Combining FA

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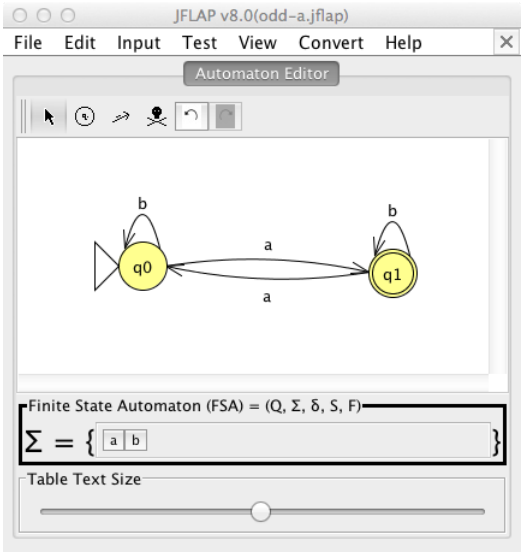
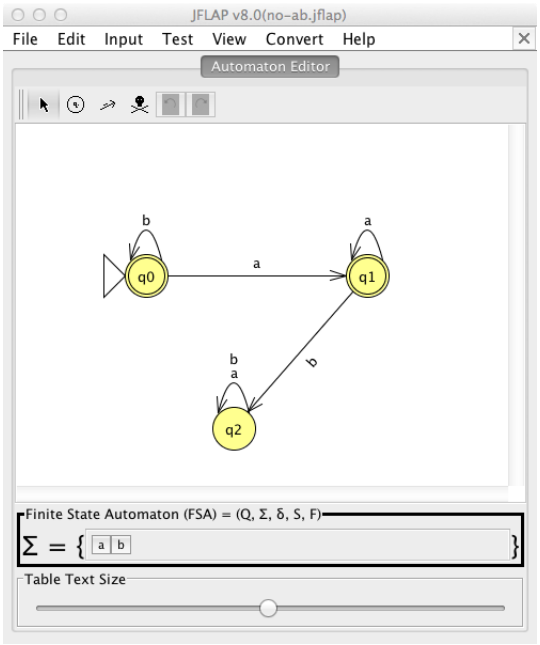
1 DFA Example

In this Exercise, we will use the "Combine Automata" feature of JFLAP to find the intersection of two DFA. For the alphabet $\Sigma = \{a, b\}$, consider the languages
$L_1 = \{w \in \Sigma^* | w$ has an odd number of a's$\}$, and
$L_2 = \{w \in \Sigma^* | w$ does not have ab as a substring$\}$.

1. Load the files odd-a.jflap and no-ab.jflap in two separate windows, as below.

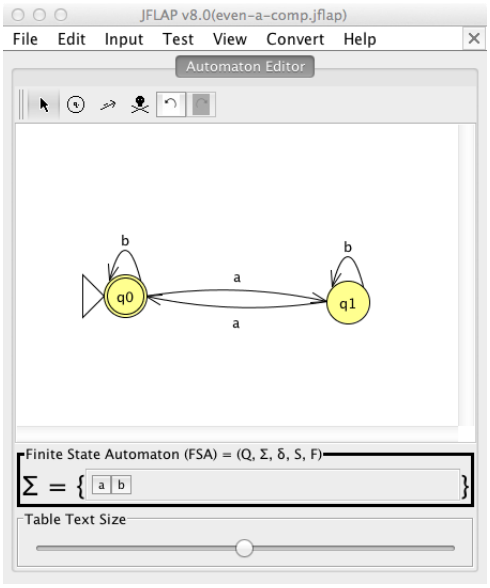


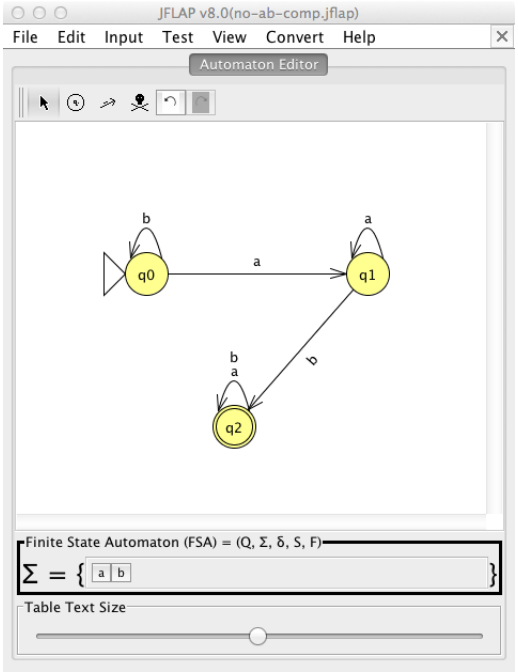


2. Recall De Morgan's Rule: $\overline{L_1 \cap L_2} = \overline{L_1} \cup \overline{L_2}$. Hence $L_1 \cap L_2 = \overline{\overline{L_1} \cup \overline{L_2}}$. Hence to find the intersection of two DFA, we first find the complements of the DFA, then take their union, and finally again the complement.

