GROUP HOMEWORK 5, CPSC 421/501, FALL 2021

JOEL FRIEDMAN

Please note:

(1) You must justify all answers; no credit is given for a correct answer without justification.
(2) Proofs should be written out formally.
(3) Homework that is difficult to read may not be graded.
(4) You may work together on homework in groups of up to four, **but you must submit a single homework as a group submission under Gradescope.**

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(1) Problem 6.1.6 of "Non-Regular Languages, the Myhill-Nerode Theorem, and Linear Algebra Tests."

(2) Problem 6.1.7 of "Non-Regular Languages, the Myhill-Nerode Theorem, and Linear Algebra Tests."

(3) [Sip], Problem 1.31, but do this as follows: explain how to take a DFA, M, recognizing a language, L, and produce an NFA, M', recognizing L^{rev}; in particular, use only Sections 1.1 and 1.2, and do not use Section 1.3 on regular expressions. Explain your general method for doing this, and give one example that illustrates all of the main parts of your method.

(4) Let $L \subset \{0,1\}^*$ be the language of integers expressed in binary that are multiples of 5, where the empty string is in L and we allow leading 0.

[Hence, listed in increasing string length, and in lexicographical order, L begins $\{\epsilon, 0, 00, 000, 101, 0000, 0101, 1010, 1111, \ldots\}$.]

Give a DFA recognizing L.

(5) Fix an alphabet, Σ.
   (a) Consider the set of DFA's $(Q, \Sigma, \delta, q_0, F)$ such that $Q = \{1, \ldots, m\}$ for some $m \in \mathbb{N}$. Is this set countable or uncountable?

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(b) Prove that there are languages over Σ that are not recognized by any DFA, using only facts about countable and uncountable sets (and nothing particular about DFA's, such as the Myhill-Nerode Theorem, beyond what is covered in Section 1.1 of [Sip]).

Department of Computer Science, University of British Columbia, Vancouver, BC V6T 1Z4, CANADA.

E-mail address: jf@cs.ubc.ca

URL: http://www.cs.ubc.ca/~jf