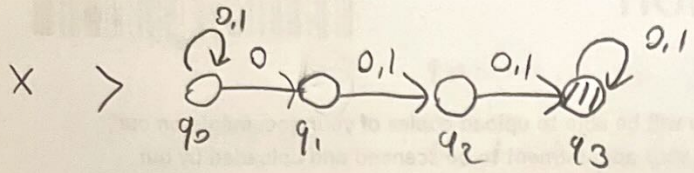
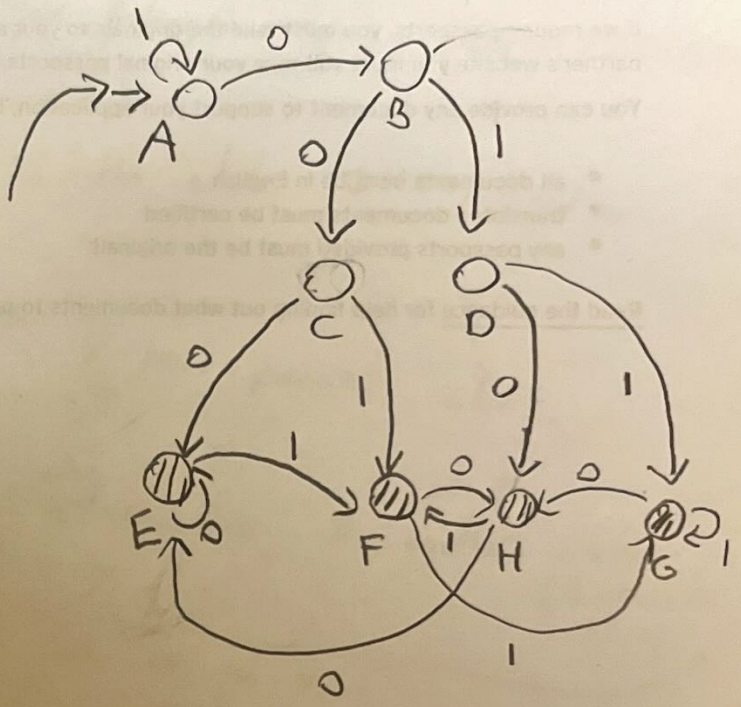
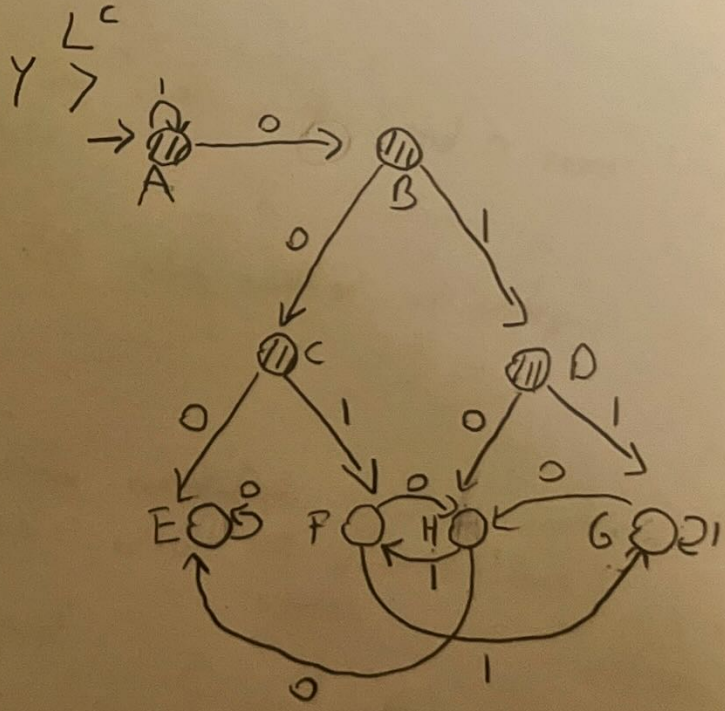
Question-1:



