Additional Example to Practice with Converting a DFA to a Regular Grammar

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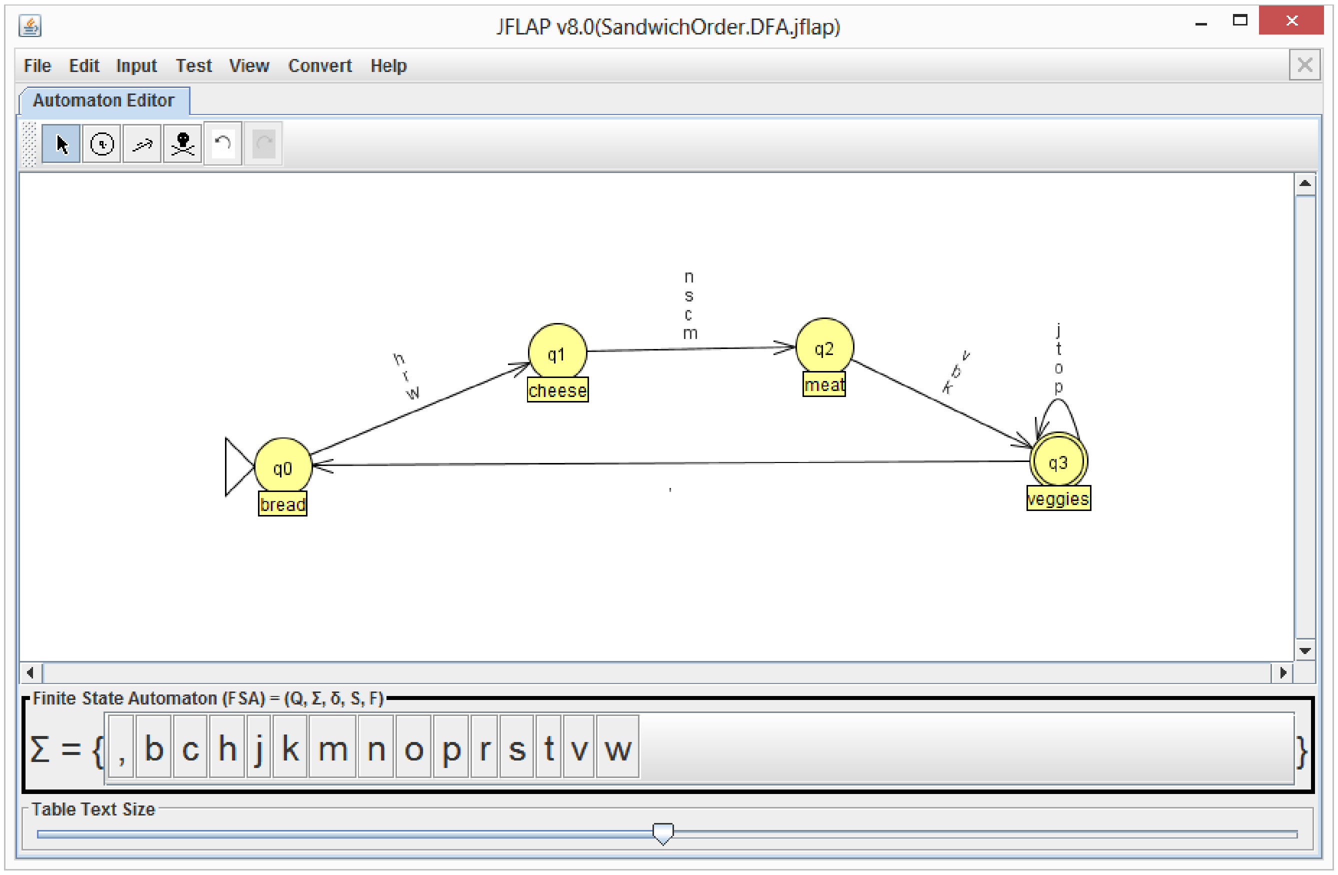
In the lesson, you learned three simple rules for converting a DFA to a regular grammar. Now you can practice with another example.

The example in the lesson was a DFA model of a round of the famous Rock-Paper-Scissors game. DFA's can be used to model many other 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**heddar, **s** for Swiss, and **n** for **n**one. The choices for meat are **k** for tur**k**ey, **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**p**inach, and **t** for **t**omato. A comma (**,**) indicates that another sandwich order follows.


JFLAP v8.0(SandwichOrder.DFA.jflap)
File Edit Input Test View Convert Help
Automaton Editor
q0
bread
q1
cheese
q2
meat
q3
veggies
h r w
n s c m
k b v
j t o p
,
Finite State Automaton (FSA) = (Q, Σ, δ, S, F)
Table Text Size

