

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 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:
 $((00)^*011) \mid 01$
5. Construct a parse tree for the string $\forall x \exists y [\mathbf{P}]$ from the following grammar with start symbol S , and whose set of terminals is $\{\forall, \exists, (,), [,], \mathbf{x}, \mathbf{y}, \mathbf{P}\}$.

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

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