CPSC 313 — Winter 2020
Assignment 1 — Finite Automata and Regular Languages

Due Monday, February 10, at 11:55 pm on Gradescope

Prior to submission, be sure to familiarize yourself with the **Policies and Guidelines** as well as the **Submission Procedure** as detailed on the assignments course webpage

http://people.ucalgary.ca/~rscheidl/313/assignments.html.

Assignments that don't follow these instructions will incur penalties, possibly even a score of zero.

1. **The Language of a 2-State DFA**

   Let $M = (Q, \Sigma, \delta, q_0, F)$ be a DFA and put $L = L(M)$. By considering the different possibilities for the set of final states F of M, prove that if Q consists of exactly two states, then one of the following hold (note that (b) and (c) are not mutually exclusive):

   (a) L is empty.

   (b) L contains the empty string.

   (c) L contains a string of length 1.

2. **DFA Design and Analysis**

   (a) Design a DFA M with at most 4 states for the language

   $$L = \{w \in \{0,1\}^* \mid \ w \text{ contains at least one 0 and } |w| \text{ is even}\}.$$

   Present your DFA in the form of a state diagram and include a brief rationale for its design.

   (b) Prove that your DFA M of part (a) accepts the language L, i.e. prove that $L(M) = L$.

3. **NFA Design and Analysis**

   (a) Design an NFA N with at most 5 states for the language

   $$L = \{w \in \{0,1\}^* \mid \ w \text{ contains the substring 1011 or the substring 100}\}.$$

   Present your NFA in the form of a state diagram and include a brief rationale for its design.

   (b) Prove that your NFA N of part (a) accepts the language L, i.e. prove that $L(N) = L$.