=='/') state=1; else state=2;
break; case 1:
if(string[i]=='/') state=3; else state=2;
break; case 2:

break; case 3:
break;
}
i++;
}
if(state==3)
printf("Comment valid: %s\n", string); else
printf("Comment not valid: %s\n", string);
}

}
```

Output:

```
Comment valid: // hi
```

6. Multiline

Comment

Code:

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

int main()
{
char string[1000];
FILE *file = fopen("comment2.txt", "r"); if (file == NULL) {
printf("Could not open file input.txt\n"); return 1;
}
while (fgets(string, sizeof(string), file))
{
int i=0, state=0; while(string[i]!='\0')
{
switch(state)
{
case 0:
if(string[i]=='/') state=1;

else state=2; break;
case 1:
if(string[i]=='/') state=3;
else if (string[i]=='*') state=4; else state=2;
break; case 2:
break; case 3:
break; case 4:
if (string[i]=='*') state=5; else state=4;
case 5:
if(string[i]=='/') state=6; else state=4;
case 6:
break;
}
i++;
}
if(state==3)
printf("Singleline Comment valid: %s\n", string); else if(state==6)
printf("Multiline Comment valid: %s\n", string); else
printf("Comment not valid: %s\n", string);
}

}
```

Output:

```
Multiline Comment valid: /* hello *
```

2(a). Write a program to recognize the valid identifiers.
Code:

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

int main()
{
char string[1000]; printf("Enter the string: ");
scanf("%s", string); // Prevents buffer overflow int i = 0, state = 0;
int num=1; while (num>0)
{
switch (state)
{
case 0: //A
if (string[i] == 'i') state = 1;
else if (isalpha(string[i]) || string[i] == '_') state = 5; break;

case 1: //B
if (string[i] == 'n') state = 2;
else if (isalpha(string[i]) || string[i] == '_' || isdigit(string[i])) state = 5;
else state = 6; break;

case 2: //C
if (string[i] == 't') state = 3;
else if (isalpha(string[i]) || string[i] == '_' || isdigit(string[i])) state = 5;
else state = 6; break;

case 3: //D
if (string[i] == '\0') state = 4;
else if (isalpha(string[i]) || isdigit(string[i]) || string[i] ==

'_') state = 5;


num--; break;
```

Output:

```
Enter the string: int a
int is keyword.
```

2(b). Write a program to recognize the valid operators.

Code:

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

int main()
{
char string[1000]; printf("Enter the string: ");
scanf("%s", string); // Prevents buffer overflow int i = 0, state = 0;
int num=1; while (num>0)
{
switch(state)
{
case 0:
if (string[i] == '+') state = 51; else if(string[i] == '*') state = 51; else if(string[i] == '/') state = 60; else if(string[i] == '=')
state = 53; else if(string[i] == '-') state = 54; else if(string[i] == '?') state = 55; else if(string[i] == '<') state = 56; else
if(string[i] == '>') state = 59; else if(string[i] == '!') state = 57; else if(string[i] == '&') state = 58; else if(string[i] == '|')
state = 61;
else if(string[i] == '~' || string[i] == '^') state = 62; break;

case 51: // Arithmetic
if (string[i] == '\0') state = 51; else if (string[i] == '+') state = 52; else if (string[i] == '=') state = 53; else state = 0;
num--; break;

case 52: // Unary break;

case 53: // Assignment

if(string[i] == '=') state = 56; else state = 0;
num--; break;

case 54: // -
if (string[i] == '\0') state = 51; else if (string[i] == '-') state = 52; else if (string[i] == '=') state = 53; else state = 0;
num--; break;

case 55: // Ternary
if (string[i] == ':') state = 55; else if(string[i] == '\0') state = 0; else state = 0;
num--; break;

case 56: //Relational
if (string[i] == '=') state = 56; else if(string[i] == '<') state = 58; else state = 0;
num--; break;

case 59: // >
if (string[i] == '>') state = 58; else if (string[i] == '=') state = 56; else state = 0;
```

```
num--; break;

case 57: // Logical
if (string[i] == '=') state = 56; else if(string[i] == '\0') state = 57; else state = 0;
num--; break;

case 58: // Bitwise
if (string[i] == '&') state = 57; else if(string[i] == '\0') state = 58; else state = 0;

num--; break;

case 60: // "/"
if (string[i] == '\0') state = 51; else state = 0;
num--; break;

case 61: // "|"
if (string[i] == '|') state = 57; else if(string[i] == '\0') state = 58; else state = 0;
num--; break;

case 62: // ~ ^
if (string[i] == '\0') state = 58; else state = 0;
num--; break;
}
i++;
}

if (state == 51) printf("%s is an Arithmatic operator.", string); else if(state == 52) printf("%s is an Unary operator.",
string); else if(state == 53) printf("%s is an Assignment operator.", string); else if(state == 55) printf("%s is ternary or
conditional operator.",
string);
else if(state == 56) printf("%s is a Relational Operator.", string); else if(state == 57) printf("%s is a Logical operator.",
string); else if(state == 58) printf("%s is a Bitwise operator.", string); else
printf("Processing  ");

return 0;
}
```

