Theory of Automata - HW2

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1 Question 1

For $\sum = \{a, b\}$, construct dfa's that accept the sets consisting of

- (a) all string exactly one a,
- (d) all strings with at least one a and exactly two b's.

Answers: (a) a Dfa that accepts at least one a. From initial states, once the Dfa read a string 'a' it will go to final state no matter which characters being read next. The dfa is shown in Fig. 1

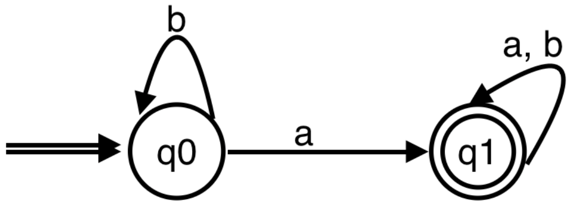


Figure 1: A dfa accepts at least one a

Answers: (b) a dfa that accepts at least one a and exactly two b's. The answer is shown in Fig. 2

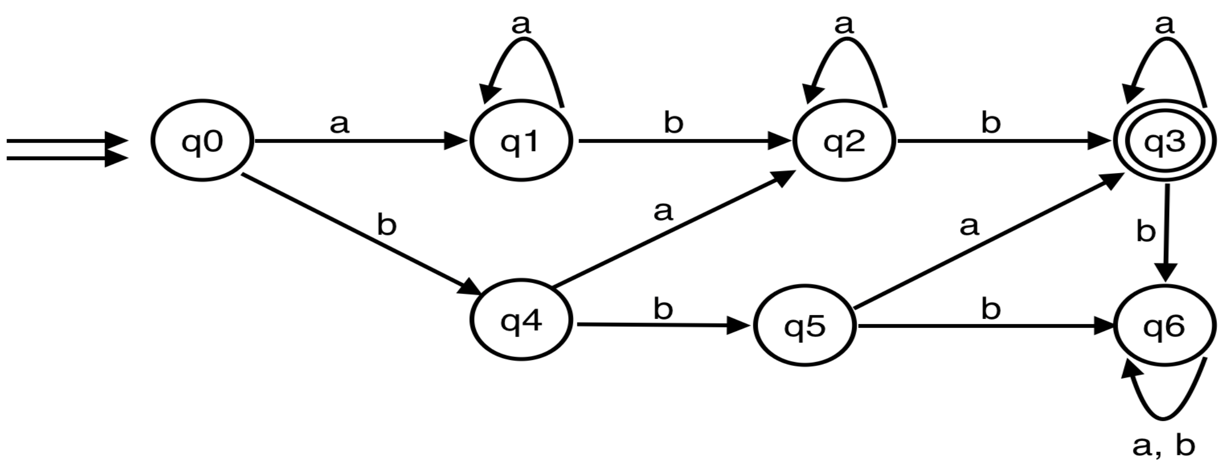


Figure 2: A dfa accepts at least one a, and exactly two b

2 Question 3

Give a set of notation description of the language accepted by the automaton depicted in the following diagram. Can you think of a simple verbal characterization of the language?.

This dfa accepts any string that contains at least one a and not ending with a.

3 Question 4

Find a dfa for the following language on $\sum = \{a, b\}$.

$L = \{w : n_a(w) \bmod 3 > 1\}$

The dfa is shown in Fig. 3

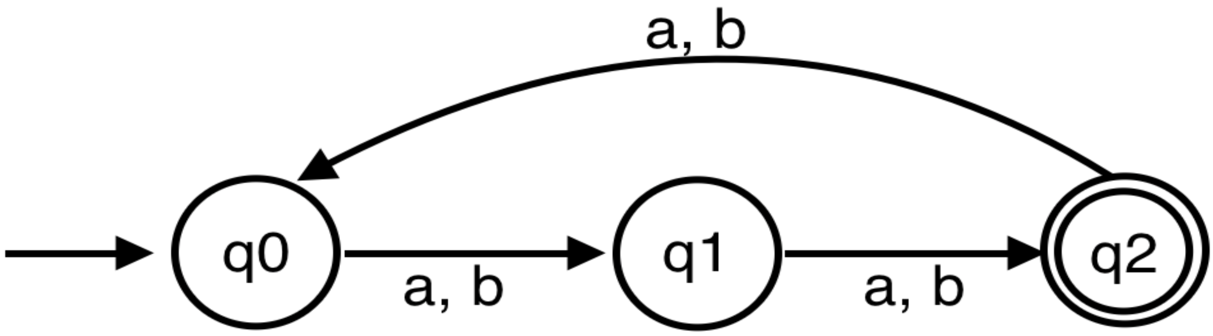


Figure 3: A Machine accepts all string with mod $3 > 1$

4 Question 6

Design an nfa with no more than five states for the set $\{abab^n : n \geq 0\} \cup \{aba^n :\geq 0\}$. The nfa is shown in Fig. 4

