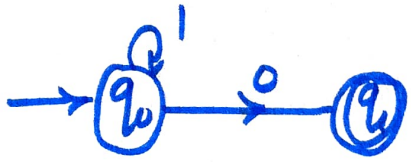
14) Construct the minimal FA that accept all the strings of 0's & 1's where every string ends with -

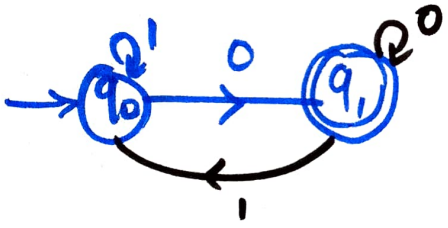
(a) 0 (b) 10 (c) 011

→ (a) $\Sigma = \{0, 1\}$; $w = X0$

$L = \{0, 00, 10, 110, 1010, 10110, \cdots\}$



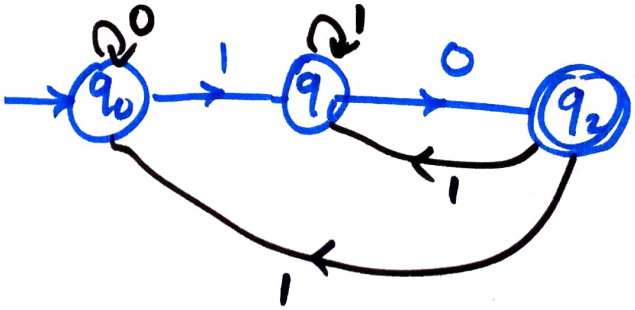
No. of States = 2



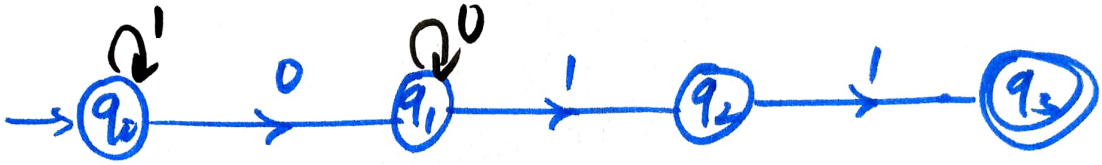
(b) $\Sigma = \{0, 1\}$; $w = X10$

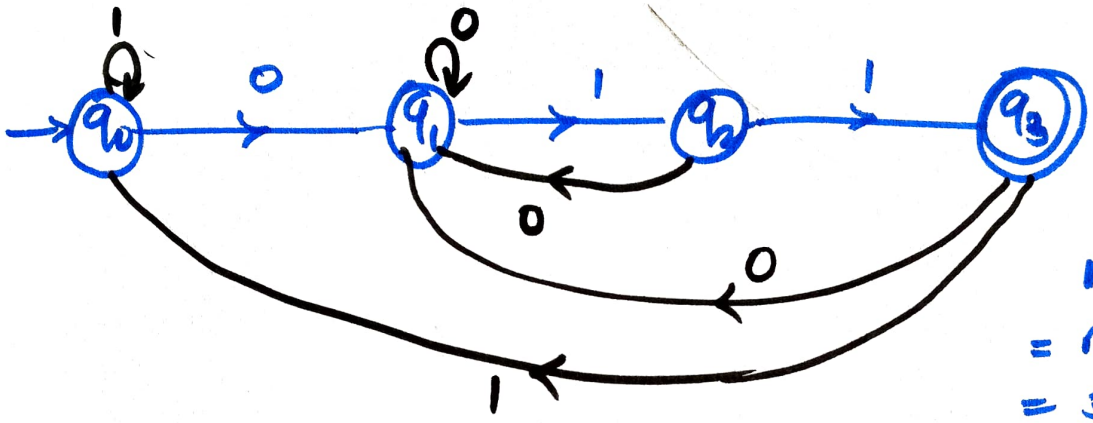
$L = \{10, 010, 0010, 110, 0110, 00110, \cdots\}$

No. of States = 3



(c) $w = x011$ $\quad L = \{011, 11011, 1011, 0011, 00011, \cdots\}$





$n = 3$

$= n+1$

$= 3+1 = 4$

No. of States = 4

Note:-

$w = xs$; $|s| = n$

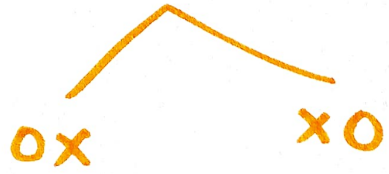
then no. of states in minimal FA to accept the language $= n+1$

15) Construct the minimal FA that accept the strings of 0's & 1's where every string contains the substring.

