CS 154 Formal Languages and Computability Assignment #2 Solutions

Department of Computer Science San Jose State University



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□ Use JFLAP to construct the transition graph for the DFA that accepts all strings (and only those strings) on the alphabet $\{a, b, c\}$ that have an odd number of *a*'s.

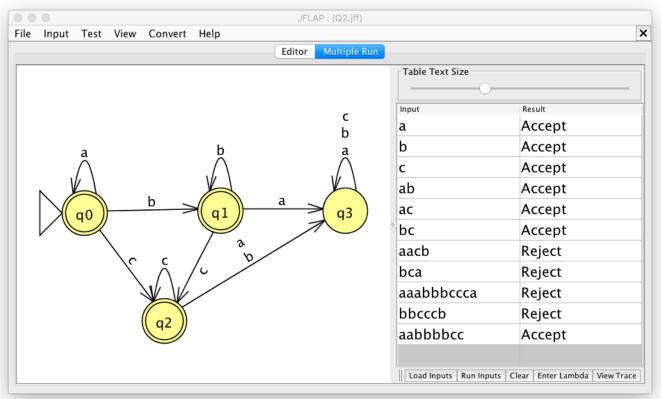
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	V			a			accbbaaba	Reject
							Load Inputs Run In	puts Clear Enter Lambda View Trace



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Use JFLAP to construct the transition graph for the DFA that accepts all strings (and only those strings) on the alphabet {a, b, c} that have the symbols in alphabetical

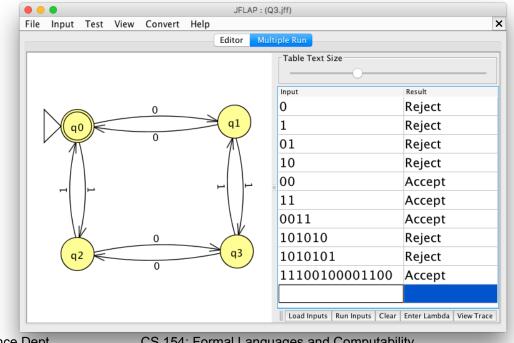
order.





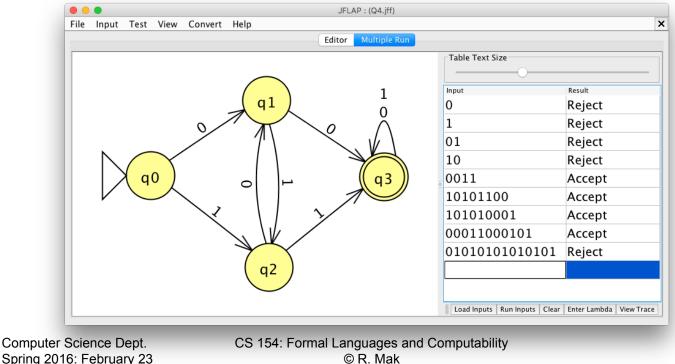
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- Describe in words the strings that the following DFA accepts and demonstrate your answer with some sample strings.
 - All strings that contain an even number of 0's or an even number of 1's.



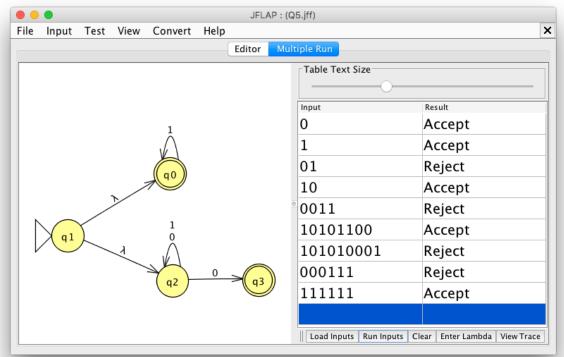


- Describe in words the strings that the following DFA accepts and demonstrate your answer with some sample strings.
 - All strings that contain either two consecutive 0's or two consecutive 1's.



