1. (40 points) Errors in a computer program can be classified according to when they are detected and, if they are detected at compile time, what part of the compiler detects them. Assuming we use C/C++, give an example of each of the following

1. A lexical error, detected by the scanner.

- Identifying correct words in a program

1. A syntax error, detected by the parser.

- Identifying syntactically correct program structures

1. A static semantic error, detected by semantic analysis.

- Identifying meaningful programs

1. A dynamic semantic error, detected by the code generated by the compiler.

2. (30 points) Convert the regular expression  
a ( a | ba )\* b\*

to an NFA using the NFA equivalents (base case, concatenation, alternation, Kleene closure) of the regular expression operations.

3. (30 points) For this question, feel free to use POSIX standard syntax. Of particular use may be bracket expressions (e.g. [0-9] matches any digit from 0 through 9) and the POSIX extended metacharacter ‘+’, which matches the preceding element one or more times (as opposed to the Kleene star, which matches zero or more times). Of course, the Kleene star (\*) and concatenation (|) metacharacters are allowed. Write the regular expressions for the following.

1. The set that includes the four keywords int, while, for, and case.
2. The set of floating point numbers of the form X ‘.’ Y ‘e’ Z where X, Y, and Z are simple sequences of digits and ‘e’ is the letter e. For example, 1.0002e12 is one such number.
3. The set of all possible words formed by upper and lower case letters, ending with the letter ‘a’ or ‘b’.