Homework 1
Due January 26, 2015

Submissions are due by the beginning of class on the specified due date. Handwritten or typed solutions are acceptable. If you do write your solutions by hand, be sure to write clearly. If the grader cannot read your answer, they cannot give you the points. Late submissions will be accepted with a 10% penalty for each day they are late.

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.
   a) A lexical error, detected by the scanner.
   b) A syntax error, detected by the parser.
   c) A static semantic error, detected by semantic analysis.
   d) A dynamic semantic error, detected by the code generated by the compiler.

2. (30 points) Convert the regular expression
   \[ a \ ( a \mid ba \) \ast b \ast \]
   to NFAs 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 (http://en.wikipedia.org/wiki/Regular_expression#POSIX_basic_and_extended). 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 preceeding 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
   (a) The set that includes the four keywords int, while, for, and case.
(b) 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.

(c) The set of all possible words formed by upper and lower case letters, ending with the letter ‘a’ or ‘b’.