Output:

2(c). Write a program to recognize the valid

number.

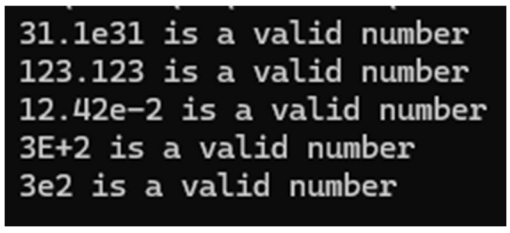
Code:

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

int main() {
FILE *file;
char buffer[100];
char lexeme[100];
char c;
int f, i, state;

file = fopen("numbers.txt", "r"); if (file == NULL) {
printf("Error opening file.\n"); return 1;
}

while (fgets(buffer, 100, file)) { buffer[strcspn(buffer, "\n")] = 0; f = 0;
i = 0;
state = 0;

while (buffer[f] != '\0')
switch (state) {
case 0:
c = buffer[f];
if (isdigit(c)) { state = 40; lexeme[i++] = c; }
else { state = 0; }
break;

case 40:
c = buffer[f];
if (isdigit(c)) { state = 40; lexeme[i++] = c; }
else if (c == '.') { state = 41; lexeme[i++] = c; }
else if (c == 'E' || c == 'e') { state = 43; lexeme[i++] = c;
}
else {
lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme);

i = 0;
state = 0; f--;
}
break;
```

```
case 41:
c = buffer[f];
if (isdigit(c)) { state = 42; lexeme[i++] = c; } else {
lexeme[i] = '\0';
printf("%s is an invalid number (expected digit after

decimal)\n", lexeme);




}


i = 0;
state = 0; f--;

break;

case 42:
c = buffer[f];
if (isdigit(c)) { state = 42; lexeme[i++] = c; }
else if (c == 'E' || c == 'e') { state = 43; lexeme[i++] = c;
}
else {
lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme); i = 0;
state = 0; f--;
}
break;

case 43:
c = buffer[f];
if (c == '+' || c == '-') { state = 44; lexeme[i++] = c; } else if (isdigit(c)) { state = 45; lexeme[i++] = c; } else {
lexeme[i] = '\0';
printf("%s is an invalid number (expected digit or sign after 'E'/'e')\n", lexeme);
i = 0;
state = 0; f--;
}

break;

case 44:
c = buffer[f];
if (isdigit(c)) { state = 45; lexeme[i++] = c; } else {
lexeme[i] = '\0';
printf("%s is an invalid number (expected digit after sign in exponent)\n", lexeme);
i = 0;
state = 0; f--;
}
```

```
break;

case 45:
c = buffer[f];
if (isdigit(c)) { state = 45; lexeme[i++] = c; } else {
lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme); i = 0;
state = 0; f--;



