



CSM 3202: Compiler Lab

Lab Report 1: Lexical Analysis and Token Classification

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This is a documentation to the Lab X done in the Compiler Lab Course. The report is submitted to Md. Saif Uddin, Lecturer, Department of Computer Science and Mathematics, Bangladesh Agricultural University.

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1 Introduction

1.1 Background of the Experiment

You will explain what lexical analysis is, why it is used in compiler design, and the overall purpose of token identification.

1.2 Objectives of the Lab

You will list 3–5 clear objectives describing what you aim to learn, such as writing lex programs, identifying tokens, and classifying input streams.

1.3 Tools and Requirements

You will list the software used (e.g. IDE, C Compiler, Windows/Ubuntu OS, terminal/command prompt).

2 Tasks and Implementations

2.1 Task 1: Characters, Words, and Lines Count

2.1.1 Task Description

This program reads a source file sequentially and counts the total number of characters, words, and lines. It correctly handles spaces, tabs, and newline characters while scanning the file.

2.1.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4
5 int main()
{
7
8     FILE *fp = NULL;
9     char ch;
10    int character = 0;
11    int word = 0;
12    int line = 0;
13    int word_flag = 0;
14
15    fp = fopen("task1.txt", "r");
16    if (fp == NULL)
17    {
18        printf("file not found");
19        exit(1);
20    }
21
22    // reading character by character
23    while ((ch = fgetc(fp)) != EOF)
24    {
25        character++;
26        if (ch == '\n')
27        {
28            line++;
29        }
}
```

```

30
31     if  (isspace(ch))
32     {
33         word_flag = 1;
34     }
35     else if (word_flag == 1)
36     {
37         word_flag = 0;
38         word++;
39     }
40
41     // printf("%c ", ch);
42 }
43
44 word++;
45
46 fclose(fp);
47 printf("Characters: %d\n", character);
48 printf("Words: %d\n", word);
49 printf("Lines: %d\n", line);
50
51 return 0;
52 }
```

Listing 1: A C program to count characters, words, and lines

2.1.3 Input & Output

You will write the input sample you provided to the program exactly as executed and insert the screenshot of your output terminal here. Make sure the image is clear and readable.

Input:

```

1 int main() {
2     printf("Hello World");
3 }
4
```

Output:

Characters:	42
Words:	6
Lines:	3

2.1.4 Explanation of Code

The program read each character from file and calculate character, when it find ' ' or '\t' or '\n' or other whitespace it count word and when it fine '\n' it count new line.

2.2 Task 2: Identify Keywords

2.2.1 Task Description

This program takes input line of C code, identify and print all the keywords present in the line. Non-keyword identifiers should not be printed.

2.2.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 int is_keyword(const char *word)
7 {
8     const char *keywords[] = {
9         "auto", "break", "case", "char", "const", " "
10        "continue", "default", "do", "double",
11        "else", "enum", "extern", "float", "for", " "
12        "goto", "if", "inline", "int", "long",
13        "register", "restrict", "return", "short", " "
14        "signed", "sizeof", "static",
15        "struct", "switch", "typedef", "union", " "
16        "unsigned", "void", "volatile", "while"};
17
18     int n = sizeof(keywords) / sizeof(keywords[0]);
19     for (int i = 0; i < n; i++)
20     {
21         if (strcmp(word, keywords[i]) == 0)
22             return 1;
23     }
24     return 0;
25 }
26
27 int main()
28 {
29     FILE *fp = NULL;
30     char ch;
31     char new_word[40];
32     int index = 0;
```

```

30
31     fp = fopen("task2.txt", "r");
32     if (fp == NULL)
33     {
34         printf("file not found");
35         exit(1);
36     }
37
38     while ((ch = fgetc(fp)) != EOF)
39     {
40         if (isalpha(ch))
41         {
42             index = 0;
43             new_word[index] = ch;
44             index++;
45
46             while ((ch = fgetc(fp)) != EOF && isalpha(
47                     ch))
48             {
49                 new_word[index] = ch;
50                 index++;
51             }
52
53             new_word[index] = '\0';
54
55             // printf("%s@ ", new_word);
56
57             if (is_keyword(new_word))
58             {
59                 printf("%s:@keyword\n", new_word);
60             }
61         }
62
63     fclose(fp);
64
65     return 0;
66 }
```

