

Additional Exercise to Practice with Mealy Machines

Martha Kosa

You have already seen some example Mealy machines. One modeled the TCP protocol, on which many everyday applications, such as Angry Birds and Groupon, rely. Another processed strings representing binary numbers. Before developing another example, it is time to check your basic understanding of Mealy machines.

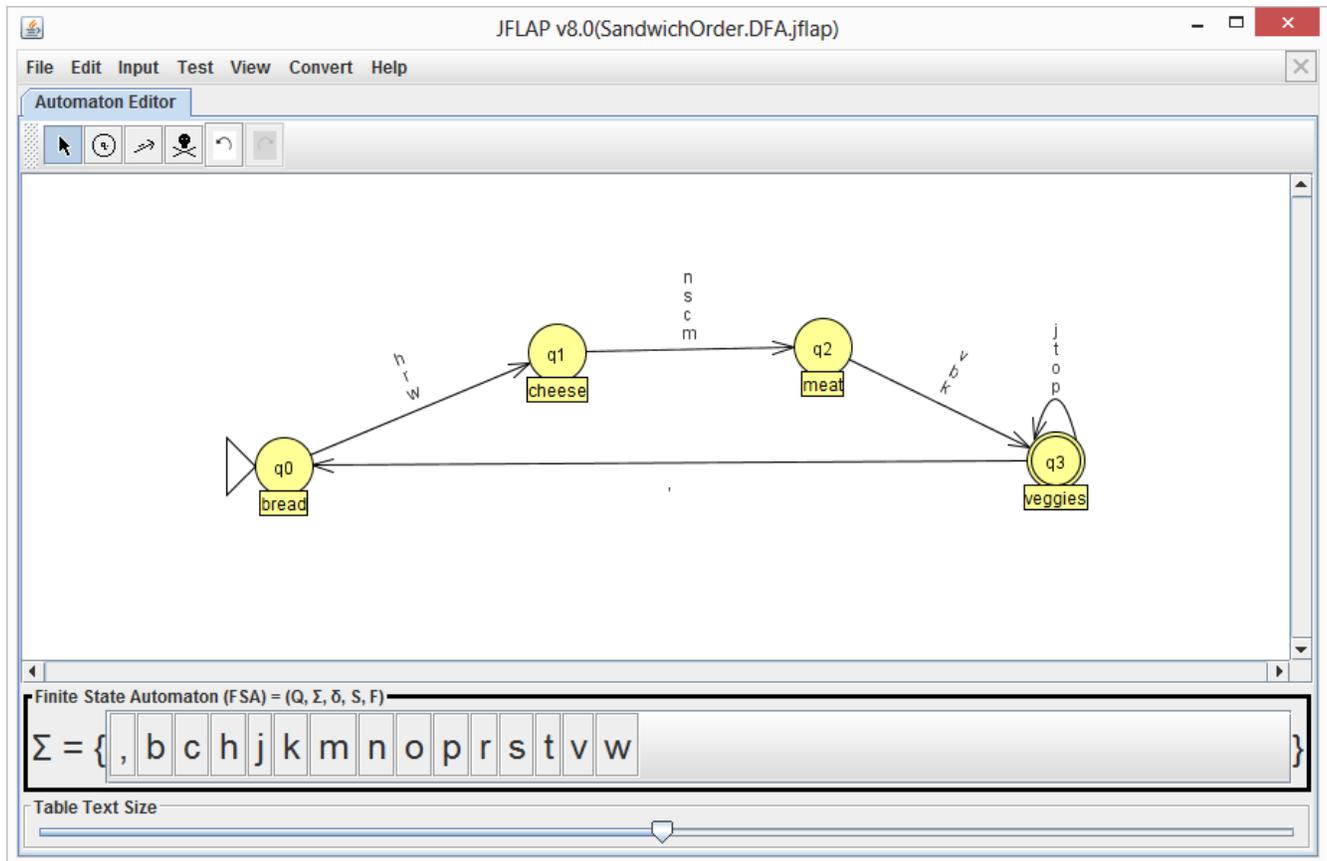
Questions to Think About:

1. Does a Mealy machine have any final states? Why or why not?
2. If a Mealy machine transition does not produce a visible string output, what should be the corresponding string in the transition?

If you have completed the lesson about converting a DFA to a regular grammar, you will be familiar with the example DFA described below. If you wish, open the file **SandwichOrder.DFA.jflap** if it has not already been loaded into JFLAP. We will use it as a basis for a Mealy machine.

DFA's (and Mealy machines, too) 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.



We have the DFA. Now your task is to design a Mealy machine. We have the states and transitions. We need to augment the transitions with outputs. What are realistic outputs? If you are making a purchase at the sandwich shop, you need to pay for your sandwich (unless you have a loyalty card and are getting a free one). At some shops, you may have different prices for different breads, cheeses, and meats. The cashier will enter your choices into the cash register, and then the grand total will be computed. Our Mealy machine will keep track of the prices of the individual sandwich components.

Try It!

1. Click the **Mealy Machine** button on the JFLAP main window.
2. Create the four states of the Mealy machine.
3. We need to know our prices to determine outputs. The costs are as follows:
 1. breads: wheat - 0.99, honey oat - 1.29, rye - 1.19
 2. cheeses: mozzarella - 0.59, cheddar - 0.69, Swiss - 0.49
 3. meats: turkey - 2.49, beef - 2.99, veggie patty - 3.19
4. Add these transitions to the Mealy machine.
5. Make realistic assumptions about any undefined outputs and complete any remaining necessary transitions for the Mealy machine. Remember that a comma signifies the end of an order.
6. Save your Mealy machine with a descriptive file name.
7. Test your machine by selecting **Input > Multiple Run**. What is the output produced by the input strings **wsv** and **wsv,hnbtpoj**? Is anything wrong with the output? If there is, fix the transitions to produce more readable outputs.
8. If you are having trouble, please open **SandwichOrder.Mealy.jflap**.

Questions to Think About:

1. Are the input and output alphabets required to be the same for a Mealy machine?
2. In a DFA, the transition function δ is a function from $Q \times \Sigma$ to Q . $Q \times \Sigma$ is the domain, and Q is the range. What is the range for the transition function for a Mealy machine?