} f++;
}

}
break;


if (state == 40 || state == 41 || state == 42 || state == 45) { lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme);
} else {
printf("%s is an invalid number\n", buffer);
}
}

fclose(file); return
```

Output



2(d). Write a program to recognize the valid comments.

Code:

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

int main()
{
    char string[1000];
    FILE *file = fopen("comment2.txt", "r");
    if (file == NULL) {
        printf("Could not open file input.txt\n");
        return 1;
    }
    while (fgets(string, sizeof(string), file))
    {
        int i=0, state=0;
        while(string[i]!='\0')
        {
            switch(state)
            {
                case 0:
                    if(string[i]=='/') state=1;
                    else state=2;
                    break;
                case 1:
                    if(string[i]=='/') state=3;
                    else if (string[i]=='*') state=4;
                    else state=2;
                    break;
                case 2:
                    break;
                case 3:
                    break;
```

```
                case 4:
                    if (string[i]=='*') state=5;
                    else state=4;
                case 5:
                    if(string[i]=='/') state=6;
                    else state=4;
                case 6:
                    break;
            }
            i++;
        }
        if(state==3)
            printf("Singleline Comment valid: %s\n", string);
        else if(state==6)
            printf("Multiline Comment valid: %s\n", string);
        else
            printf("Comment not valid: %s\n", string);
    }
return 0;
}
```

Output:

```
Multiline Comment valid: /* hello *
```

2(e). Program to implement Lexical

Analyzer. Code:

```
#include <stdio.h> #include
<stdlib.h> #include <ctype.h>
#include <string.h> #define
BUFFER_SIZE 1000 void
check(char *lexeme);

int main() {
	FILE *f1;
	char buffer[BUFFER_SIZE], lexeme[50]; // Static buffer for input and lexeme storage
	char c;
	int f = 0, state = 0, i = 0; f1 =
	fopen("Input.txt", "r");
	fread(buffer, sizeof(char), BUFFER_SIZE - 1, f1);
	buffer[BUFFER_SIZE - 1] = '\0'; // Null termination fclose(f1);

	while (buffer[f] != '\0') { c =
		buffer[f];
		switch (state) { case 0:
				if (isalpha(c) || c == '_') { state = 1;
					lexeme[i++] = c;
				}
				else if (c == ' ' || c == '\t' || c == '\n') { state = 0;
				}
				else if(isdigit(c)) { state = 13;
					lexeme[i++] = c;
				}
				else if (c == '/') {
					state = 11;		// For comment
				}
				else if (c == ';' || c == ',' || c == '{' || c == '}') { printf(" %c is a symbol\n", c);
					state = 0;
				}
				else if (strchr("+-*/=%?<>!&|~^", c)) {
```

```
                        state = 50;
                        lexeme[i++] = c;
                }
                else {
                        state = 0;
                }
                break;

        case 1:
                if (isalpha(c) || isdigit(c) || c == '_') { state = 1;
                        lexeme[i++] = c;
                } else {
                        lexeme[i] = '\0'; // Null-terminate the lexeme check(lexeme);  // Check if
                        it's a keyword or identifier state = 0;
                        i = 0;
                        f--; // Step back to reprocess the current non-alphanumeric


character
                }
                break;

        case 13:
                if(isdigit(c)) { state = 13;
                        lexeme[i++] = c;
                }
                else if(c=='.') { state=14;
                        lexeme[i++]=c;
                }
                else if(c=='E'||c=='e') { state=16;
                        lexeme[i++]=c;