Listing 2: A C program to Identify Keywords

2.2.3 Input & Output

Input:

```
1 int main() {  
2     float num = 2.5;  
3     return 0;  
4 }
```

Output:

```
int : keyword  
float : keyword  
return : keyword
```

2.2.4 Explanation of Code

Firstly each word is identified and a function is used to check if that word in keyword array.

2.3 Task 3: Identification of Valid and Invalid Identifiers

2.3.1 Task Description

A program to extract all identifiers from a given line and classify them as valid or invalid.

2.3.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 int is_identifier(const char *word)
7 {
8     const char *keywords[] = {
9         "auto", "break", "case", "char", "const", " "
10        "continue", "default", "do", "double",
11        "else", "enum", "extern", "float", "for", " "
12        "goto", "if", "inline", "int", "long",
13        "register", "restrict", "return", "short", " "
14        "signed", "sizeof", "static",
15        "struct", "switch", "typedef", "union", " "
16        "unsigned", "void", "volatile", "while"};
17
18     if (isdigit(word[0]))
19     {
20         return 0;
21     }
22
23     int n = sizeof(keywords) / sizeof(keywords[0]);
24     for (int i = 0; i < n; i++)
25     {
26         if (strcmp(word, keywords[i]) == 0)
27             return 0;
28     }
29     return 1;
30 }
```

```

28 int main()
29 {
30
31     FILE *fp = NULL;
32     char ch;
33     char new_word[40];
34     int index = 0;
35
36     fp = fopen("task3.txt", "r");
37     if (fp == NULL)
38     {
39         printf("file\u00a9not\u00a9found");
40         exit(1);
41     }
42
43     while ((ch = fgetc(fp)) != EOF)
44     {
45         if (isalnum(ch) || ch == '_')
46         {
47             index = 0;
48             new_word[index] = ch;
49             index++;
50
51             while ((ch = fgetc(fp)) != EOF && (isalnum
52                 (ch) || ch == '_'))
53             {
54                 new_word[index] = ch;
55                 index++;
56             }
57
58             new_word[index] = '\0';
59
60             // printf("%s@ ", new_word);
61
62             if (is_identifier(new_word) == 1)
63             {
64                 printf("%s\u00a9Valid\u00a9Identifier\u00a9\n",
65                     new_word);
66             }
67             else
68             {

```

```

67         printf ("%s : Invalid Identifier\n",
68             new_word);
69     }
70 }
71 fclose(fp);
72
73 return 0;
74
75 }
```

Listing 3: A C program to Identification of Valid and Invalid Identifiers

2.3.3 Input & Output

Input:

```
1 id1 , _id2 , 3id , id 5
```

Output:

