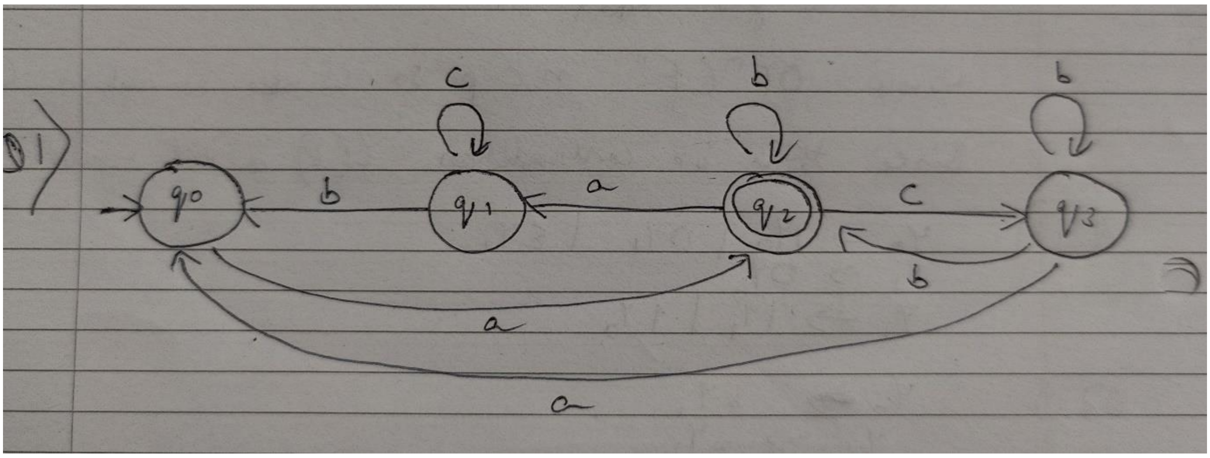
Q1)



Q2)

Accepted = 1) ab

2) abb

3) abbb

Not Accepted = 1) ac

2) ca

3) bc

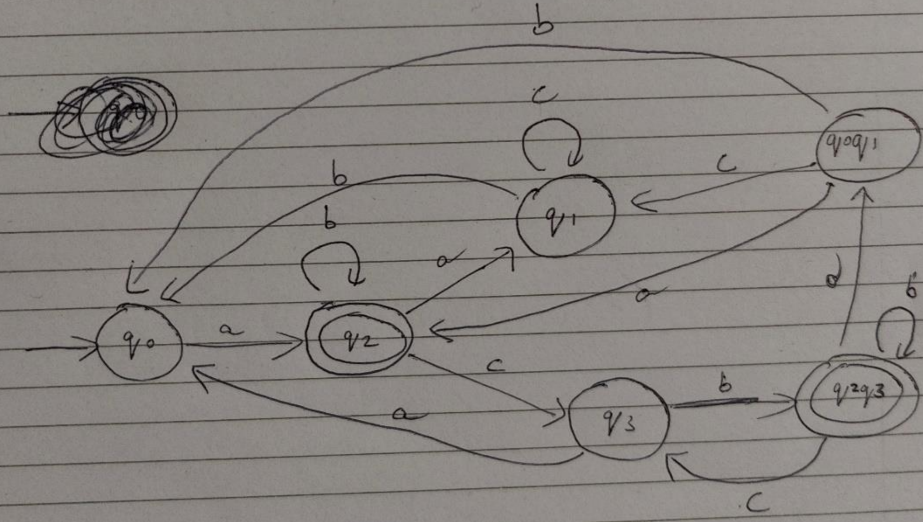
Q3) Epsilon is not accepted as the initial state is not an accepting state (not the final state) and it needs to read letters to reach the final state.

Q4) By following the subset contradiction, i will create the transition table for A and then the new transition table which will help construct the DFA.

Q4)

δ	a	b	c
q_0	$\{q_2\}$	$\emptyset$	$\emptyset$
q_1	$\emptyset$	$\{q_0\}$	$\{q_1\}$
q_2	$\{q_1\}$	$\{q_2\}$	$\{q_3\}$
q_3	$\{q_0\}$	$\{q_2, q_3\}$	$\emptyset$

δ'	a	b	c
$\{q_0\}$	$\{q_2\}$	$\emptyset$	$\emptyset$
$\{q_2\}$	$\{q_1\}$	$\{q_2\}$	$\{q_3\}$
$\{q_1\}$	$\emptyset$	$\{q_0\}$	$\{q_1\}$
$\{q_3\}$	$\{q_0\}$	$\{q_2, q_3\}$	$\emptyset$
$\{q_2, q_3\}$	$\{q_0, q_1\}$	$\{q_2, q_3\}$	$\{q_3\}$
$\{q_0, q_1\}$	$\{q_2\}$	$\{q_0\}$	$\{q_1\}$



Q5)

By following the marking table construction, there are no dead states, and all pairs were marked so the DFA A is already minimal.

~~Lab 7~~

Q5)

q_1	X				
q_2	X	X			
q_3	X	X	X		
q_0q_1	X	X	X	X	
q_2q_3	X	X	X	X	X
	q_0	q_1	q_2	q_3	q_0q_1

$(q_0, q_2) \xrightarrow{a} (q_2, ?)$ cannot merge so marked

$(q_0, q_3) \xrightarrow{a} (q_0, q_2)$

$(q_0, q_3) \xrightarrow{b} (?, q_2q_3)$ cannot merge so marked

$(q_0, q_0q_1) \xrightarrow{a} (q_2, q_2)$

$(q_0, q_0q_1) \xrightarrow{b} (?, q_0)$ cannot merge so marked

$(q_1, q_3) \xrightarrow{a} (?, q_0)$ cannot merge so marked

$(q_1, q_0q_1) \xrightarrow{a} (?, q_2)$ cannot ~~merge~~ merge so marked

$(q_2, q_2q_3) \xrightarrow{a} (q_1, q_0q_1)$ marked since (q_1, q_0q_1) is marked

$(q_3, q_0q_1) \xrightarrow{a} (q_0, q_2)$ marked since (q_0, q_2) is marked

As all pairs are marked in the table, we have arrived at proof that ~~$(q_0, q$~~ DFA A is already minimal.

Q6)

The CFG for FSA A is:

Q6)

CFG for FSA A:

~~$S \to aY$~~
~~$X \to bS \mid cX$~~
~~$Y \to aX \mid bY \mid cZ$~~
~~$Z \to aS \mid bY \mid bZ$~~

$S \to aY$
$Y \to aX \mid bY \mid cZ$
$X \to bS \mid cX$
$Z \to aS \mid bY \mid bZ$

The first rule (for S) ensures that word starts with A and goes to Y (q_2). Then from Y it allows us to go to X (q_1) if a is read and it repeats b ~~if b is read~~ arbitarily if b is read, if c is read it goes to Z (q_3). From X if b is read it goes back to S (q_0) and if c is read then it repeats arbitarily. From Z (q_3) if a is read it goes to S (q_0), if b is read it can either go to Y (q_2) or repeat arbitarily.

Q7)

A language L is considered regular if it can be defined by a finite state automation or an regular expression. In this case since w belongs to L(A) and L(A) is regular so all the elements in L are also regular. Even though L can have at most a length of 42 it is regular as L is essentially a subset of L(A) with an additional rule.

Q8)

Q8) 1) 000

$S \rightarrow 0X \rightarrow 0SXX \rightarrow 0XX \rightarrow 00X \rightarrow 000$

2) 110

$S \rightarrow X1S \rightarrow SXX1S$

110 cannot be derived as there is nothing that can produce two 1's in a row as the options leads to having 0's in front of the 1's.