                }
                else {
                        lexeme[i]='\0';
                        printf("%s is a valid number\n", lexeme); i=0;
                        state=0; f-
                        -;
                }
                break;

        case 50: // Operator Handling
```

```
switch (lexeme[0]) { case
	'+':
		if (c == '+') {
			printf("%s is a Unary operator\n", lexeme); state = 0;
		}
		else if (c == '=') {
			printf("%s is an Assignment operator\n", lexeme); state = 0;
		}
		else {
			printf("%s is an Arithmetic operator\n", lexeme); state = 0;
			f--;
		}
		break;

	case '-':
		if (c == '-') {
			printf("%s is a Unary operator\n", lexeme); state = 0;
		}
		else if (c == '=') {
			printf("%s is an Assignment operator\n", lexeme); state = 0;
		}
		else {
			printf("%s is an Arithmetic operator\n", lexeme); state = 0;
			f--;
		}
		break;

	case '*':
	case '/':
	case '%':
		if (c == '=') {
			printf("%s is an Assignment operator\n", lexeme); state = 0;
		}
		else {
			printf("%s is an Arithmetic operator\n", lexeme); state = 0;
			f--;
		}
```

```
            break;

        case '=':
            if (c == '=') {
                printf("%s is a Relational operator\n", lexeme); state = 0;
            }
            else {
                printf("%s is an Assignment operator\n", lexeme); state = 0;
                f--;
            }
            break;

        case '<':
        case '>':
            if (c == '=' || c == lexeme[0]) {
                printf("%s is a Relational operator\n", lexeme); state = 0;
            }
            else {
                printf("%s is a Relational operator\n", lexeme); state = 0;
                f--;
            }
            break;

        case '!':
        case '&':
        case '|':
            if (c == '=') {
                printf("%s is a Logical operator\n", lexeme); state = 0;
            }
            else if (c == lexeme[0]) {
                printf("%s is a Logical operator\n", lexeme); state = 0;
            }
            else {
                printf("%s is a Logical operator\n", lexeme); state = 0;
                f--;
            }
            break;
```

```
                        case '~':
                        case '^':
                                printf("%s is a Bitwise operator\n", lexeme); state = 0;
                                f--;
                                break;

                        case '?':
                                if (c == ':') {
                                        printf("%s is a Ternary or conditional operator\n",
lexeme);
                                        state = 0;
                                }
                                else {
                                        state = 0; f--;
                                }
                                break;

                        default:
                                state = 0;
                                break;
                }
                lexeme[0] = '\0'; i =
                0;
                break;

        default:
                state = 0; break;
    }
    f++;
  }
}

void check(char *lexeme) { char
  *keywords[] = {
  "auto", "break", "case", "char", "const", "continue", "default", "do",
  "double", "else", "ef", "extern", "float", "for", "goto", "if",
  "inline", "int", "long", "register", "restrict", "return", "short", "signed",
  "sizeof", "static", "struct", "switch", "typedef", "union", "unsigned", "void", "volatile", "while"
};
  for (int i = 0; i < 32; i++) {
    if (strcmp(lexeme, keywords[i]) == 0) {
```

```
            printf("%s is a keyword\n", lexeme);
            return;
        }
    }
    printf("%s is an identifier\n", lexeme);
}
```