```

id1 : Valid Identifier
_id2 : Valid Identifier
3id : Invalid Identifier
id : Valid Identifier
5 : Invalid Identifier
```

2.3.4 Explanation of Code

Firstly identified each word and check with conditions of identifier in a function.

2.4 Task 4: Identification of Numeric Constants

2.4.1 Task Description

A program to detect and classify numeric constants into integer and floating point.

2.4.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 int is_number(const char *word)
7 {
8     int flag = 0;
9     int i = 0;
10    while (word[i] != '\0')
11    {
12        if (word[i] == '.')
13        {
14            flag++;
15        }
16        i++;
17    }
18    if (flag > 1)
19    {
20        return 0;
21    }
22    else if (flag == 1)
23    {
24        return 1;
25    }
26    else
27    {
28        return 2;
29    }
30 }
31
32 int main()
33 {
```

```

34
35     FILE *fp = NULL;
36     char ch;
37     char new_word[40];
38     int index = 0;
39
40     fp = fopen("task4.txt", "r");
41     if (fp == NULL)
42     {
43         printf("file not found");
44         exit(1);
45     }
46
47     while ((ch = fgetc(fp)) != EOF)
48     {
49         if (isdigit(ch) || ch == '.')
50         {
51             index = 0;
52             new_word[index] = ch;
53             index++;
54
55             while ((ch = fgetc(fp)) != EOF && (isdigit
56                 (ch) || ch == '.'))
57             {
58                 new_word[index] = ch;
59                 index++;
60             }
61
62             new_word[index] = '\0';
63
64             // printf("%s@ ", new_word);
65
66             if (is_number(new_word) == 1)
67             {
68                 printf("%s:@Float\n", new_word);
69             }
70             else if (is_number(new_word) == 2)
71             {
72                 printf("%s:@Integer\n", new_word);
73             }
74         }

```

```

74     {
75         printf ("%s : Not a number\n",
76                 new_word);
77     }
78 }
79
80 fclose(fp);
81
82 return 0;
83 }
```

Listing 4: A C program to identification of Numeric Constants

2.4.3 Input & Output

Input:

```
1 a = 10 ; b = 2.27 ; c = 300 ;
```

Output:

```
10 : Integer
2.27 : Float
300 : Integer
```

2.4.4 Explanation of Code

Firstly all word which are similar like digit is seperated then the are check through a user defined function.

2.5 Task 5: Identification of Operators

2.5.1 Task Description

A programm to identify all assignment, arithmetic, relational, and logical operators.

2.5.2 Source Code

```
1 #include <stdio.h>
2
3 int main()
4 {
5     FILE *fp = fopen("task5.txt", "r");
6     if (fp == NULL)
7     {
8         printf("File not found\n");
9         return 1;
10    }
11
12    char ch, next_ch;
13
14    while ((ch = fgetc(fp)) != EOF)
15    {
16        int next_ch = fgetc(fp);
17        if (next_ch != EOF)
18        {
19            // Check 2-character operators
20            if (ch == '+' && next_ch == '+')
21            {
22                printf("++: arithmetic Operator\n");
23                continue;
24            }
25            else if (ch == '-' && next_ch == '-')
26            {
27                printf("--: arithmetic Operator\n");
28                continue;
29            }
30            else if (ch == '=' && next_ch == '=')
31            {
32                printf("==: relational Operator\n");
33                continue;
34            }
35        }
36    }
37 }
```

```

34 }
35 else if (ch == '!' && next_ch == '=')
36 {
37     printf("!=: relationalOperator\n");
38     continue;
39 }
40 else if (ch == '>' && next_ch == '=')
41 {
42     printf(">=: relationalOperator\n");
43     continue;
44 }
45 else if (ch == '<' && next_ch == '=')
46 {
47     printf("<=: relationalOperator\n");
48     continue;
49 }
50 else if (ch == '&' && next_ch == '&')
51 {
52     printf("&&=: logicalOperator\n");
53     continue;
54 }
55 else if (ch == '||' && next_ch == '||')
56 {
57     printf("||=: logicalOperator\n");
58     continue;
59 }
60 else if (ch == '+' && next_ch == '=')
61 {
62     printf("+=: assignmentOperator\n");
63     continue;
64 }
65 else if (ch == '-' && next_ch == '=')
66 {
67     printf("-=: assignmentOperator\n");
68     continue;
69 }
70 else if (ch == '*' && next_ch == '=')
71 {
72     printf("*=: assignmentOperator\n");
73     continue;
74 }