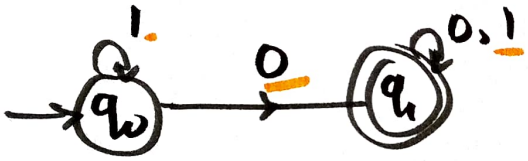
1) 0 2) 10 3) 010

→ $\Sigma = \{0, 1\}$

1) X 0 X



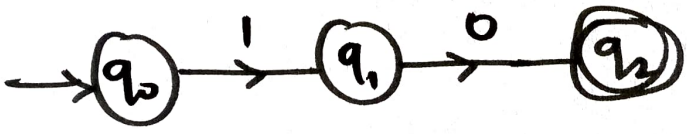
$L = \{0, 01, 10, 00, 001, \cdots\}$

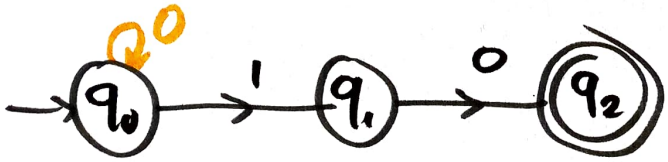


No. of States = 2

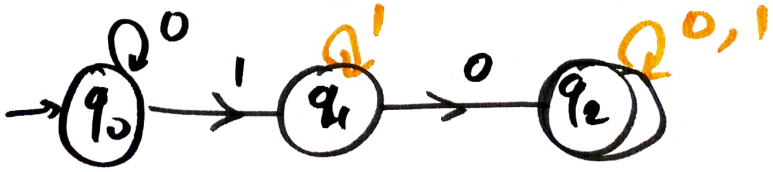
2) X 10 X

$L = \{10, 110, 010, 100, 101, \cdots\}$





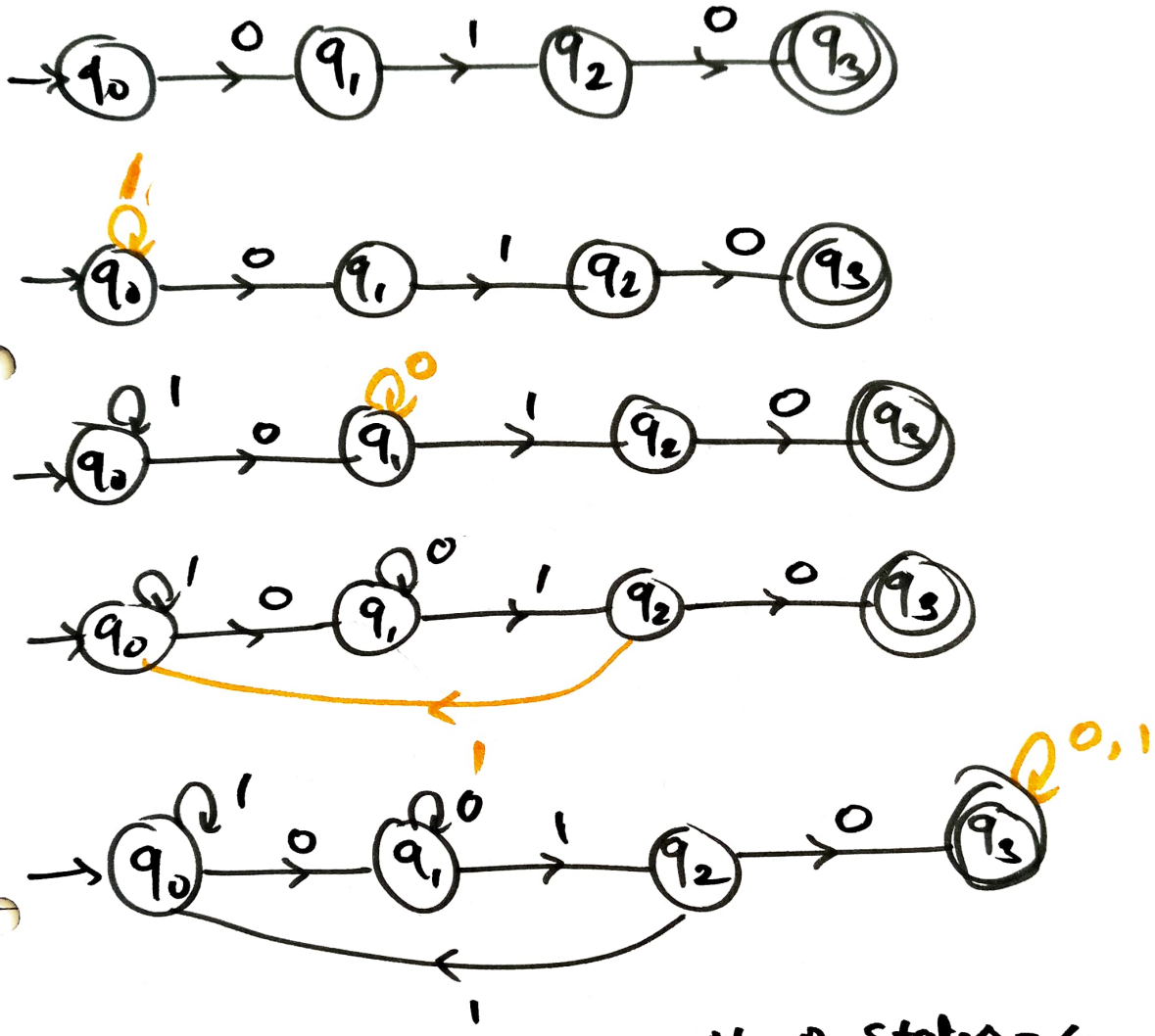
No. of States = 3



3) X010 x

X010 | 010 X

$L = \{010, 1010, 0010, 0100, 0101, \ldots\}$



No. of States = 4

Note :- $W = xSx$; $|S| = n$ then no. of states in minimal FA to accept the language is $\boxed{n+1}$

16) Construct FA that accepts all the strings of 0's & 1's where every string -

i) Starts & ends with '0'.

