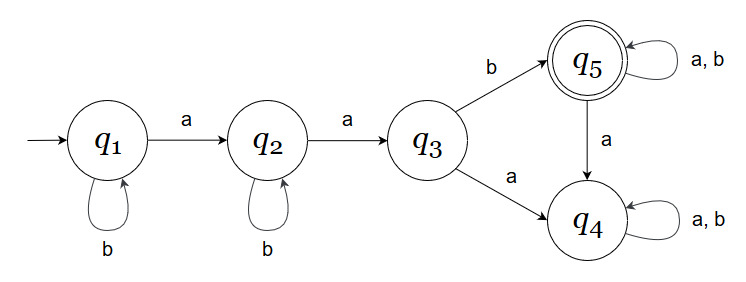
CSci 435: Formal Languages and Automata

Instructor: Dr. M. E. Kim Date: September 7th, 2018

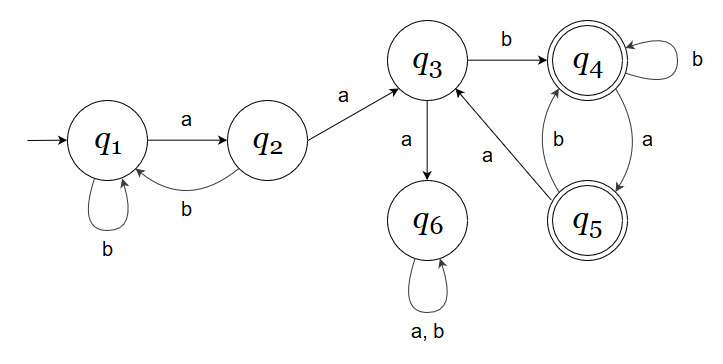
Due: 5:00 PM, September 7th (Fri.), 2018. (No Extension) Name: \_\_**Aaron Johnson**\_\_

**Home Assignment 1: 100 points + 10 points (optional) ­­­­­­­(83/100)**

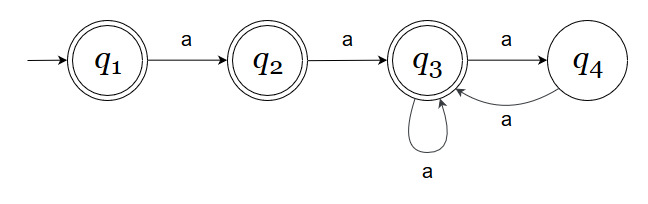
Q1. [16/20] For Σ = {a, b}, construct a DFA that accept the language

1. [8/10] consisting of all strings with at least one b and exactly two a’s.

Partially correct solution, Trap state is missing.

