CSE105 Sample Questions for Final Exam

1. Show that if
   \[ E_{TM} = \{ \langle M \rangle \mid M \text{ is a TM and } L(M) = \phi \} \]
   were decidable, then
   \[ EQ_{TM} = \{ \langle M_1, M_2 \rangle \mid M_1, M_2 \text{ are TM with } L(M_1) = L(M_2) \} \]
   is also decidable.

2. Label the following T (true) or F (false):
   a. For every DFA there is a CFG which derives the same language as that of the DFA.
   b. In using the subset construction to construct a DFA that accepts the same language as an
      NFA, the DFA will never have more states than the NFA.
   c. Every language can be derived from a CFG.
   d. Every decidable language is Turing-recognizable.
   e. The complement of any Turing-recognizable language is Turing-recognizable.

3. Write a regular expression for floating point literals, which consist of a decimal point,
   any sequence of decimal digits, an exponent, and a type. A decimal integer consists of one or
   more of decimal digits without leading zeroes. An exponent consists of the characters “e” or “E”,
   followed by an optional + or −, followed by a decimal integer. A type consists of the keywords
double or float. You can use the shorthand notation for regular expressions if you wish.

4. Construct a state diagram of an NFA accepting the set described by the following regular expression
   over the alphabet \{ 0,1 \}, indicating the start and final state(s) of the NFA:
   \[(00)^*011 \mid 01\]

5. Construct a parse tree for the string \(\forall x \exists y [P]\) from the following grammar with start symbol S, and
   whose set of terminals is \(\{ \forall, \exists, (, ), [ , ] , x, y, P \} \).

   \[
   S \rightarrow Q[F] \\
   Q \rightarrow \forall LQ \mid \exists LQ \mid e \\
   L \rightarrow x \mid y \\
   F \rightarrow P
   \]

6. Construct a CFG that generates the set of strings over the alphabet \{ 0,1 \} with an even number of
   0’s and any number of 1’s. \(\epsilon, 0000 \text{ and } 010111 \text{ should be in the set, but } 000 \text{ and } 011 \text{ should not.}\)
   Indicate the start symbol of the CFG.

7. Fill in the blanks:
   a. A derivation is rightmost if
   b. Diagonalization is useful for
   c. The definition of mapping reducible is
   d. The main output of a parser is
   e. The Church-Turing thesis is