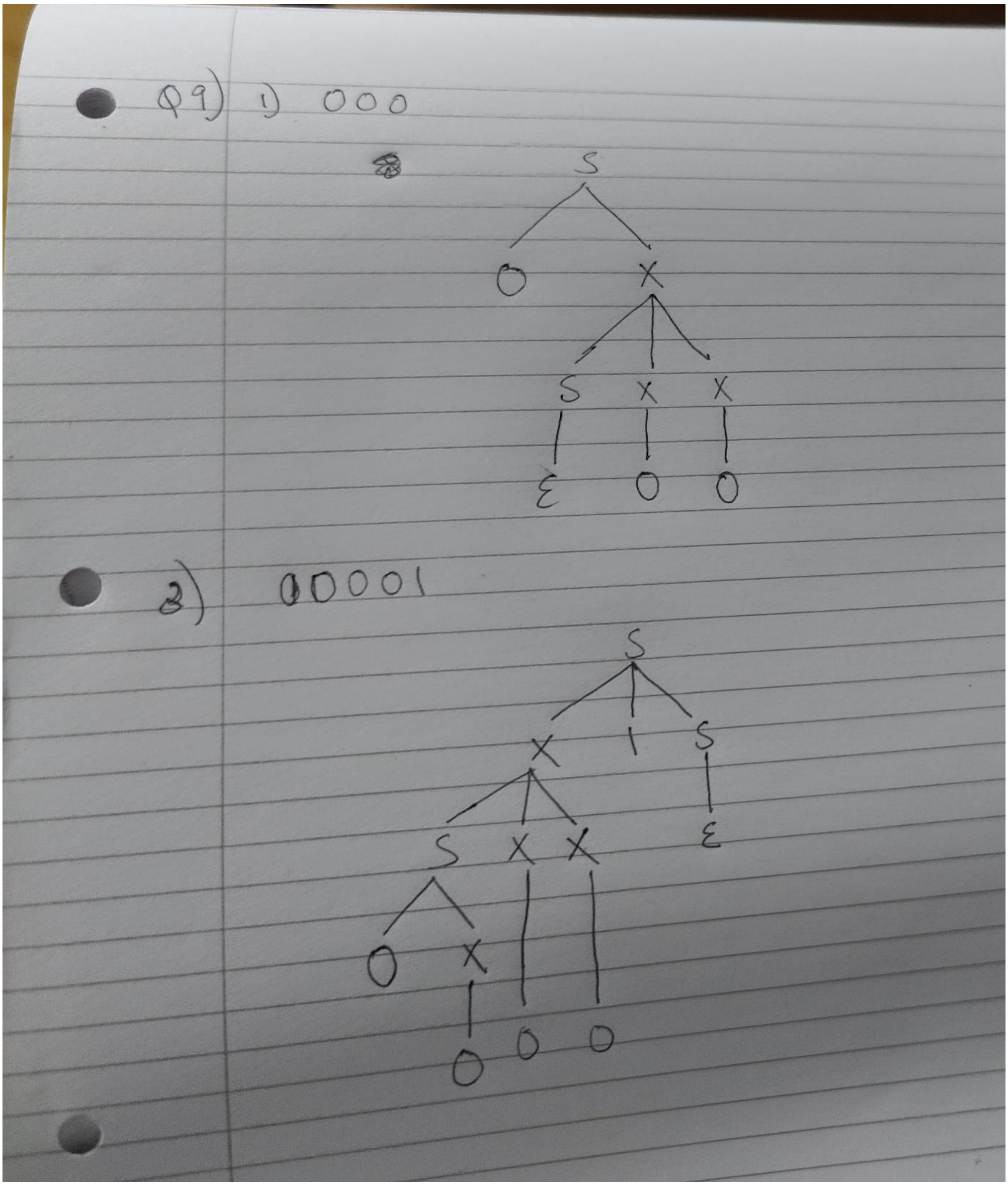
3) 00001

$S \rightarrow X1S \rightarrow SXX1S \rightarrow 0XXX1S \rightarrow 00XX1S \rightarrow$

~~→ 000~~

$\rightarrow 000X1S \rightarrow 00001S \rightarrow 00001$

Q9)



Q10)

The grammar G is not in Chomsky normal form (CNF) because it contains a rule of the form S → X1S. This rule expands a nonterminal (S) to a sequence of a nonterminal (X), a terminal (1), and another nonterminal (S). This structure doesn't conform to any of the three allowed forms in CNF.

Q11)

Q 11) $S \to X1S \mid 0X \mid \varepsilon$
$X \to SXX \mid 0S \mid 0$

After applying the start routine We must apply start routine as S appears on the right hand side. We add the variable S_0:

$$S_0 \to S$$
$$S \to X1S \mid 0X \mid \varepsilon$$
$$X \to SXX \mid 0S \mid 0$$

We then apply the BIN routine and break the rules X1S and SXX in two, introducing variables S_1 & S_2:

$$S_0 \to S$$
$$S \to XS_1 \mid 0X \mid \varepsilon$$
$$X \to SS_2 \mid 0S \mid 0$$
$$S_1 \to 1S$$
$$S_2 \to XX$$

We then apply the DEL routine & ~~break the~~ to remove the rule $S \to \varepsilon$ & obtain the grammar:

$$S_0 \to S \mid \varepsilon$$
$$S \to XS_1 \mid 0X$$
$$X \to SS_2 \mid 0S \mid 0$$
$$S_1 \to 1S \mid 1$$
$$S_2 \to XX \mid 1$$

We must apply the UNIT routine to remove the rule $S_0 \to S$ and obtain the grammar:

$$S_0 \to XS_1 \mid 0X \mid \varepsilon$$
$$S \to XS_1 \mid 0X$$
$$X \to SS_2 \mid 0S \mid 0$$
$$S_1 \to 1S \mid 1$$
$$S_2 \to XX \mid 1$$

We then apply the TERM routine to remove Terminals from non-unary rules

$$S_0 \to XS_1 \mid U_1X \mid \varepsilon$$
$$S \to XS_1 \mid U_1X$$
$$X \to SS_2 \mid U_1S \mid 0$$
$$S_1 \to U_2S \mid 1$$
$$S_2 \to XX \mid 1$$

$$U_1 \to 0$$
$$U_2 \to 1$$