COMP 4200 - Formal Languages: Homework #4

Due on Thursday, February 29, 2024, at 10:00 pm
Instructor: Hugh Kwon

Instructions:

- Submit your work as a single PDF through GradeScope (link on Canvas). You will need to match your solution to each question (click for the instruction). Failure to match your solution to the appropriate question will result in a grade of 0 for each unmatched question.
- Note that it is your responsibility to make your submissions readable by TAs. If your handwriting is not readable by the TA, he may not give you full credits (or any credits at all) for the illegible part.
- You will not only be graded on your mathematics, but also on your organization, proper use of English, spelling, punctuation, and logic.
- Late submissions will NOT be graded unless as specified by the Late Assignment Submission policy in the syllabus.
- For any questions regarding the assignment or grading of the assignment, please email our TAs.

Problem 1

Total: 20 points (10 points each)
Convert the following regular expressions into equivalent NFAs.

1. a*(b ∪ c)*c
2. ((b ∪ a)* ∪ (c ∪ a))*(cb)*

Problem 2

Total: 20 points (10 points each)
Convert the following NFAs into equivalent regular expressions. Show **all the intermediate steps** (i.e. GNFAs) and make appropriate comments to help graders understand your steps.
For example, step 1: remove state "q_0"; step 2: remove state "q_3", etc.

1. Convert the NFA in Figure 1 into an equivalent regular expression.

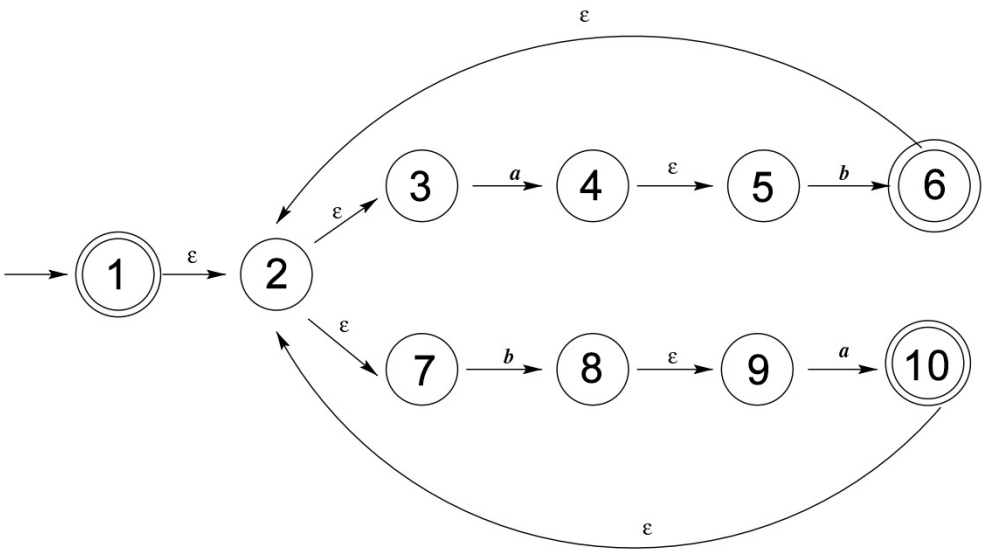

Figure 1:

2. Convert the NFA in Figure 2 into an equivalent regular expression.

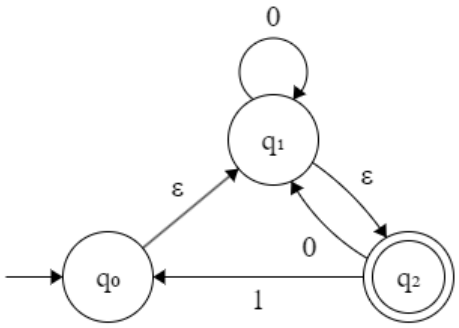

Figure 2:

Problem 3

Total: 20 points (10 points each)
Alphabet $\Sigma = \{0, 1\}$
For each provided language (X and Y), please answer these two questions:
(a) Is the language regular or non-regular?
(b) If your answer is regular, please provide either a DFA, NFA or regular expression (choose only one) that recognizes the language. If your answer is non-regular, please prove it by contradiction using Pumping Lemma. The presentation format of the proof is expected to follow those examples in the book.

1. $X = \{0^m 1^n \mid m > n \geq 0\}$
2. $Y = \{0^n \mid n \text{ is a prime}\}$