```

```

75         else if (ch == '/' && next_ch == '=')
76     {
77         printf("/=:assignmentOperator\n");
78         continue;
79     }
80     else
81     {
82         ungetc(next_ch, fp);
83     }
84 }

85 // Single-character operators
86 if (ch == '=')
87     printf("=:assignmentOperator\n");
88 else if (ch == '+')
89     printf("+:arithmeticOperator\n");
90 else if (ch == '-')
91     printf("-:arithmeticOperator\n");
92 else if (ch == '*')
93     printf("*:arithmeticOperator\n");
94 else if (ch == '/')
95     printf("/:arithmeticOperator\n");
96 else if (ch == '%')
97     printf("%/:arithmeticOperator\n");
98 else if (ch == '>')
99     printf(">:relationalOperator\n");
100 else if (ch == '<')
101     printf("<:relationalOperator\n");
102 else if (ch == '!')
103     printf("!:logicalOperator\n");
104 }
105
106 fclose(fp);
107 return 0;
108 }
109 }
```

Listing 5: A C program to Identification of Operators

2.5.3 Input & Output

Input:

```
1 if (a >= 10 && b != 5) a = a + 1 ;
```

Output:

```
>= : relational Operator  
&& : logical Operator  
!= : relational Operator  
= : assignment Operator  
+ : arithmetic Operator
```

2.5.4 Explanation of Code

Using simply if condition for character match.

2.6 Task 6: Identification of Punctuation and Special Symbols

2.6.1 Task Description

A program to Identification of Punctuation and Special Symbols.

2.6.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 int main()
7 {
8
9     FILE *fp = NULL;
10    char ch;
11    char new_word[40];
12    int index = 0;
13
14    fp = fopen("task2.txt", "r");
15    if (fp == NULL)
16    {
17        printf("file not found");
18        exit(1);
19    }
20
21    while ((ch = fgetc(fp)) != EOF)
22    {
23        if (ispunct(ch))
24        {
25            printf("%c : Punctuation Symbol\n", ch);
26        }
27        else if (!isdigit(ch) && !isalpha(ch) && !
28               isspace(ch))
29        {
30            printf("%c : special Symbol\n", ch);
31        }
32    }
33 }
```

```
32     fclose(fp);
33
34     return 0;
35 }
36 }
```

Listing 6: A C program to Identification of Punctuation and Special Symbols

2.6.3 Input & Output

Input:

```
1 if(a%2==0) printf("%d is even", a);
```

Output:

```
( : Punctuation Symbol
) : Punctuation Symbol
{ : Punctuation Symbol
= : Punctuation Symbol
. : Punctuation Symbol
; : Punctuation Symbol
; : Punctuation Symbol
} : Punctuation Symbol
```

2.6.4 Explanation of Code

Using buiidin function to Identification of Punctuation and Special Symbols.

2.7 Task 7: Identification of Single-line and Multi-line Comments

2.7.1 Task Description

A program that detects and prints single-line comments (//...) and multi line comments /*...*/. Handle multiple comments in the same file and report unterminated comments as lexical errors.

2.7.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 int main()
7 {
8
9     FILE *fp = NULL;
10    char ch, next_ch;
11
12    fp = fopen("task7.txt", "r");
13    if (fp == NULL)
14    {
15        printf("file not found");
16        exit(1);
17    }
18
19    while ((ch = fgetc(fp)) != EOF)
20    {
21        if (ch == '/')
22        {
23            next_ch = fgetc(fp);
24            if (next_ch == '/')
25            {
26                printf("Single-line comments\n");
27                while ((ch = fgetc(fp)) != EOF && ch
28                      != '\n')
29                ;
30            }
31        }
32    }
33 }
```

```

30     else if (next_ch == '*')
31     {
32         int flag = 0;
33         while ((ch = fgetc(fp)) != EOF)
34         {
35             next_ch = fgetc(fp);
36             // printf("%c\n", ch);
37             // printf("%c\n", next_ch);
38             if (ch == '*' && next_ch == '/')
39             {
40                 flag = 1;
41                 break;
42             }
43             ungetc(next_ch, fp);
44         }
45
46         if (flag == 1)
47         {
48             printf("Multi-line comments\n");
49         }
50         else
51         {
52             printf("Unterminated Multi-line
53                   comments , Lexical error\n");
54         }
55     }
56 }
57
58 fclose(fp);
59
60 return 0;
61 }
```

