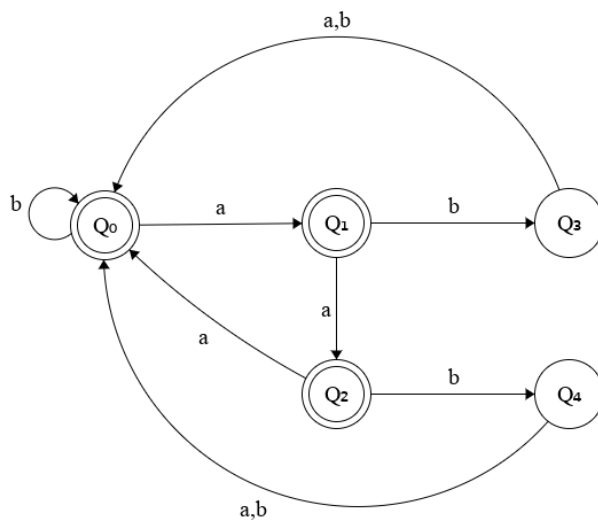


CS 321: Assignment 4

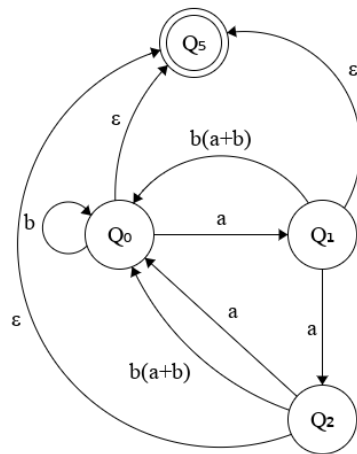
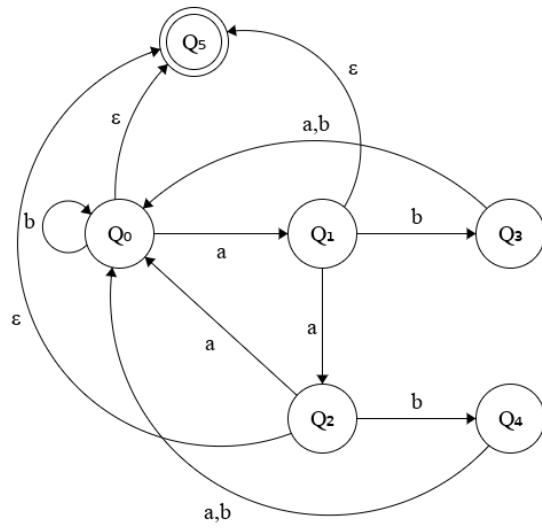
Jared Wasinger

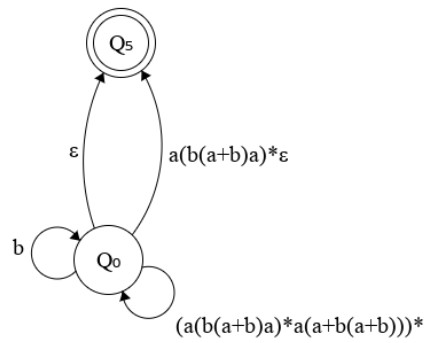
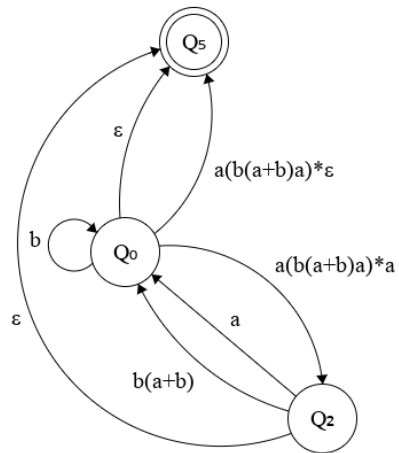
October 21, 2016

1. Give a regular expression R such that $\overline{L(R)} = L((ab + aab) * b)$
Want a regular expression: $(\Sigma^* \setminus \{ab, aab\})^* a$
Let C be the language described by $\Sigma^* \setminus \{ab, aab\} =$



Reduce to regular expression



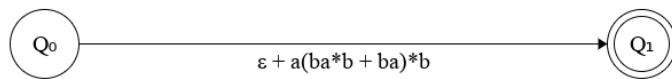


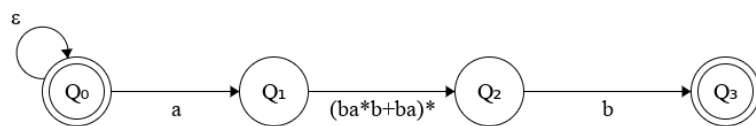
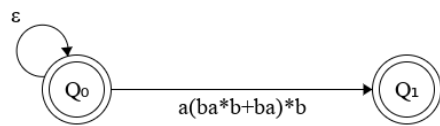
Regular Expression that describes C: $a(b(a+b)a)^* + (a(b(a+b)a)^*a(a+b(a+b))))^*$

