CSE105 Sample Questions for Final Exam

1. Show that if
   $E_{TM} = \{< M >| \ M \text{ is a TM and } L(M) = \phi\}$
   were decidable, then
   $EQ_{TM} = \{< M_1, M_2 >| \ M_1, M_2 \text{ are TM with } L(M_1) = L(M_2)\}$
   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 integer*, 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) | 01

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

   $S \rightarrow Q[F]$
   $Q \rightarrow \forall LQ \mid \exists LQ \mid \epsilon$
   $L \rightarrow \mathbf{x} \mid \mathbf{y}$
   $F \rightarrow \mathbf{P}$

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. (ϵ, 0000 and 010111 should be in the set, but 000 and 011 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