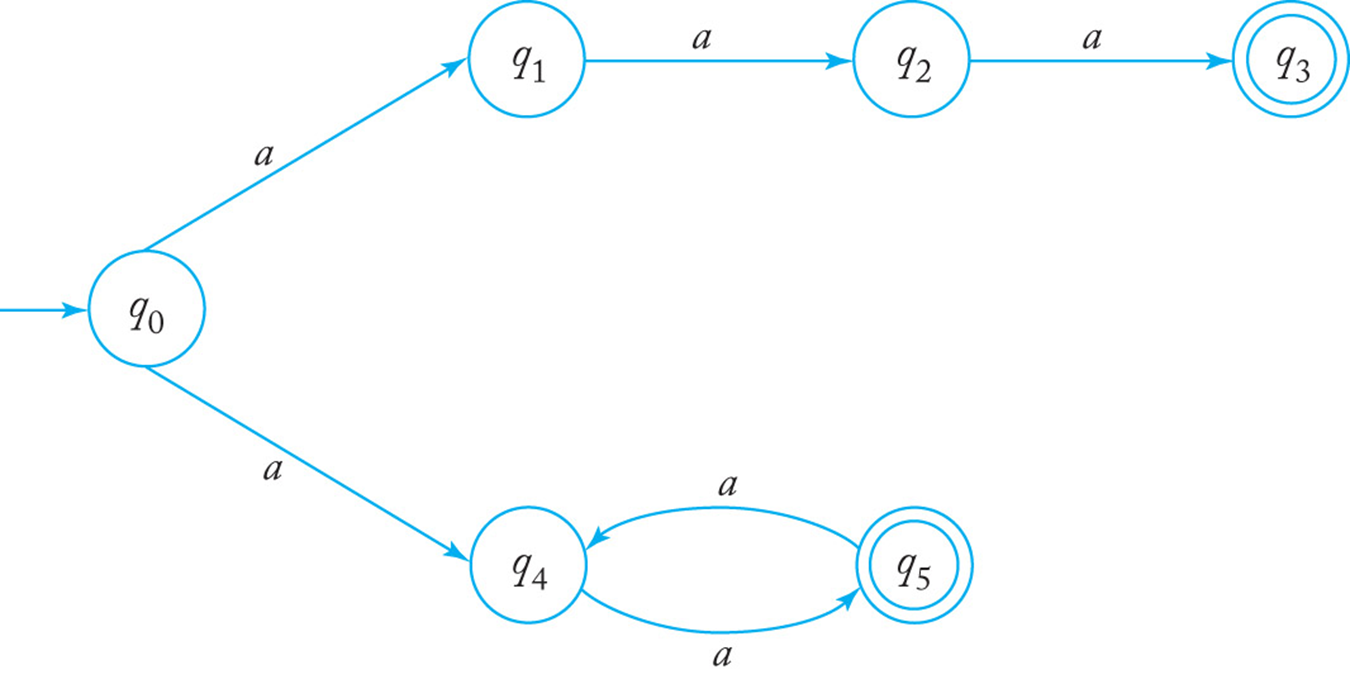
1. [8/10] every ‘*aa’* is followed immediately by a ‘*b’*. For example, the strings *aab*, *aaba*, *aabaabbaab* are in the language, but *aaab* and *aabaa* are not.

λ, a, aba should be accepted, too.

Q2. [10/10] Show that the language L = { *a****n***| *n* ≥ 0, *n* ≠ 3 } is regular.

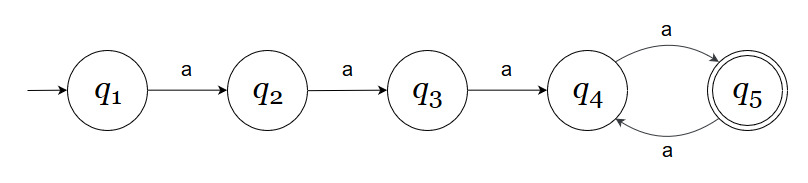
Your machine is NFA, not a DFA. How would you construct its DFA?

Q3. [20/20] For a given NFA in the figure,

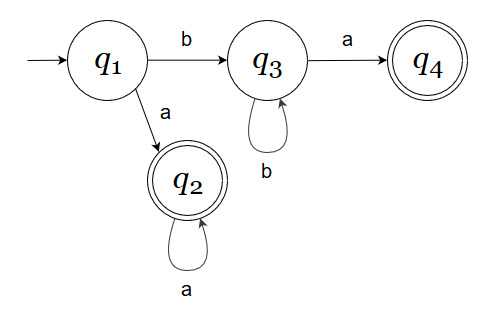


1. [10/10] Give a language *L* that is accepted by the NFA. Describe L in the proper mathematical format, not in the verbal English description. E.g.) L = { *a****n***| *n* ≥ 0, *n* ≠ 3 }