Listing 7: A C program to Identification of Single-line and Multi-line Comments

2.7.3 Input & Output

Input:

```
1 // this is comment;  
2 /* multi line comment  
3 */  
4 /* this is
```

Output:

```
Single-line comments  
Multi-line comments  
Unterminated Multi-line comments, Lexical error
```

2.7.4 Explanation of Code

Using a flag variable and loop for comment condition .

2.8 Task 8: Identification of String Literals and Character Constants

2.8.1 Task Description

A program to detect valid and invalid string literals and character constants.

2.8.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <string.h>
4
5 void check_string(const char *word)
6 {
7     int len = strlen(word);
8
9     if (len >= 2 && word[0] == '"' && word[len-1] == '"')
10        printf("%s: Valid String Literal\n", word);
11    else if (len >= 2 && word[0] == '\'' && word[len-1] != '\'')
12        printf("%s: Invalid String Literal\n", word);
13    else if (len >= 1 && word[0] == '\'' && word[len-1] != '\'')
14        printf("%s: Unterminated String Literal\n",
15               word);
16    else if (len >= 2 && word[0] == '\\' && word[len-1] == '\\')
17        printf("%s: Multiple Character Constant(
18               Invalid)\n", word);
19    else if (len = 3 && word[0] == '\\' && word[len-1]
20             == '\\')
21    {
22        printf("%s: valid Character Constant\n", word
23               );
24    }
25    else if (len = 2 && word[0] == '\\' && word[len-1]
26             == '\\')
27    {
```

```

23         printf("%s:@Empty@Character@Constant(Invalid)\n", word);
24     }
25     else{
26         printf("%s:@Unterminated@Character@Constant(Invalid)\n", word);
27     }
28
29 }
30
31
32 int main()
33 {
34     FILE *fp = fopen("task8.txt", "r");
35     if (!fp) {
36         printf("file@not@found");
37         return 1;
38     }
39
40     char ch;
41     char buffer[30];
42     int i;
43
44     while ((ch = fgetc(fp)) != EOF)
45     {
46         if (ch == '\'')
47         {
48             i = 0;
49             buffer[i++] = ch;
50
51             while ((ch = fgetc(fp)) != EOF && ch != '\\n')
52             {
53                 buffer[i++] = ch;
54                 if (ch == '\'')
55                     break;
56             }
57
58             buffer[i] = '\0';
59             //printf("@%s@\\n", buffer);
60             check_string(buffer);

```

```

61     }
62 }
63
64 fclose(fp);
65 return 0;
66 }
```

Listing 8: A C program to Identification of String Literals and Character Constants

2.8.3 Input & Output

Input:

```

1 "a"
2 "hi"
3 "hello
4 'a'
5 ''
6 'ab'
7 'a'
```

Output:

