Name: Debdatta Kundu
Roll no: 1811092
Batch: B2

TACC IA-2

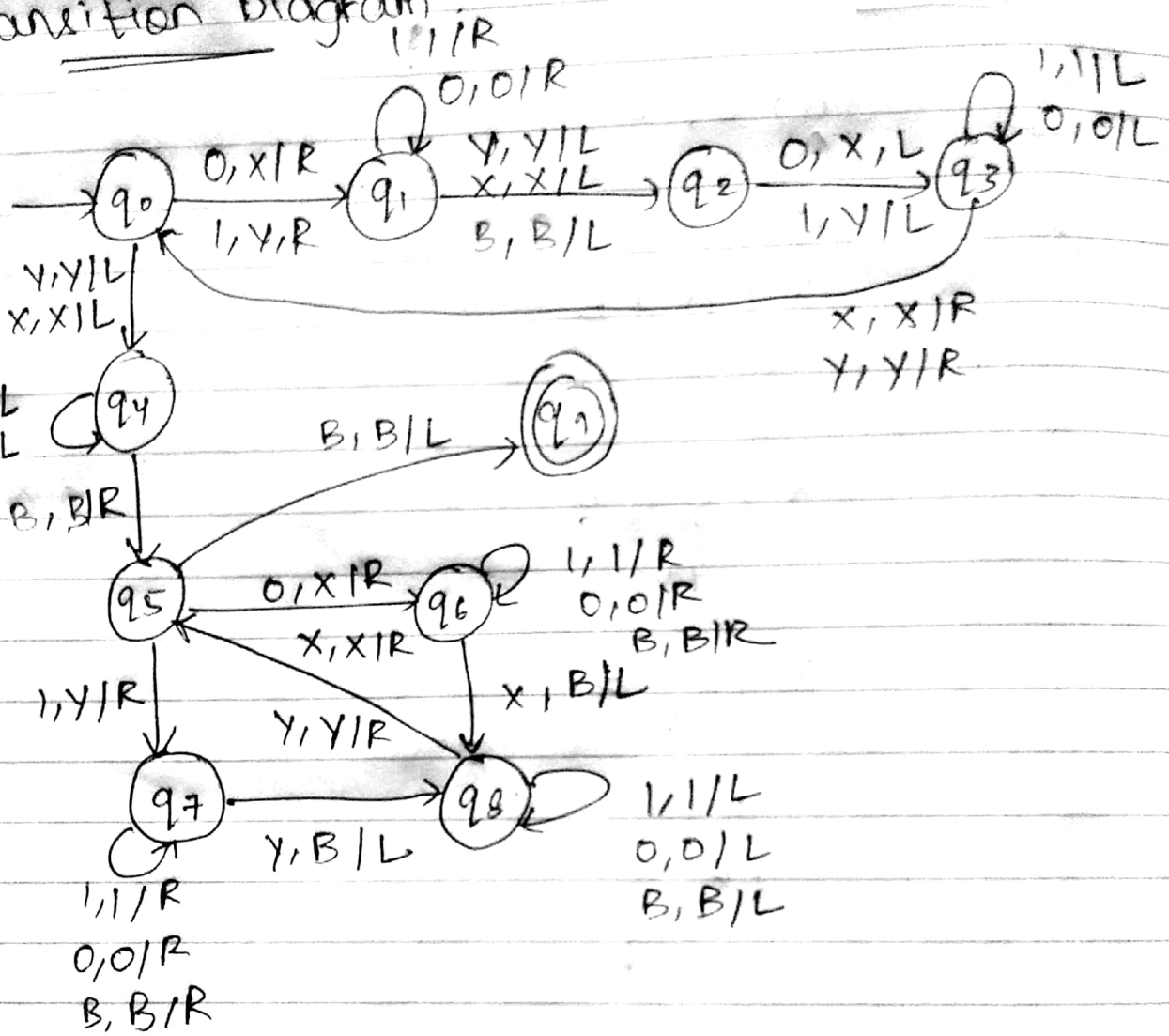
Q.2 Construct a Turing Machine for language $L = \{ww \mid w \in \{0,1\}\}$

Ans: Logic Used:

→ The first thing is to find middle of string. For this, convert a 0 or 1 from begenning of string into X or Y respectively and corresponding 0 or 1 into X or Y from end of string.
→ After continuously doing this, you will finally reach a point when all 0's and 1's have been converted to X and Y. At this point, you are at mid-point of string.
→ Now convert all X's and Y's on left of mid point to 0's and 1's. At this point first half of the string is in the form of 0 and 1. second half is in the form of X & Y.
→ Now, start from beginning of string. If you have zero then convert it into X and move right till reaching the second half. Here, if we find X then convert it into Blank (B).
→ Then traverse back till you find an X or Y. Convert the 0 or 1 on the right of it into X and Y respectively and correspondingly convert its X or Y in second half of string to Blank B.
→ Keep doing this till all symbols on left part are converted to X and Y & all symbols in right part are converted into blanks. If one part is converted but in other some symbols are left then string is not accepted. If you did not find an X or Y in the second half for a corresponding 0 or 1 in first half then also string not accepted.

In all other cases, string is accepted.

(*) Transition Diagram:



(*) 7-Tuple Definition:

$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9\}$

$\Sigma = \{0, 1\}$

$X = \{0, 1, B, X, Y\}$

$q_0 = \{q_0\}$

B = Blank

$F = \{q_9\}$

(*) Transition Table:

	0	1	B	X	Y
q_0	(q_1, X, R)	(q_1, Y, R)	-	(q_4, X, L)	(q_4, Y, L)
q_1	$(q_1, 0, R)$	$(q_1, 1, R)$	(q_2, B, L)	(q_2, X, L)	(q_2, Y, L)
q_2	(q_3, X, L)	(q_3, Y, L)	-	-	-
q_3	$(q_3, 0, L)$	$(q_3, 1, L)$	-	(q_0, X, R)	(q_0, Y, R)
q_4	-	-	(q_5, B, R)	$(q_4, 0, L)$	$(q_4, 1, L)$
q_5	(q_6, X, R)	(q_7, Y, R)	(q_9, B, L)	-	-
q_6	$(q_6, 0, R)$	$(q_6, 1, R)$	(q_6, B, R)	(q_8, B, L)	-
q_7	$(q_7, 0, R)$	$(q_7, 1, R)$	(q_7, B, R)	-	(q_8, B, L)
q_8	$(q_8, 0, L)$	$(q_8, 1, L)$	(q_8, B, L)	(q_5, X, R)	(q_5, Y, R)
q_9	-	-	-	-	-

(*) simulation:

(g) B 0 1 0 1 B
↑
q_0

B X 1 0 1 B
↑
q_1

B X 1 0 1 B
↑
q_1

B X 1 0 1 B
↑
q_1

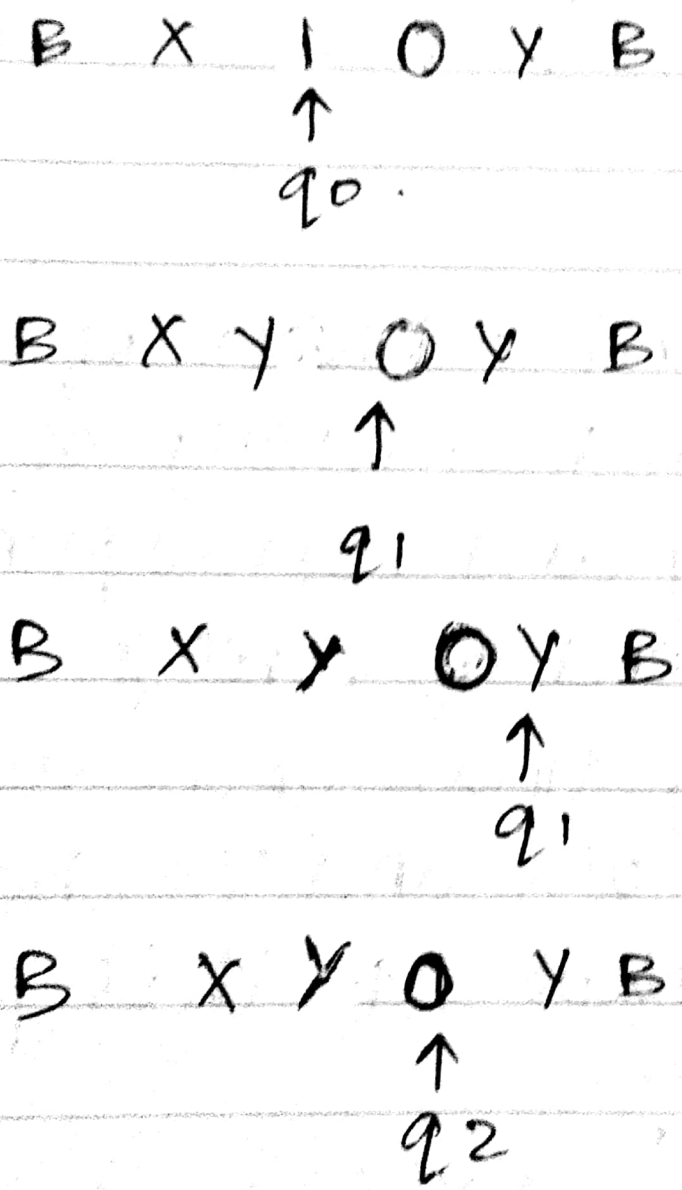
B X 1 0 1 B
↑
q_1

B X 1 0 1 B
↑
q_2

B X 1 0 Y B
↑
q_3

B X 1 0 Y B
↑
q_3

B X 1 0 Y B
↑
q_3



B X Y X Y B

↑

q_3

B X Y X Y B

↑

q_0

B X Y X Y B

↑

q_4

B X 1 X Y B

↑

q_4

B 0 1 X Y B

↑

q_4

B 0 1 X Y B

↑

q_5