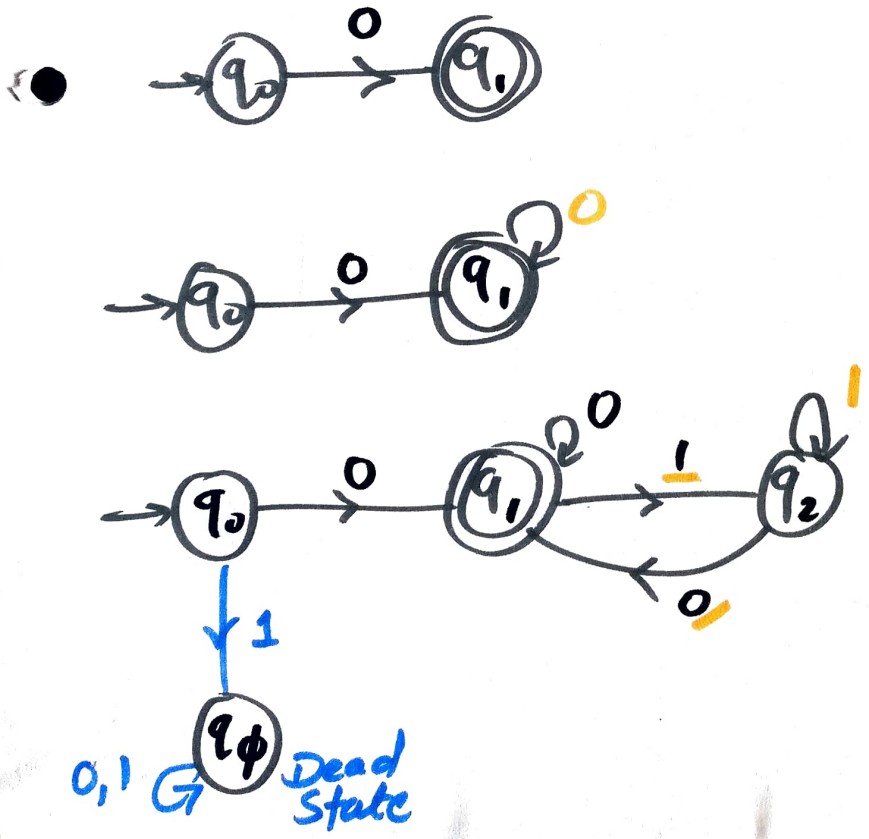
ii) Starts & ends with same symbol.

iii) Starts & ends with different symbol.

→ $\Sigma = \{0, 1\}$

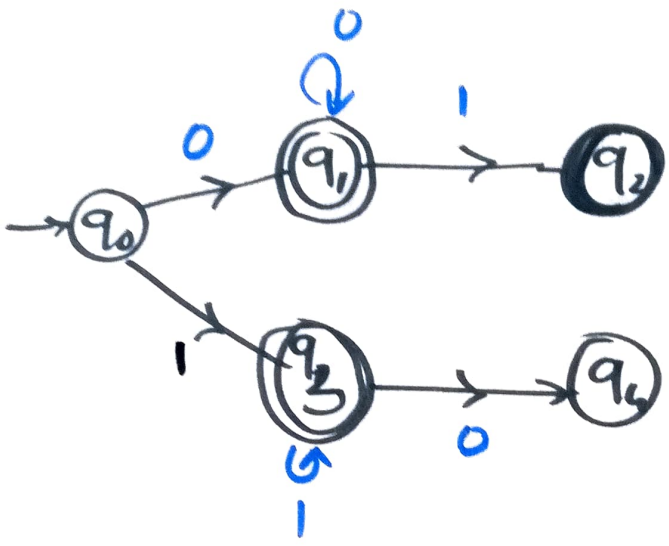
i) $W = 0 \; X \; 0$; 0

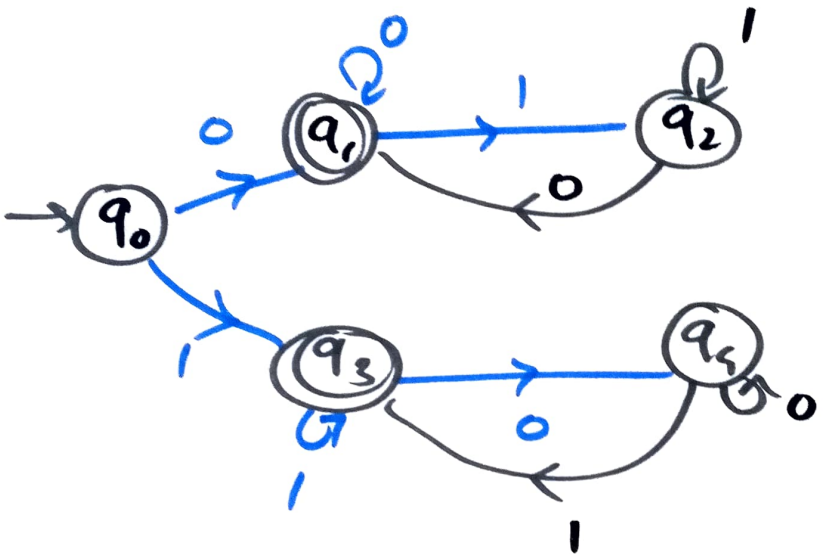
$L = \{ 0, 00, 010, 0110, 01010, \ldots \}$



ii) $W = 0 \times 0 , 0$

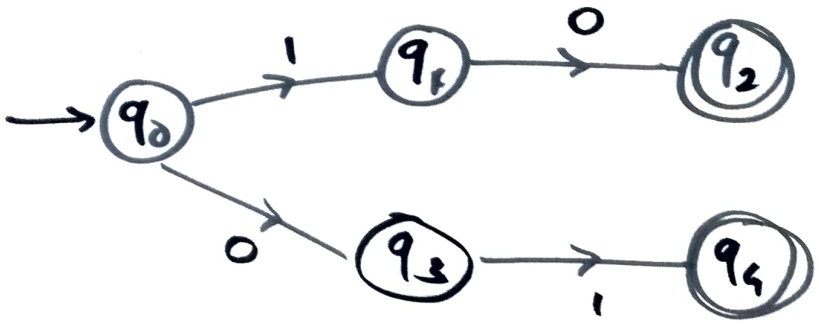
$1 \times 1 , 1$ $\quad L = \{0, 1, 00, 11, 010, 101, \ldots\}$