```

" : Valid String Literal
"hi" : Valid String Literal
"hello" : Unterminated String Literal
'a' : valid Character Constant
' '
' ' : Multiple Character Constant(Invalid)
' ' : Unterminated Character Constant(Invalid)
'a' : Unterminated Character Constant(Invalid)
```

2.8.4 Explanation of Code

Word are separated then first and last character to detect valid and invalid string literals and character constants

2.9 Task 9: Full Lexical Token Classification and Token Stream Generation

2.9.1 Task Description

A lexical analyzer that scans a file and classifies each lexeme

2.9.2 Source Code

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <ctype.h>
4 #include <string.h>
5
6 char *keywords[] = {
7     "auto", "break", "case", "char", "const", "continue",
8         "default", "do", "double",
9     "else", "enum", "extern", "float", "for", "goto", "if",
10        "inline", "int", "long",
11    "register", "restrict", "return", "short", "signed",
12        "sizeof", "static",
13    "struct", "switch", "typedef", "union", "unsigned",
14        "void", "volatile", "while"
15};
16 int keyword_count = 34;
17
18 int is_keyword(const char *word) {
19     for (int i = 0; i < keyword_count; i++) {
20         if (strcmp(word, keywords[i]) == 0)
21             return 1;
22     }
23     return 0;
24 }
25
26 int is_identifier(const char *word) {
27     if (!isalpha(word[0]) && word[0] != '_')
28         return 0;
29
30     for (int i = 1; word[i] != '\0'; i++)
31         if (!isalnum(word[i]) && word[i] != '_')
32             return 0;
33 }
```

```

29     return !is_keyword(word);
30 }
31
32 int is_number(const char *word) {
33     int dots = 0;
34     for (int i = 0; word[i] != '\0'; i++) {
35         if (word[i] == '.') dots++;
36         else if (!isdigit(word[i])) return 0;
37     }
38     return dots <= 1;
39 }
40
41 int main() {
42     FILE *fp = fopen("task9.txt", "r");
43     if (!fp) {
44         printf("File not found!\n");
45         return 1;
46     }
47
48     char ch;
49
50     while ((ch = fgetc(fp)) != EOF) {
51
52         /* -----
53          IDENTIFIERS & KEYWORDS
54          ----- */
55
56         if (isalpha(ch) || ch == '_') {
57             char word[100];
58             int i = 0;
59             word[i++] = ch;
60
61             while ((ch = fgetc(fp)) != EOF && (isalnum(
62                 ch) || ch == '_'))
63                 word[i++] = ch;
64
65             word[i] = '\0';
66             ungetc(ch, fp);
67
68             if (is_keyword(word))
69                 printf("%s : Keyword\n", word);

```

```

69         else
70             printf("%s : Identifier\n", word);
71
72         continue;
73     }
74
75     /* -----
76      NUMBERS (INTEGER / FLOAT)
77      ----- */
78     if (isdigit(ch)) {
79         char num[100];
80         int i = 0;
81         num[i++] = ch;
82
83         while ((ch = fgetc(fp)) != EOF && (isdigit(ch) || ch == '.'))
84             num[i++] = ch;
85
86         num[i] = '\0';
87         ungetc(ch, fp);
88
89         if (is_number(num)) {
90             if (strchr(num, '.'))
91                 printf("%s : Float Constant\n",
92                         num);
93             else
94                 printf("%s : Integer Constant\n",
95                         num);
96         } else {
97             printf("%s : Invalid Number\n", num);
98         }
99         continue;
100    }
101
102    /* -----
103      STRING LITERALS
104      ----- */
105    if (ch == '\"') {
106        char buffer[200];
107        int i = 0;
108        buffer[i++] = ch;

```

```

107
108     while ((ch = fgetc(fp)) != EOF && ch != '\"')
109         {
110             if (ch == '\n') break;
111             buffer[i++] = ch;
112         }
113
114     buffer[i++] = '\"';
115     buffer[i] = '\0';
116
117     if (ch == '\"')
118         printf("%s:\\String Literal\\n", buffer
119             );
120     else
121         printf("%s:\\Unterminated String\\
122             Literal\\n", buffer);
123
124     /* -----
125        CHARACTER CONSTANTS
126        ----- */
127     if (ch == '\\') {
128         char buf[10];
129         int i = 0;
130         buf[i++] = ch;
131         buf[i++] = fgetc(fp);
132         buf[i++] = fgetc(fp);
133         buf[i] = '\0';
134
135         if (buf[2] == '\\')
136             printf("%s:\\Character Constant\\n",
137                 buf);
138         else
139             printf("%s:\\Invalid Character\\
140                 Constant\\n", buf);
141
142         continue;
143     }

