CECS 342
Lab assignment 1
Due date: Wednesday, September 14
20 points

Consider the following example of an assignment statement:

result = oldsum – value / 100;

Following are the tokens and lexemes of this statement:

Token	Lexeme
IDENT	result
ASSIGN_OP	=
IDENT	oldsum
SUB_OP	-
IDENT	value
DIV_OP	/
INT_LIT	100
SEMICOLON	;

Lexical analyzers extract lexemes from a given input string and produce the corresponding tokens. In the early days of compilers, lexical analyzers often processed an entire source program file and produced a file of tokens and lexemes. Now, however, most lexical analyzers are subprograms that locate the next lexeme in the input, determine its associated token code, and return them to the caller, which is the syntax analyzer. So, each call to the lexical analyzer returns a single lexeme and its token. The only view of the input program seen by the syntax analyzer is the output of the lexical analyzer, one token at a time.

The lexical-analysis process includes skipping comments and white space outside lexemes, as they are not relevant to the meaning of the program. Also, the lexical analyzer inserts lexemes for user-defined names into the symbol table, which is used by later phases of the compiler. Finally, lexical analyzers detect syntactic errors in tokens, such as ill-formed floating-point literals, and report such errors to the user.

Suppose we need a lexical analyzer that recognizes only arithmetic expressions,

including variable names and integer literals as operands. Assume that the variable names consist of strings of uppercase letters, lowercase letters, and digits but must begin with a letter. Names have no length limitation. The first thing to observe is that there are 52 different characters (any uppercase or lowercase letter) that can begin a name, which would require 52 transitions from the transition diagram's initial state. However, a lexical analyzer is interested only in determining that it is a name and is not concerned with which specific

name it happens to be. Therefore, we define a character class named LETTER for all 52 letters and use a single transition on the first letter of any name.

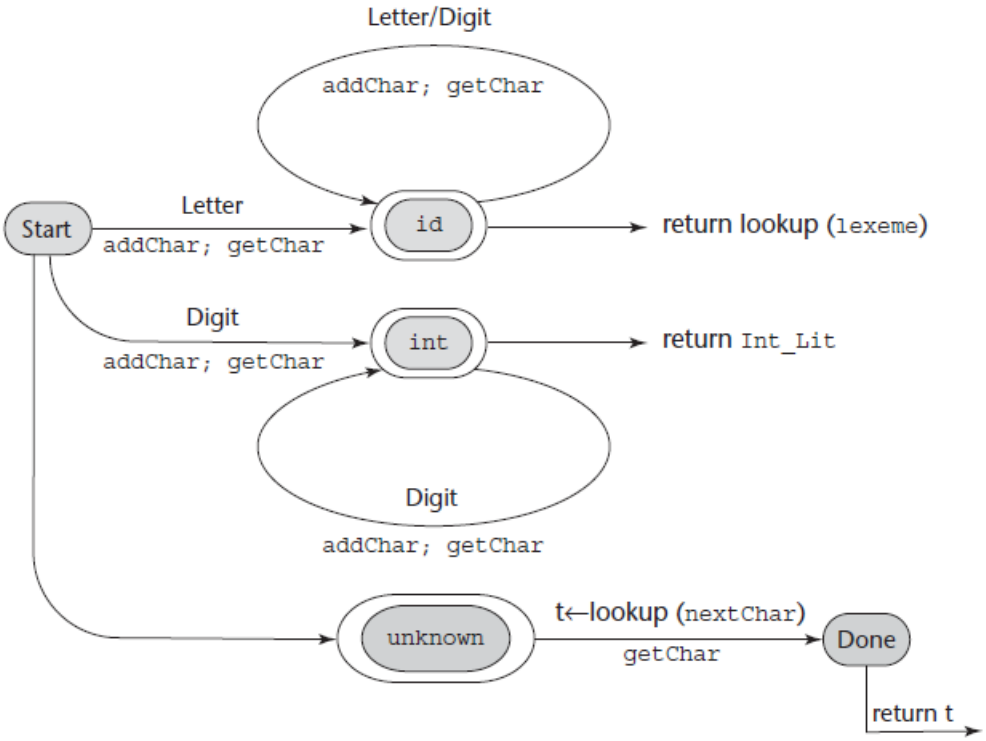
Another opportunity for simplifying the transition diagram is with the integer literal tokens. There are 10 different characters that could begin an integer literal lexeme. This would require 10 transitions from the start state of the state diagram. Because specific digits are not a concern of the lexical analyzer, we can build a much more compact state diagram if we define a character class named DIGIT for digits and use a single transition on any character in this character class to a state that collects integer literals. Because our names can include digits, the transition from the node following the first character of a name can use a single transition on LETTER or DIGIT to continue collecting the characters of a name.

Next, we define some utility subprograms for the common tasks inside the lexical analyzer. First, we need a subprogram, which we can name getChar, that has several duties. When called, getChar gets the next character of input from the input program and puts it in the global variable nextChar. getChar must also determine the character class of the input character and put it in the global variable charClass. The lexeme being built by the lexical analyzer, which could be implemented as a character string or an array, will be named lexeme.

We implement the process of putting the character in nextChar into the string array lexeme in a subprogram named addChar. This subprogram must be explicitly called because programs include some characters that need not be put in lexeme, for example the white-space characters between lexemes. In a more realistic lexical analyzer, comments also would not be placed in lexeme.

When the lexical analyzer is called, it is convenient if the next character of input is the first character of the next lexeme. Because of this, a function named getNonBlank is used to skip white space every time the analyzer is called. Finally, a subprogram named lookup is needed to compute the token code for the single-character tokens. In our example, these are parentheses and the arithmetic operators. Token codes are numbers arbitrarily assigned to tokens by the compiler writer.

The state diagram below describes the patterns for our tokens. It includes the actions required on each transition of the state diagram.



Attached is a partial implementation of a lexical analyzer specified in the state diagram abovr, including a main driver function for testing purposes:

You need to complete the program written in C. Name the program lab2.

Create a text file with the following strings to text your program:

(sum + 47) / total
oldsum - value /100

Output:

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
Next token is: 11, Next lexeme is oldsum
Next token is: 22, Next lexeme is -
Next token is: 11, Next lexeme is value

Next token is: 24, Next lexeme is /
Next token is: 10, Next lexeme is 100
Next token is: -1, Next lexeme is EOF

Grading;

1. One member of a group of two students submits the lab1.c file to the Canvas. (Missing lab1.c file -20 points)
2. A pdf file with code and runtime output (Missing code -5 points and output -5 points)