CSC236 – Problem Set 11

There are two components of this problem set: a preliminary question designed to check your understanding of the basic topics covered this week, and a set of more challenging questions designed to make you think critically about the material and apply it in new contexts. Get in the habit of starting work early – the less time you give yourself, the most stressed you’ll find yourself each week!

Caution: you must submit two separate files in two separate locations on MarkUs, one for the Preliminary and one for the Challenge.

To avoid suspicions of plagiarism, clearly state any resources (people, print, electronic) outside of your group, the course notes, and the course staff, you consulted at the beginning of your assignment submission.

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Preliminary: due April 1, 2014 8:00 pm

This question is an opportunity for you to check your understanding of the topics and practice writing formal solutions. This is a valuable learning opportunity – if you see that you’re at a loss, get help quickly!

Your goal should not be to get the right answer, but to convince the marker that you know what you’re doing. This question is marked on the following 3-point scale:

<table>
<thead>
<tr>
<th>3: You’ve mastered this topic</th>
<th>1: You don’t really know what you’re doing</th>
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<td>2: You’re almost there, but missing something</td>
<td>0: You didn’t submit/had absolutely no clue</td>
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This question must be completed INDIVIDUALLY.

Let \( L = \{ w \in \{a, b, c\}^* \mid \text{the second-last and third-last characters of } w \text{ are the same}\} \). Give an NFA that accepts this language. Justify in one or two sentences why your NFA is correct.
Challenges: due FRIDAY (!!) April 4, 2014 noon

Answer each question completely, always justifying your claims and reasoning. Your solution will not just be graded on correctness, but on its clarity as well. Technically correct answers that are hard to understand will not receive full marks. Mark values for each question are contained in the [square brackets].

You may work in groups of up to THREE to complete these questions.

1. [4] Perform the subset construction on the following NFA, to obtain a DFA accepting the same language. Identify and remove any unreachable states (states that can’t ever be reached from the initial state). Show all of your work!

   ![NFA diagram]

   - Initial state: 0
   - Final states: 1
   - Transitions:
     - From 0 to 1 on input 'a'
     - From 1 to 0 on input 'b'
     - From 0 to 2 on input 'b'
     - From 2 to 0 on input 'a'

2. [4] We saw on the previous problem set that given a DFA accepting a language $L$, we could construct a DFA $\mathcal{D}$ accepting the complement of $L$ simply by making all final states of $\mathcal{D}$ non-final, and vice versa. Does the same hold for non-deterministic finite automata? If so, give proof; if not, give a counter-example with justification.

3. [6] Prove that the language $L = \{1^n \mid n \text{ is a perfect square}\}$ is not regular. **You should prove that no DFA can accept $L$, using the method we saw in class.**

   Hint: you must give a mathematical argument in your proof – no hand-waving! Consider the difference between consecutive perfect squares, and note that any “loop” in a DFA has length $\leq$ the number of states.