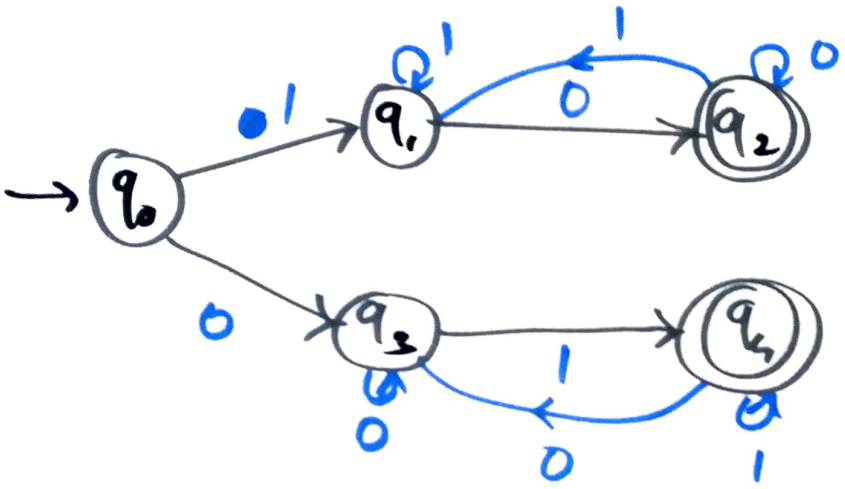




iii) $w = \begin{matrix} 1 & x & 0 \\ 0 & x & 1 \end{matrix}$

$L = \{10, 01, 110, 001, \cdots\}$





17) Construct minimal FA that accepts all the strings of 0's & 1's where every string.

