MISR UNIVERSITY
FOR SCIENCE & TECHNOLOGY
College of Information Technology

جـامعـة مـصـر
للعلـوم والتكنـولـوجيـا
كليـة تكنولوجيـا المعلومـات

LEXICAL ANALYZER

Build Scanner

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1. Introduction

1.1. phases of Compiler

1. Lexical Analysis (Scanner)

- Your code implements this phase
- Responsibilities:
  - Reads source code character by character
  - Groups characters into tokens (lexemes)
  - Identifies token types using regular patterns
  - Removes whitespace/comments
  - Handles simple errors (like invalid characters)

2. Syntax Analysis (Parser)

- Not implemented in your code
- Would use your tokens to build parse trees
- Checks grammar/structure against language rules

3. Semantic Analysis

- Not implemented
- Performs type checking
- Verifies variable declarations
- Ensures semantic correctness

4. Intermediate Code Generation

- Not implemented
- Produces abstract machine code (e.g., three-address code)

5. Optimization

- Not implemented

- Improves intermediate code efficiency

6. Code Generation

- Not implemented
- Produces target machine code

1.2. P

2. Lexical Analyzer

Breaks lexem into token which is machine language

3. Software Tools

3.1. Computer Program

Xcode

3.2. Programming Language

C++

4. Implementation of a Lexical Analyzer

```
#include <iostream>     // library for input and output
#include <fstream>      // library for file input and
output
#include <cctype>       // library for character
classification
#include <string>       // library for string class
#include <unistd.h>     // for realpath
    #include <limits.h>     // for PATH_MAX

    // Character classes
    #define LETTER 0        // for letter characters
    #define DIGIT 1         // for digit characters
    #define UNKNOWN 99      // for unknown characters
    #define END_OF_FILE -1  // for end of file marker

    // Token codes
```

```
19.     #define INT_LIT 10      // integer literal
20.     #define IDENT 11        // identifier
21.     #define ASSIGN_OP 20    // assignment operator
22.     #define ADD_OP 21       // addition operator
23.     #define SUB_OP 22       // subtraction operator
24.     #define MULT_OP 23      // multiplication operator
25.     #define DIV_OP 24       // division operator
26.     #define LEFT_PAREN 25   // left parenthesis
27.     #define RIGHT_PAREN 26  // right parenthesis
28.
29.     using namespace std;    // using standard namespace
30.
31.     // Global declarations
32.     int charClass;          // current character class
33.     string lexeme;          // current lexeme being
   built
34.     char nextChar;          // next character in input
35.     int nextToken;          // code for next token
36.     ifstream inFile;        // input file stream
37.
38.     // Function to add character to lexeme
39.     void addChar() {
40.         lexeme += nextChar; // append character to
   lexeme
41.     }
42.
43.     // Function to get next character from input
44.     void getChar() {
45.         if (inFile.get(nextChar)) {  // if successfully
   read character
46.             if (isalpha(nextChar))  // if character is
   letter
47.                 charClass = LETTER;
48.             else if (isdigit(nextChar)) // if character
   is digit
49.                 charClass = DIGIT;
50.             else                        // otherwise
   unknown
51.                 charClass = UNKNOWN;
52.         } else {                        // if end of file
53.             charClass = END_OF_FILE;
54.         }
55.     }
```

```
56.
57.     // Function to skip whitespace
58.     void getNonBlank() {
59.         while (isspace(nextChar)) { // while character
   is whitespace
60.             getChar();              // get next
   character
61.         }
62.     }
63.
64.     // Function to lookup operators
65.     int lookup(char ch) {
66.         switch (ch) {               // check character
67.             case '(':               // left parenthesis
68.                 addChar();
69.                 nextToken = LEFT_PAREN;
70.                 break;
71.             case ')':               // right parenthesis
72.                 addChar();
73.                 nextToken = RIGHT_PAREN;
74.                 break;
75.             case '+':               // addition operator
76.                 addChar();
77.                 nextToken = ADD_OP;
78.                 break;
79.             case '-':               // subtraction
   operator
80.                 addChar();
81.                 nextToken = SUB_OP;
82.                 break;
83.             case '*':               // multiplication
   operator
84.                 addChar();
85.                 nextToken = MULT_OP;
86.                 break;
87.             case '/':               // division operator
88.                 addChar();
89.                 nextToken = DIV_OP;
90.                 break;
91.             case '=':               // assignment
   operator
92.                 addChar();
93.                 nextToken = ASSIGN_OP;
```

```
94.                 break;
95.             default:                // unknown operator
96.                 addChar();
97.                 nextToken = END_OF_FILE;
98.                 break;
99.         }
100.        return nextToken;
101.    }
102.
103.    // Lexical analyzer function
104.    int lex() {
105.        lexeme = "";                // initialize lexeme
106.        getNonBlank();              // skip whitespace
107.
108.        switch (charClass) {        // based on character
    class
109.            case LETTER:            // if letter
110.                addChar();         //call the function to
    add it to the lexeme
111.                getChar();        // call the function to
    get the next char
112.                while (charClass == LETTER || charClass
    == DIGIT) { // while letter or digit
113.                    addChar();  //call the function to
    add it to the lexeme
114.                    getChar();  // call the function to
    get the next char
115.                }
116.                nextToken = IDENT; // set token to
    identifier
117.                break;
118.
119.            case DIGIT:             // if digit
120.                addChar();          //call the function
    to add it to the lexeme
121.                getChar();          // call the function
    to get the next char
122.                while (charClass == DIGIT) { // while
    more digits
123.                    addChar();     //call the function
    to add it to the lexeme
124.                    getChar();     // call the function
    to get the next char
```

```
125.                 }
126.                 nextToken = INT_LIT; // set token to
   integer literal
127.                 break;
128.
129.             case UNKNOWN:          // if unknown
130.                 lookup(nextChar); // lookup operator
131.                 getChar();
132.                 break;
133.
134.             case END_OF_FILE:      // if end of file
135.                 nextToken = END_OF_FILE;
136.                 lexeme = "EOF";
137.                 break;
138.         }
139.
140.         // Print token information
141.         cout << "Next token is: " << nextToken << ",
   Next lexeme is: " << lexeme << endl;
142.         return nextToken;
143.     }
144.
145.     // Main function
146.     int main() {
147.         // Open input file - CHANGED THIS LINE TO FIX
   THE ERROR
148.
   inFile.open("/Users/macbookpro/Downloads/front.in"); //
   absolute path to input file
149.
150.         if (!inFile.is_open()) {  // if file didn't
   open
151.             cout << "ERROR - cannot open front.in" <<
   endl; // print error
152.             return 1;             // return error code
153.         }
154.
155.         getChar();               // read first
   character
156.
157.         do {                     // loop until end of
   file
```

```
158.            lex();                  // call lexical
   analyzer
159.        } while (nextToken != END_OF_FILE);
160.
161.        inFile.close();             // close input file
162.        return 0;                   // return success
163.    }
```

