Assignment 3
## CSCE 4323/5173: Formal Languages and Computability
Fall 2022

All solutions should be contained in a single document, named Assignment3.pdf. They must all be neatly typed, and may include images of DFAs or NFAs which are created either using "tikz" in LaTeX or images of automata created in JFLAP and included in your PDF file.

Points will be deducted for PDF text which does not contain correct mathematical notation and formatting. You should be using Overleaf (`https://overleaf.com/`) or a similar LaTeX editor for your write up.

Theorem 1. Regular languages are closed under complementation.

1. Prove Theorem 1 (i.e. if L is a regular language, then $\bar{L} = \Sigma^* \setminus L$ is also regular).

2. Give regular expressions generating the following languages. In all parts, the alphabet is $\{0, 1\}$.

   a. $\{w \mid$ every odd position of w is a 1$\}$

   b. $\{w \mid w$ contains at least two 0s and at most one 1$\}$

3. Use the procedure described in Lemma 1.55 to covert the following regular expressions to nondeterministic finite automata.

   a. $(0 \cup 1)^*000(0 \cup 1)^*$

   b. $(((00)^*(11)) \cup 01)^*$

4. Use the procedure described in Lemma 1.60 to covert the following finite automata to regular expressions.

a.

b.
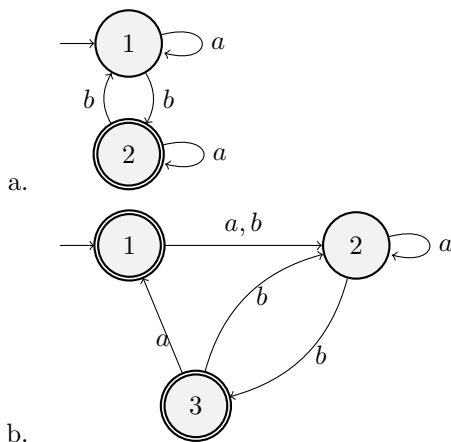
5. Let $\Sigma = \{0, 1, +, =\}$ and

   $ADD = \{x = y + z \mid x, y, z$ are binary integers, and x is the sum of y and $z\}$.

   Prove that ADD is not regular.

6. Prove that the following language is not regular. You may use the pumping lemma and the closure of the class of regular languages under union, intersection, and complement.

   $\{w \mid w \in \{0, 1\}^*$ is not a palindrome$\}$[1]

---

[1] A palindrome is a string that reads the same forward and backward.