1) Starts with 00 (or) 11

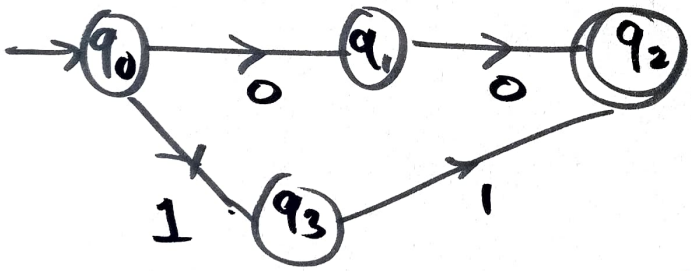
2) Ends with 00 (or) 11

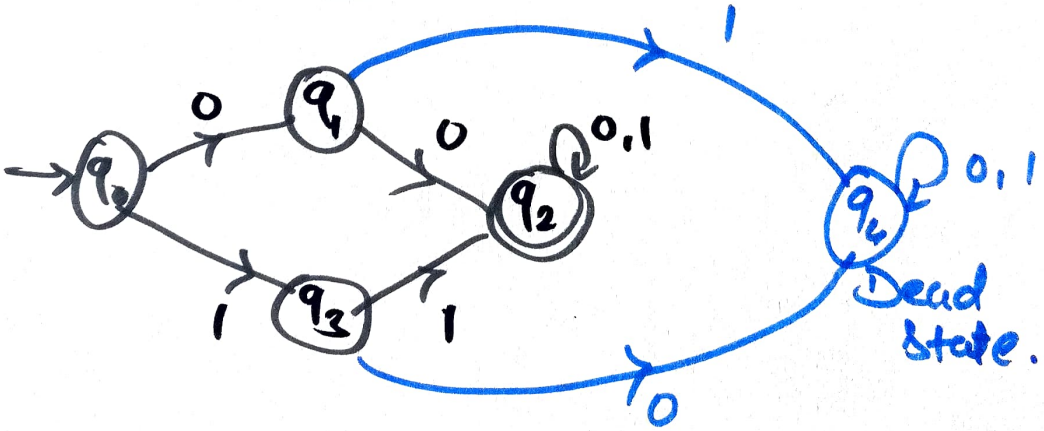
3) ends with 10 (or) 01

→ $\Sigma = \{0, 1\}$

- 1) $w = 00x$; $11x$

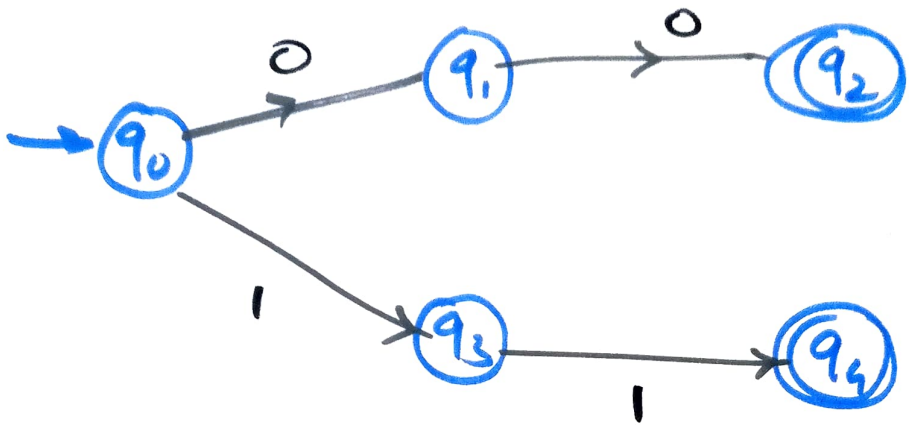
-

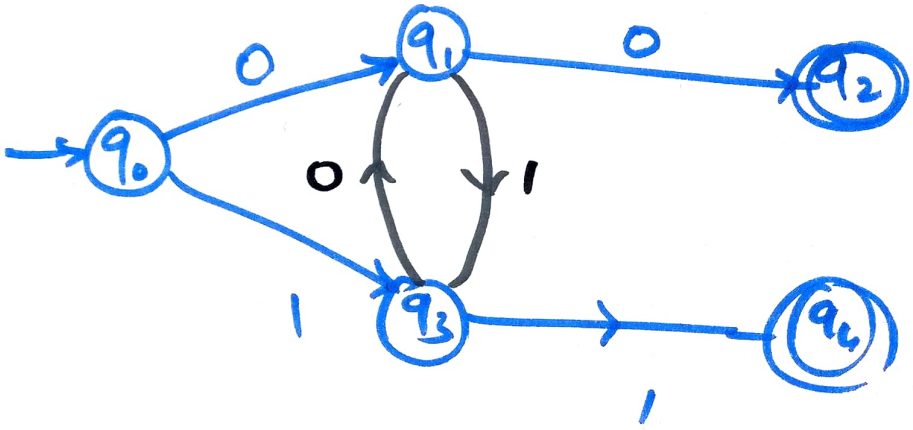


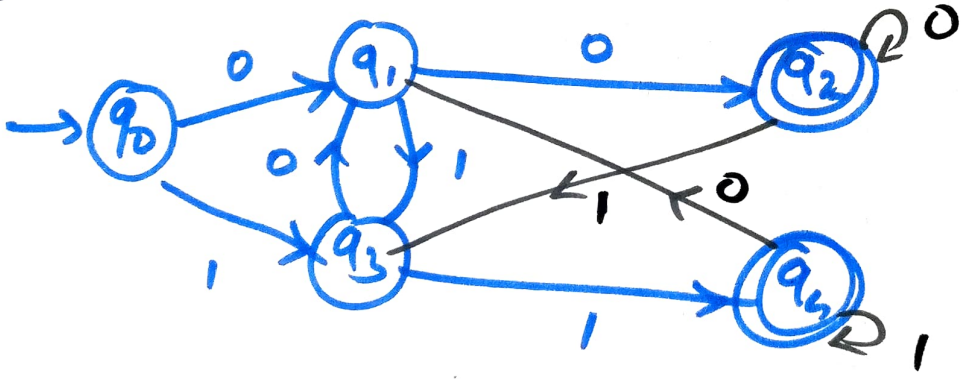


ii) $w = \begin{cases} x\,0\,0 \\ x\,1\,1 \end{cases}$

$x \to 0, 1$



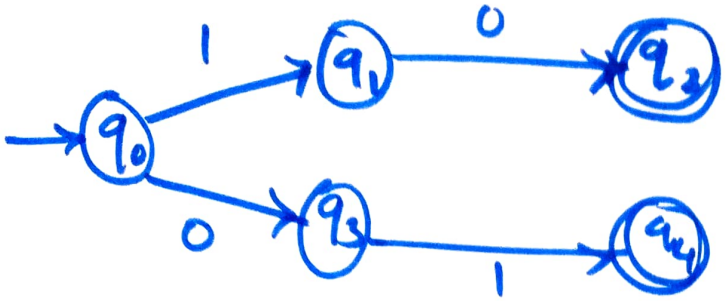


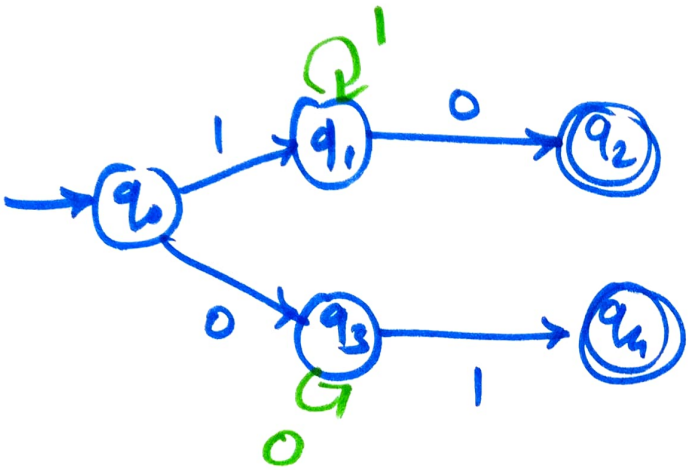


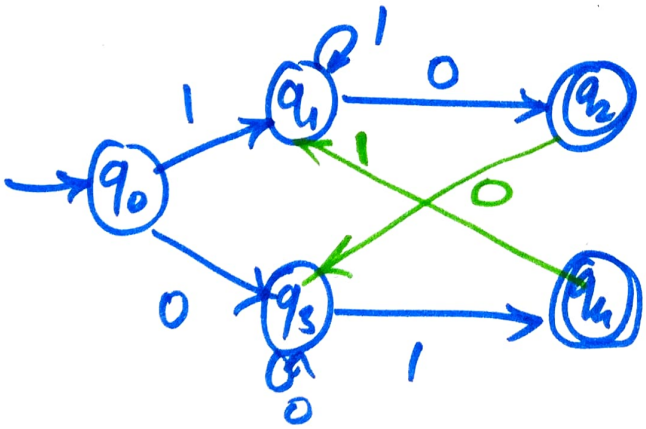
iii) $w = X10$

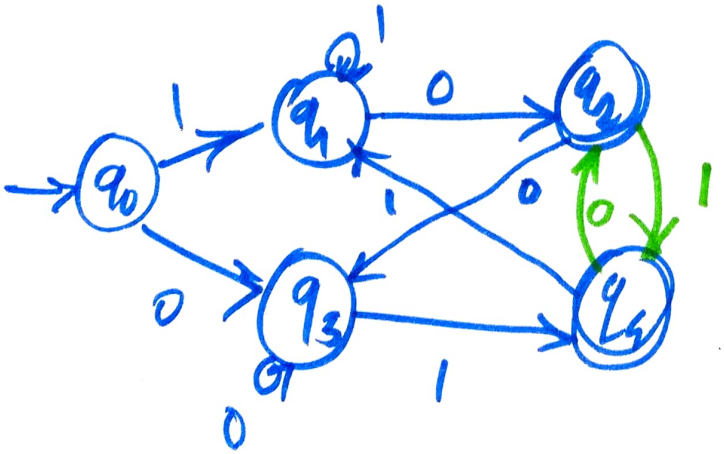
$X01$

$L = \{10, 01, 110, 001, 1001, 0110, 101, 010, \ldots\}$







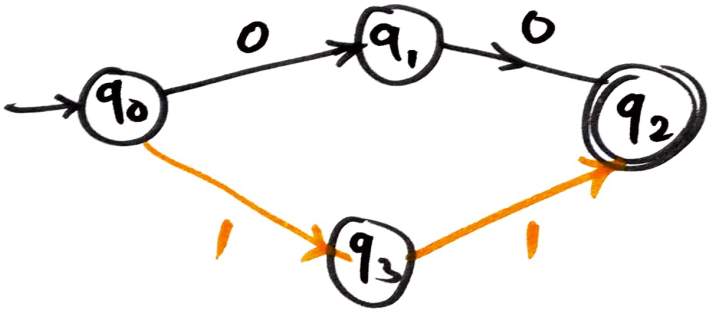


18) Construct minimal FA that accept the all the strings of 0's & 1's where every string contains a substring.

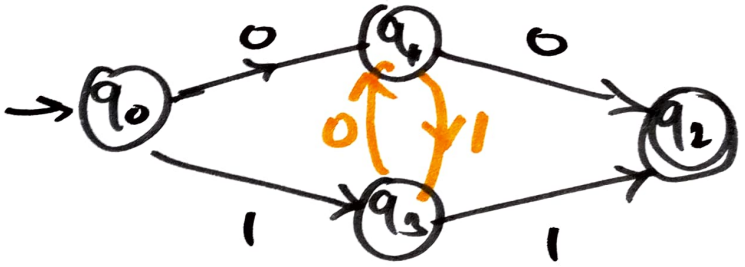
1) DIBIT 2) TRIBIT

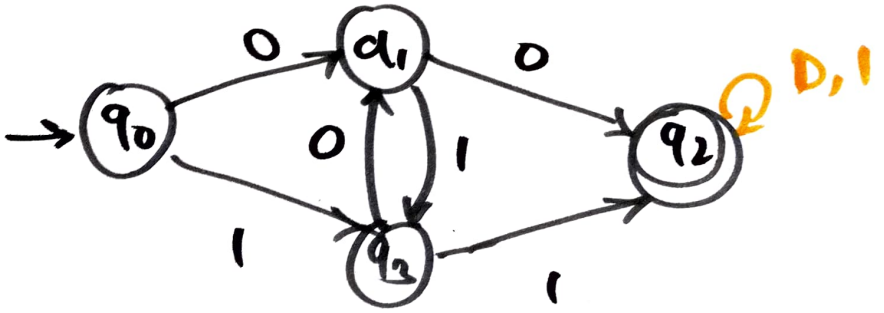
→ 1) $w = \begin{matrix} x00x \\ x11x \end{matrix}$ } is DIBIT