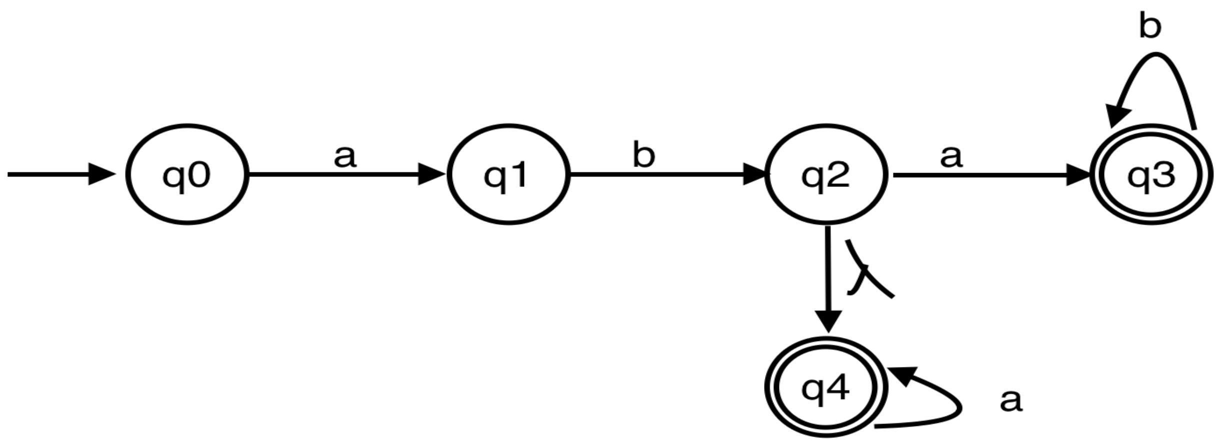
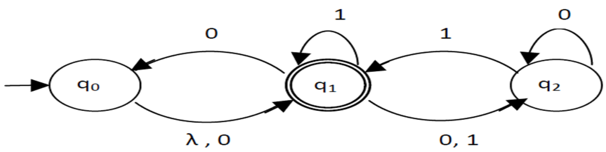


Figure 4: A nfa accepts the set $\{abab^n : n \geq 0\} \cup \{aba^n :\geq 0\}$

5 Question 9

Convert the following nfa into equivalent dfa. The dfa is shown in Fig. 5



nfa

δ	0	1
q0	{q1, q2}	{q1, q2}
q1	{q0, q2}	{q1, q2}
q2	q2	{q1}

dfa

δ	0	1
[q0]	[q1, q2]	[q1, q2]
[q1, q2]	[q0, q2]	[q1, q2]
[q0, q2]	[q1, q2]	[q1, q2]

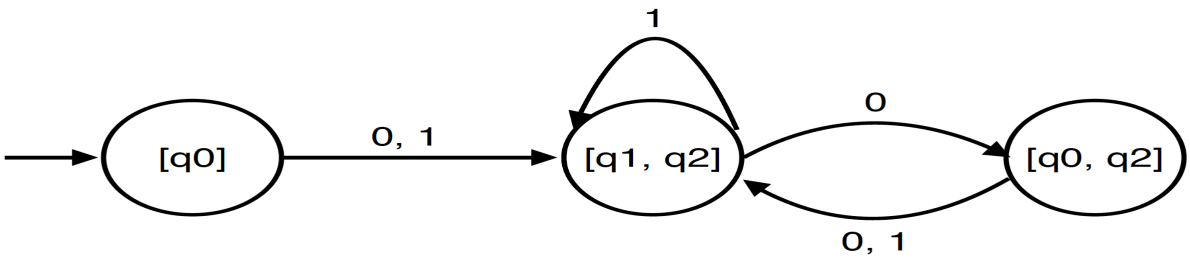


Figure 5: Convert nfa into equivalent dfa

6 Question 10 (b)

Find the minimal dfa's for the following languages:

$L = \{a^n b : n \geq 0\} \cup \{b^n a : n \geq 1\}$

The first dfa for the language L is shown in Fig.7 (C). The minimal dfa is depicted in 7 (D). Steps to minimize dfa is shown in Fig.6

The answer for this problem is found in Fig. 7 D

(a)

q1	X					
q2		X				
q3	X		X			
q4		X		X		
q5	X		X		X	
q6		X		X		X
	q0	q1	q2	q3	q4	q5

