

Assignment 02

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INDEX NO. : 210518H

QUESTION 01

a) The grammar given here could be simplified into a single regular expression.

$$S \rightarrow A10B$$

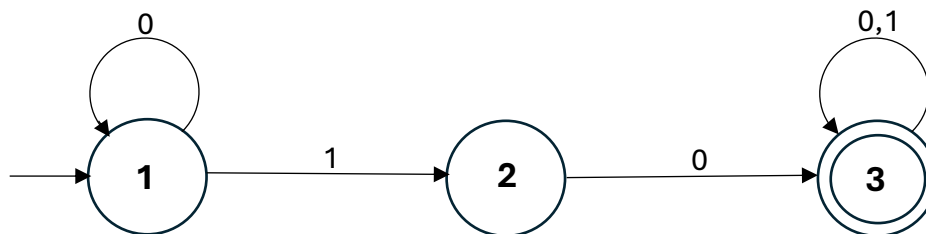
$$A \rightarrow 0A \mid \Lambda \quad \rightarrow \quad A \rightarrow 0^*$$

$$B \rightarrow 1B \mid 0B \mid \Lambda \quad \rightarrow \quad B \rightarrow (0|1)^*$$

Based on the above simplification of A and B, we could write a regular expression for S as follows;

$$S \rightarrow 0^*10(0|1)^*$$

Using this expression, we could draw a state diagram for NFA representing the language.



b) L1 represents a language which is;

- Starting with a string of length greater than or equal to zero containing '0's.
- Followed by the string '10'.
- Ending with a string of length greater than or equal to zero containing any combination of '0's and '1's.

c) CFG \rightarrow CNF

Step 01 – Eliminate Λ -productions

$$S \rightarrow A10B \mid A10 \mid 10B \mid 10$$

$$A \rightarrow 0A \mid 0$$

$$B \rightarrow 1B \mid 0B \mid 1 \mid 0$$

Step 02 - Eliminate unit productions

The modified grammar doesn't contain any unit productions. Therefore, we could skip this step.

Step 03 - Restrict the RHS of productions to single terminals or strings of ≥ 2 non-terminals

First we will remove the terminals by introducing two new states as follows;

$$X \rightarrow 0$$

$$Y \rightarrow 1$$

The new grammar as follows;

$$S \rightarrow AXYB \mid AXY \mid XYB \mid XY$$

$$A \rightarrow XA \mid 0$$

$$B \rightarrow YB \mid XB \mid 1 \mid 0$$

$$X \rightarrow 0$$

$$Y \rightarrow 1$$

Step 04 - Replace each production having > 2 non-terminals on RHS by an equivalent set of productions each having exactly 2 nonterminals on the RHS

We will introduce two more states here;

$$P \rightarrow AX$$

$$Q \rightarrow YB$$

The final modified grammar is as follows;