**L = { *an* | *n* % 2 = 0, *n* = 3, n > 1}**

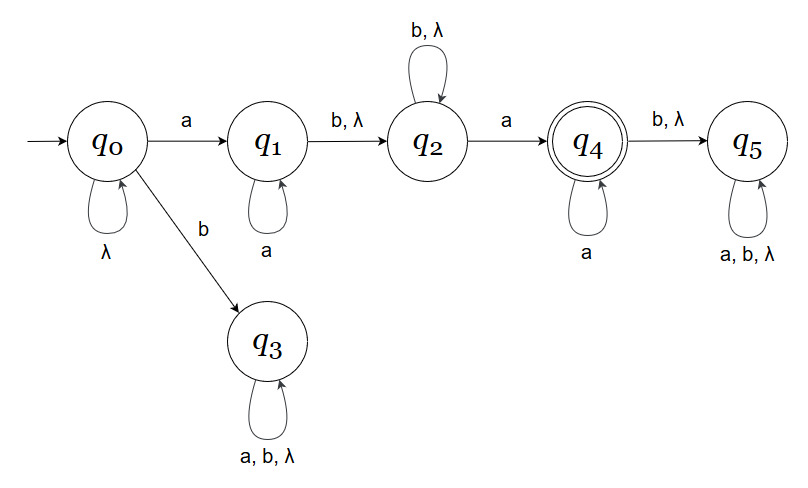
1. [10/10] Find a *DFA* that accepts the ***complement*** of the language defined by the NFA, i.e. .

Q4. [8/10] Construct an NFA with the minimum number of states that accepts

*L* = { *an* | *n* ≥ 0 } ∪ { *bna* | *n* ≥ 1 }.

Q1 is also a final state, Partially correct

Q5. [8/10] Convert the NFA defined by the transitions below with the initial state *q0* and the final state *q2* into an *equivalent DFA*. Draw the transition graph of the DFA.

 δ(*q0, a*) = { *q0, q1* }, δ(*q1, b*) = { *q1, q2* }, δ(*q2, a*) = { *q2* }, δ(*q1,* λ) = { *q1, q2* }.

Partially correct, Trap state is missing.

Q6. [5/10] Show that if L is regular, so is LR.

**Suppose L = { *an* | *n* ≥ 0 }, a regular language.**

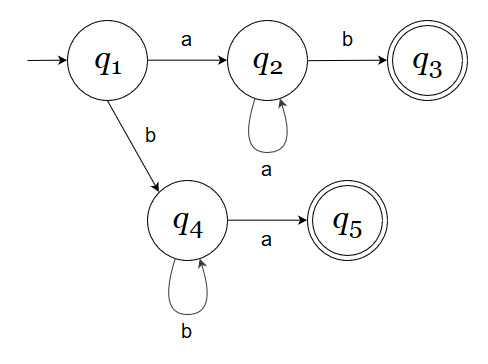
**LR = { *an* | *n* ≥ 0 }, L = LR**

**So LR must be regular.**

Incomplete solution

Q7. [15/20] For a given language, L = { *anb* | *n* ≥ 1 } ∪ { *bna* | *n* ≥ 1},

1. [8/10] Construct a *minimal DFA* with the minimum number of states that accepts L .



Partially correct

Not a minimal DFA. Only one final state will be needed if you merge q3 & q5.

Since it’s a DFA, a transition with a & b from q3 to a trap state is needed.

1. [0/10] Prove that your DFA in 1) is minimal. Hint: Check if any pair of the states are indistinguishable to be merged in the same class so that the number of states are minimized

**There are no cycles to consolidate in this DFA, meaning it is minimal.**

This is **not** a proof, but an intuition for your justification of minimal DFA. See the solution.

Q8. [8/10, optional] Prove or disprove the following conjecture.

If M = (Q, Σ, δ, *q0*, F) is a minimal DFA for a regular language *L*,

then = (Q, Σ, δ, *q0*, Q - F) is a minimal DFA for .

**Suppose in M, |Q| = 8 and |F| = 5. This means that Q-F states are not final in M.**

**In M, |Q|-|F| = 3.**

**If in M, |Q| = 8 and |F| = 5, then in , |Q| = 8 and |F| = 3.**

**In , |Q|-|F| = 5.**

**|F| in M = |Q|-|F| in , so must be minimal DFA.**

Interesting approach

In the proof, you should not assume a certain number of states in M or M’.

You have to prove it in the general case.