Homework 3: DFA Minimization and Non-regular Languages

CSE 30151 Spring 2022

Due: Thursday, February 17 at 11:59pm

Instructions

- Use this document to create a PDF file containing your solutions. Do this either by (1) printing this document, writing your solutions on it, and scanning[1] your work into a PDF; or (2) writing your solutions on this PDF digitally.

- If you need extra blank pages, feel free to insert them as needed. The amount of blank space provided beneath a problem does not necessarily indicate the expected length of your solution.

- You have the option to submit your solutions all at once or in parts; late penalties will only be applied to problems that are late. Individual problems cannot be submitted for grading in this way more than once.

- If you are making a complete submission, before uploading, name your file `hw3.pdf`. If you are submitting your work in parts, name your file(s) `hw3-123.pdf`, replacing `123` with the numbers of the problems you are submitting in that file.

- Submit your PDF file(s) in Canvas under Assignments > Homework 3: DFA Minimization and Non-regular Languages. You may re-submit your files any number of times before the due date.

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[1]For tips on scanning your work using your mobile device, see `https://help.gradescope.com/article/0chl25eed3-student-scan-mobile-device`.

1. For the following DFA, determine the classes of equivalent states, and use them to provide the equivalent minimum-state DFA. **(4 points)**
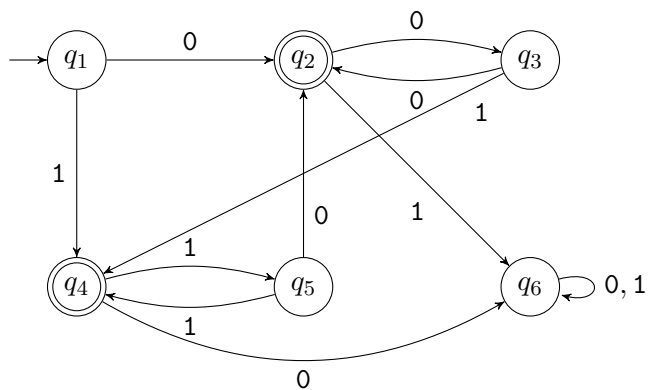
2. As you have already learned, for any two languages L_1 and L_2, if L_1 and L_2 are regular, then their concatenation, $L_1 L_2$, is regular. Show that the converse is not true; that is, if L is a regular language and $L = L_1 L_2$, then it is not always the case that L_1 and L_2 are both regular. **(4 points)**

3. For each of the following languages, prove that it is not regular.

(a) $L_1 = \{\mathtt{a}^n \mathtt{b}^m \mathtt{c}^{n+m} \mid n, m \geq 0\}$ **(4 points)**

(b) $L_2 = \{w \in \{\mathtt{a}, \mathtt{b}\}^* \mid |c_{\mathtt{a}}(w) - c_{\mathtt{b}}(w)| \leq 2\}$, where $c_a(w)$ stands for the number of occurrences of symbol a in string w. **(4 points)**

4. For each of the following languages, state whether it is regular or not regular, and prove your answer.

   (a) $L_3 = \{w0^n w \mid w \in \{0,1\}^* \wedge n = |w|\}$ **(4 points)**

(b) $L_4 = \{\mathtt{a}^n \mathtt{b}^m \mathtt{c}^{n+m} \mid n, m \geq 0 \wedge n, m \leq 100\}$ (**4 points**)

(c) **Extra credit** (cannot be submitted late).

$L_5 = \{xyzy^Rx \mid x, y, z \in \{\mathtt{a}, \mathtt{b}\}^*\}$ **(4 points)**