CS 5000: Theory of Computability
Assignment 4

Vladimir Kulyukin
Department of Computer Science
Utah State University

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Learning Objectives

1. Regular and Non-Regular Languages
2. Pumping Lemma
3. DFA Minimization

Introduction

This assignment will give you an opportunity to practise proofs by contradiction and get exposed to the pumping properties of regular languages. If you use a math-friendly editor to type your solutions, please please please pdf your solution. Since both graders, Astha and Prakhar, and I use Ubuntu most of the time, docx files slow us down, because we have to switch to Windows. OpenOffice does not handle docx equations correctly. However, if you submit your pdfs, grading goes much faster. In short, you will do me a great favor by pdfing your files.

Problem 1 (1 point)

Is there a regular language over an alphabet of 3 symbols, i.e., $\{a, b, c\}$ or $\{0, 1, 2\}$ that has a non-regular proper subset? If yes, state such a language and its proper non-regular subset. If not, argue why not.

Problem 2 (3 points)

For each language, state if it is regular or not. Sketch a proof of your statement.

1. $L = \{a^n b^n c^n | n \geq 0\}$.
2. $L = \{xx^R | x \in \Sigma^*\}$, where x^R is the reversal of x and $\Sigma = \{a\}$.

3. $L = \{xcx^R | x \in \Sigma^*\}$, where $\Sigma = \{a, b\}$.
4. $L = \{a^n c^m b^p | n + m = p\}$.
5. $L = \{0^n 1^m | n \geq m\}$.

Problem 3 (1 point)

Let $M = (Q, \Sigma, \delta, q_0, F)$, where

1. $Q = \{q_0, q_1, q_2, q_3, q_4\}$;
2. $\Sigma = \{0, 1\}$;
3. $\delta(q_0, 0) = q_1; \delta(q_0, 1) = q_3; \delta(q_1, 0) = q_2; \delta(q_1, 1) = q_4;\ \delta(q_2, 0) = q_1; \delta(q_2, 1) = q_4; \delta(q_3, 0) = q_2; \delta(q_3, 1) = q_4;\ \delta(q_4, 0) = q_4; \delta(q_4, 1) = q_4$.
4. $F = \{q_2, q_4\}$.

Convert M to its minimal version and draw it.

What to Submit

Submit your solution via Canvas.