3. How do you get the complement of a DFA? We assume that all states have outgoing transitions for all the letters in the alphabet. The words that were not accepted should now be accepted, and vice-versa. Hence we swap accept states with non-accept states.

4. Create two more DFA that are complements of those two above. These are shown below.

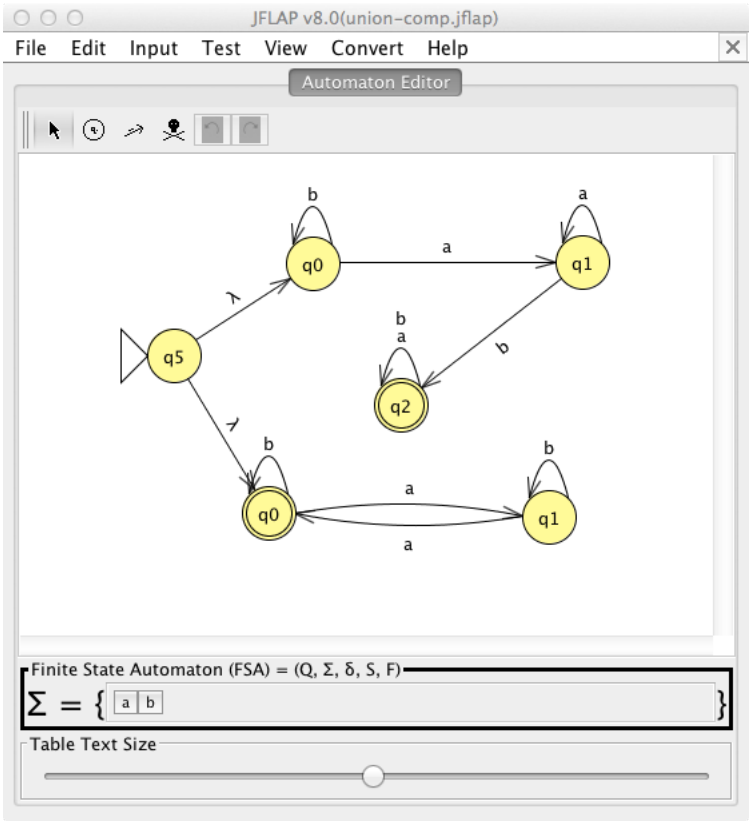




5. Describe in words the languages $\overline{L_1}$ and $\overline{L_2}$.

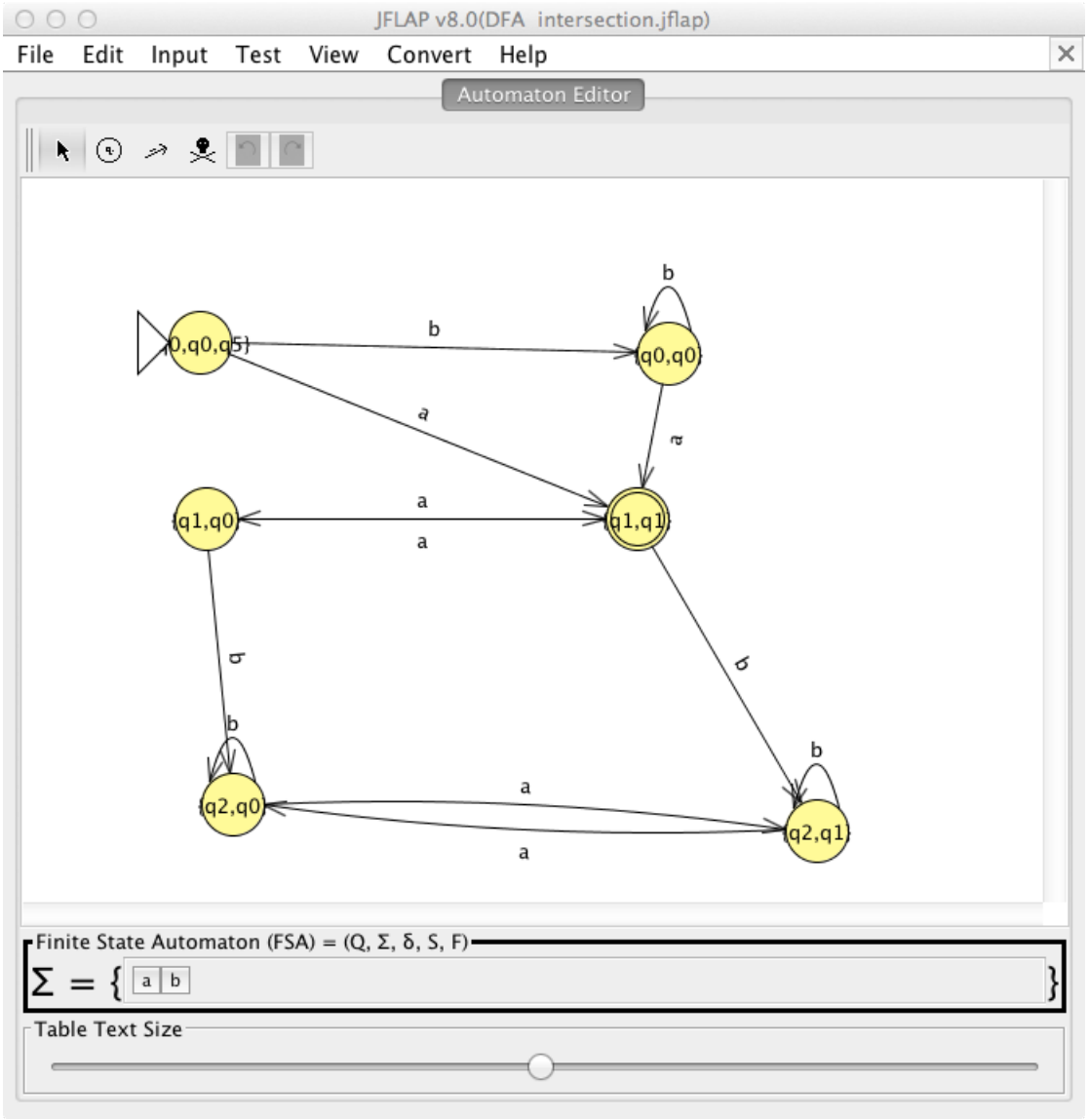
6. In one of the windows of these two DFA, choose Convert from the menu and click on Combine Automata. A dialog box asks you to pick the second DFA. This opens a new window in which both DFA are drawn. Only one has an initial state. Which one?