Output:

```
int is a keyword
main is an identifier
 { is a symbol
int is a keyword
a is an identifier
= is an Assignment operator
10 is a valid number
 ; is a symbol
int is a keyword
b is an identifier
= is an Assignment operator
20 is a valid number
int is a keyword
sum is an identifier
=um is an Assignment operator
0 is a valid number
 ; is a symbol
sum is an identifier
=um is an Assignment operator
a is an identifier
+ is an Arithmetic operator
b is an identifier
 ; is a symbol
printf is an identifier
sum is an identifier
a is an identifier
+ is a Unary operator
 ; is a symbol
a is an identifier
+ is an Assignment operator
b is an identifier
 ; is a symbol
 } is a symbol
C is an identifier
```

4. Implement following programs using Lex.

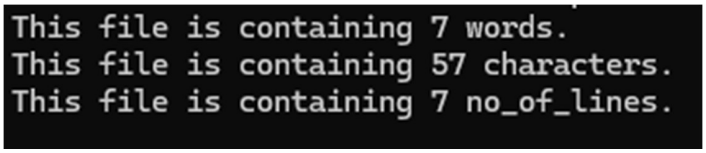
a. Write a Lex program to take input from text file and count no of characters, no. of lines & no. of words.

Code:

```
%{

#include<stdio.h>

int

words=0,characters=0,n

o_of_lines=0;

%}

%%

\n

{no_of_lines++,words++;

}

. characters++; [\t ]+

words++;

%%

void main(){

yyin =

fopen("4_1.txt","r");

yylex();
```

```
printf("This file is
containing %d
words.\n",words);
printf("This file is
containing %d
characters.\n",character
s); printf("This file is
containing %d
no_of_lines.\n",no_of_lin
es);

}

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

Output:



b. Write a Lex program to take input from text file and count number of vowels and consonants.

Code:

```
%{

#include<stdio.h>

int vowels=0, consonant=0;

%}

%%

[aeiouAEIOU]

vowels++; [a-zA-Z]

consonant++;

. ;

\n ;

%%

void main(){

yyin = fopen("input.txt","r");

yylex();

printf("This file is containing %d vowels.\n",vowels);

printf("This file is containing %d

consonants.\n",consonant);

}

int yywrap(){

return(1);} Output:
```

```
This file is containing 12 vowels.
This file is containing 22 consonants.
```

c. Write a Lex program to print out all numbers from the given file.

Code:

```
%{
 #include<stdio.h>
%}
%%
[0-9]+(.[0-9]+)?([eE][+-]?[0-9]+)?  printf("%s is valid number \n",yytext);
\n       ;
.        ;
%%

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

Output:

```
45 is valid number
414 is valid number
37 is valid number
4 is valid number
```

d. Write a Lex program which adds line numbers to the given file and display the same into different file.

Code:

```
%{
int line_number = 1;
%}
%%
.+ {fprintf(yyout,"%d: %s",line_number,yytext);line_number++;}
%%
int main() {
yyin = fopen("input.txt","r");
yyout = fopen("op.txt","w");
yylex();
printf("Done");
return 0;
}
int

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

Ouput:

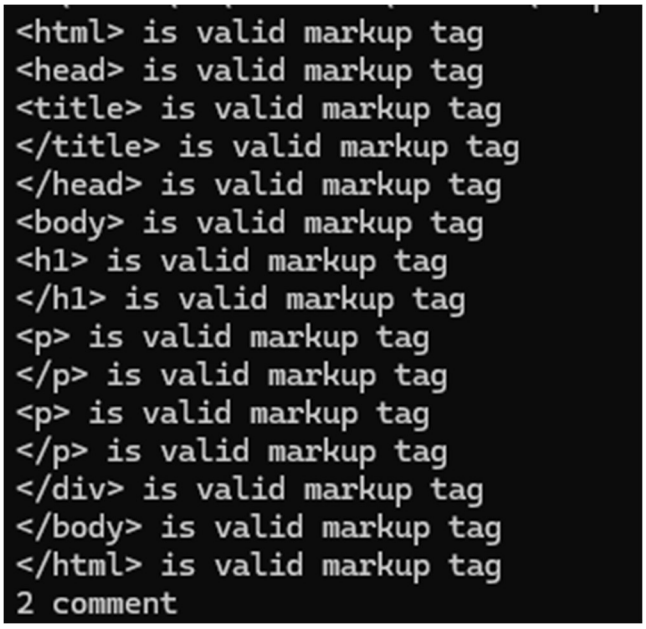
```
1: 45
2: 414
3: 37
4: 4a
```

e. Write a Lex program to printout all markup tags and HTML comments in file.

Code:

```
%{
#include<stdio.h
> int num=0;
%}
%%
"<"[A-Za-z0-9]+">"|"<"[/A-Za-z0-9]+">" printf("%s is valid markup tag
\n",yytext); "<!--"[A-Za-z ]*"-->" num++;
.|\n ;
%%
int main() {
yyin = fopen("htmlfile.txt","r");
yylex();
printf("%d
comment",num); return
0;
}
int yywrap(){return(1);}
```

Output:



5(a). Write a Lex program to count the number of C comment lines from a given C program. Also eliminate them and copy that program into separate file.

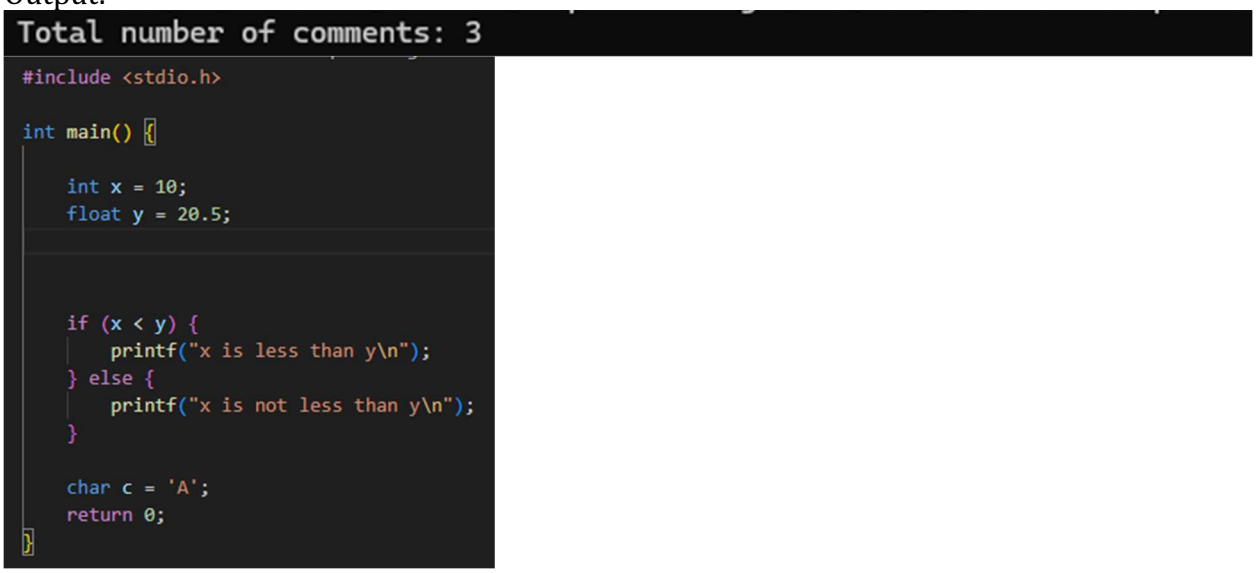
Code:

```
%{
#include <stdio.h>
int comment_count =
0; FILE *outfile;
%}
%%
"//".*                    { comment_count++; /* Skip single-line comment */ }
"/*"([^*]*\*+)*?"/"          { comment_count++; /* Skip multi-line comment
*/ }
.|\n                      { fputc(yytext[0], outfile); }
%%
int main(int argc, char
  **argv) { if (argc < 2) {
    printf("Usage: %s <input_file>\n",
    argv[0]); return 1;
  }
  FILE *infile = fopen("sample.c",
  "r"); if (!infile) {
    perror("Cannot open input file");
    return 1;
  }
  outfile = fopen("cleaned_code.c",
  "w"); if (!outfile) {
    perror("Cannot open output file");
    return 1;
  }
  yyin = infile;
  yylex();
  fclose(infile);
  fclose(outfile)
  ;
  printf("Total number of comments: %d\n", comment_count);
  return 0;
}
int
  yywrap()
  { return
  1;
}
```

Sample.c :

```
#include

<stdio.h> int

main() {
  // This is a single-line
  comment int x = 10;
  float y = 20.5;

  /*
    This is a multi-line
    comment It should be
    removed
  */

  if (x < y) {
    printf("x is less than y\n");
  } else {
    printf("x is not less than y\n");
  }

  char c = 'A';  // Character
  literal return 0;
}
```

Output:



5(b). Write a Lex program to recognize keywords, identifiers, operators, numbers, special symbols, literals from a given C program.

Code:

```
%{
#include
<stdio.h>
#include
<string.h>
#include
<ctype.h>      FILE
*outfile;
// C keywords list
char *keywords[] =
{
   "int", "float", "return", "if", "else", "while", "for", "char", "double",
   "do", "switch", "case", "break", "continue", "void", "long", "short",
   "unsigned", "signed", "static", "struct", "union", "typedef", "const",
   "goto", "enum", "default", "sizeof", "volatile", "register", NULL
};
int is_keyword(const char
   *word) { for (int i = 0;
   keywords[i]; i++) {
      if (strcmp(keywords[i], word) == 0)
         return 1;
   }
   return 0;
```