$$S \rightarrow PQ \mid PY \mid XQ \mid XY$$

$$A \rightarrow XA \mid 0$$

$$B \rightarrow YB \mid XB \mid 1 \mid 0$$

$$P \rightarrow AX$$

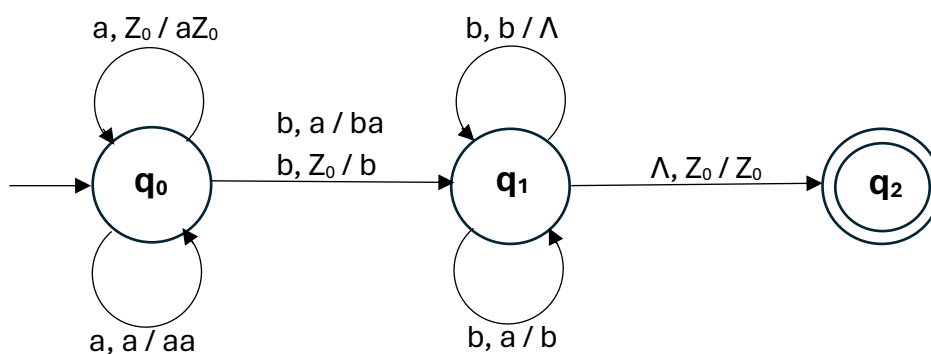
$$Q \rightarrow YB$$

$$X \rightarrow 0$$

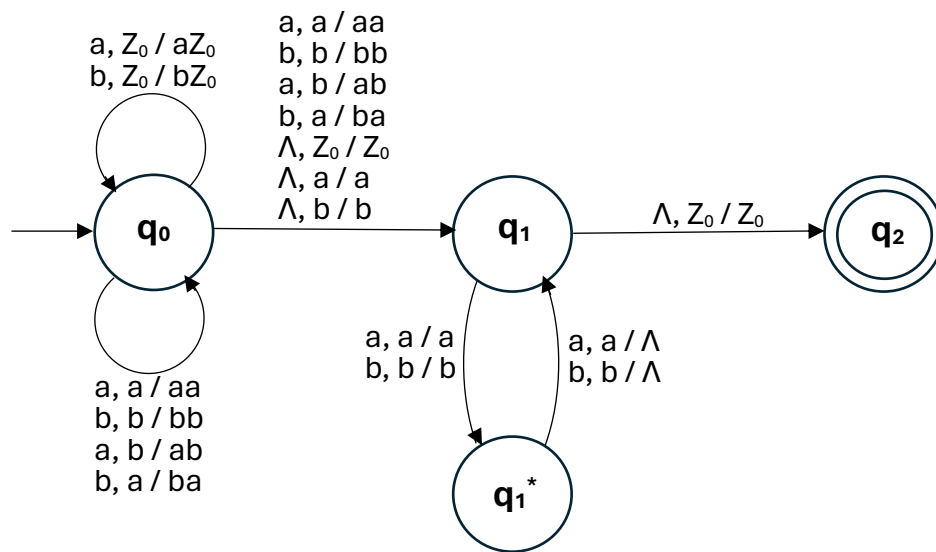
$$Y \rightarrow 1$$

QUESTION 02

a) $L = \{a^n b b b^{2n} \mid n \geq 0\}$



b) $L = \{ \Sigma = \{a, b\}, \text{ includes : "aabaabbaaaa", "babbaaabbbbaabb", "babbbbaabb" } \}$



QUESTION 03

a)

i) This TM reverses the input string.

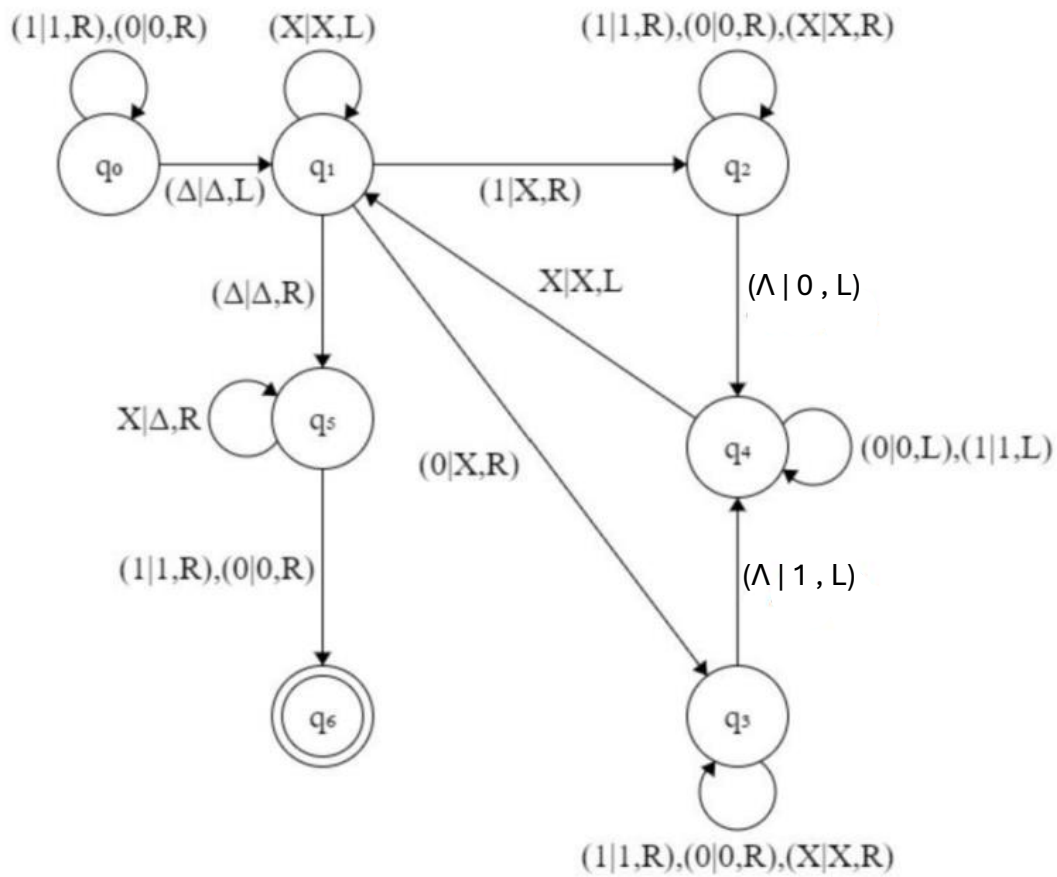
Initial (S_1)