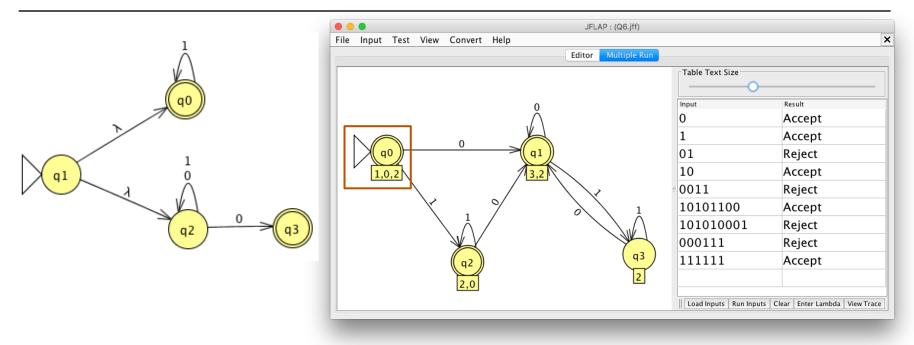


- Describe in words the strings that the following NFA accepts and demonstrate your answer with some sample strings.
 - All strings that contain all 1's or end with a 0.



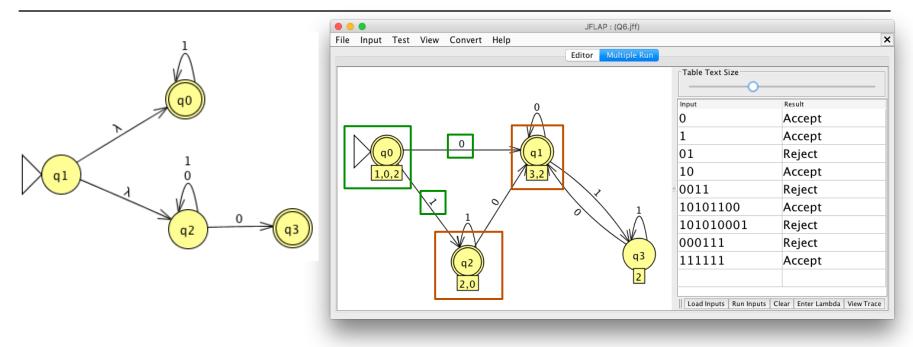


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□ NFA start state q_0 has λ -transitions to states q_1 and q_2 , so label the DFA start state $\{q_0, q_1, q_2\}$.

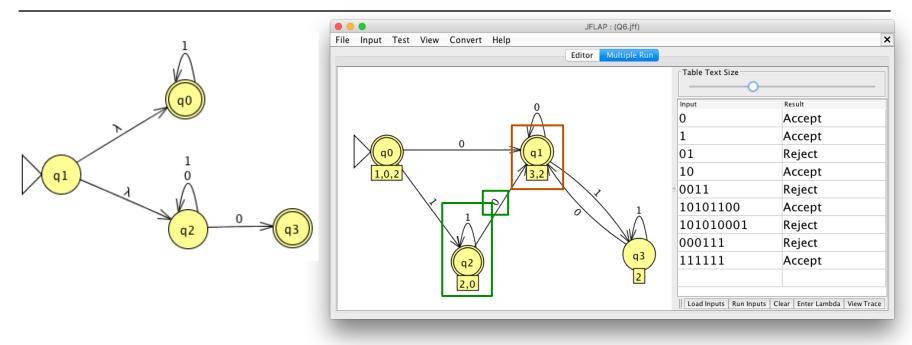




- $\square \text{ NFA: } \delta(q_0, 0) = \phi \text{ and } \delta(q_1, 0) = \phi \text{ and } \delta(q_2, 0) = \{q_2, q_3\}, \text{ so } DFA \ \delta(\{q_0, q_1, q_2\}, 0) = \{q_2, q_3\}. \text{ Perform the union.}$
- □ NFA: $\delta(q_0, 1) = \{q_0\}$ and $\delta(q_1, 1) = \phi$ and $\delta(q_2, 1) = \{q_2\}$, so DFA $\delta(\{q_0, q_1, q_2\}, 1) = \{q_0, q_2\}$.