```
}
%}
```

```
%%
\"([^"\\]|\\.)*\"     { fprintf(outfile, "String literal: %s\n", yytext); }
\'([^'\\]|\\.)\'     { fprintf(outfile, "Character literal: %s\n",
yytext); } [0-9]+\.[0-9]+                        { fprintf(outfile, "Float
number: %s\n", yytext); } [0-9]+{ fprintf(outfile, "Integer
number: %s\n", yytext); } [a-zA-Z_][a-zA-Z0-9_]*  {
                    if (is_keyword(yytext))
                       fprintf(outfile, "Keyword: %s\n",
                    yytext); else
                       fprintf(outfile, "Identifier: %s\n", yytext);
                  }
"=="|"!="|"<="|">="|"="|"+"|"-"|"*"|"/"|"<"|">"  {
                    fprintf(outfile, "Operator: %s\n", yytext);
                  }
[{}()[\];,]          { fprintf(outfile, "Special symbol: %s\n",
yytext); } [ \t\n]+   ; // Skip whitespace
.                  { fprintf(outfile, "Unknown token: %s\n", yytext); }
%%
int main(int argc, char
   **argv) { if (argc < 2) {
      printf("Usage: %s <input_file>\n",
      argv[0]); return 1;
   }
```

```
    FILE *infile = fopen("sample.c",
    "r"); if (!infile) {
        perror("Cannot open input file");
        return 1;
    }
    outfile = fopen("tokens.txt",
    "w"); if (!outfile) {
        perror("Cannot open output file");
        return 1;
    }
    yyin = infile;
    yylex();
    fclose(infile);
    fclose(outfile)
    ;
    printf("Tokenization complete. Output written to
    tokens.txt\n"); return 0;
}
int yywrap()
    { return 1;
}
```

Sample.c :

```c
#include <stdio.h>

int main() {
    int a = 10;
    float b = 20.5;
    char c = 'Z';
    const char *str = "Hello, World!";

    if (a < b) {
        printf("a is less than b\n");
    } else {
        printf("a is not less than b\n");
    }

    return 0;
}
```

Output:

```
Tokenization complete. Output written to tokens.txt
```

Unknown token:

Identifier:

include

Operator: <

Identifier: stdio

Unknown token:

. Identifier: h

Operator: >

Keyword: int

Identifier: main

Special symbol: (

Special symbol:)

Special symbol: {

Keyword: int

Identifier: a

Operator: =

Integer number:

10 Special

symbol: ;

Keyword: float

Identifier: b

Operator: =

Float number:

20.5 Special

symbol: ;

Keyword: char

Identifier: c

Operator: =

Character literal:

'Z' Special symbol:

; Keyword: const

Keyword: char

Operator: *

Identifier: str

Operator: =

String literal: "Hello, World!"

Special symbol: ;

Keyword: if

Special symbol:

(Identifier: a

Operator: <

Identifier: b

Special symbol:

) Special

symbol: {

Identifier:

printf Special

symbol: (

String literal: "a is less than b\n"

Special symbol:)

Special symbol:

; Special

symbol: }

Keyword: else

Special symbol:

{ Identifier:

printf Special

symbol: (

String literal: "a is not less than

b\n" Special symbol:)

Special symbol: ;

Special symbol: }

Keyword: return

Integer number: 0

Special symbol: ;

Special symbol: }

6.Program to implement Recursive Descent Parsing in C.

Code:

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

char
inp[100]; int
l = 0;

void match(char t)
   { if (inp[l] == t)
   {
      l++;
  } else {
      printf("Error\n");
      exit(0);
   }
}

void E();
void E_prime();

void E() {
  if (inp[l] == 'i') {
      match('i');
       E_prime()
            ;
   }
 }
void E_prime() {
  if (inp[l] == '+') {
      match('+');
      match('i');
       E_prime()
            ;
   } else if (inp[l] ==
      '-') { match('-');
```

```
    match('i');
    E_prime();
} else {
    return; // epsilon case
```

```
  }
}
int main() {
  printf("Enter expression: ");
  scanf("%s", inp);

  E();

  if (inp[l] == '$') { // End of
    input printf("Success\n");
  } else {
    printf("Error\n");
  }

  return 0;
}
```

Output:

```
Enter expression: ii
Error
```

```
Enter expression: i+i-i$
Success
```

7(a).To Study about Yet Another Compiler-Compiler(YACC).

YACC (Yet Another Compiler Compiler) is a parser generator tool used in compiler design to produce syntax analyzers for context-free grammars. It works closely with Lex, where Lex handles lexical analysis and YACC performs syntax analysis based on grammar rules. YACC generates efficient LALR(1) parsers and allows grammar specification in a structured format with declarations, grammar rules, and associated C actions. It interprets token streams from Lex to understand program structure and syntax. Widely used in building compilers and interpreters, YACC simplifies the implementation of parsing logic for programming languages.

7(b).Create Yacc and Lex specification files to recognizes arithmetic expressions involving +, -, * and / .

Code:

Lex:

```
%{
#include<stdlib.h>
void yyerror(char
*); #include
"1.tab.h"
%}
%%
[0-9]+ return num;
[-/+*\n] return
*yytext; [ \t] ;
. yyerror("invalid");
%%
int
   yywrap()
   { return
   1;
```

```
}
```

Yacc:

```
%{
#include<stdio.h
> int
yylex(void);
void yyerror(char *);
%}
%token num
%%
S:E'\n' {printf("Valid syntax.");
return 0;} E:E'-'T {}
 |E'+'T {}
 |T {}
T:T'/'F
{}
 |T'*'F {}
 |F {}
F:num {}
%%
void yyerror(char *s){
   printf("%s\n",s);
}
int main(){
   yyparse(); return 0;
}
```

Output:

7(c).Create Yacc and Lex specification files are used to generate a calculator which accepts integer type arguments.

Code:

Lex:

```
%{
#include<stdlib.h>
#include "1.tab.h"
void yyerror(char
*);
%}
%%
[0-9]+ {yylval=atoi(yytext); return
num;} [-+*/\n] {return *yytext;}
[()/] {return
*yytext;} [ \t] ;
. {yyerror("invalid");}
%%
int
   yywrap()
   { return
   1;
}
```

Yacc:

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

```
%}

%token num
```

```
%%
S:E'\n' {printf("%d\n",$1);
return 0;} E:E'-'T {$$=$1-$3;}
 |T {$$=$1;}
T:T'+'F {$$=$1+$3;}
 |F {$$=$1;}
F:F'*'G {$$=$1*$3;}
 |G {$$=$1;}
G:G'/'H
{$$=$1/$3;}
 |H {$$=$1;}
H:'('E')'
{$$=$2;}
 |num {$$=$1;}
%%
void yyerror(char *s){
   printf("%s\n",s);
}
int main(){
   yyparse(); return 0;
}
```

Output:

7(d).Create Yacc and Lex specification files are used to convert infix expression to postfix expression. Code:

Lex:

```
%{
#include<stdlib.h>
#include "1.tab.h"
void yyerror(char
*);
%}
%%
[0-9]+ {yylval.num=atoi(yytext); return
INTEGER;} [A-Za-z_][A-Za-z_0-9]*
{yylval.str=yytext; return ID;} [-+*/\n] {return
*yytext;}
[ \t] ;
. {yyerror("Invalid character.");}
%%
int
   yywrap()
   { return
   1;
}
```

Yacc:

```
%{
#include<stdio.h
> int
yylex(void);
```

```
void yyerror(char *);

%}

%union{
```

```
   char
   *str; int
   num;
}
%token <num> INTEGER
%token <str> ID
%%
S:E'\n' {printf("\n");}
E:E'-'T {printf("-");}
 |T {}
T:T'+'F {printf("+");}
 |F {}
F:F'*'G {printf("*");}
 |G {}
G:G'/'H {printf("/");}
 |H {}
H:INTEGER {printf("%d",$1);}
 |ID {printf("%s",$1);}
%%
void yyerror(char *s){
   printf("%s\n",s);
}
int main(){
   yyparse(); return 0;
}
```

Output: