CMSC 430 Project 1

The first project involves modifying the attached lexical analyzer and the compilation listing generator code. You need to make the following modifications to the lexical analyzer, `scanner.l`:

1. A new token ARROW should be added for the two character punctuation symbol =>.
2. The following reserved words should be added:

   ```
   case, else, endcase, endif, if, others, real, then, when
   ```

   Each reserved words should be a separate token. The token name should be the same as the lexeme, but in all upper case.

3. Two additional logical operators should be added. The lexeme for the first should be `or` and its token should be OROP. The second logical operator added should be `not` and its token should be NOTOP.
4. Five relational operators should be added. They are =, /=, >, >= and <=. All of the lexemes should be represented by the single token RELOP.
5. One additional lexeme should be added for the ADDOP token. It is binary -.
6. One additional lexeme should be added for the MULOP token. It is /.
7. A new token REMOP should be added for the remainder operator. Its lexeme should be `rem`.
8. A new token EXPOP should be added for the exponentiation operator. Its lexeme should be **.
9. A second type of comment should be added that begins with // and ends with the end of line. As with the existing comment, no token should be returned.
10. The definition for the identifiers should be modified so that underscores can be included, however, consecutive underscores, leading and trailing underscores should not be permitted.
11. A real literal token should be added. It should begin with a sequence of one or more digits following by a decimal point followed by zero or more additional digits. It may optionally end with an exponent. If present, the exponent should begin with an `e` or `E`, followed by an optional plus or minus sign followed by one or more digits. The token should be named REAL_LITERAL.
12. A Boolean literal token should be added. It should have two lexemes, which are `true` and `false`. The token should be named BOOL_LITERAL.

You must also modify the header file `tokens.h` to include each the new tokens mentioned above.

The compilation listing generator code should be modified as follows:

1. The `lastLine` function should be modified to compute the total number of errors. If any errors occurred the number of lexical, syntactic and semantic errors should be displayed.

If no errors occurred, it should display `Compiled Successfully`. It should return the total number of errors.

2. The `appendError` function should be modified to count the number of lexical, syntactic and semantic errors. The error message passed to it should be added to a queue of messages that occurred on that line.

3. The `displayErrors` function should be modified to display all the error messages that have occurred on the previous line and then clear the queue of messages.

An example of the output of a program with no lexical errors is shown below:

```
1  (* Program with no errors *)
2
3  function test1 returns boolean;
4  begin
5      7 + 2 > 6 and 8 = 5 * (7 - 4);
6  end;

Compiled Successfully
```

Here is the required output for a program that contains more than one lexical error on the same line:

```
1  -- Function with two lexical errors
2
3  function test2 returns integer;
4  begin
5      7 $ 2 ^ (2 + 4);
Lexical Error, Invalid Character $
Lexical Error, Invalid Character ^
6  end;

Lexical Errors 2
Syntax Errors 0
Semantic Errors 0
```

You are to submit two files.

1. The first is a `.zip` file that contains all the source code for the project. The `.zip` file should contain the flex input file, which should be a `.l` file, all `.cc` and `.h` files and a `makefile` that builds the project.

2. The second is a Word document (PDF or RTF is also acceptable) that contains the documentation for the project, which should include the following:
   a. A discussion of how you approached the project
   b. A test plan that includes test cases that you have created indicating what aspects of the program each one is testing and a screen shot of your compiler run on that test case
   c. A discussion of lessons learned from the project and any improvements that could be made

Grading Rubric

Criteria	Meets	Does Not Meet
	70 points	**0 points**
	Defines new comment lexeme (5)	Does not define new comment lexeme (0)
	Correctly modifies identifier definition to include underscores (5)	Does not correctly modify identifier definition to include underscores (0)
	Adds real and Boolean tokens (5)	Does not add real and Boolean tokens (0)
	Defines additional logical operators (5)	Does not define additional logical operators (0)
	Defines additional relational operators (5)	Does not define additional relational operators (0)
Functionality	Defines additional arithmetic operators (5)	Does not define additional arithmetic operators (0)
	Defines additional reserved words and arrow symbol(5)	Does not define additional reserved words and arrow symbol (0)
	Adds new tokens to the token header file (5)	Does not add new tokens to the token header file (0)
	Implements modifications to display multiple errors on the same line (15)	Does not implement modifications to display multiple errors on the same line (0)
	Implements modifications to count and display each type of compilation error (15)	Does not Implement modifications to count and display each type of compilation error (0)
	15 points	**0 points**
	Includes test case containing all lexemes (5)	Does not include test case containing all lexemes (0)
Test Cases	Includes test case with multiple errors on one line (5)	Does not include test case with multiple errors on one line (0)
	Includes test case with no errors (5)	Does not include test case with no errors (0)
	15 points	**0 points**
	Discussion of approach included (5)	Discussion of approach not included (0)
Documentation	Lessons learned included (5)	Lessons learned not included (0)
	Comment blocks with student name, project, date and code description included in each file (5)	Comment blocks with student name, project, date and code description not included in each file (0)