

# COMP 335: Introduction to Theoretical Computer Science

## Assignment 2

Nathan Grenier

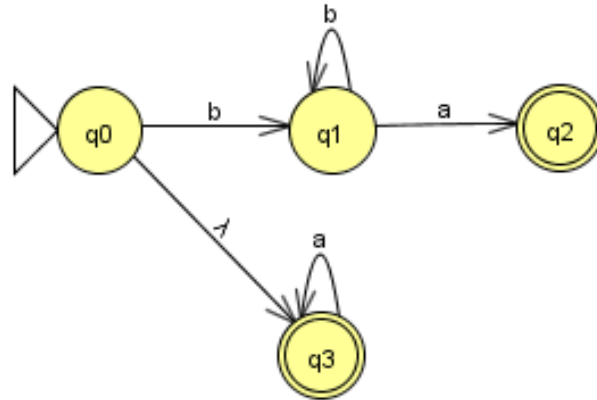
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1. [20 Points] For each of the following languages over the alphabet  $\Sigma = \{a, b\}$  give an NFA (as a transition diagram) with the specified number of states. *Hint:* try simplifying a DFA and/or use  $\lambda$  transitions.

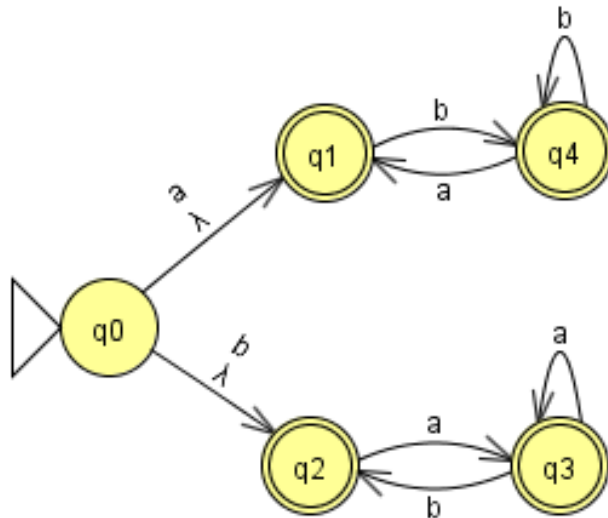
(a) The language  $\{a^n : n \geq 0\} \cup \{b^n a : n \geq 1\}$  with at most 4 states.

**Solution:**



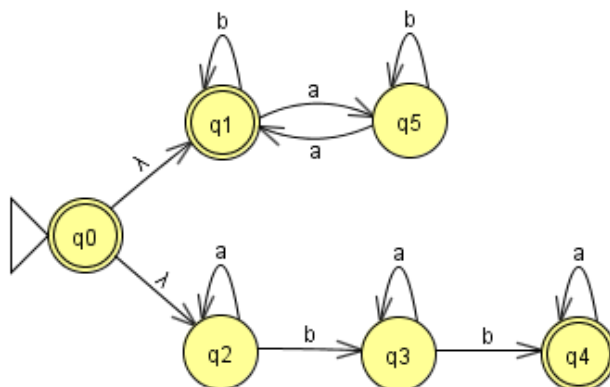
(b) The language  $\{w : w \text{ either has no consecutive a's or no consecutive b's}\}$  with at most 5 states.

**Solution:**



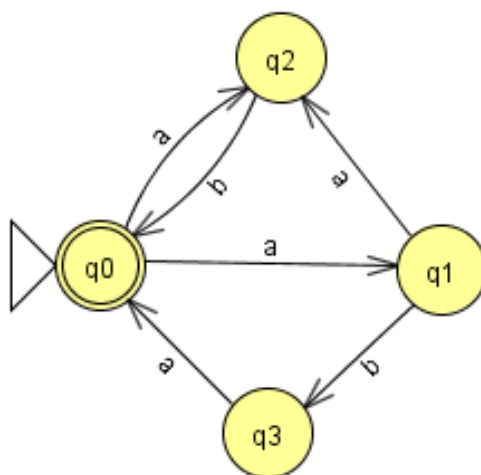
- (c) The language  $\{w : w \text{ contains an even number of a's or exactly two b's}\}$  with at most 6 states.

**Solution:**



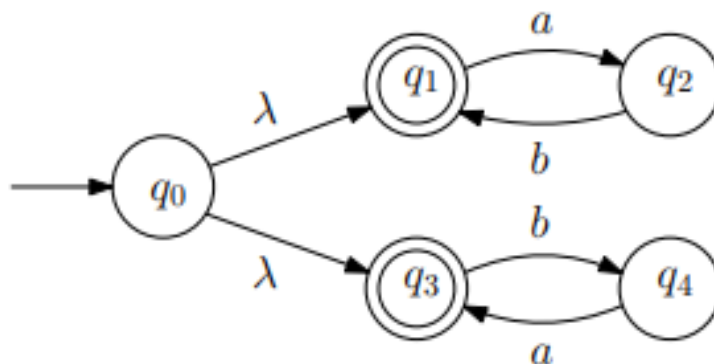
- (d) The language  $\{ab, aab, aba\}^*$  with at most 4 states.

**Solution:**



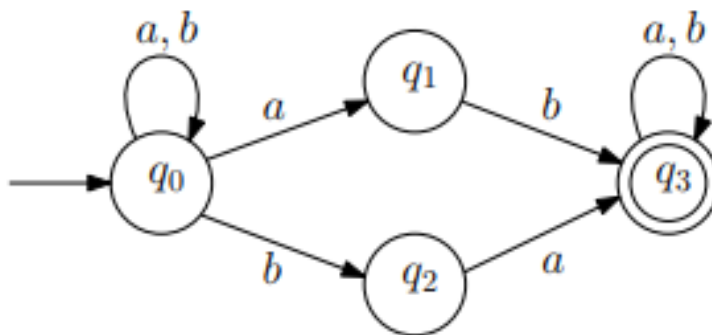
2. [20 Points] Let  $\Sigma = \{a, b\}$ . Convert each NFA below to a DFA using the subset construction. Draw the transition diagram of your DFA, label the states of your DFA by subset of states of the original NFA.

a)



**Solution:**

b)



**Solution:**

3. [20 Points] Find a regular expression for each of the following languages.

(a)  $\{ba^n b^m : n \geq 3, m \geq 2\}$

**Solution:**

(b)  $\{w \in \{a, b\}^* : \text{every maximal substring of } w \text{ consisting entirely of symbols } a$   
is of length exactly 3}

**Solution:**

(c)  $\{w \in \{a, b\}^* : w \text{ does not contain } bab \text{ as a substring}\}$

**Solution:**

(d)  $\{w \in \{a, b\}^* : w \text{ begins with } bb \text{ and } n_b(w) \bmod 3 = 0\}$

**Solution:**