COT4420 Theory of Computation October 7, 2024

**Problem Set 3**

**Due October 14, 2024**
**Note: no late homework will be accepted for revised problem set 3**
**Total points are 65 pts.**

1. (6 pts) Which of the following sequences belong to the set denoted by the regular expression:

$$(1 + 10^*1)^* \, (0 + 10 \, (1 + 00)^*11)$$

(a) 100010110
(b) 100111101
(c) 101010101
(d) 0111110
(e) 10000011
(f) 110

2. (4 pts) Consider the two regular expressions:
$r = a^* + b^*$ and $s = ab^* + ba^*$

(a) Find a string in *r* but not in *s*.
(b) Find a string in *s* but not in *r*.
(c) Find a string in both *r* and *s*.
(d) Find a string in {a, b}* that is in neither *r* nor *s*.

3. (5 pts) Construct a d.f.a. that accepts the language generated by the following regular grammar: $G = (\{S, A, B\}, \{a, b\}, P, S)$ with *P*:

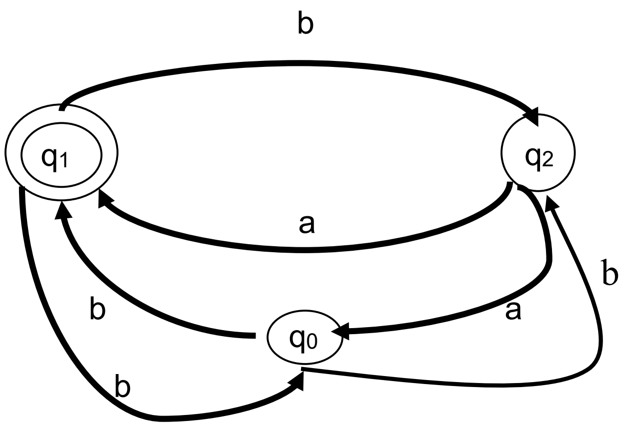
$S \rightarrow bA \mid aB \mid \lambda$
$A \rightarrow abS \mid baS$
$B \rightarrow aaS \mid bbS$

4. (15 pts) First construct an n.f.a with the fewest states you can that accepts the set:
$\{bab^na : n \geq 0\} \cup \{ba^nb : n \geq 0\}$.

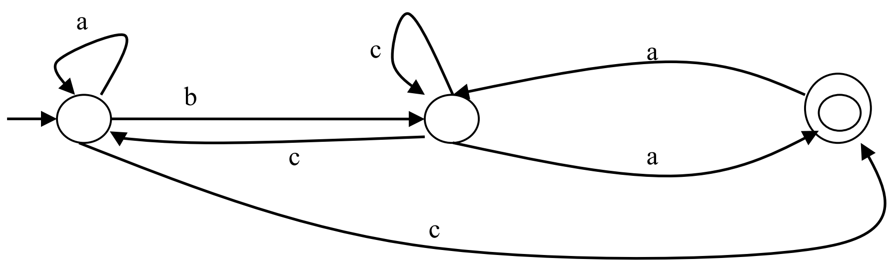
Next convert the n.f.a. you constructed to a d.f.a.

5. (15 pts) Which of the following languages are regular sets. Justify your answers.
(a) $\{ (11011)^{3n} : n \geq 0 \}$
(b) $\{ a^nb^m : n + m \text{ is even} \}$
(c) $\{ xx^Rx : x \in \{a, b, c\}\}$ (note that that $x^R$ denotes the *reverse* of the string x.)
(d) $\{xwx^R : w, x \in \{a, b\}^+ \}$
(e) { strings over {a, b} containing a prime number of b's less than 100 }

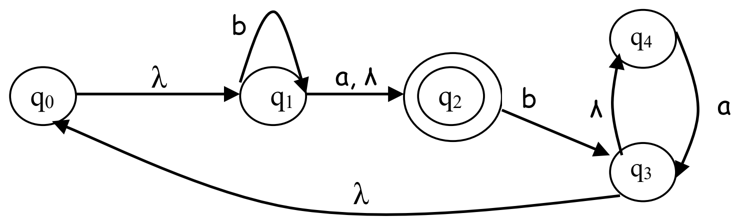
6. (5 pts) Consider the following n.f.a. Find an equivalent regular grammar. The start state is $q_0$.




7. (15 pts) Using generalized transition graphs, eliminate the middle state and find the equivalent regular expression for the acceptor below.



This problem will not be graded but it is useful to try to solve it to be sure you understand the concepts. It will be covered during the review of the homework. Consider the n.f.a pictured below:




Eliminate the λ transitions from this n.f.a to create an equivalent n.f.a without λ (or epsilon) transitions.

This problem will not be graded but it is useful to try and solve it. It will be covered during the review of the homework.
Suppose that we know that $L_1 \cup L_2$ is regular and that $L_1$ is finite. Can we conclude that $L_2$ is regular? Explain