(b)

q1	X					
q2	X	X				
q3	X	X	X			
q4		X	X	X		
q5	X	X	X		X	
q6	X	X	X	X	X	X
	q0	q1	q2	q3	q4	q5

(c)

q1	X					
q2	X	X				
q3	X	X	X			
q4	X	X	X	X		
q5	X	X	X		X	
q6	X	X	X	X	X	X
	q0	q1	q2	q3	q4	q5

(d)

q2	X	X				
q3	X	X	X			
q4	X	X	X	X		
q5	X	X	X		X	
q6	X	X	X	X	X	X
	q0	q1	q2	q3	q4	q5

Figure 6: Minimal dfa procedures: (a) first scan for all pairs (b-c) repeating steps, (d) final table

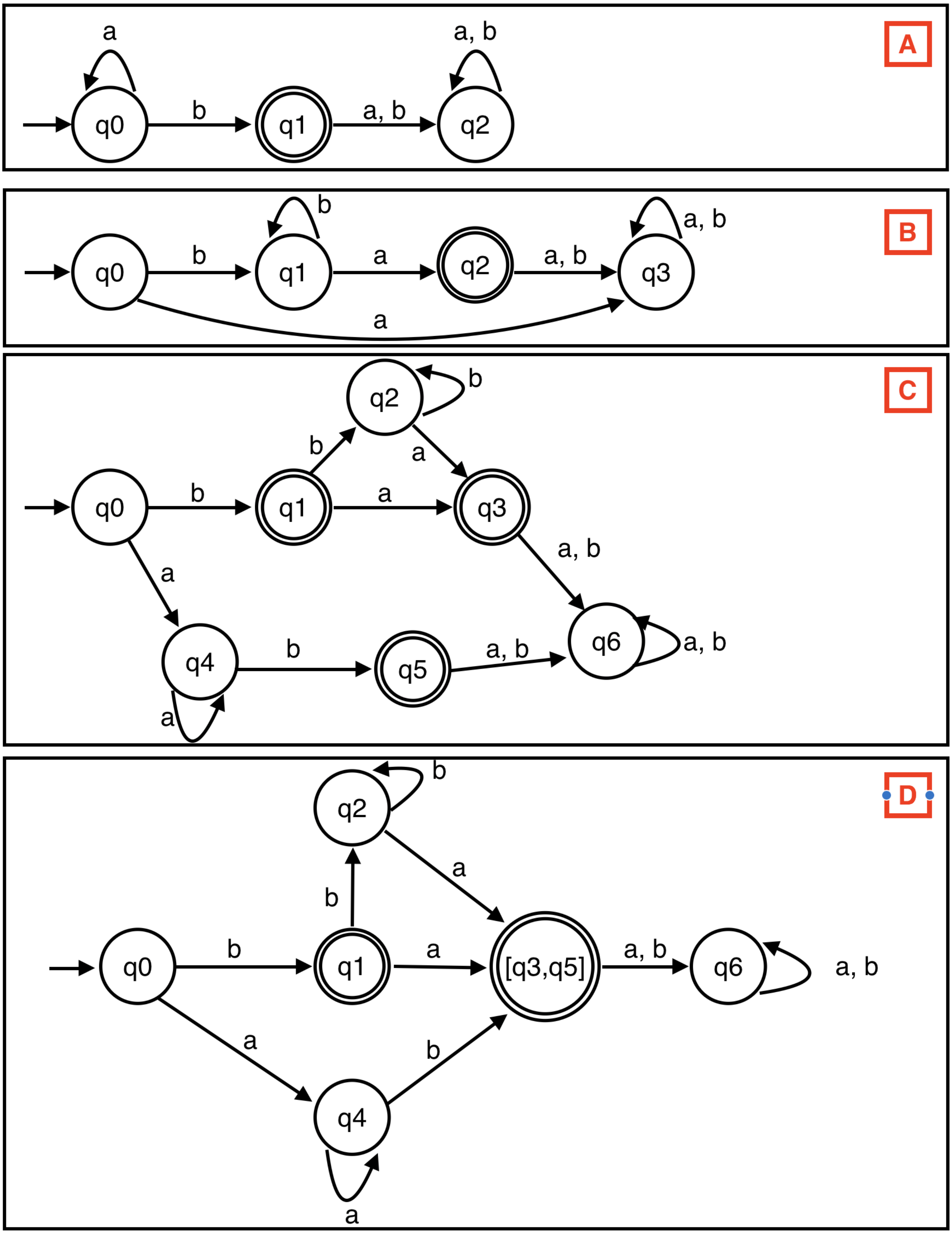


Figure 7: (A) $L = a^n b$, (B) $L = b^n a$, (C) Language L, (D) minimal dfa