164.References

Concepts of programming languages book

Youtube

Chatgbt

Deebseak

Important Note: -

Technical reports include a mixture of text, tables, and figures. Consider how you can present the information best for your reader. Would a table or figure help to convey your ideas more effectively than a paragraph describing the same data?

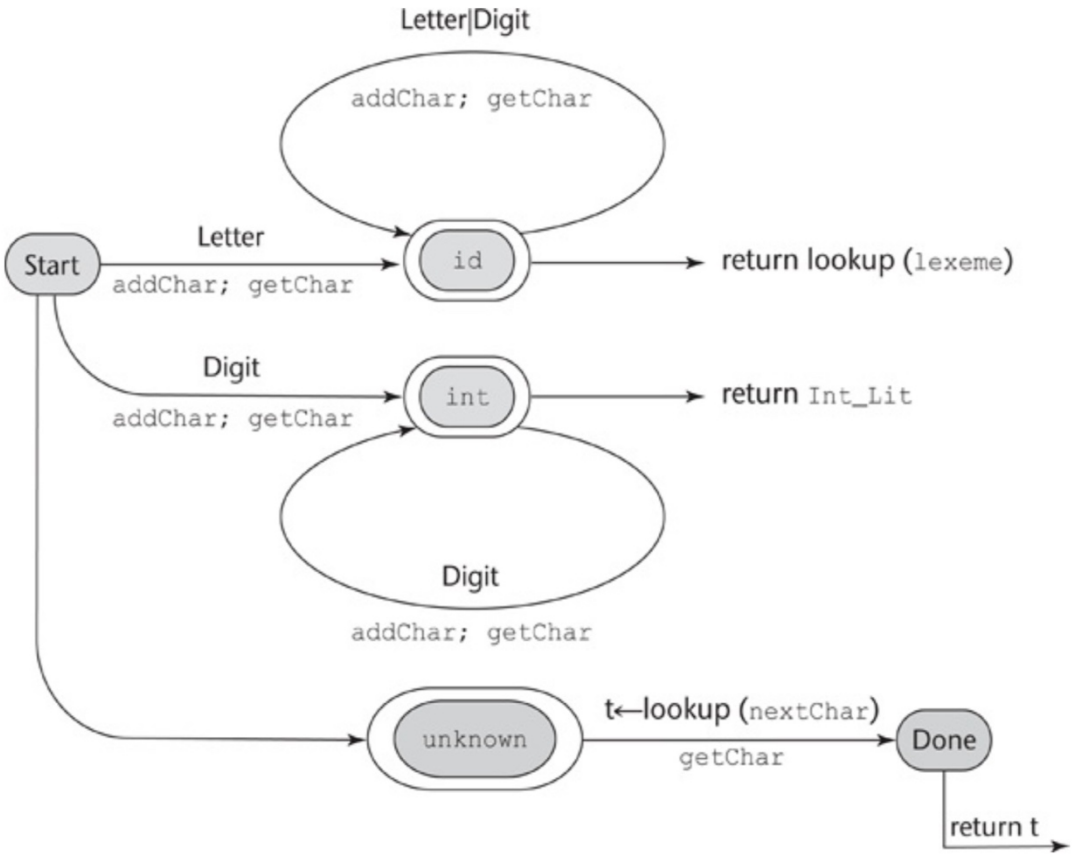
Figures and tables should: -

- Be numbered
- Be referred to in-text, e.g. *In Table 1*…, and
- Include a simple descriptive label - above a table and below a figure

(sum + 47) / total

TOKEN	LEXEME
LEFT_PAREN	(
IDENT	Sum
ADD_OP	+
INT_LIT	47
RIGHT_PAREN	)
DIV_OP	/
IDENT	total

```
Next token is: 25, Next lexeme is: (
Next token is: 11, Next lexeme is: sum
Next token is: 21, Next lexeme is: +
Next token is: 10, Next lexeme is: 47
Next token is: 26, Next lexeme is: )
Next token is: 24, Next lexeme is: /
Next token is: 11, Next lexeme is: total
```


Letter|Digit
addChar; getChar
Start
Letter
addChar; getChar
id
return lookup (lexeme)
Digit
addChar; getChar
int
return Int_Lit
Digit
addChar; getChar
unknown
t←lookup (nextChar)
getChar
Done
return t