7. To take the union of these the two, add a new initial state and add two λ-transitions from this new initial state to the two original initial states, as below.

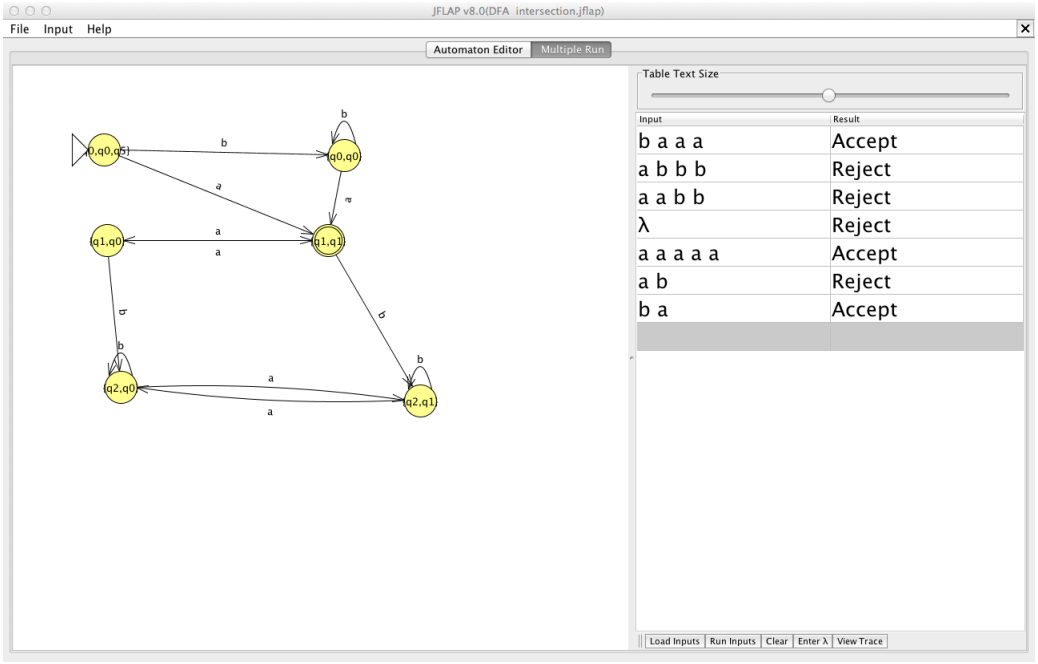


8. Convert this NFA into a DFA.

9. Find the complement of this last DFA. Verify that your result is as below.


JFLAP v8.0(DFA intersection.jflap)
File Edit Input Test View Convert Help
Automaton Editor
{0,q0,q5}
{q0,q0}
{q1,q0}
{q1,q1}
{q2,q0}
{q2,q1}
b
a
Finite State Automaton (FSA) = (Q, Σ, δ, S, F)
Σ = { a b }
Table Text Size

10. Now test this with multiple inputs as below.



11. Describe in words the language of this last DFA.

2 References

1. Introduction to the Theory of Computation (Third Edition), Michael Sipser. Cengage Learning. 2013.

2. JFLAP - An Interactive Formal Languages and Automata Package, Susan H. Rodger and Thomas W Finley. Jones and Bartlett Publishers. 2006