To DFA

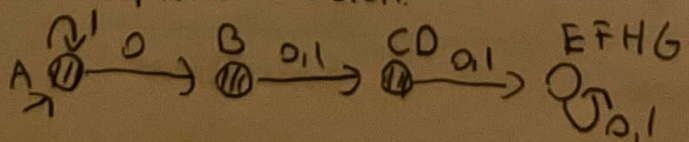
	q	6	q'	
A ←	q0	0	q0,q1	→ B
	q0	1	q0	→ A
B	q0,q1	0	q0,q1,q2	→ C
	q0,q1	1	q0,q2	→ D
C	q0,q1,q2	0	q0,q1,q2,q3	→ E
	q0,q1,q2	1	q0,q2,q3	→ F
D	q0,q2	0	q0,q1,q3	→ H
	q0,q2	1	q0,q3	→ G
E*	q0,q1,q2,q3	0	q0,q1,q2,q3	→ E
	q0,q1,q2,q3	1	q0,q2,q3	→ F
F*	q0,q2,q3	0	q0,q1,q3	→ H
	q0,q2,q3	1	q0,q3	→ G
G*	q0,q3	0	q0,q1,q3	→ H
	q0,q3	1	q0,q3	→ G
H*	q0,q1,q3	0	q0,q1,q2,q3	→ E
	q0,q1,q3	1	q0,q2,q3	→ F





Final States = {A, B, C, D}

Simplified version:



Question 2.2.5

a) To solve this question, we need to create a state for each possible 0,1 combinations in a 5-length string. Total number of combinations would be $2^5 = 32$. When a new character input arrives our 5 length string (state) transforms to another 5 length string (state)

For instance: if we are in the state 01100, and a new input arrives.

01100 — input 0 → 11000
01100 — input 1 → 11001
} new possible states.

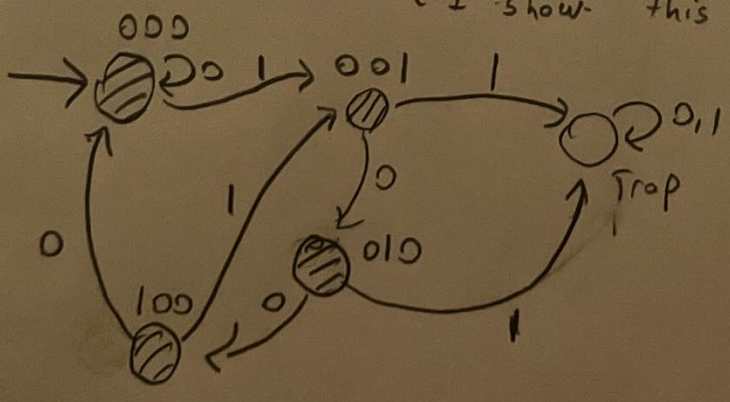
for each state, we will able to transform to another state (5 character string) (5 character string)
↳ in case of an input.

☆ Since we need at least 2 zeros. The states with 1 and 0 zeros can be reduced to one trap state

$2^5 - \binom{5}{4} - \binom{5}{0} + 1 = 27$ total number of states

2^5 → All
$\binom{5}{4}$ → 1 zero strings
$\binom{5}{0}$ → 0 zero string
$+1$ → trap

ex: Demonstration for the block of three consecutive symbols contains at least two 0's. (I show this since it possess less states)



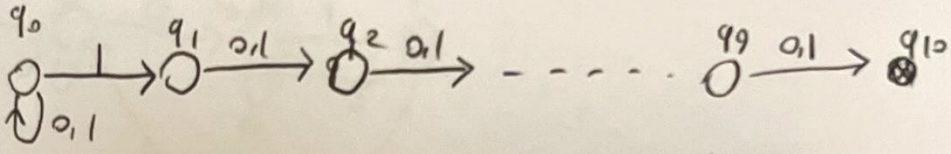
} $2^3 - \binom{3}{1} - \binom{3}{0} + 1 = 5$ //

it is working in the easier example.

Question 2.2.5

b) This question is the classic bad example for the NFA DFA transformations.

NFA >

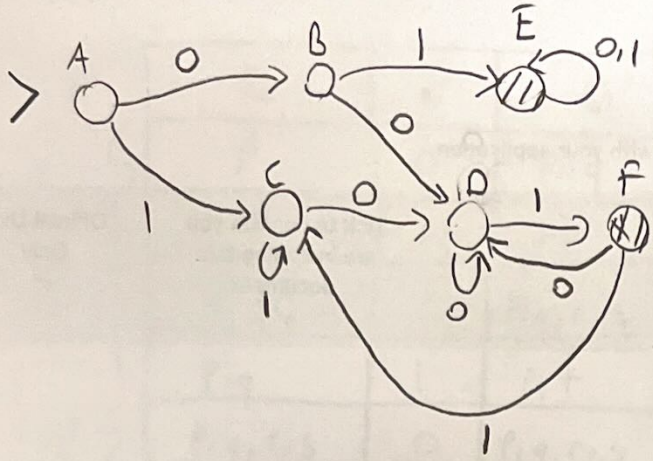


For DFA version we need at least $2^n = 2^{10} = 1024$ states. (n is 10)

The reason for this comes from we need to know all occurences of the 1's in the last 10 characters. To know this we need to know all possible combinations and which combination (state) we are currently belong.

Question 2.2.5:

c)

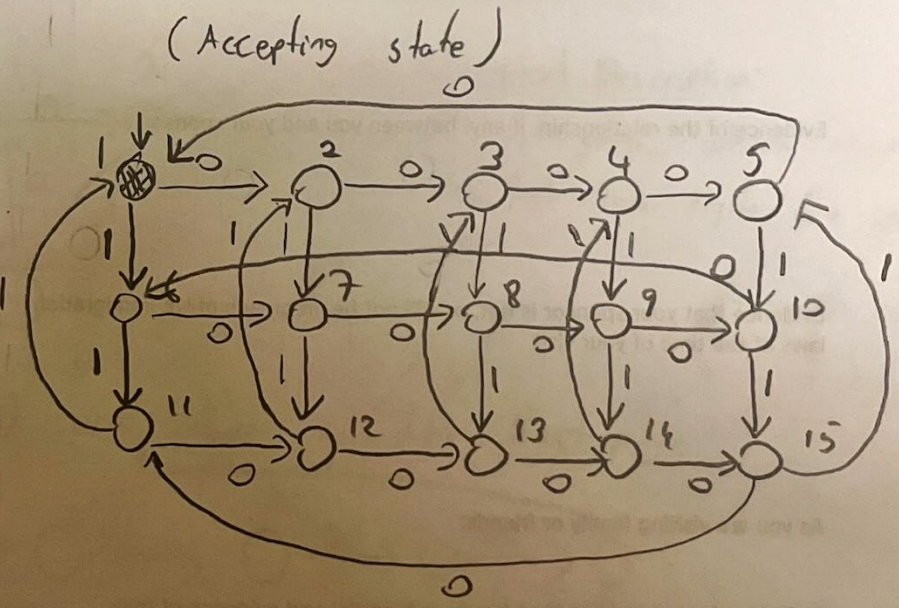


final states = {E, F}

d)

For this question we will decide states by looking the number of 1's and 0's in mod 3 and 5 respectively. Total number of states 3.5 = 15

1 - Zero 0 Zero 1
2 - One 0 Zero 1
3 - Two 0 Zero 1
4 - Three 0 Zero 1
5 - Four 0 Zero 1
6 - Zero 0 one 1
7 - One 0 One 1
8 - two 0 One 1
9 - three 0 one 1
10 - Four 0 one 1
11 - Zero 0 two 1
12 - one 0 two 1
13 - two 0 two 1
14 - three 0 two 1
15 - Four 0 two 1

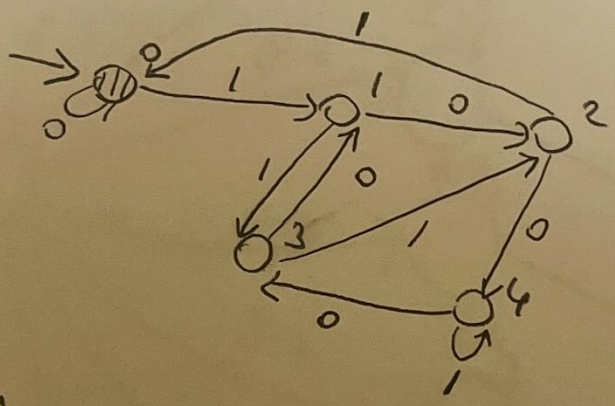


only Accepting state is 1

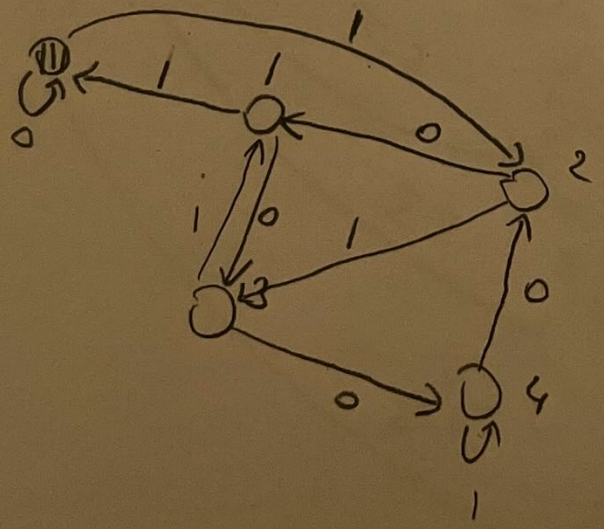
Question 2.2.6

B) To solve this question we will firstly solve for normal ordering binary strings and checking whether they are divisible by 5 or not.

For normal order:

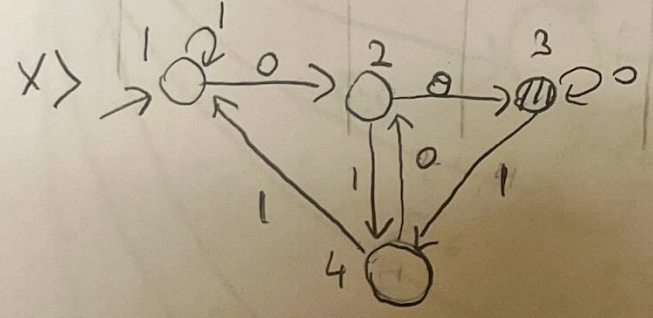


Reversing a dfa means switching the start and final state and changing the directions of inputs (arrows). This will work since this time we will start from the end and go in the opposite directions.



Question 2.3.3

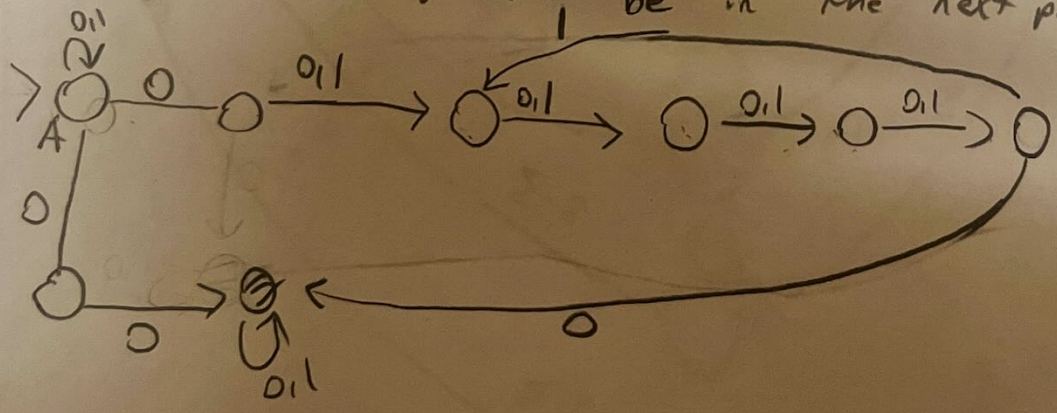
	Q	δ	Q'	
1	p	0	p,q	→ 2
	p	1	p	
2	p,q	0	p,q,r,s	→ 3
	p,q	1	p,t	→ 4
3*	p,q,r,s	0	p,q,r,s	→ 3
	p,q,r,s	1	p,t	→ 4
4*	p,t	0	p,q	→ 2
	p,t	1	p	→ 1



Informal Description:
The language which accepts the last two digits are 00 or 01.

Question 2.3.4

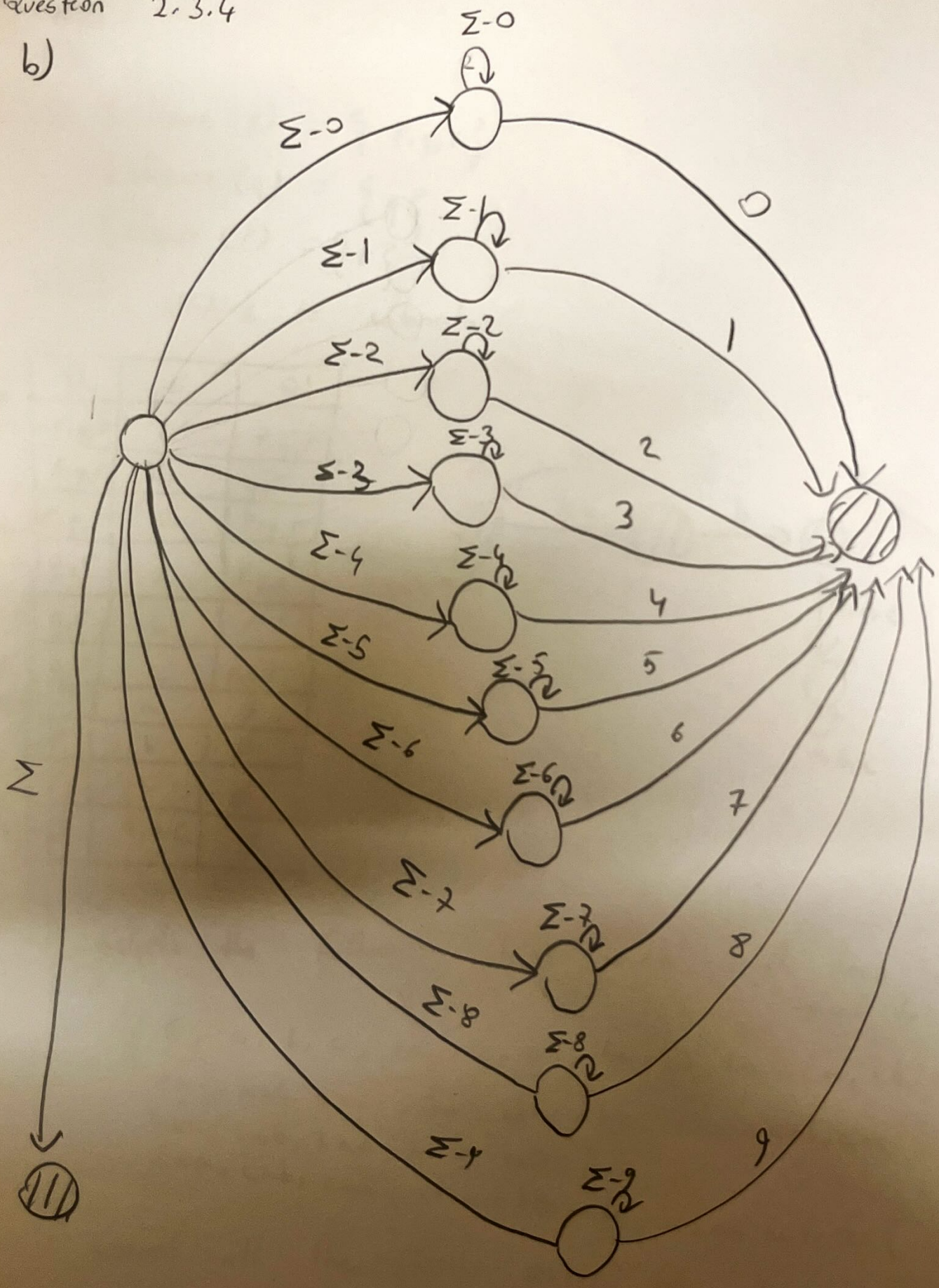
C)



B) will be in the next page

Question 2.3.4

b)



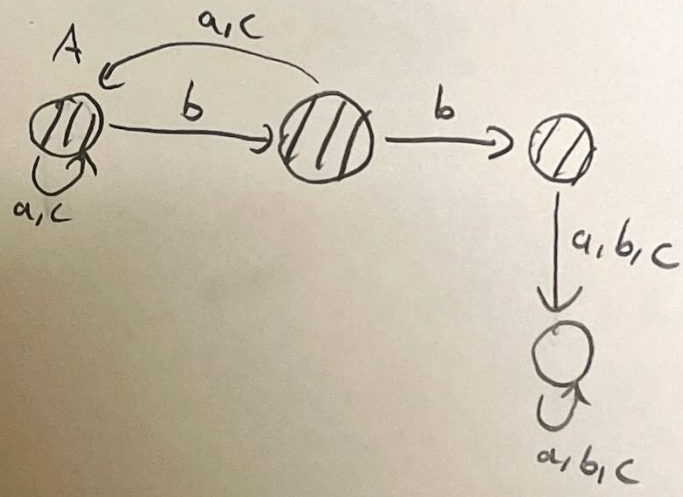
Question
2.5.2

a) Eclosure (p) = {p, q, r}
Eclosure (q) = {q}
Eclosure (r) = {r}

b c)

NFA-ε to Automata

	Q	σ	Q'
A* C	p,q,r	a	p,q,r
	p,q,r	b	q,r
	p,q,r	c	p,q,r
B*	q,r	a	p,q,r
	q,r	b	r
	q,r	c	p,q,r
C*	r	a	∅
	r	b	∅
	r	c	∅
N	∅	a,b,c	∅



it accepts the following strings with length less or equal to 3

= {ε, a, b, c, aa, ab, ac, ba, bb, bc, ca, cb, cc,
aaa, aab, aac, aba, abb, abc, aca, acb, acc,
baa, bab, bac, bca, bcb, bcc,
caa, cab, cac, cba, cbb, cbc, cca, ccb, ccc}

it except all the strings except bba, bbb, bbc.