Σ = { , b c h j k m n o p r s t v w }

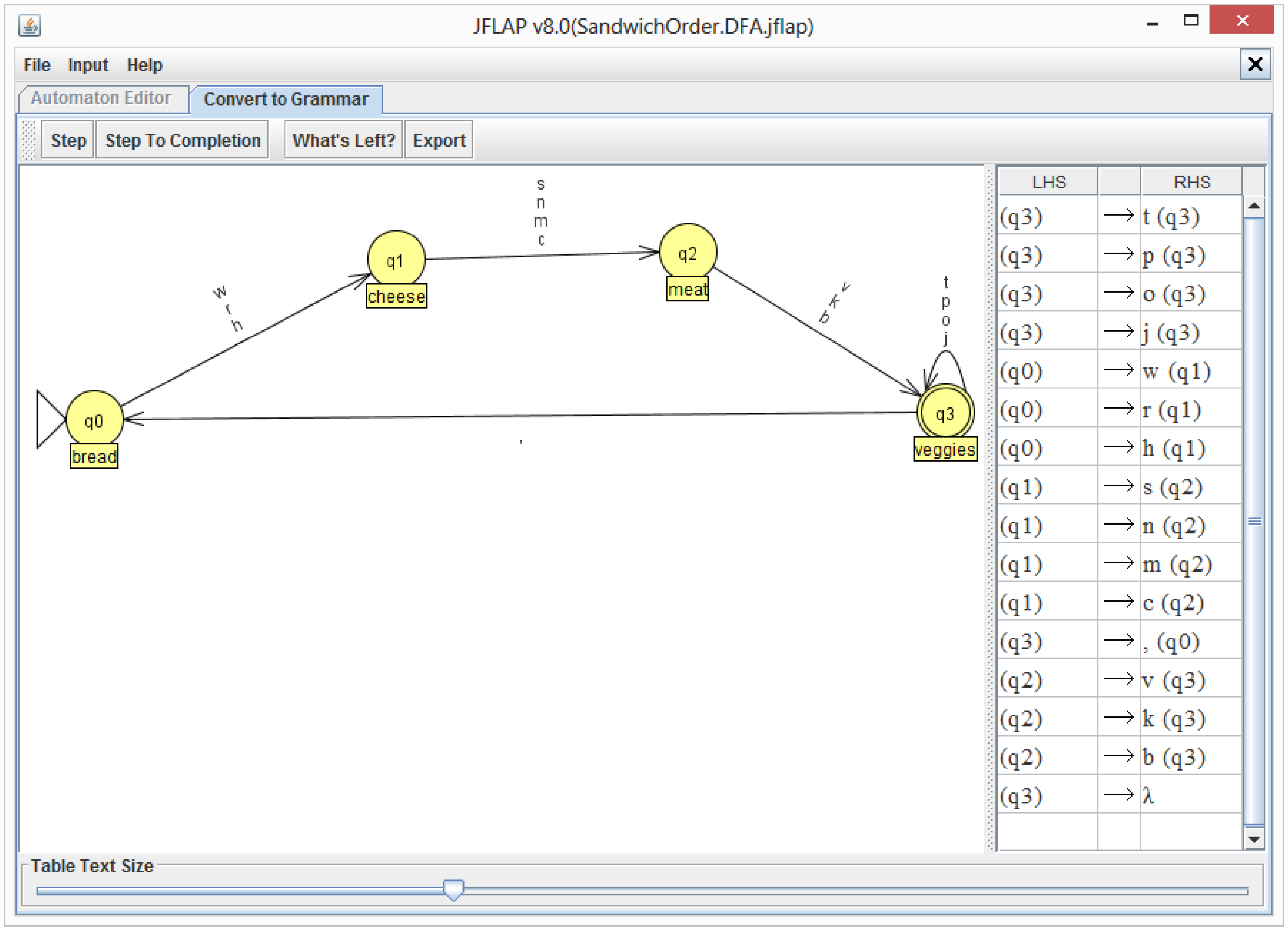
Questions to Think About:

1. What is the length of the shortest string accepted by the DFA?
2. How many such shortest strings are there? Why? (Hint: Think back to your discrete mathematics course.)

3. What is the order in which components of a sandwich must be chosen? Why?
4. Can a valid string end with a comma? Why or why not?
5. How many variables will the corresponding regular grammar have? Why?
6. How many production rules will the corresponding regular grammar have? Why?
7. How many lambda rules will the corresponding regular grammar have? Why. Remember that a **lambda rule** is a rule of the form A → λ, where A is a variable.

Try It!

Convert the pictured DFA into an equivalent regular grammar. To check your work, open the file **SandwichOrder.DFA.jflap** if it has not already been loaded into JFLAP. Convert the DFA to a grammar by selecting ***Convert > Convert to Grammar > Step to Completion.*** Your resulting grammar should be similar to the one pictured below. The variables in the picture are enclosed in parentheses.



LHS		RHS
(q3)	→	t (q3)
(q3)	→	p (q3)
(q3)	→	o (q3)
(q3)	→	j (q3)
(q0)	→	w (q1)
(q0)	→	r (q1)
(q0)	→	h (q1)
(q1)	→	s (q2)
(q1)	→	n (q2)
(q1)	→	m (q2)
(q1)	→	c (q2)
(q3)	→	, (q0)
(q2)	→	v (q3)
(q2)	→	k (q3)
(q2)	→	b (q3)
(q3)	→	λ

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 grammar.

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

Design a DFA to allow pizzas, burritos, or banana splits to be ordered. Have fun!

Questions to Think About:

1. Does this grammar have recursive production rules? Why or why not?
2. If it does have recursive production rules, how is the recursion stopped?
3. What can you say about the number of strings in a language with a grammar with no recursive production rules?