

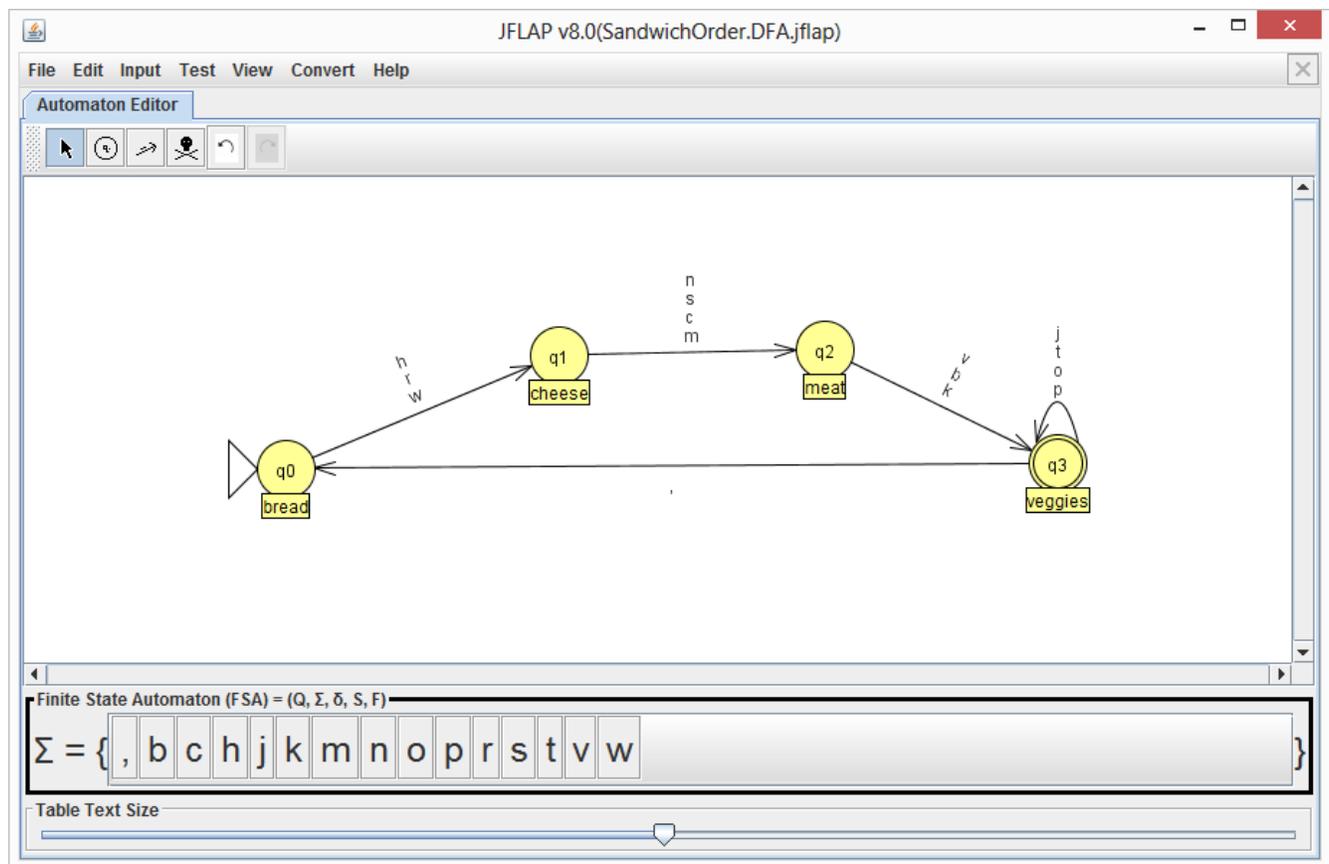
## Additional Example to Practice with Converting a DFA to a Regular Expression

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In the lesson, you learned the process for converting a DFA to a regular expression. Now you can practice with another example. If you have completed the lesson about converting a DFA to a regular grammar, you will be familiar with this example DFA.

DFA's can be used to model many real-world tasks. It might be getting close to lunchtime for you now, and you may have volunteered to pick up lunch for friends at a sandwich restaurant, provided that they have given you money. :) At the sandwich restaurant, you choose your bread, cheese (optional), meat (or veggie patty for the vegetarians), and then your vegetables. Since you may be ordering multiple sandwiches, you need to indicate that another sandwich is following. Here is a possible automaton with a small standard selection of choices for bread, cheese, meat, and veggies.

The choices for bread are **h** for **h**oney oat, **r** for **r**ye, and **w** for **w**heat. The choices for cheese are **m** for **m**ozzarella, **c** for **c**eddar, **s** for **S**wiss, and **n** for **n**one. The choices for meat are **k** for **t**urkey, **b** for **b**eef, and **v** for **v**eggie patty. The choices for veggies are **j** for **j**alapeno, **l** for **l**ettuce, **p** for **s**pinach, and **t** for **t**omato. A comma (,) indicates that another sandwich order follows.



