

COMPSCI/SFWRENG 2FA3  
Discrete Mathematics with Applications II  
Winter 2021

## Assignment 5

Dr. William M. Farmer and Dr. Mehrnoosh Askarpour  
McMaster University

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Assignment 5 consists of a problem with three subproblems. You must write your solutions to the problems using LaTeX.

Please submit Assignment 5 as two files, `Assignment_5_YourMacID.tex` and `Assignment_5_YourMacID.pdf`, to the Assignment 5 folder on Avenue under Assessments/Assignments. *YourMacID* must be your personal MacID (written without capitalization). The `Assignment_5_YourMacID.tex` file is a copy of the LaTeX source file for this assignment (`Assignment_5.tex` found on Avenue under Contents/Assignments) with your solution entered after each problem. The `Assignment_5_YourMacID.pdf` is the PDF output produced by executing

```
pdflatex Assignment_5_YourMacID
```

This assignment is due **Sunday, March 7, 2021 before midnight**. You are allow to submit the assignment multiple times, but only the last submission will be marked. **Late submissions and files that are not named exactly as specified above will not be accepted!** It is suggested that you submit your preliminary `Assignment_5_YourMacID.tex` and `Assignment_5_YourMacID.pdf` files well before the deadline so that your mark is not zero if, e.g., your computer fails at 11:50 PM on March 7.

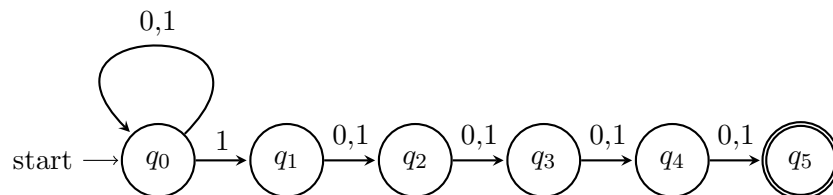
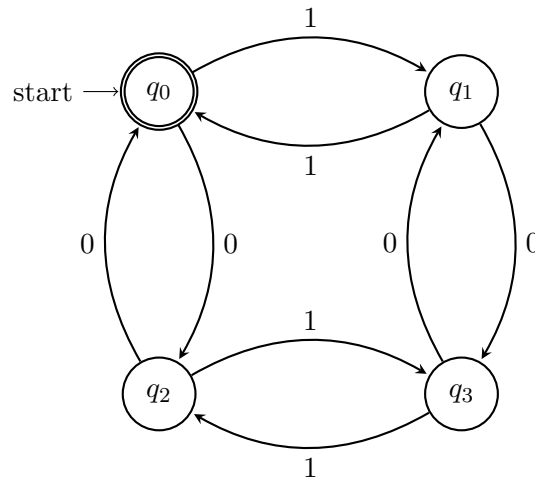
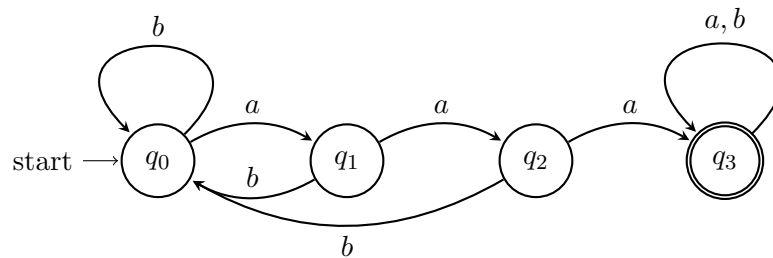
**Although you are allowed to receive help from the instructional staff and other students, your submission must be your own work. Copying will be treated as academic dishonesty! If any of the ideas used in your submission were obtained from other students or sources outside of the lectures and tutorials, you must acknowledge where or from whom these ideas were obtained.**

## Presenting DFAs and NFAs Transition Diagrams

In this assignment you are asked to present DFAs as transition diagrams. You can do this in one of two ways.

The first way is to present the diagram using the LaTeX graphics package TikZ. The TikZ code can either be written by hand or automatically generated using the finism system available at <http://finism.io>.

Here are some examples of how it can be used to create DFA and NFA transition diagrams that appear in the lectures slides:



The second way is to take a picture of a hand-written transition diagram and then embed it into your assignment using the following LaTeX code:

```

\begin{center}
\includegraphics[scale = 0.5]{diagram.jpg}
\end{center}

```

Please make sure your diagram is legible.

