

# COMP 4200 - Formal Languages: Homework #3

Due on Thursday, September 21, 2023, at 10:00 pm

*Instructor: Hugh Kwon*

## Instructions:

- Submit your work as a single PDF through GradeScope (link on Canvas). You will need to match your solution to each question (click for the instruction). Failure to match your solution to the appropriate question will result in a grade of 0 for each unmatched question.
- Note that it is your responsibility to make your submissions readable by TAs. If your handwriting is not readable by the TA, he may not give you full credits (or any credits at all) for the illegible part.
- You will not only be graded on your mathematics, but also on your organization, proper use of English, spelling, punctuation, and logic.
- Late submissions will NOT be graded unless as specified by the Late Assignment Submission policy in the syllabus.
- For any questions regarding the assignment or grading of the assignment, please email our TAs.

## Problem 1

**Total: 30 points (10 points each)**

Construct NFAs that recognize the following languages:

1. All binary numbers that contain a 1 in the 2nd location from the right (e.g. 10, 10111, ...).
2. All binary numbers that contain 00 or 11.
3. All binary numbers that contain an even number of 0's and an odd number of 1's.

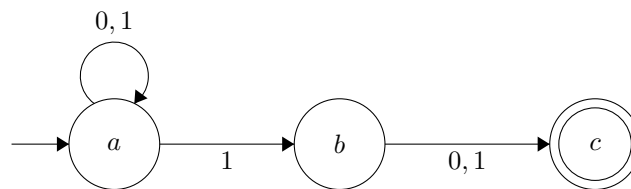
## Problem 2

**Total: 30 points**

Via subset construction, construct DFAs from all three NFAs that were constructed in problem 1. You must show the transition tables of the DFAs you construct and their state diagram.

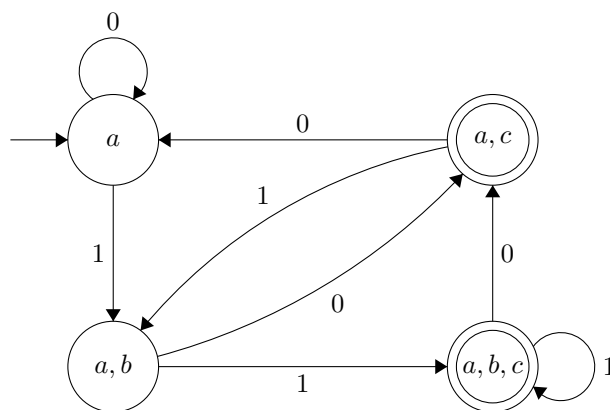
**Solution - Problems 1.1 and 2.1**

NFA



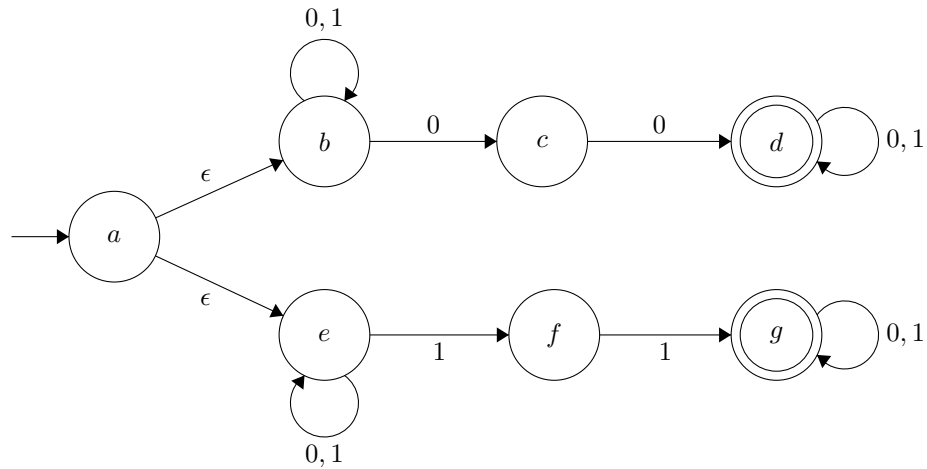
State	0	1
a	a	a,b
a,b	a,c	a,b,c
a,c	a	a,b
a,b,c	a,c	a,b,c

DFA



**Solution - Problems 1.2 and 4.2**

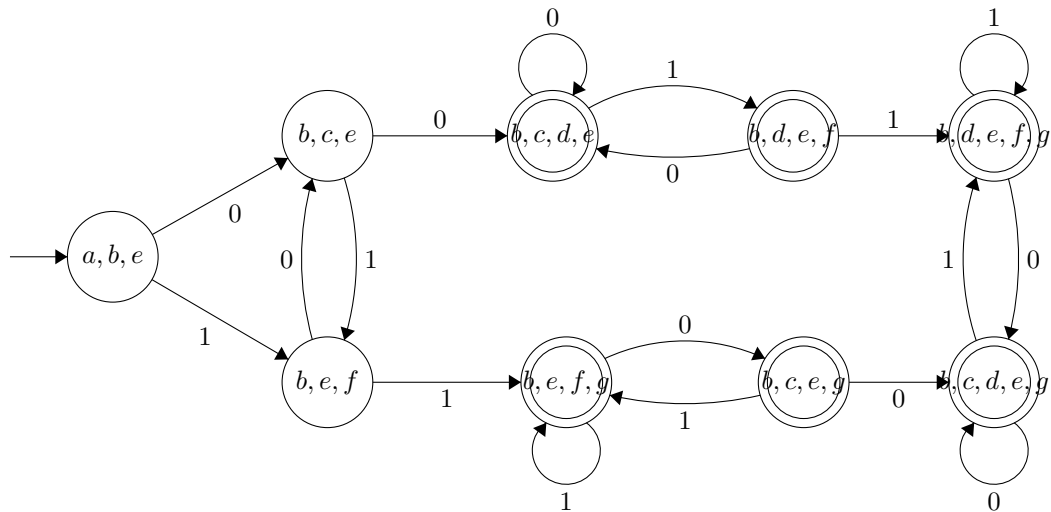
NFA



State	0	1
a,b,e	b,c,e	b,e,f
b,c,e	b,c,d,e	b,e,f
b,e,f	b,c,e	b,e,f,g
b,c,d,e	b,c,d,e	b,d,e,f
b,e,f,g	b,c,e,g	b,e,f,g
b,d,e,f	b,c,d,e	b,d,e,f,g
b,c,e,g	b,c,d,e,g	b,e,f,g
b,d,e,f,g	b,c,d,e,g	b,d,e,f,g
b,c,d,e,g	b,c,d,e,g	b,d,e,f,g

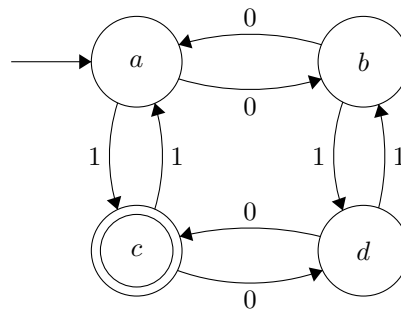
DFA

*Note:* The resulting DFA can be simplified since all accepting states can be merged in this case, but that is a procedure external to the Subset Construction algorithm.



### Solution - Problems 1.3 and 2.3

NFA



State	0	1
a	b	c
b	a	d
c	d	a
d	c	b

DFA is the same as the NFA above.