```

```

143  /* -----
144   COMMENTS
145  ----- */
146  if (ch == '/') {
147      char next = fgetc(fp);
148
149      if (next == '/') {
150          printf("//\u003a:\u003aSingle-line\u003aComment\n");
151          while ((ch = fgetc(fp)) != EOF && ch
152                 != '\n');
153          continue;
154      }
155
156      else if (next == '*') {
157          printf("/*\u003a*/\u003aMulti-line\u003aComment\n");
158          ;
159          char prev = 0;
160          while ((ch = fgetc(fp)) != EOF) {
161              if (prev == '*' && ch == '/')
162                  break;
163              prev = ch;
164          }
165          continue;
166      }
167
168  /* -----
169   OPERATORS
170  ----- */
171  char next = fgetc(fp);
172  if (next != EOF) {
173      char op[3] = {ch, next, '\0'};
174
175      if (!strcmp(op, "==") || !strcmp(op, "!=")
176                  ||
177          !strcmp(op, ">=") || !strcmp(op, "<="))
178      { printf("%s\u003a:\u003aRelational\u003aOperator\n", op)
179          ; continue; }

```

```

178
179     if (!strcmp(op, "++") || !strcmp(op, "--"))
180     )
181     { printf("%s: Arithmetic Operator\n", op)
182       ; continue; }
183
184     if (!strcmp(op, "&&") || !strcmp(op, "||"))
185     )
186     { printf("%s: Logical Operator\n", op);
187       continue; }
188
189     if (!strcmp(op, "+=") || !strcmp(op, "-=")
190       ||
191       !strcmp(op, "*=") || !strcmp(op, "/="))
192     )
193     { printf("%s: Assignment Operator\n", op)
194       ; continue; }
195
196     ungetc(next, fp);
197   }
198
199   /* -----
200    * ----- SPECIAL SYMBOLS & PUNCTUATIONS ----- */
201   if (ispunct(ch)) {
202     printf("%c: Special Symbol\n", ch);
203   }
204
205   fclose(fp);
206   return 0;
207 }

```

Listing 9: A C program for Full Lexical Token Classification and Token Stream Generation

2.9.3 Input & Output

Input:

```
1 int x = 10 ;
2 float y = 2.5 ;
3 printf("Hello") ;
```

Output:

```
int : Keyword
x : Identifier
= : Operator
10 : Integer Constant
; : Special Symbol
float : Keyword
y : Identifier
= : Operator
2.5 : Float Constant
; : Special Symbol
printf : Identifier
( : Special Symbol
"Hello" : String Literal
) : Special Symbol
; : Special Symbol
```

2.9.4 Explanation of Code

Combind previous problem code methods.

2.10 Task 10: Detection of Lexical Errors

2.10.1 Task Description

A program that detects and reports common lexical errors:

- Invalid identifiers: `2sum`, `a-bc`, `@total`
- Untermminated strings: `"hello`
- Unclosed comments: `/* comment`
- Invalid characters: `@`, (in identifiers)

2.10.2 Source Code

```
1 #include <stdio.h>
2 #include <ctype.h>
3 #include <string.h>
4
5 int is_keyword(const char *word) {
6     char *keywords[] = {
7         "int", "float", "char", "double", "long", "short", "
8             void", "return",
9             "if", "else", "while", "for", "break", "continue",
10            "struct", "union"
11        };
12     int n = sizeof(keywords) / sizeof(keywords[0]);
13
14     for (int i = 0; i < n; i++) {
15         if (strcmp(word, keywords[i]) == 0)
16             return 1;
17     }
18     return 0;
19 }
20
21 int is_valid_identifier(const char *word) {
22     if (!isalpha(word[0]) && word[0] != '_')
23         return 0;
24
25     for (int i = 1; word[i] != '\0'; i++)
26         if (!isalnum(word[i]) && word[i] != '_')
27             return 0;
28
29     return 1;
30 }
31
32 int main() {
```

```

31 FILE *fp = fopen("task10.txt", "r");
32 if (!fp) {
33     printf("Cannot open file.\n");
34     return 1;
35 }
36
37 char ch;
38
39 while ((ch = fgetc(fp)) != EOF) {
40
41     /* =====
42      INVALID IDENTIFIERS (start with digit,
43      contain symbols)
44      ===== */
45     if (isalnum(ch) || ch == '_' || ch == '@' ||
46         ch == '$' || ch == '#') {
47
48         char word[100];
49         int i = 0;
50         word[i++] = ch;
51
52         while ((ch = fgetc(fp)) != EOF &&
53                 (isalnum(ch) || ch == '_' || ch ==
54                  '@' || ch == '$' || ch == '#'))
55         {
56             word[i++] = ch;
57         }
58
59         word[i] = '\0';
60         ungetc(ch, fp);
61
62         int invalid_char = 0;
63         for (int j = 0; word[j]; j++) {
64             if (word[j] == '@' || word[j] == '$'
65                 || word[j] == '#')
66                 invalid_char = 1;
67         }
68
69         if (isdigit(word[0]) || invalid_char || !
70             is_valid_identifier(word)) {

```

```

66         printf("Error:\u00a9Invalid\u00a9identifier\u00a9'%s
67             '\n", word);
68     }
69
70     continue;
71 }
72 /* =====
73     UNTERMINATED STRING
74 ===== */
75 if (ch == '') {
76     char buffer[200];
77     int i = 0;
78     buffer[i++] = ch;
79     int closed = 0;
80
81     while ((ch = fgetc(fp)) != EOF) {
82         if (ch == '') {
83             closed = 1;
84             buffer[i++] = ch;
85             break;
86         }
87         if (ch == '\n')
88             break;
89
90         buffer[i++] = ch;
91     }
92
93     buffer[i] = '\0';
94
95     if (!closed)
96         printf("Error:\u00a9Unterminated\u00a9string\u00a9
97             literal\u00a9%s\n", buffer);
98
99     continue;
100 }
101 /* =====
102     UNCLOSED COMMENTS /* comment ...
103 ===== */
104 if (ch == '/') {

```

```

105     char next = fgetc(fp);
106
107     if (next == '*') {
108         int closed = 0;
109         char prev = 0;
110
111         while ((ch = fgetc(fp)) != EOF) {
112             if (prev == '*' && ch == '/') {
113                 closed = 1;
114                 break;
115             }
116             prev = ch;
117         }
118
119         if (!closed)
120             printf("Error:Unclosed comment\n");
121
122         continue;
123     }
124
125     ungetc(next, fp);
126 }
127
128 /* =====
129    INVALID STANDALONE CHARACTERS
130 ===== */
131     if (ch == '@' || ch == '$' || ch == '#') {
132         printf("Error:Invalid character%c\n",
133               ch);
134     }
135
136     fclose(fp);
137     return 0;
138 }
```

Listing 10: A C program to Detection of Lexical Errors

2.10.3 Input & Output

Input:

```
1 int 2sum = 10 ;
2 char *s = "Hello" ;
3 float x@ = 2.5;
```

Output:

```
Error: Invalid identifier '2sum'
Error: Invalid identifier '10'
Error: Invalid identifier 'x@'
Error: Invalid identifier '2'
Error: Invalid identifier '5'
```

2.10.4 Explanation of Code

Using previous code methods.

3 Conclusion

Lexical analysis is an essential phase of the compiler where the source code is scanned and broken into meaningful units called tokens. It acts as a bridge between raw program text and the syntax analyzer, ensuring that the input program is structured, valid, and easy to process in later stages. In this lab, I implemented basic lexical analysis tasks such as identifying keywords, operators, special symbols, and comments. I also detected single-line and multi-line comments and handled error cases like unterminated comment blocks. Through these tasks, I gained practical understanding of how a lexical analyzer processes characters, builds tokens, and performs error detection before syntax analysis begins.