

CS 591 S2—Formal Language Theory: Integrating Experimentation and Proof—Fall 2019

Problem Set 3

Due by 12:30pm on Friday, October 18

Problem 1 (25 Points)

Define a function $\mathbf{diff} \in \{0,1\}^* \rightarrow \mathbb{Z}$ by: for all $w \in \{0,1\}^*$,

$\mathbf{diff} w =$ the number of 1's in w – the number of 0's in w .

Let $X = \{w \in \{0,1\}^* \mid |w| \leq 6 \text{ and } \mathbf{diff} w = 0\}$.

Use Forlan to find and show the correctness of a regular expression α such that $L(\alpha) = X$. Try to make α as simple as possible (see `Reg.compareComplexity`), and use Forlan to display the closure complexity, size, number of concatenations, and number of symbols of α , as well as whether α is standardized. Try to do as much as possible of the work of finding and showing the correctness of α using Forlan. (Include a listing of your Forlan session.)

Problem 2 (5 Points)

Solve Exercise 3.3.7, finding regular expressions α and β such that $\mathbf{cc} \alpha = \mathbf{cc} \beta$ but $\mathbf{size} \alpha \neq \mathbf{size} \beta$. Use Forlan to check your solution. (Provide a transcript of your Forlan session.)

Problem 3 (10 Points)

Use `Reg.locallySimplifyTrace` to illustrate how reduction rule (20) works as part of local simplification. (Include a listing of your Forlan session.)

Problem 4 (60 points)

Let \mathbf{diff} be as in Problem 1, and define $Y = \{w \in \{0,1\}^* \mid \text{for all prefixes } v \text{ of } w, -2 \leq \mathbf{diff} v \leq 2\}$.

(a) Find a regular expression α such that $L(\alpha) = Y$. [15 points]

(b) Prove that your answer to part (a) is correct. [45 points]