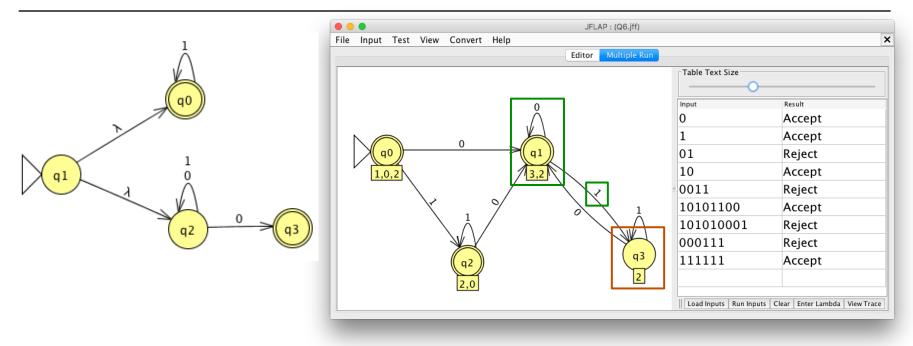
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- □ NFA: $\delta(q_0, 0) = \phi$ and $\delta(q_2, 0) = \{q_2, q_3\}$, so DFA $\delta(\{q_0, q_2\}, 0) = \{q_2, q_3\}$.
- □ NFA: $\delta(q_0, 1) = \{q_0\}$ and $\delta(q_2, 1) = \{q_2\}$, so DFA $\delta(\{q_0, q_2\}, 1) = \{q_0, q_2\}$.



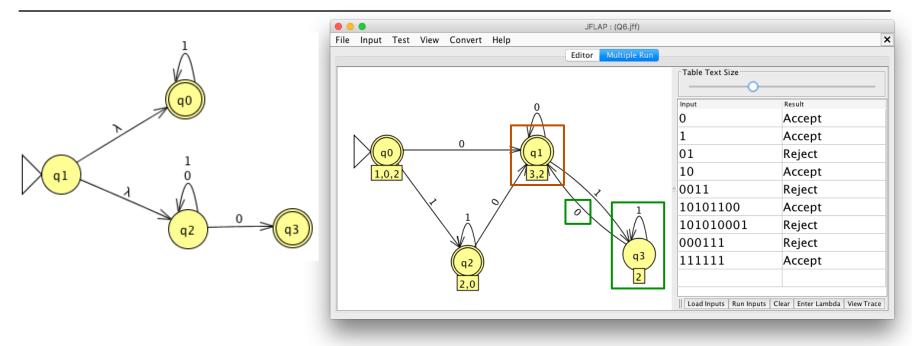
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- □ NFA: $\delta(q_2, 0) = \{q_2, q_3\}$ and $\delta(q_3, 0) = \phi$, so DFA $\delta(\{q_2, q_3\}, 0) = \{q_2, q_3\}$.
- □ NFA: $\delta(q_2, 1) = \{q_2\}$ and $\delta(q_3, 1) = \phi$, so DFA $\delta(\{q_2, q_3\}, 1) = \{q_2\}$.

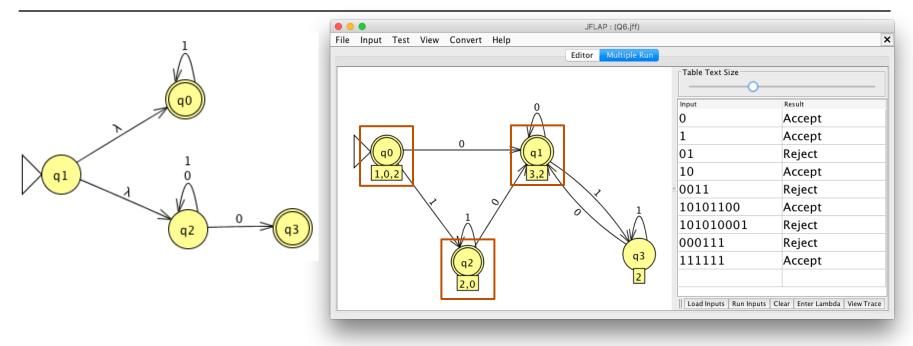


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- $\square \text{ NFA: } \delta(q_2, 0) = \{q_2, q_3\} \text{ so DFA } \delta(\{q_2\}, 0) = \{q_2, q_3\}.$
- $\square \text{ NFA: } \delta(q_2, 1) = \{q_2\} \text{ so DFA } \delta(\{q_2\}, 1) = \{q_2\}.$





□ Since NFA q_0 and q_3 are final states, DFA $\{q_0, q_1, q_2\}$, $\{q_0, q_2\}$, and $\{q_2, q_3\}$ must be final states.



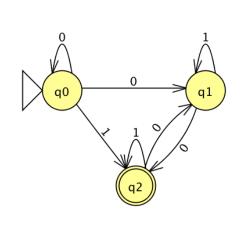
□ Construct the NFA where $\Sigma = \{0, 1\}$, q_0 is the starting state, and q_2 is the final state.

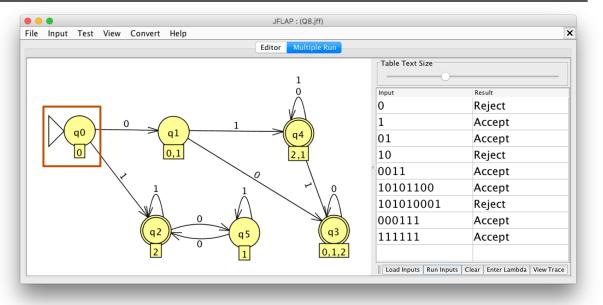
	0	1
q_0	q_0, q_1	q_2
q_1	q_2	q_1
q_2	q_1	q_2

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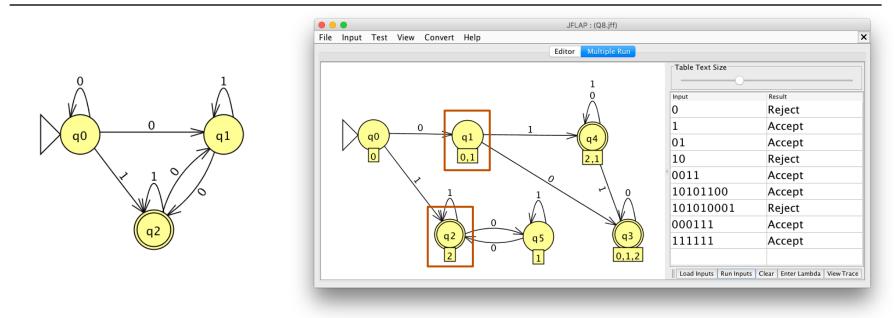




□ NFA: start state q_0 , so DFA start state $\{q_0\}$

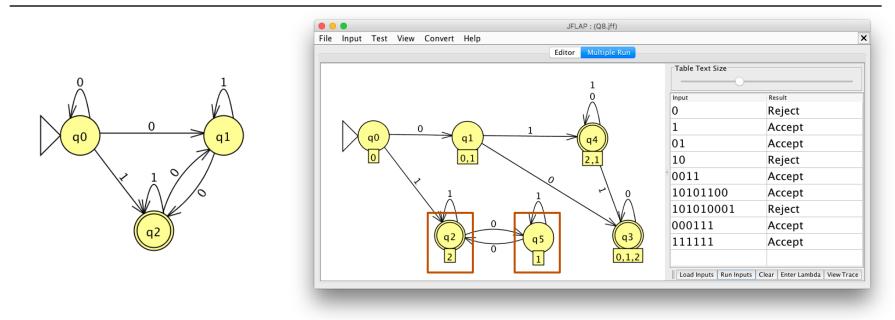


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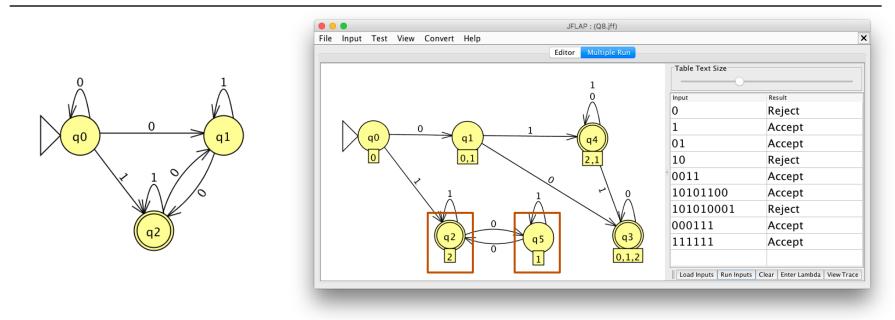
 $\square \text{ NFA: } \delta(q_0, 0) = \{q_0, q_1\}, \text{ so DFA } \delta(\{q_0\}, 0) = \{q_0, q_1\}$ $\square \text{ NFA: } \delta(q_0, 1) = \{q_2\}, \text{ so DFA } \delta(\{q_0\}, 1) = \{q_2\}$