Δ	0	0	1	1	0	1	0	1	0	0	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
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Final (S_2)

Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	0	0	1	0	1	0	1	1	0	0	Δ
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ii)



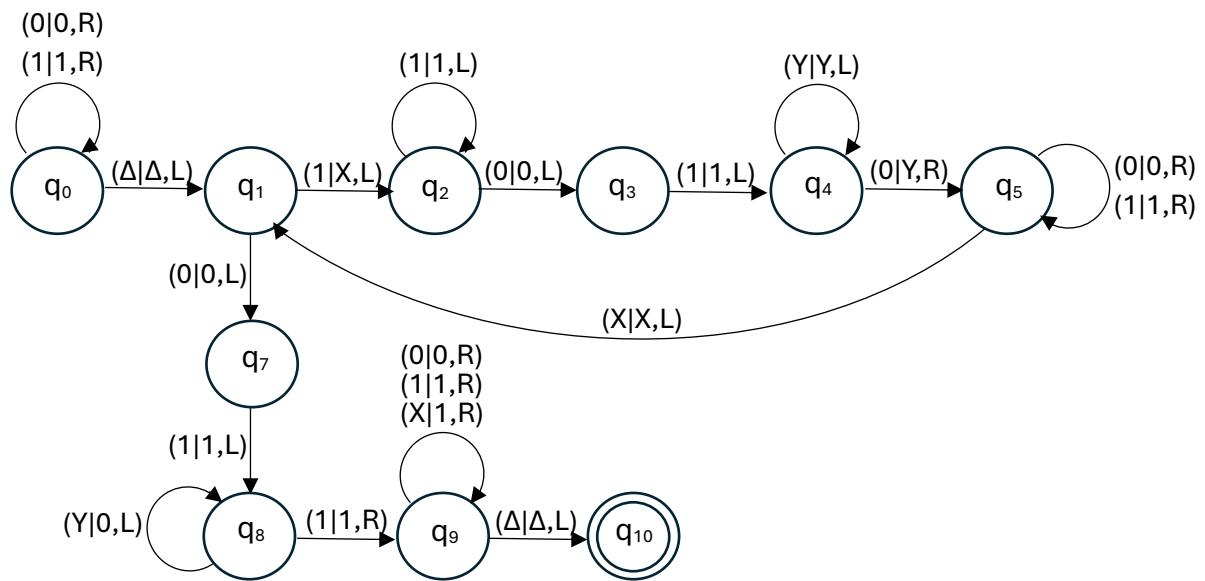
Initial (S_1)

Δ	0	0	1	1	0	1	0	1	0	0	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
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Final (S_3)

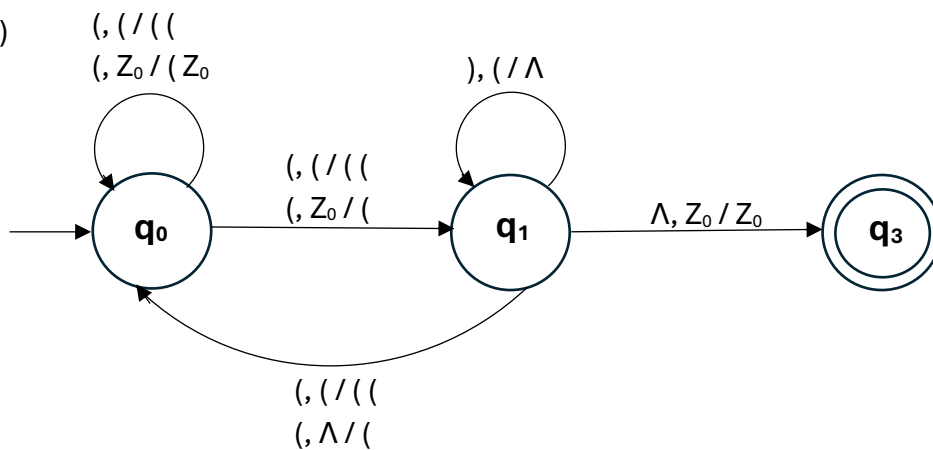
Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	1	1	0	1	0	1	0	0	1	1	Δ
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b)



QUESTION 04

a)



b)

