

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

Assignment 5

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

Revised: March 2, 2021

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 allowed 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.

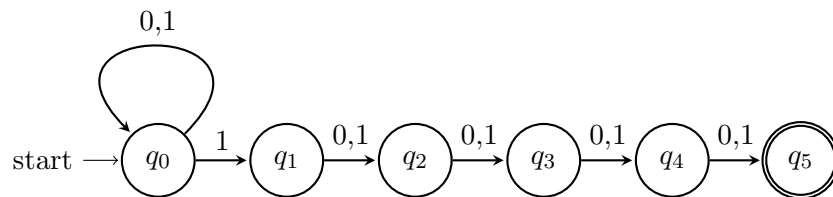
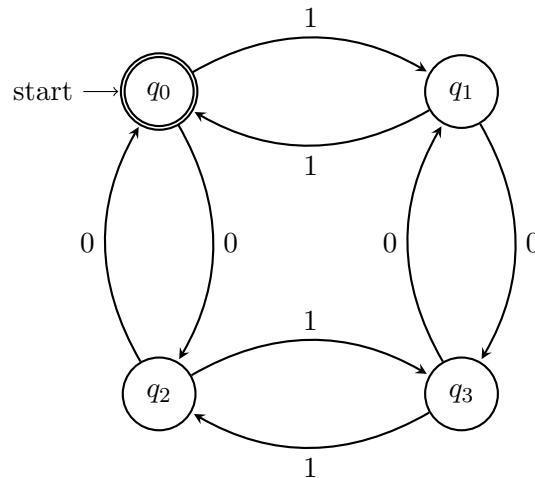
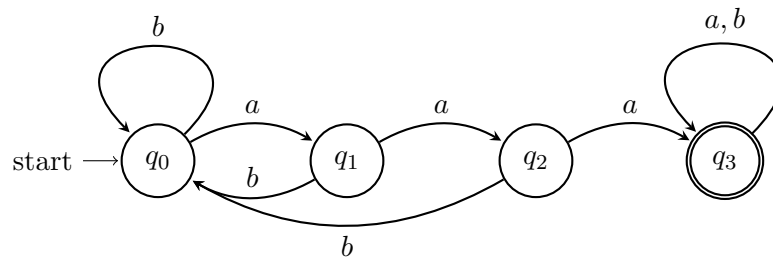
Although you are allowed to receive help from the instructional staff and other students, your submission must be your own work. Copying will be treated as academic dishonesty! If any of the ideas used in your submission were obtained from other students or sources outside of the lectures and tutorials,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

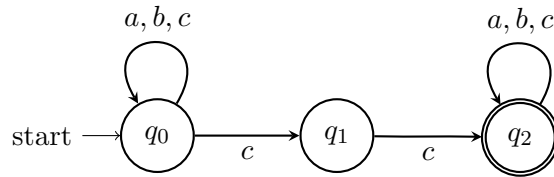
Let $\Sigma = \{a, b, c\}$ and $L = \{x \in \Sigma^* \mid x \text{ contains "cc"}\}$:

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.

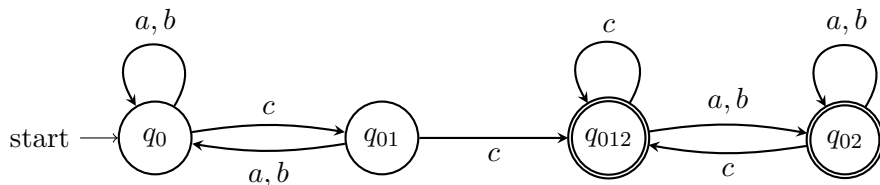
Mohammad Omar Zahir, zahirm1, March 7th

1. Below is the constructed NFA that accepts L .



2. The following is the equivalent DFA, along with the subset construction table for the above NFA. The crossed out sections are inaccessible, and do not have to be included. Since q_0 is the single start state in the NFA, it is also the start state for our equivalent DFA. Similar to the start state, because q_2 was the end state in the NFA, and it is used in q_{012} and q_{02} , it makes these states the end states.

$P(Q)$	Σ		
	a	b	c
\emptyset	\emptyset	\emptyset	\emptyset
q_0	q_0	q_0	q_{01}
q_1	\emptyset	\emptyset	q_2
q_2	q_2	q_2	q_2
q_{01}	q_0	q_0	q_{012}
q_{02}	q_{02}	q_{02}	q_{012}
q_{12}	q_2	q_2	q_2
q_{012}	q_{02}	q_{02}	q_{012}



3. Despite the fact that the DFA constructed above already excludes the inaccessible states that have been labelled, it is still not minimal. The definition of a minimal DFA would be that there are no unnecessary states, which is not the case since we can see that the transition from q_{012} to q_{02} can be simplified to just simply q_{012} , as the transitions within q_{02} are essentially repeated, and can be moved to the single state q_{012} , as is done below.