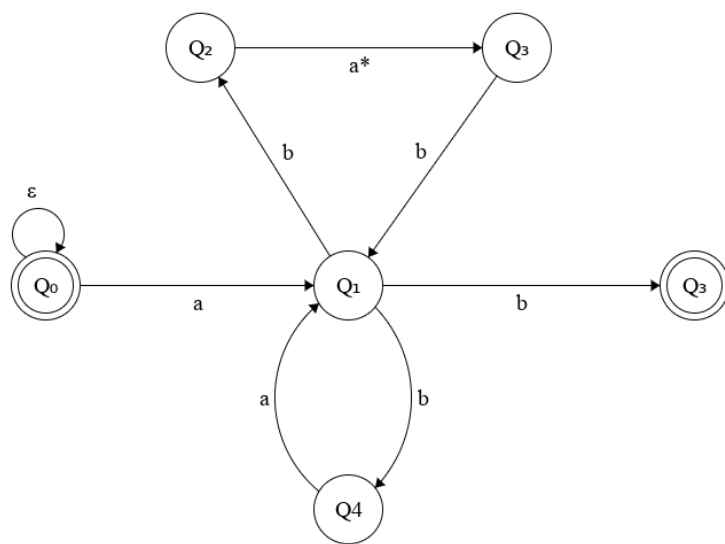
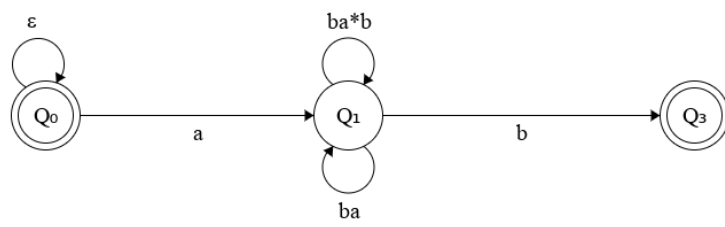
$$b(a+b))^* + b^*$$

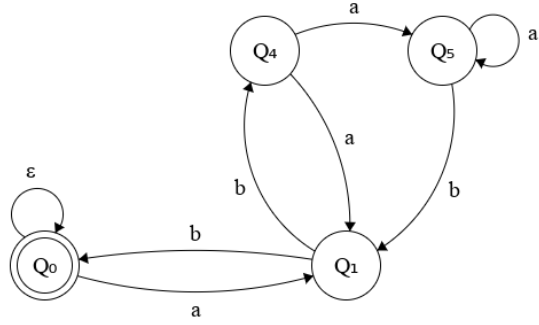
$$\text{Complement of } L(R) = C * b = (a(b(a+b)a)^* + (a(b(a+b)a)^* a(a+b(a+b)))^* + b^*) * a$$

2. Give a DFA equivalent to the following regular expression:
 $\epsilon + a(ba^*b + ba)^*b$









DFA Transition table

State	a	b	ε
$\{q_0\}$	$\{q_1\}$	$\{\emptyset\}$	$\{q_0\}$
$\{q_1\}$	$\{\emptyset\}$	$\{q_0, q_4\}$	$\{\emptyset\}$
$\{q_0, q_4\}$	$\{q_1, q_5\}$	$\{\emptyset\}$	$\{\emptyset\}$
$\{q_1, q_5\}$	$\{q_5\}$	$\{q_1, q_4\}$	$\{\emptyset\}$
$\{q_1, q_4\}$	$\{q_5\}$	$\{q_0, q_4\}$	$\{\emptyset\}$

Convert NFA to DFA

3. $A = \{w \in \{a, b\}^* | 10\text{th character from the end of } w \text{ is } b\}$. Prove that if DFA M has $L(M)$, then M has at least 1024 states.

Solution:

$$\text{let } X = \{\delta^*(s, w) | w \in \{a, b\}^* | \text{len}(w) = 10\}$$

- (a) First character is 'b'
- (b) Each subsequent character is 'a' or 'b'
- (c) Total number of states in $X = \sum_{i=0}^9 i < 92^i + 1 = 1024$

Contrapositive

- (a) Suppose M has fewer than 1024 states.
- (b) In order for M to have $L(A)$, there must be repeated states in M
- (c) However, if states are repeated, then by the Pigeonhole principle, there must be cycles in M .
- (d) By the definition of a cycle, two strings of differing length will end up in the same final state. A DFA with less than 1024 states will 'forget' where it is at in the string it is reading in.
- (e) Let j be an integer greater than 10.
- (f) $\delta(s, b(a+b)^{j-1}) \in F(M)$ - a string where b is not the 10th to the last character will be accepted by M , and rejected by A .