More Fun With Automata
Homework 3, CS500, Fall 2014

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1 Ex 23, Automata Notes

Given a language L, the language $sort(L)$ consists of the words in L with their characters sorted in alphabetical order. For instance, if

$$L = \{bab, cca, abc\}$$

then

$$sort(L) = \{abb, acc, abc\}.$$

Give an example of a regular langauge L_1 such that $sort(L_1)$ is nonregular and a nonregular language $sort(L_2)$ such that $sort(L_2)$ is regular. You may use any technique you like to prove that the languages are regular.

Answer:

2 Infinite sequences of languages

Find an infinite sequence of languages $A_0 \subset A_1 \subset A_2 \subset \cdots \subset A_k \subset \ldots$ such that for each even n, A_n is regular, and for each odd n, A_n is non-regular. Prove your solution is correct.

Answer:

3 Regex Golf

Go to and solve at least 5 of the puzzles. Solving means finding a regular expression that matches a substring of every string on the "match" list, and no substring of any string on the "none of these" list. Of your solutions, submit the 5 you like best, along with the score for each. Your solutions should be proper regular expressions, defined as follows:

- You may use ranges, such as [a-z]
- You may use the start-of-string character: ând the end-of-string character: $.

- You may use the OR character: |; the Kleene star operator: *; and parentheses: (,).
- You may NOT use backrefs or other constructs that allow the construction of expressions that match non-regular languages. (The server allows some of these, despite calling the game "regexp golf," but this assignment does not.)

Answer:

4 Context-Free Grammars

Give Context-Free Grammars that generate the following languages over alphabet $\{0,1\}$. Also say whether each language is regular.

(a) $\{w : w$ **contains at least two 1's**$\}$

Answer:

(b) $\{w : w$ **starts and ends with the same symbol, and has odd length**$\}$

Answer:

(c) $\{wx : x$ **is a substring of the reverse of** $w\}$

Answer:

5 Grammar and language

What language is generated by the following grammar? Prove whether it is a regular language or not. THere are 3 variables: S, A, B **and two terminals** $\{0, 1\}$

(a) $S \to AA, B$

Answer:

(b) $A \to 0A, A0, 1$

Answer:

(c) $B \to 0B00, 1$

Answer:

6 Exercise 36, Automata notes

Show that a 1-DCA can be simulated by a DPDA, and similarly for 1-NCAs and NPDAs. Do you think this is true for two-counter automata as well?

Answer: