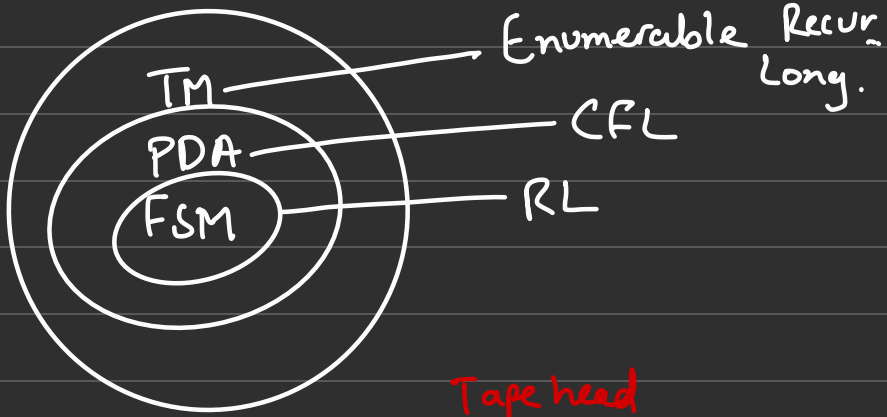
TURING MACHINE



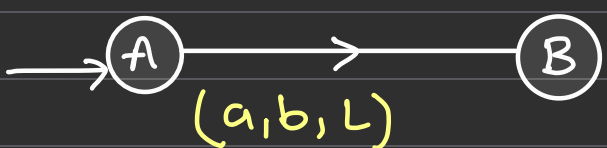
Tape Alphabets $\Sigma = \{a, b, 0, 1, X, Y, Z_0\}$

Blank ($\sqcup$) is special symbol.

$$\sqcup \notin \Sigma$$

OPERATIONS:

- Read/Scan symbol below tape head.
- Write/update symbol below tape head.
- Move tape head one step right.
- Move tape head one step left.



read 'a' replace it with 'b' and move left.

7-TUPLES

Q = set of states
Σ = set of input Alphabets
δ = Transition function
Γ = tape symbols
F = final states
B = Blank symbol
q_0 = Initial state

TRANSITION:

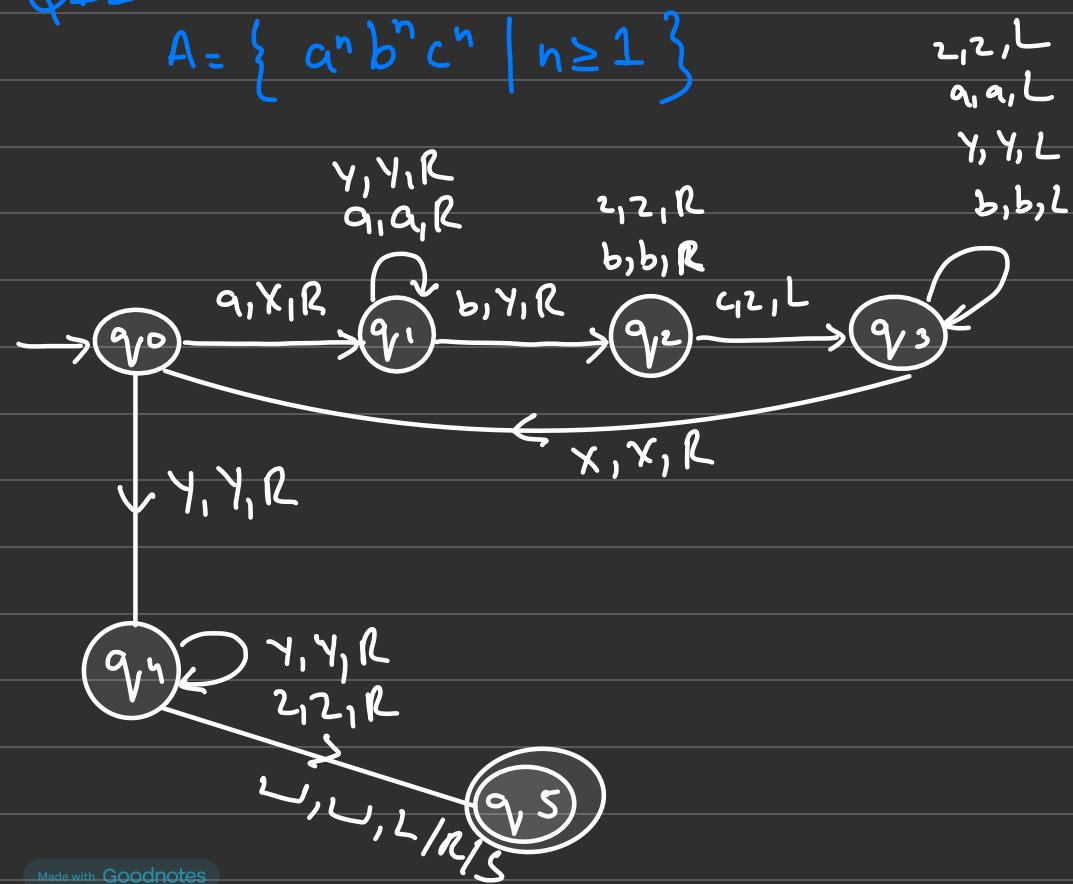
$$\delta = Q \times \Gamma \longrightarrow Q \times \Gamma \times (\text{Left/Right/static})$$

$$(q_0, a) \longrightarrow (q_1, z, L)$$

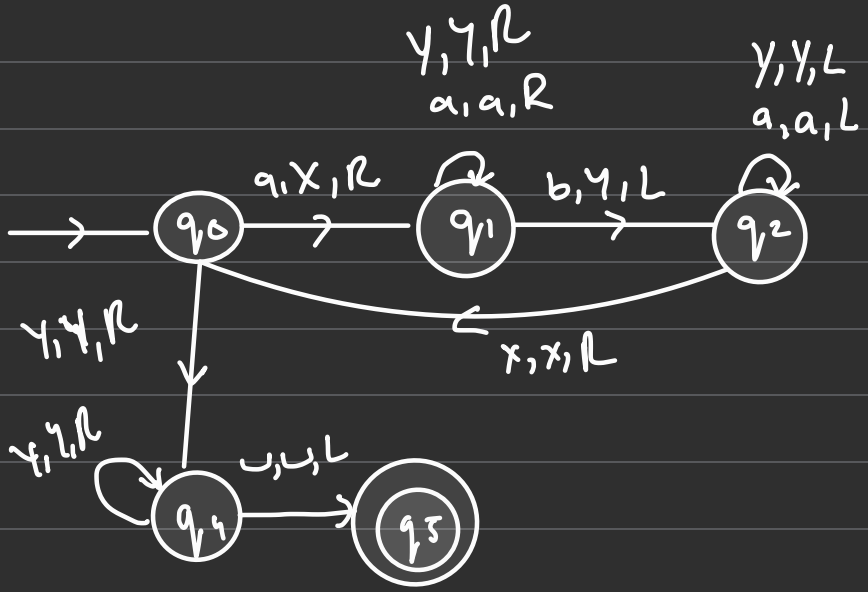
TM
- → Lang Accept
- → Func. computation $x+y / x-y / xxy$

Q#1

$$A = \{ a^n b^n c^n \mid n \geq 1 \}$$



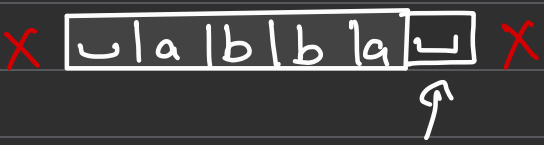
Q#2 $A = \{ a^n b^n \mid n \geq 1 \}$

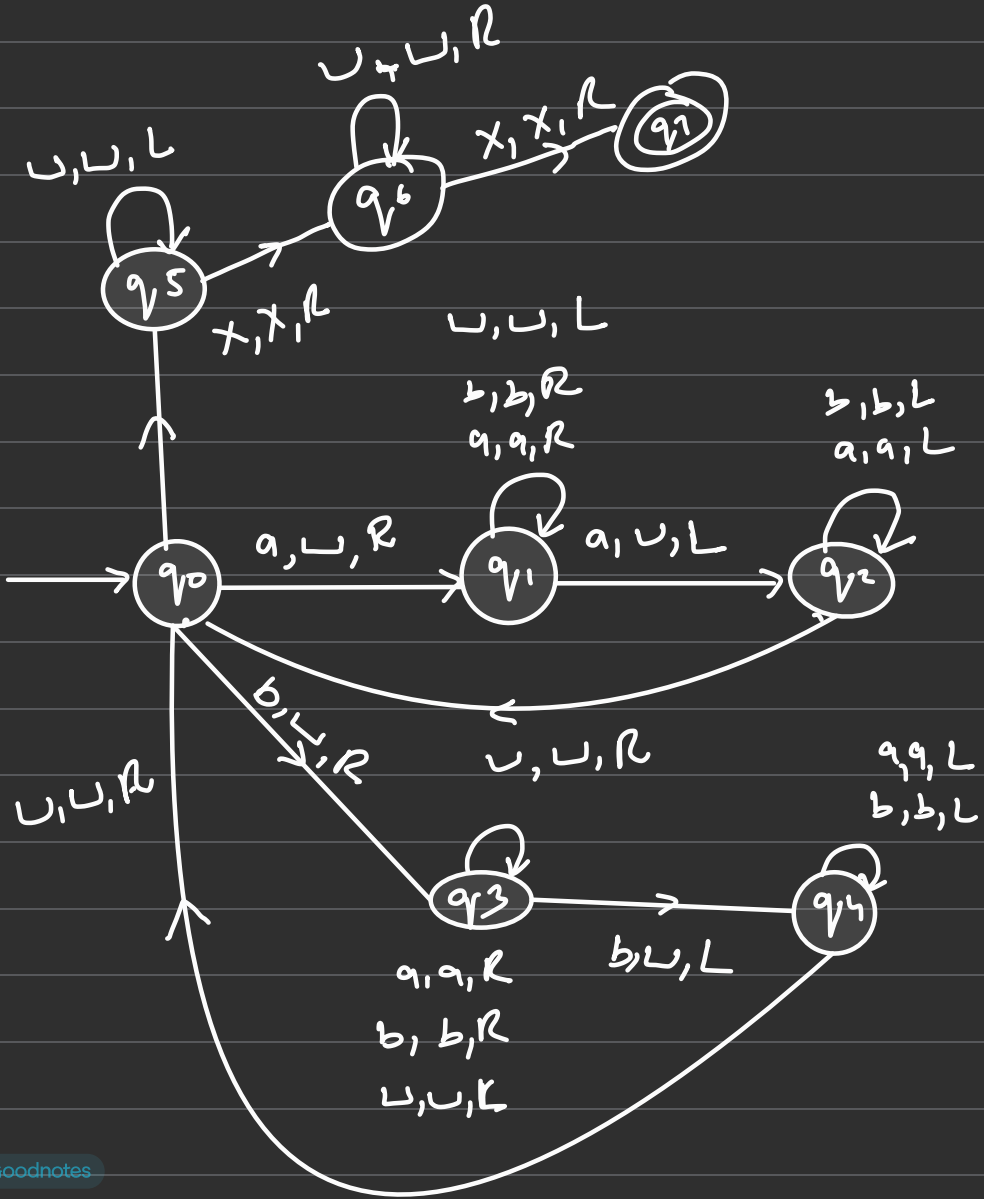


␣	a	a	b	b	␣
␣	X	a	b	b	␣
␣	X	a	Y	b	␣
␣	X	a	Y	b	␣

␣	X	a	Y	b	␣
␣	X	X	Y	b	␣
␣	X	X	Y	Y	␣

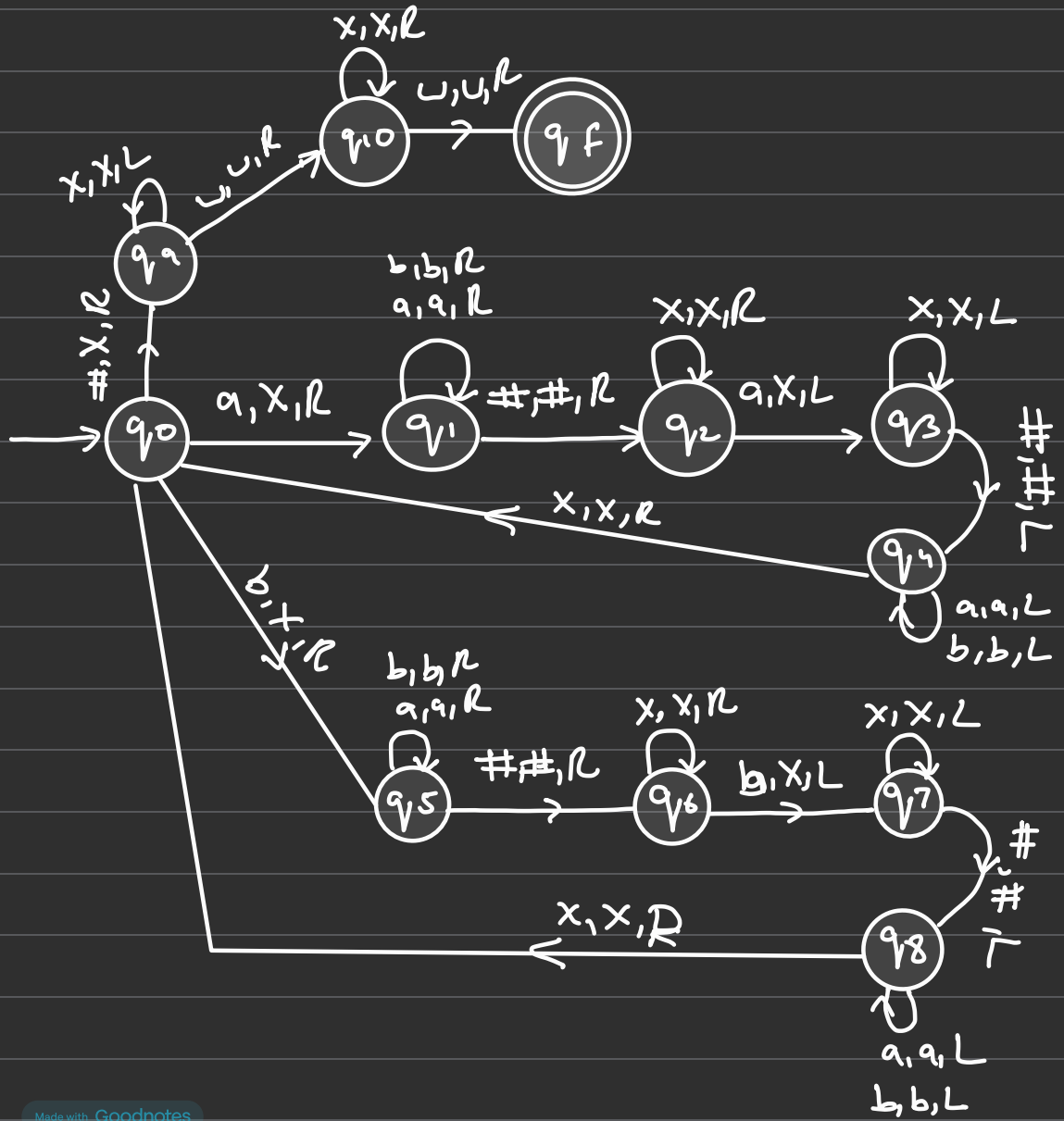
$A = \{ ww^R \mid w \in \{a,b\} \}$



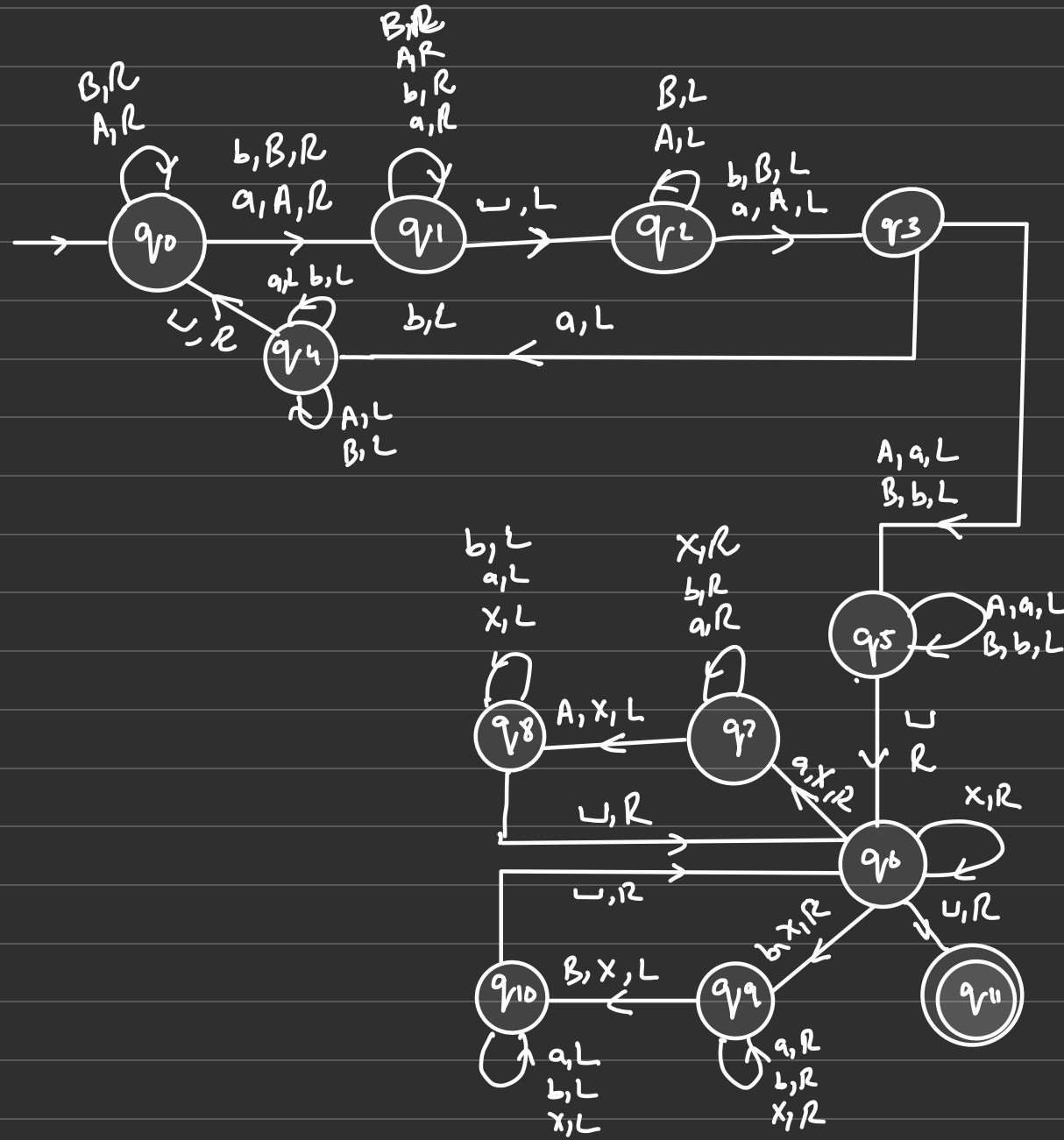


$w\#w \quad w \in \{a,b\}^*$

␣	a	b	#	a	b	␣



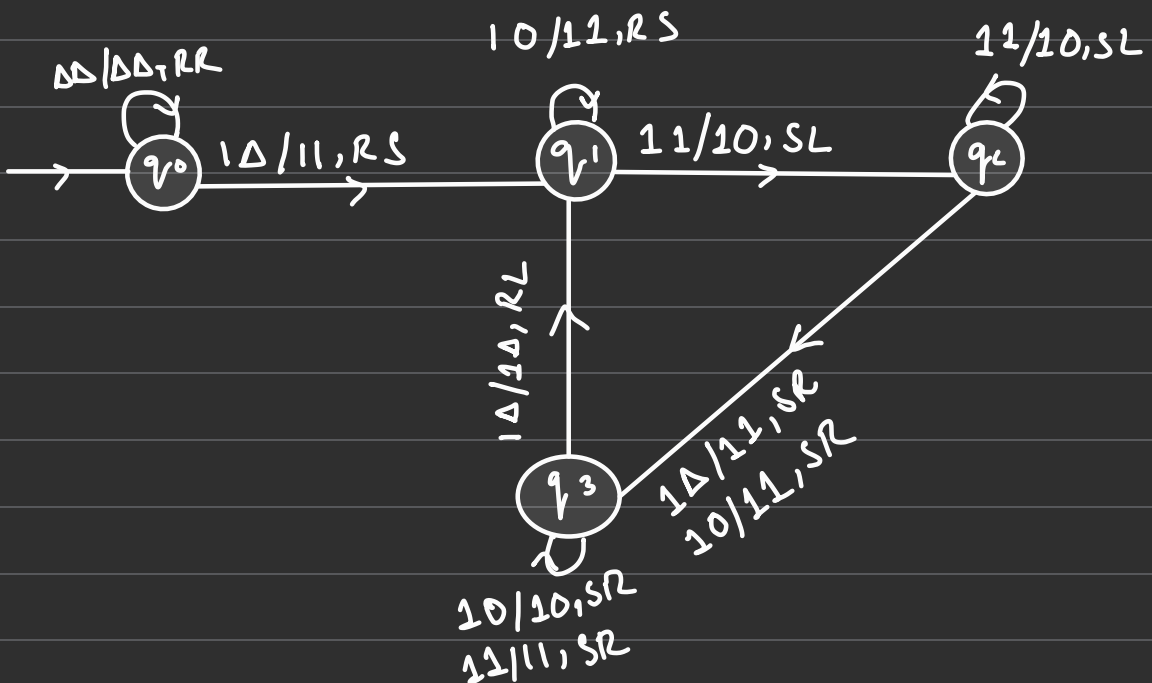
$w \in \{a, b\}^*$ ww



Q. Convert unary representation to binary.

E.g : 1111(4) → 100

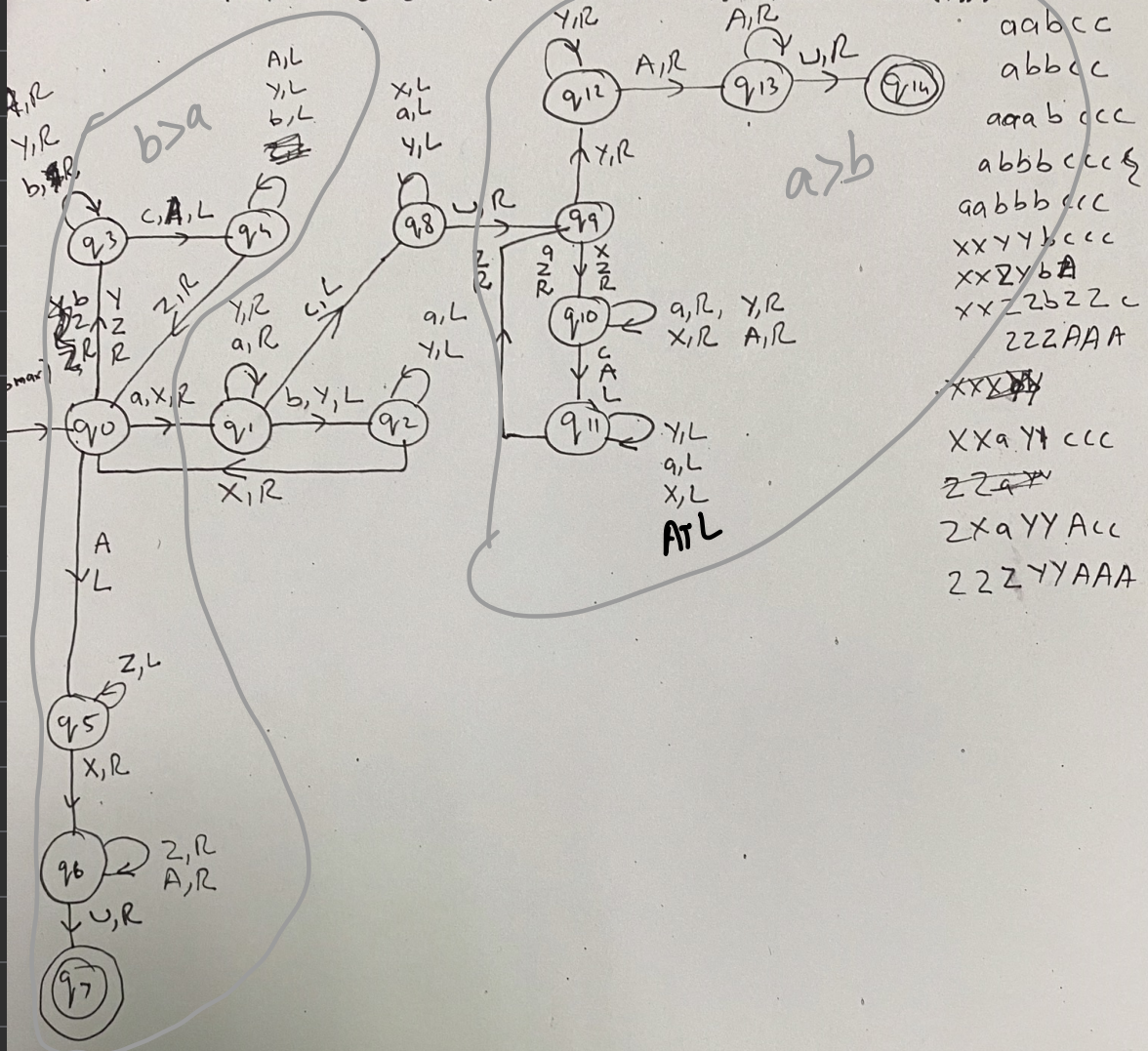
T_1: Δ1111Δ
T_2: ΔΔΔΔΔ



Duration:	20 Minutes	Total Marks:	10	
Paper Date:		Weight		
Section:		Page(s):		
Exam:	Quiz 3	Roll No.	21L-1798	

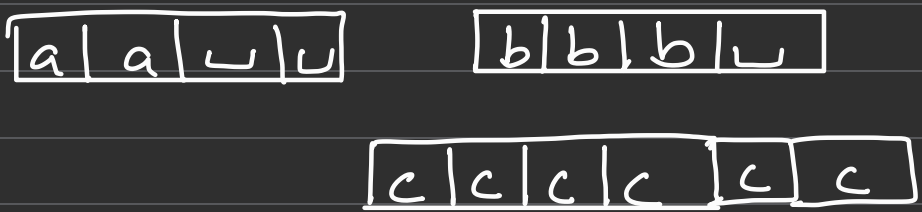
Instruction/Notes: Use back side of this ass for rough work. Write down final answers only in the given space provided.

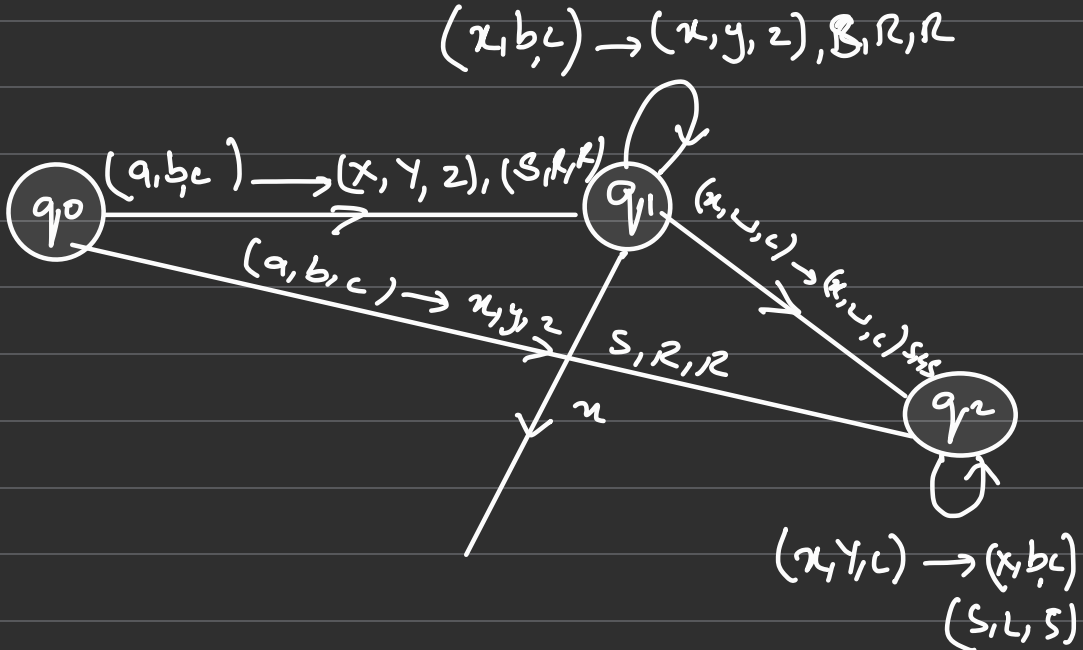
Problem # 1: Design a deterministic one-tape Turing machine, with input alphabet {a, b, c}, that accepts the language L = { $a^i b^j c^k$ where i>=1, j >=1, and k = max{i, j} }



aabcc
abbcc
aaabccc
abbbcccc
aabbbccc
XXYYbccc
XXZYbA
XXZZbZZc
ZZZAAA
XXXYY
XXaYYccc
ZZaYY
ZXaYYAcc
ZZZYYAAA

Q. $\{ a^i b^j c^k \mid i,j,k \geq 1 \quad k = i \times j \}$

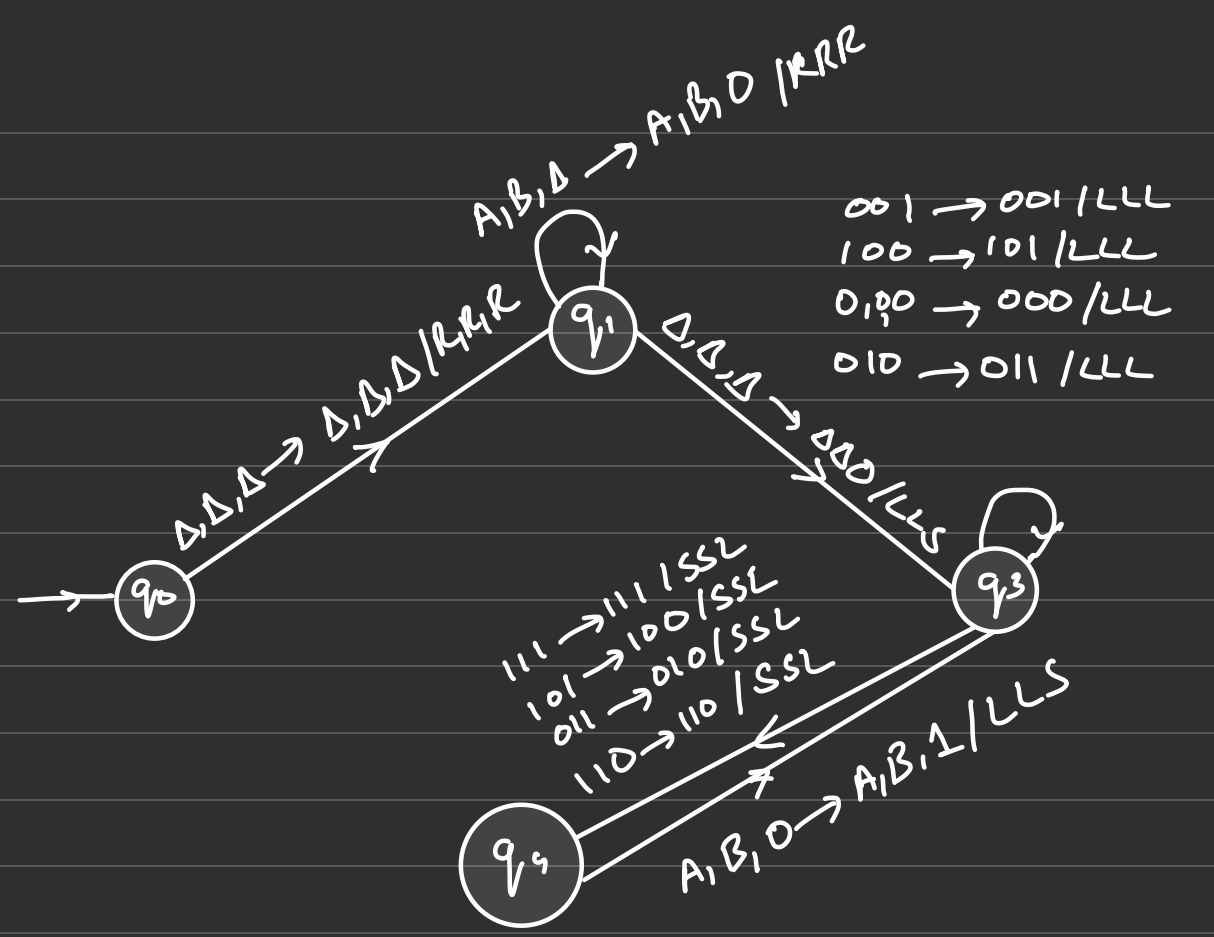




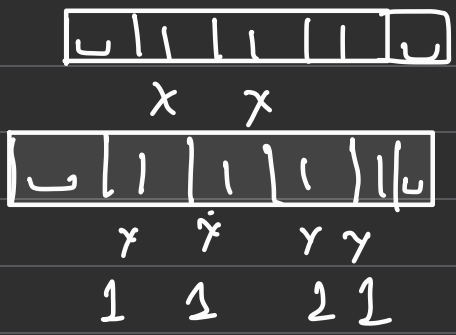
Q. Add 2 Binary Nos

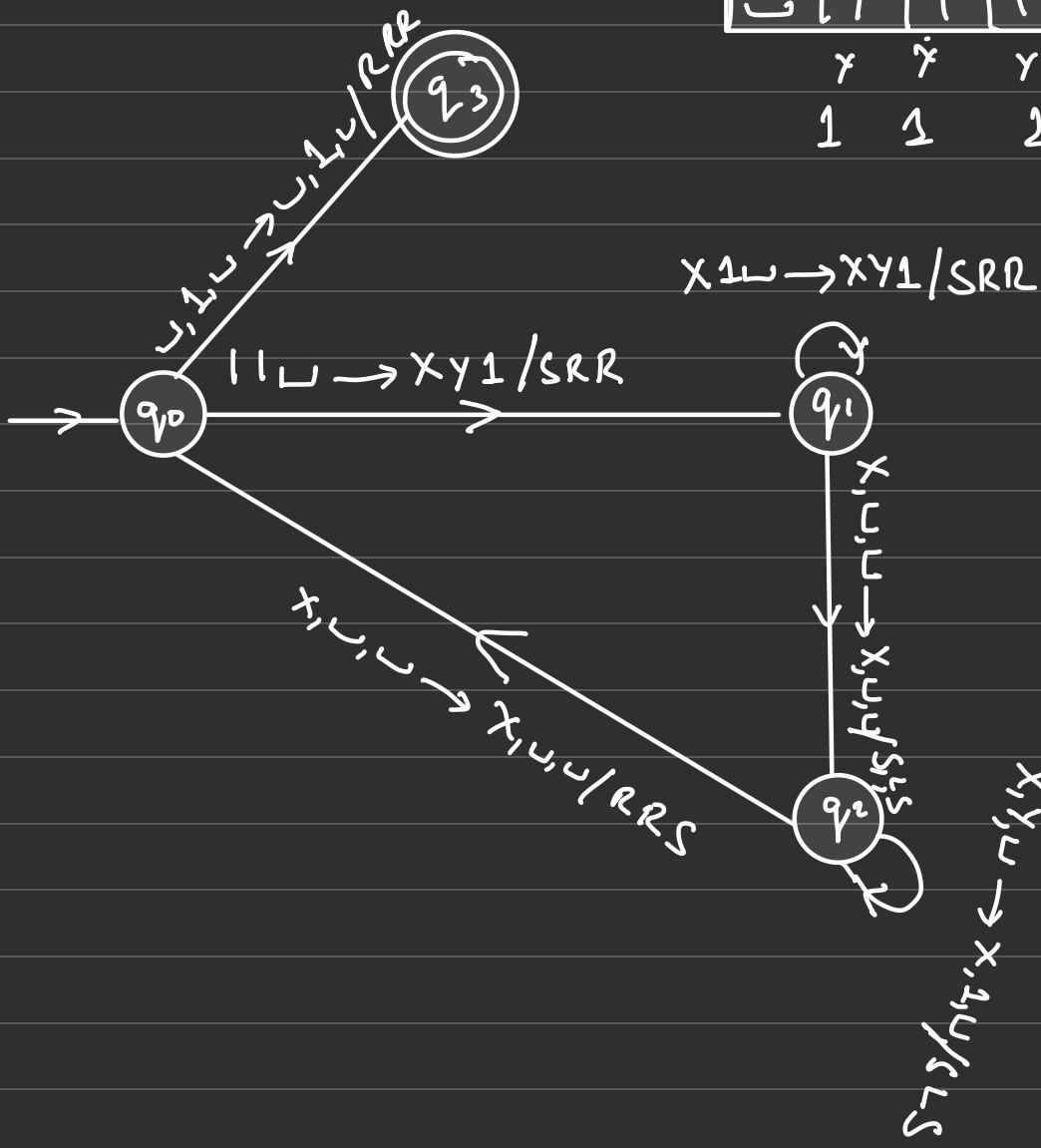
A = 1101
B = 0011
C = 10000

X	Y	Z	Sum	C
0	0	0	0	0
0	1	0	1	0
0	0	1	1	0
1	0	0	1	0
1	1	0	0	1
0	1	1	0	1
1	0	1	0	1
1	1	1	1	1



Q. Multiply 2 nos in unary form.





mod division

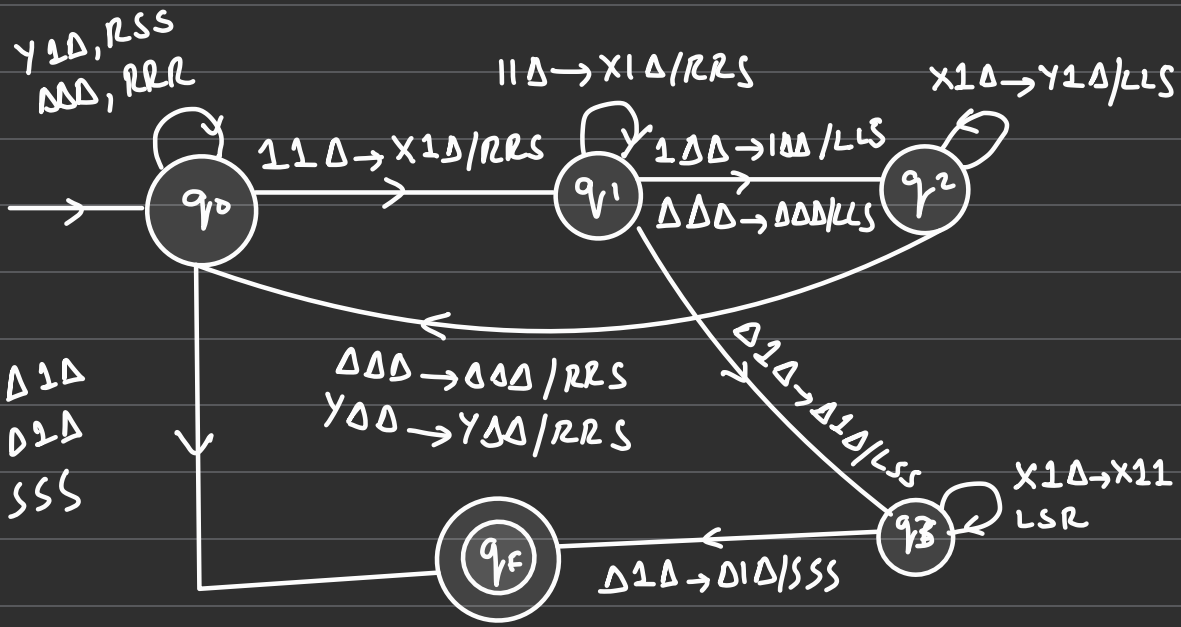
Q. Mod of 2 no.s in unary.

S.T. 2 = 1

T_1 : Δ 11 111 Δ

T_2 : Δ 11Δ

T_3 : ΔΔ ΔΔ

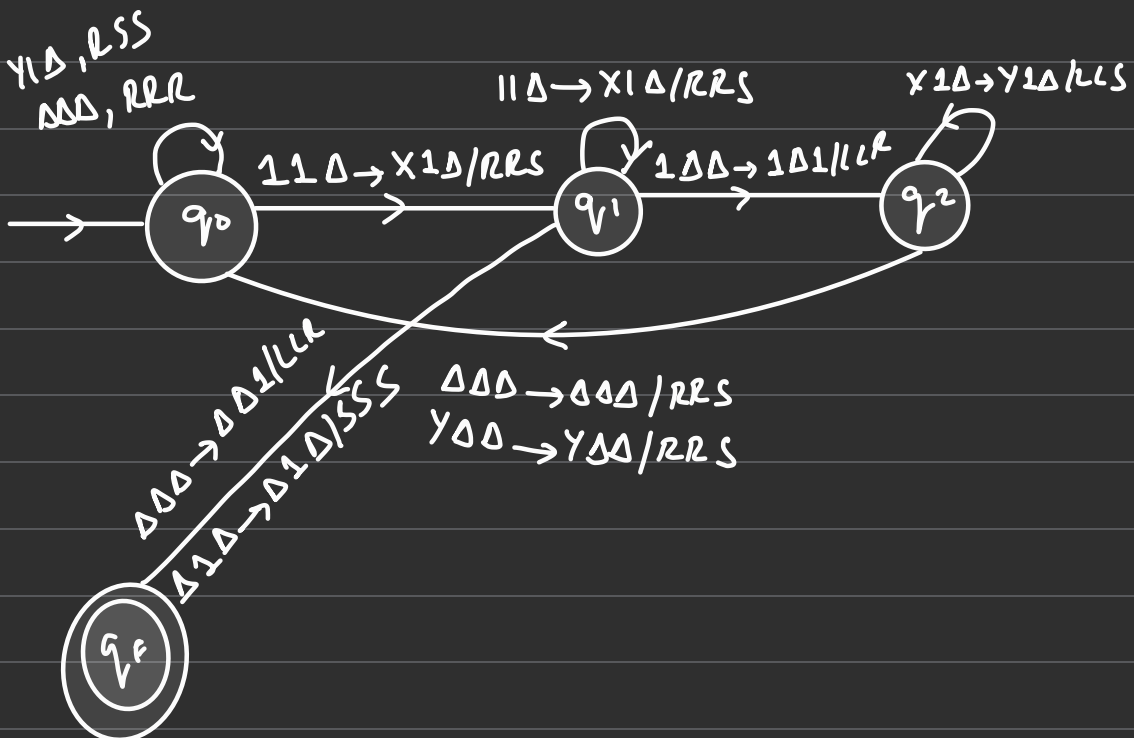


Q. Division of 2 unary nos.

T_1 : Δ 11 111 Δ

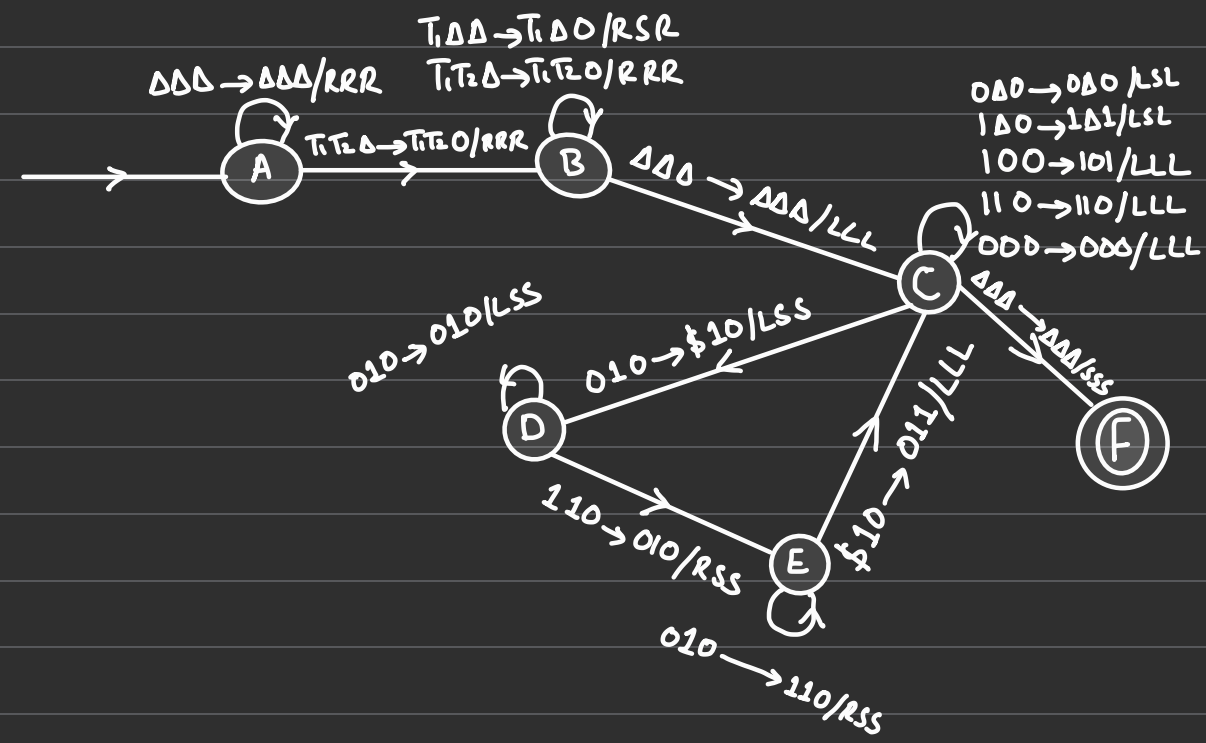
T_2 : Δ 11Δ

T_3 : ΔΔ ΔΔ



Q. Subtract

	Δ	1	1	0	0	Δ
$T_1 = \{0,1\}$	Δ	1	1	1	Δ	Δ
$T_2 = \{0,1\}$	Δ	Δ	Δ	Δ	Δ	Δ



MULTITRACK

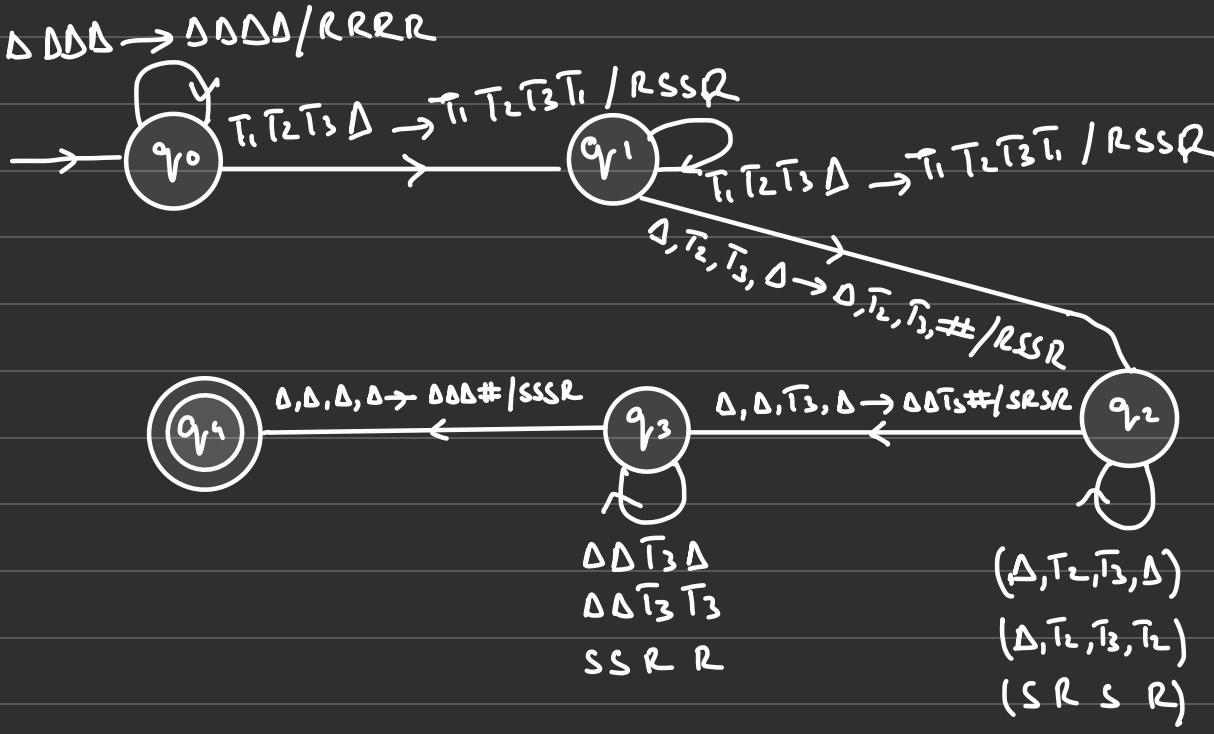
All the tape heads will move on a single transition.

$$(a, X, b) \longrightarrow (q, Y, Z), R$$

TOA-ASSIGNMENT-4

Moeez Ali
21L-1798

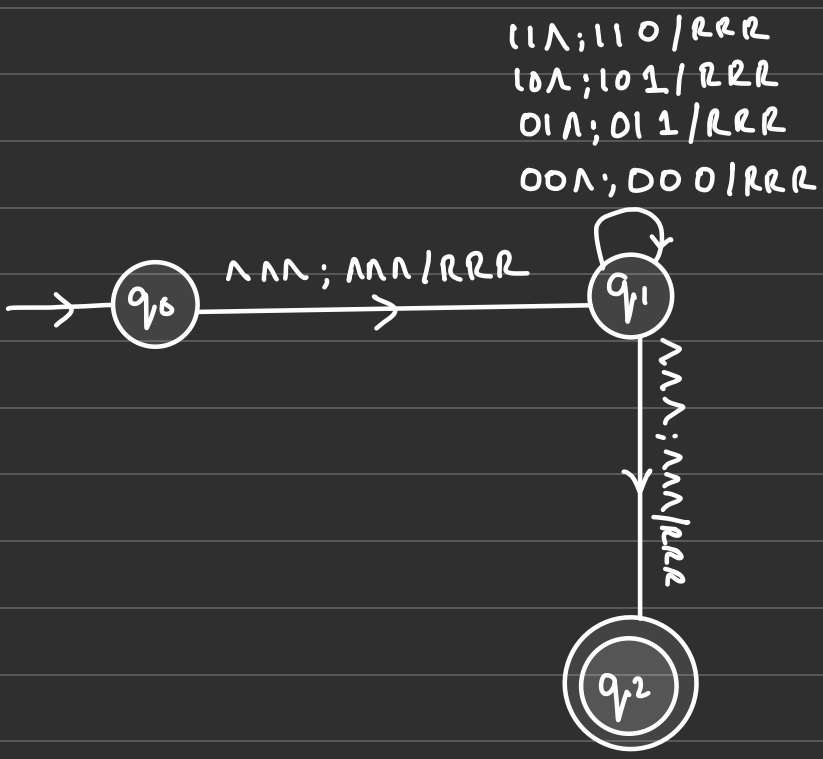
T_1 Δ a b Δ
T_2 Δ b b a Δ
T_3 Δ b Δ
T_4 Δ Δ Δ Δ Δ ...