## Problems

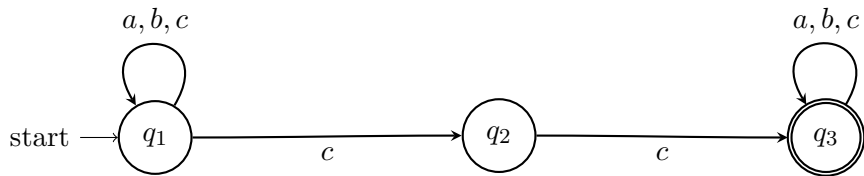
Let  $\Sigma = \{a, b, c\}$  and  $L = \{x \in \Sigma^* \mid x \text{ contains "cc"}\}$ :

1. [7 points] Construct an NFA that accepts  $L$ .
2. [8 points] Construct the equivalent DFA using the subset construction.
3. [5 points] Is the constructed DFA minimal? If not, construct the equivalent minimal DFA.

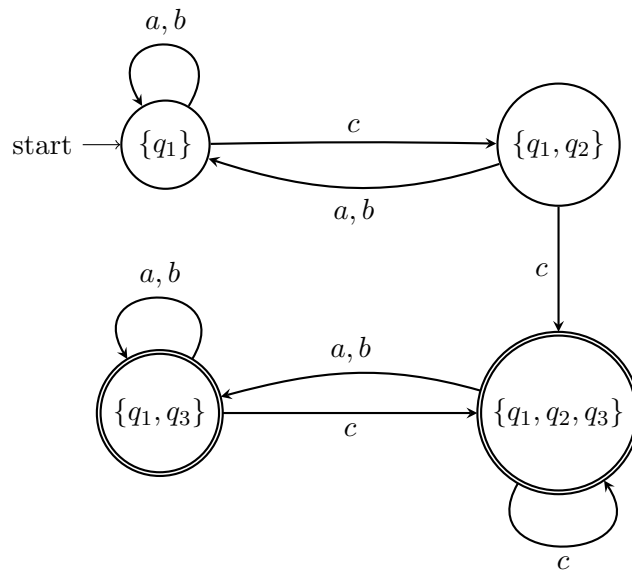
Present your FAs using transition diagrams.

**Aamina Hussain, hussaa54, March 7, 2021**

1. The NFA transition diagram is below.



2. The equivalent DFA of the above NFA is below.



Transition Table:

The unreachable states are  $\{\emptyset\}$ ,  $\{q_2\}$ ,  $\{q_3\}$ , and  $\{q_2, q_3\}$ .

	$\Sigma$	a	b	c
$P(Q)$				
	$\{\emptyset\}$	$\{\emptyset\}$	$\{\emptyset\}$	$\{\emptyset\}$
start $\rightarrow$	$\{q_1\}$	$\{q_1\}$	$\{q_1\}$	$\{q_1, q_2\}$
	$\{q_2\}$	$\{\emptyset\}$	$\{\emptyset\}$	$\{q_3\}$
final $\rightarrow$	$\{q_3\}$	$\{q_3\}$	$\{q_3\}$	$\{q_3\}$
	$\{q_1, q_2\}$	$\{q_1\}$	$\{q_1\}$	$\{q_1, q_2, q_3\}$
final $\rightarrow$	$\{q_1, q_3\}$	$\{q_1, q_3\}$	$\{q_1, q_3\}$	$\{q_1, q_2, q_3\}$
final $\rightarrow$	$\{q_2, q_3\}$	$\{q_3\}$	$\{q_3\}$	$\{q_3\}$
final $\rightarrow$	$\{q_1, q_2, q_3\}$	$\{q_1, q_3\}$	$\{q_1, q_3\}$	$\{q_1, q_2, q_3\}$

3. The DFA in question 2 is not minimal. This is because there are some equivalent states as you can see in the transition table above. States  $\{q_1, q_3\}$  and  $\{q_1, q_2, q_3\}$  are equivalent. The states they transition to in each case (for input a, b, and c) are the same. Removing the state  $\{q_1, q_3\}$  would result in the same strings being accepted or rejected. Therefore, the new DFA is equivalent and minimal.

The equivalent minimal DFA is below.

