Homework 2

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February 9, 2018

1. Give the state diagram of a DFA recognizing the following language. The alphabet is $\{0,1\}$.

   $$\{w : w \text{ has length exactly 3 and its last symbol is different from its first symbol}\}$$

2. Give a DFA (both a state diagram and a formal description) recognizing the following language. The alphabet is $\{0,1\}$.

   $$\{w : w \text{ has odd length or contains an even number of 0s}\}$$

3. Show that the following language is regular, where the alphabet is $\{0,1\}$.

   $$\{w : w \text{ contains an equal number of occurrences of the substrings 01 and 10}\}$$

4. For any string $w = w_1 w_2 \cdots w_n$, the reverse of w, written as $w^{\mathcal{R}}$, is the string w in reverse order $w_n \cdots w_2 w_1$. For any language A, let $A^{\mathcal{R}} = \left\{w^{\mathcal{R}} : w \in A\right\}$. Show that if A is regular, so is $A^{\mathcal{R}}$.