Concatenate 3 strings in T_4

Q#2

T_1:	Δ	1	0	1	1	Δ
T_2:	Δ	1	1	0	0	Δ
T_3:	Δ	Δ	Δ	Δ	Δ	Δ



Perform XOR on T_1, T_2 and store result into T_3

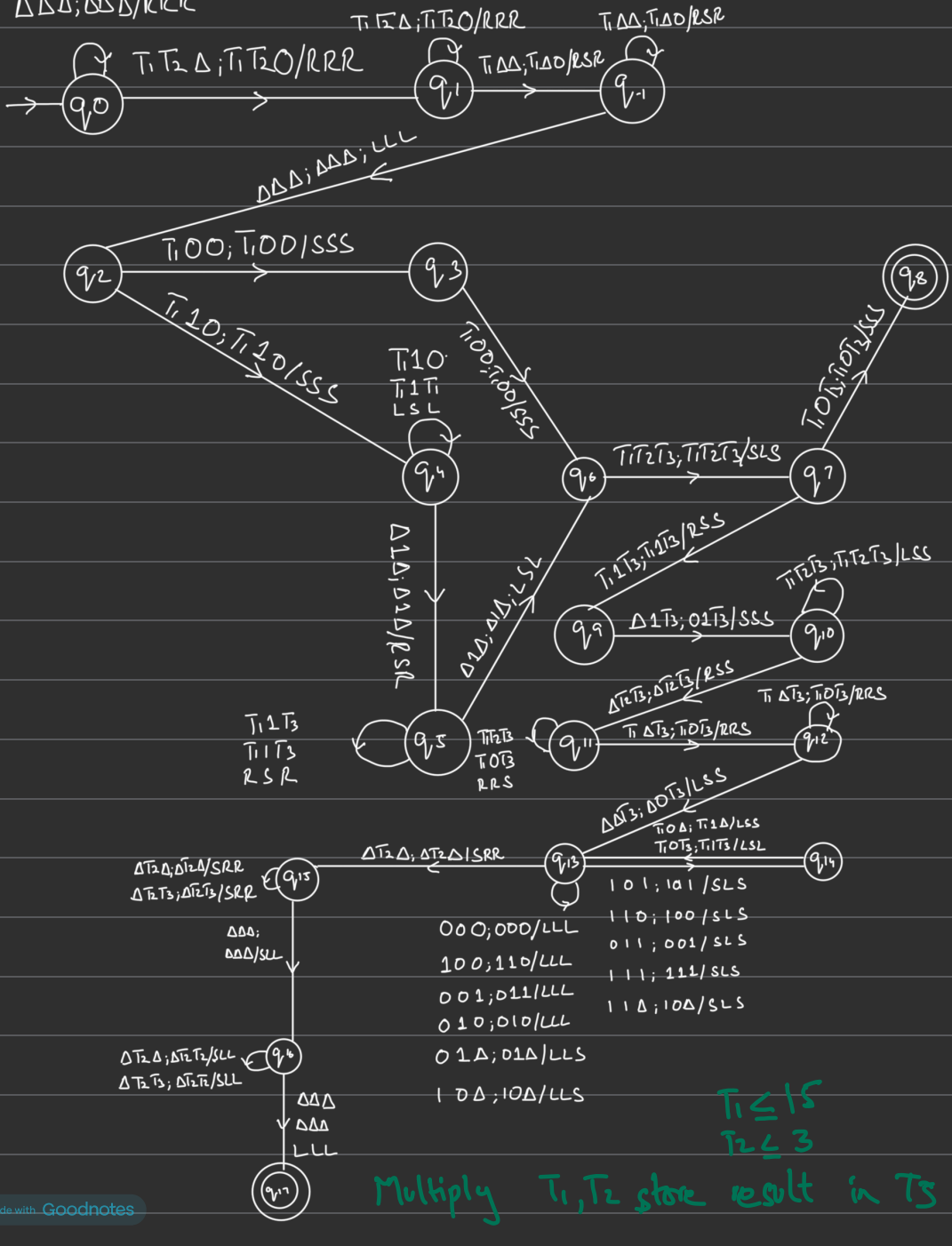
Q#3

T_1: Δ 1 1 1 1 Δ

T_2: Δ 1 1 Δ Δ Δ

T_3: Δ Δ Δ Δ Δ ⌀

ΔΔΔ; ΔΔΔ/RRR



$T_1 \leq 15$

$T_2 \leq 3$

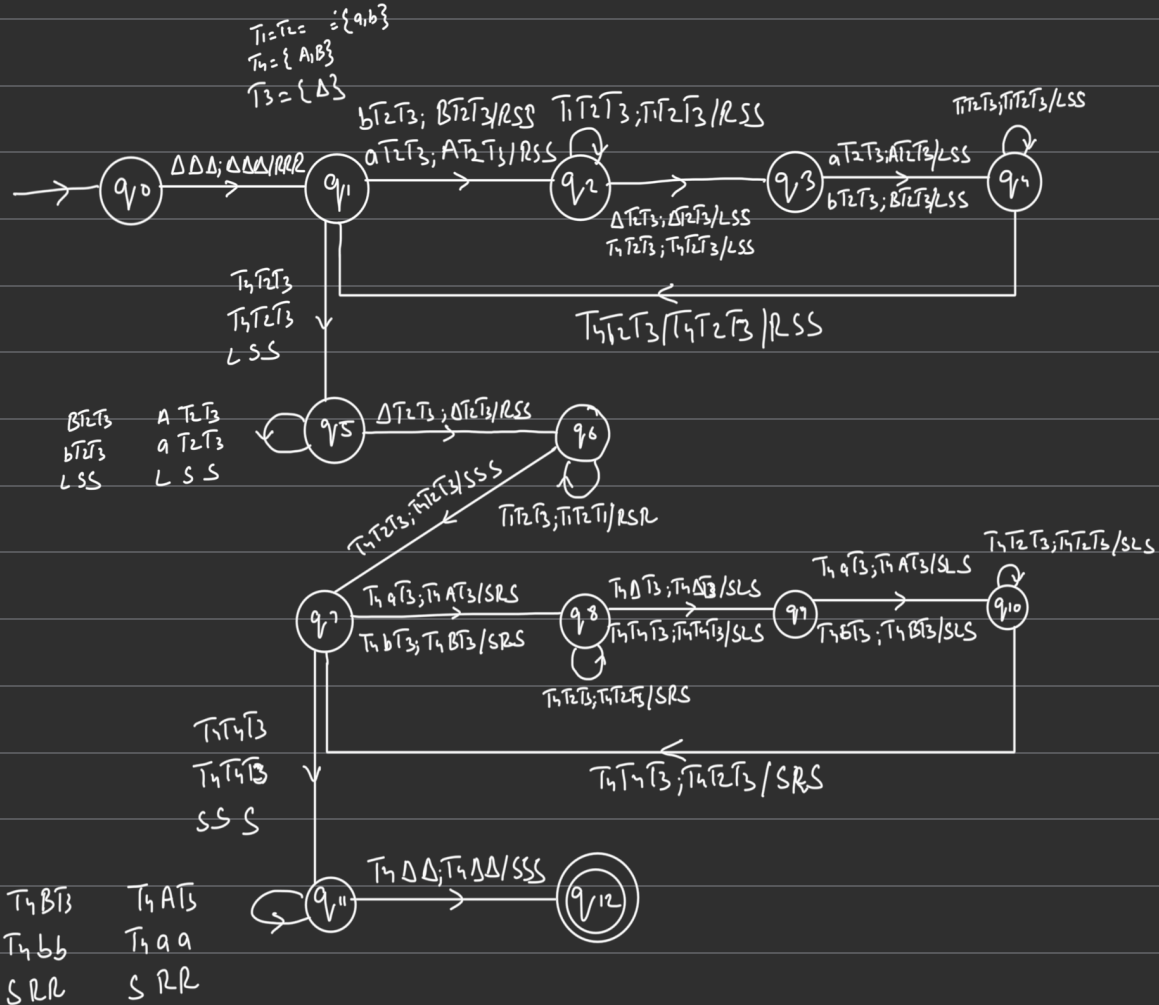
Multiply T_1, T_2 store result in T_3

Q#4

T_1: Δ a b b b Δ

T_2: Δ b b b a b a Δ

T_3: Δ Δ Δ Δ . . . .



Concatenate 1st half of 1st string and 2nd half of 2nd string.