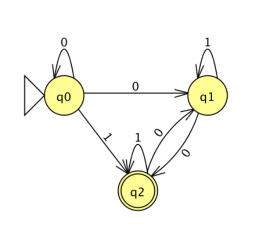
 $\square \text{ NDA: } \delta(q_2, 0) = \{q_1\}, \text{ so DFA } \delta(\{q_2\}, 0) = \{q_1\}$ $\square \text{ NDA: } \delta(q_2, 1) = \{q_2\}, \text{ so DFA } \delta(\{q_2\}, 1) = \{q_2\}$

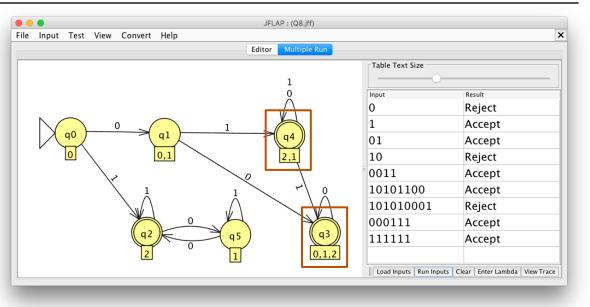




NDA: $\delta(q_1, 0) = \{q_2\}$, so DFA $\delta(\{q_1\}, 0) = \{q_2\}$ NDA: $\delta(q_1, 1) = \{q_1\}$, so DFA $\delta(\{q_1\}, 1) = \{q_1\}$



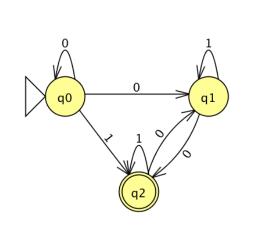


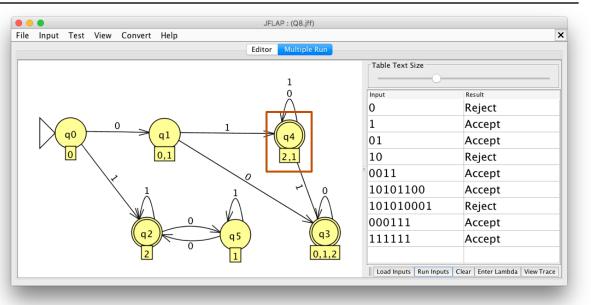


- $\square \text{ NFA: } \delta(q_0, 0) = \{q_0, q_1\} \text{ and } \delta(q_1, 0) = \{q_2\}, \\ \text{so DFA } \delta(\{q_0, q_1\}, 0) = \{q_0, q_1, q_2\}$
- $\square \text{ NFA: } \delta(q_0, 1) = \{q_2\} \text{ and } \delta(q_1, 1) = \{q_1\}, \\ \text{so DFA } \delta(\{q_0, q_1\}, 1) = \{q_1, q_2\}$



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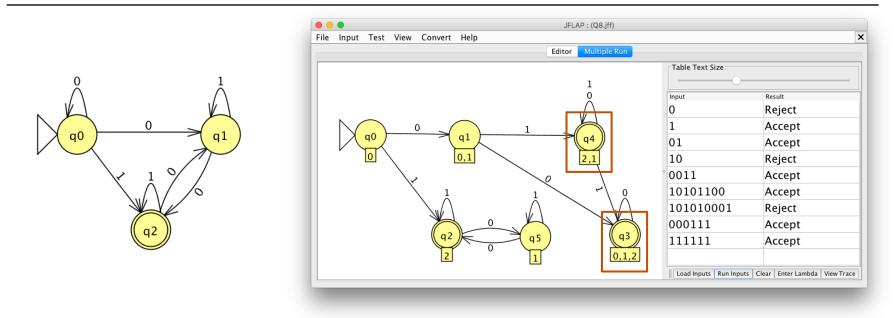




- □ NDA: $\delta(q_1, 0) = \{q_2\}$ and $\delta(q_2, 0) = \{q_1\}$, so DFA $\delta(\{q_1, q_2\}, 0) = \{q_1, q_2\}$
- D NDA: $\delta(q_1, 1) = \{q_1\}$ and $\delta(q_2, 1) = \{q_2\}$, so DFA $\delta(\{q_1, q_2\}, 1) = \{q_1, q_2\}$



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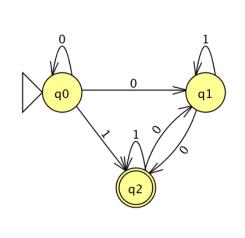