$L = \{00, 11, 011, 100, 1001, 0110, \ldots\}$



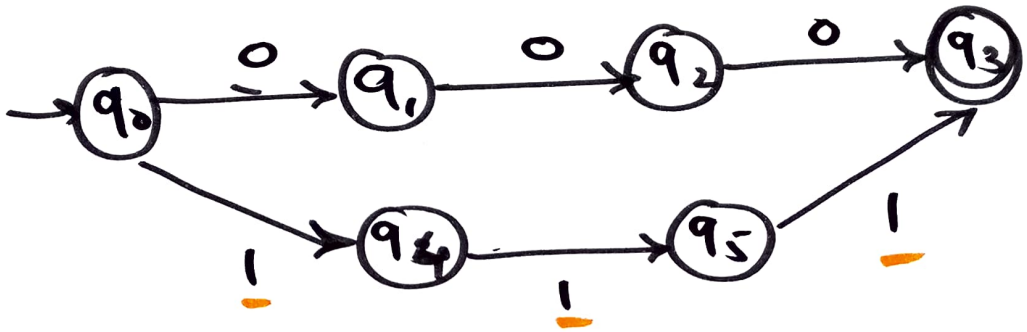
01011 ✓
0101 ✗
10100 ✓

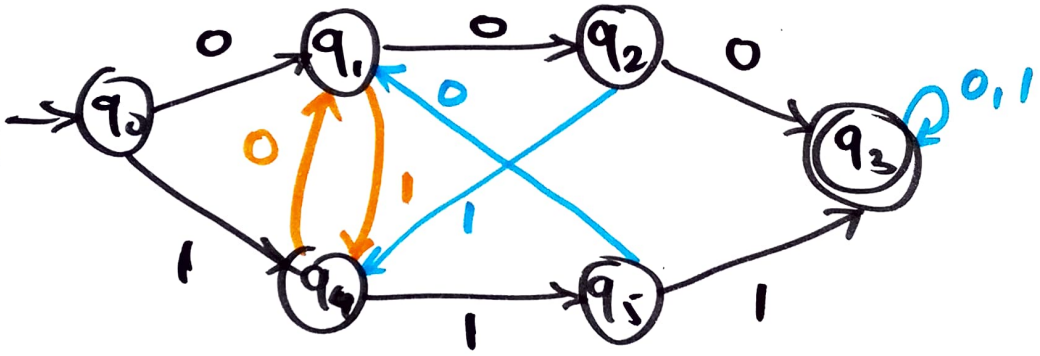




2) $\left.\begin{matrix} x000x \\ x111x \end{matrix}\right\}$ is TRIBIT

$L = \{000, 111, 0111, 1000, 101000, 01110, 0111010, \ldots\}$



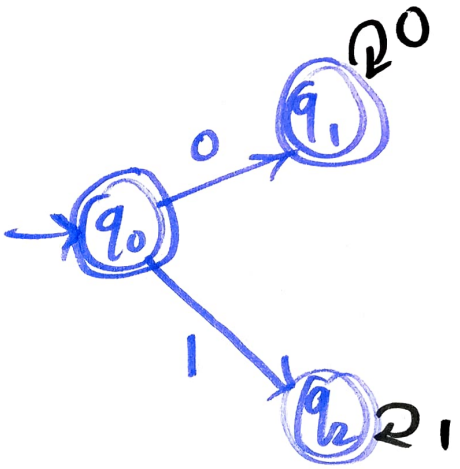


19) Construct minimal FA that accept all the strings of 0's & 1's where the occurence of the substring 01 & 10 in the string is same.

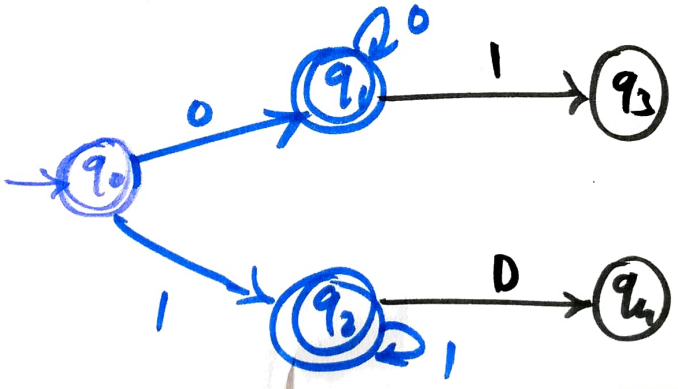
→ $\Sigma = \{0, 1\}$ $FM = \{Q, \Sigma, \delta, q_0, F\}$

- $L = \{ \epsilon \rightarrow$ No 01 & 10 (0th occurence), $0 \rightarrow$ No 01 & 10, occurence is zero.
  $1 \rightarrow$ No 01 & 10, 0 - No occurence

  01 0, 10 1, 01 10, 10 11, 01 00,
  10 01, 00 10, 11 00 1, 01 01 0, 10 01 01, ...}
  1 - times 2 - times

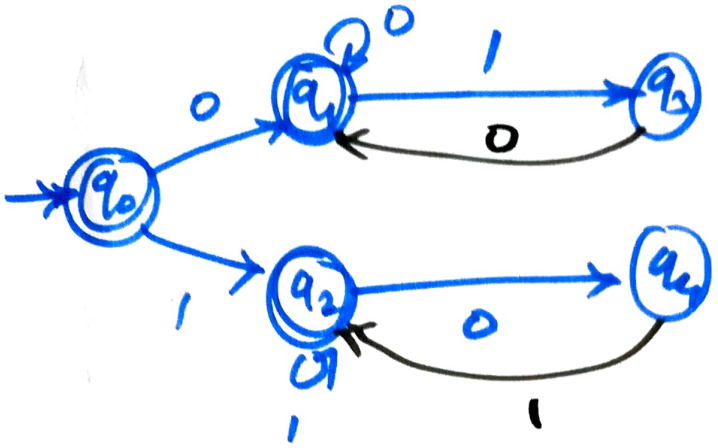


→ ϵ, 0, 00, 1, 11 ...



01 X
001 x

10 X
110 x

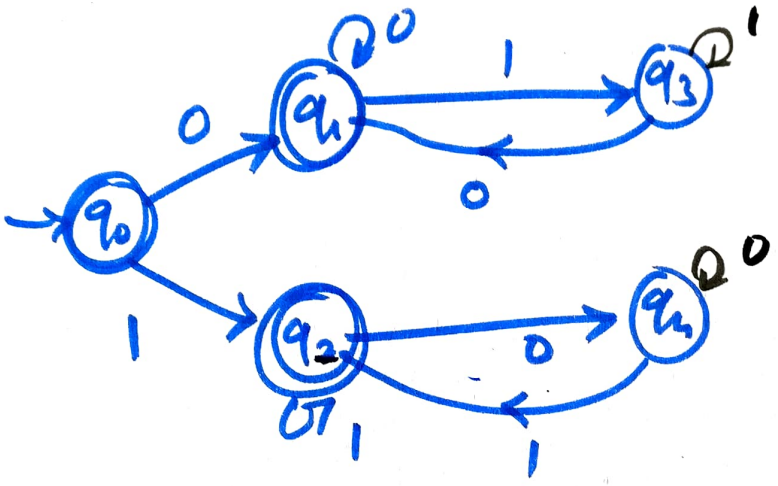


010 ✓

0100

101

1011



011 X | 01111 X

0101 X | 001101 X

100 X | 1000 X

1010 X | 110010 X

$M = \{ Q = \{q_0, q_1, q_2, q_3, q_4\}$;

$\Sigma = \{0, 1\}$, $q_0 = \{q_0\}$, $F = \{q_0, q_1, q_2\}$ }

δ:

δ	0	1
→ q_0	q_1	q_2
q_1	q_1	q_3
q_2	q_4	q_2
q_3	q_1	q_3
q_4	q_4	q_2

20) Construct minimal FA that accepts all the strings of 0's & 1's where

a) The occurence of substring is even :- 10

b) The occurence of substring is odd :- 10

→ $\Sigma = \{0, 1\}$

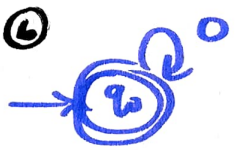
a) No. of time 10 occurs is even = 0, 2, 4 ...