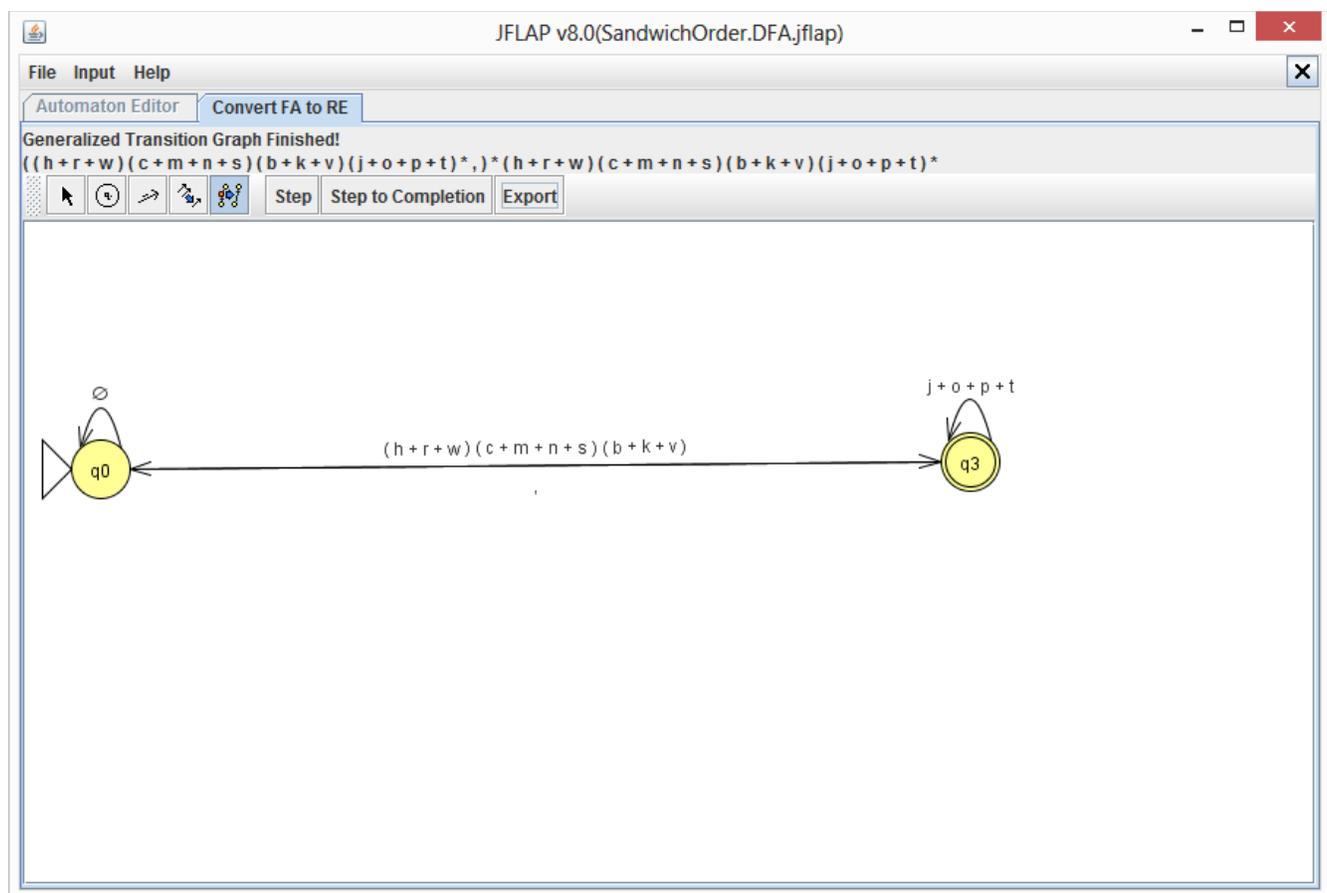
### Questions to Think About:

1. How many paths (containing states only) in the DFA exist between state q0 and state q3 in

- which no state is repeated?
- How many times can state  $q_3$  be visited without revisiting  $q_0$ ,  $q_1$ , and  $q_2$ ? Why? What regular expression operator allows repetition to be described?
  - What happens if a transition from state  $q_3$  back to  $q_0$  is taken? What is required next in order for the corresponding string to be accepted?
  - How many times can  $q_3$  be visited now? What regular expression operator can describe this possibility?

**Try It!**

Convert the pictured DFA into an equivalent regular expression. To check your work, open the file SandwichOrder.DFA.jflap if it has not already been loaded into JFLAP. Convert the DFA to a regular expression by selecting **Convert > Convert to RE > Step to Completion**. Your resulting regular expression should be similar to the one pictured below.



Modify the DFA to add the capability to select condiments (mustard, mayonnaise, etc.) after veggies are chosen, and indicate any changes in the resulting converted regular expression.

Modify the DFA to add the capability to have a plain cheese sandwich and indicate any changes in the resulting converted regular expression.

Design a DFA to allow pizzas, burritos, or banana splits to be ordered and determine the corresponding regular expression. Have fun!

**Questions to Think About:**

1. What is the effect of  $\emptyset^*$  in the generalized transition graph?
2. For what string  $x$  does  $x^*$  have the same effect as  $\emptyset^*$ ?
3. How many strings satisfy the regular expression corresponding to the sandwich shop DFA?