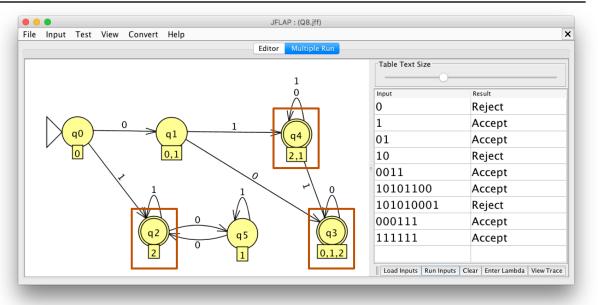
 $\square \text{ NDA: } \delta(q_0, 0) = \{q_0, q_1\} \text{ and } \delta(q_1, 0) = \{q_2\} \text{ and } \delta(q_2, 0) = \{q_1\}, \text{ so DFA } \delta(\{q_0, q_1, q_2\}, 0) = \{q_0, q_1, q_2\}$

 $\square \text{ NDA: } \delta(q_0, 1) = \{q_2\} \text{ and } \delta(q_1, 1) = \{q_1\} \text{ and } \delta(q_2, 1) = \{q_2\}, \text{ so DFA } \delta(\{q_0, q_1, q_2\}, 1) = \{q_1, q_2\}$



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□ NDA final state q_2 , so DFA final states $\{q_2\}$, $\{q_1, q_2\}$, and $\{q_0, q_1, q_2\}$



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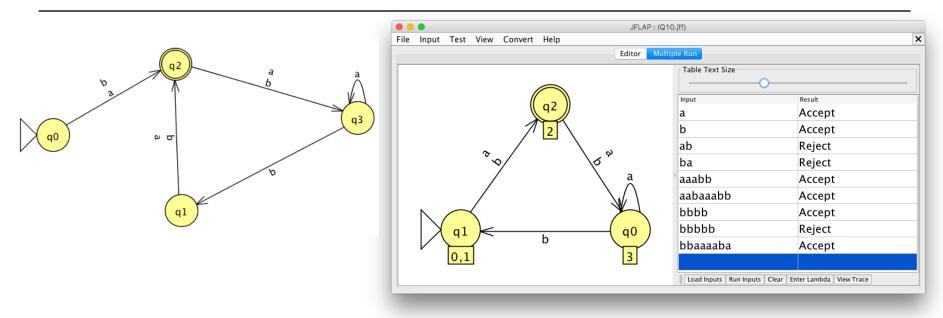
□ Construct the DFA where $\Sigma = \{a, b\}$, q_0 is the starting state, and q_2 is the final state.

	JFLAP : (Q9.jff)		
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2	ab	Reject	
	(q3) ba	Reject	
ф0 [№] Ф	aaal	bb Accept	
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	bbb	b Accept	
ql	bbb	bb Reject	
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	a	b
q_0	q_2	q_2
q_1	q_2	q_2
q_2	q_3	q_3
q_3	q_3	q_1



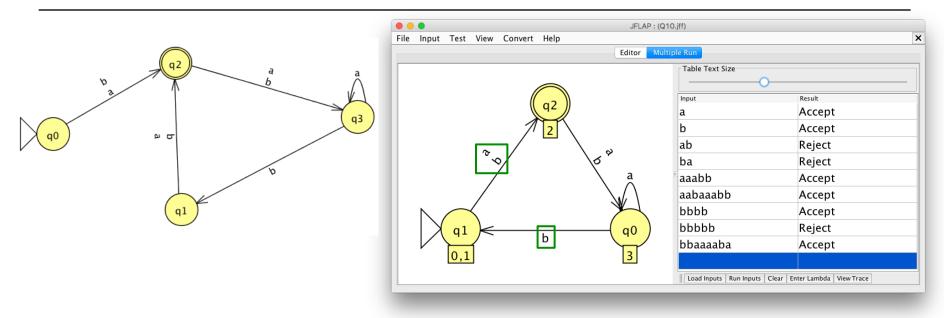
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- □ State q_2 is final: 013|2
- □ From states q_0 and q_1 , all strings lead to final state q_2 : 01|3|2
- No further partitioning is possible.



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- **Original:** $\delta(q_0, w) = \delta(q_1, w) = q_2$ for all w in Σ Minimized: $\delta^*(\{q_0, q_1\}, w) = \{q_2\}$
- Original: $\delta(q_3, b) = q_1$ Minimized: $\delta(\{q_3\}, b) = \{q_0, q_1\}$



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