CSCI3136
Assignment 2

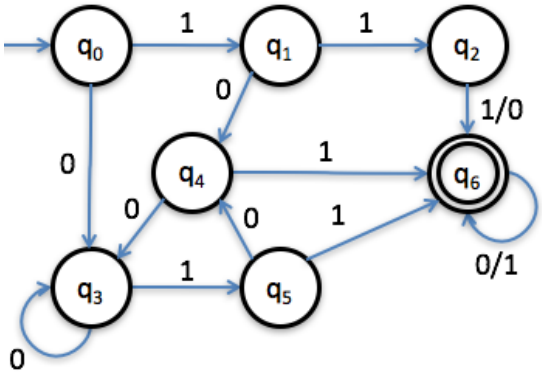
Instructor: Alex Brodsky

Due: 9:00am, Monday, May 31, 2019

1. **[10 marks]** Construct a DFA for the language of binary strings specified by the following regular expression:

   $$(1|0)*(110|011|101|111)(0|1)*$$

   Note that the standard approach is to first construct an NFA and transform it to a DFA.



   Note: To understand how this DFA works, consider what each state represents:

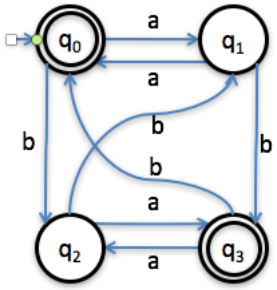
   q_0 : initial state, no input yet
   q_1 : last char read 1
   q_2 : last 2 chars read 11
   q_3 : last char read 0 or last 2 char read 00
   q_4 : last 2 chars read 10
   q_5 : last 2 chars read 01
   q_6 : final state, have read one of (110, 011, 101, or 111)

   This is all the DFA needs to keep track off.

2. **[10 marks]** Recall that $L = \{a^p | p \textit{ is prime}\}$ is not regular. Prove, using the properties of regular languages that, that $L' = \{a^p b^q | p, q \textit{ are not prime}\}$ is also not regular.

   Proof by contradiction. Assume that L' is regular. Let $L_a = \{a^*\}$ and $L'' = L_a \backslash (L' \cap L_a)$. Observe that $L' \cap L_a$ is the set $\{a^q | q \textit{ is not prime}\}$ and hence $L'' = \{a^p | p \textit{ is prime}\}$. Since regular languages are closed under intersection and symmetric difference, L'' must also be regular. But, we know it is not. Contradiction.

3. **[10 marks]** Give a regular expression that specifies the language recognized by the following DFA.



After reduction to a two state GNFA, the four REs are

R_1 : $aa|baa|((bb|ab|bab)(bb)*a)$
R_2 : $(bb|ab|bab)(bb)*$
R_3 : $\emptyset$
R_4 : $\emptyset$

Hence, the final RE is simply: $R_1 * R_2$

4. **[10 marks]** Suppose L is regular. Will the langauge $L' \subseteq L$ also regular? Be sure to prove your answer.

No. Let $L = \{a^*\}$ and $L' = \{a^p | p \textit{ is prime}\}$. Since, L is regular, by definition of Kleene-*, L' is not regular, by the previous question, and $L' \subset L$, it follows that a subset of a regular language is not necessarily regular.

5. **[10 marks]** We know from our discussion that the language $\{0^n 1^n | n \geq 0\}$ is not regular. Is the language $L = \{0^n w 1^n | n \geq 0, w \in \{0,1\}^*\}$ regular? Be sure to prove your answer.

L is regular. Proof: Choose any $\sigma \in L$. Therefore $\sigma = 0^n w 1^n$. Since $n \geq 0$, we can rewrite $\sigma = 0^0 w' 1^0 = w'$, where $w' \in \{0,1\}^*$, which is the set of all binary strings; a regular language.

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Summer 2019

Student Name	Login ID	Student Number	Student Signature

	Mark
Question 1	/10
Question 2	/10
Question 3	/10
Question 4	/10
Question 5	/10
Total	**/50**

Comments:

Assignments are due by 9:00am on the due date before class and should include this cover page. Assignment *must* be submitted electronically via Brightspace. Please submit a PDF. You can do your work on paper and then scan in and submit the assignment.

Plagiarism in assignment answers will not be tolerated. By submitting their answers to this assignment, the authors named above declare that its content is their original work and that they did not use any sources for its preparation other than the class notes, the textbook, and ones explicitly acknowledged in the answers. Any suspected act of plagiarism will be reported to the Facultys Academic Integrity Officer and possibly to the Senate Discipline Committee. The penalty for academic dishonesty may range from failing the course to expulsion from the university, in accordance with Dalhousie Universitys regulations regarding academic integrity.