CSCI 3130: Formal Languages and Automata Theory — Practice Final Exam

The Chinese University of Hong Kong, Fall 2017

For each of these statements, say if it is true or false. Give a proof or provide a counterexample for your answer.

(In the actual exam, you will be provided with a short list of undecidable/NP-hard languages.)

(1) There is a 2-state NFA for the language `(01)*`.

(2) There is a 2-state DFA for the language `(01)*`.

(3) If L is regular over $\Sigma = \{\texttt{0}, \texttt{1}\}$, then L' is also regular, where

$$L' = \{x \mid x \in L \text{ and } x \text{ starts and ends with the same symbol}\}.$$

(4) The language $L = \{wxw^R x^R : x, w \in \Sigma^*\}$ is context-free over alphabet $\Sigma = \{\texttt{a}, \texttt{b}\}$.

(5) If L_1 and L_2 are regular languages, then the following language is context-free:

$$L = \{xy \mid x \in L_1,\ y \in L_2, \text{ and } |x| = |y|.\}$$

(6) The grammar $\quad S \to S\texttt{a} \mid \texttt{a} \quad$ is $LR(0)$.

(7) The following language is decidable:

$$L = \{\langle R \rangle \mid \text{Regular expression } R \text{ generates at least one string of even length.}\}$$

(8) The following language is decidable:

$$L = \{\langle G_1, G_2 \rangle \mid \text{CFG } G_2 \text{ generates some string that CFG } G_1 \text{ does not generate.}\}$$

(9) The following language is decidable:

$$L = \{\langle M, k \rangle \mid \text{TM } M \text{ accepts at most } k \text{ inputs.}\}$$

(10) The following language is NP-complete:

$$L = \{\langle \phi, \psi \rangle \mid \text{Boolean formulas } \phi \text{ and } \psi \text{ share a common satisfying assignment.}\}$$