$L = \{ \epsilon, 0, 1, 1010, 0 \cdots 0, 1 \cdots 1, \cdots \cdots \}$

(a)

ϵ

(b)

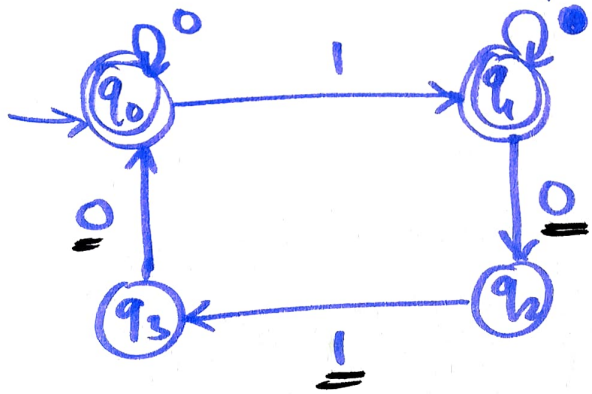


$\epsilon, 0, 00, \cdots$

(c)

$\epsilon, 0, 00, 1, 11, 111 \cdots$

(d)



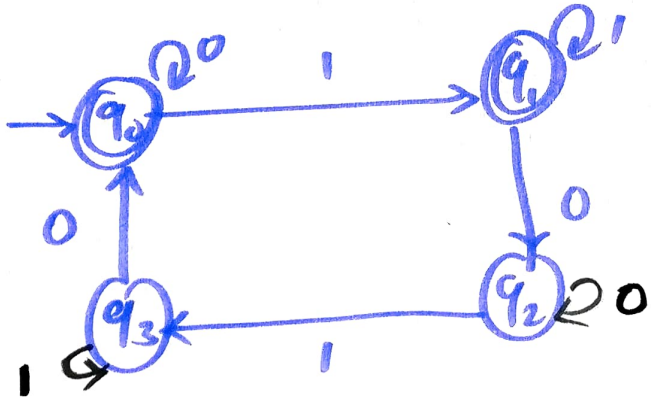
010 ✗

0101 ✗

101 ✗

1010 ✓

(e)



0100 ✗

01011 ✗

101010 ✗

01<u>10</u>10 ✓

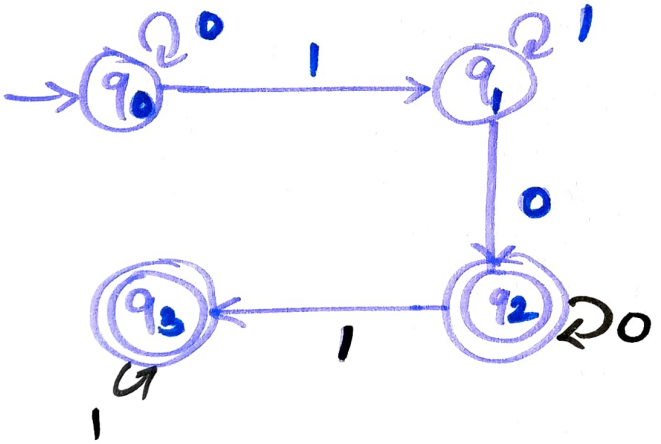
b) No. of times 10 occurs = odd - 1, 3, 5, ...

→ $L = \{ 10, 1010 10, 101, 010, 0010, \cdots \}$

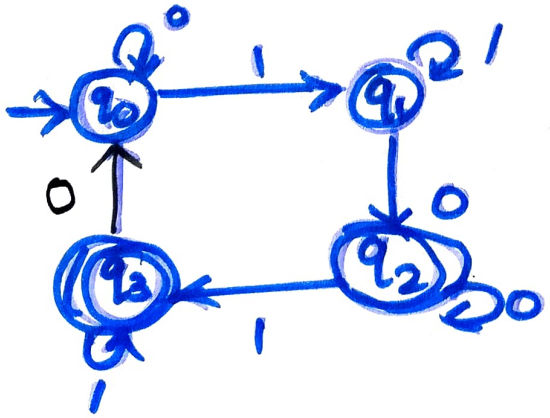
10 ✓

010 ✓
0010 ✓

110 ✓
01110 ✓
11110 ✓
0110 ✓



101 ✓
1001 ✓
10011 ✓
100110 ✗
1010 ✗



01010 ✗

2) Construct the minimal FA that accepts all the strings of 0's & 1's

i) 2nd symbol from left end is '0'

ii) 3rd symbol from right end is '1'

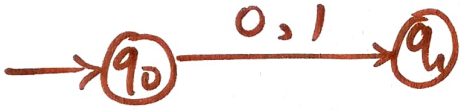
→ $\Sigma = \{0, 1\}$

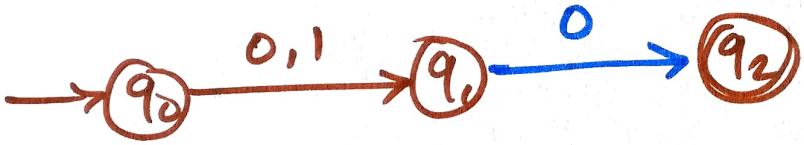
i) $w = x\,0$

x → 0, 1

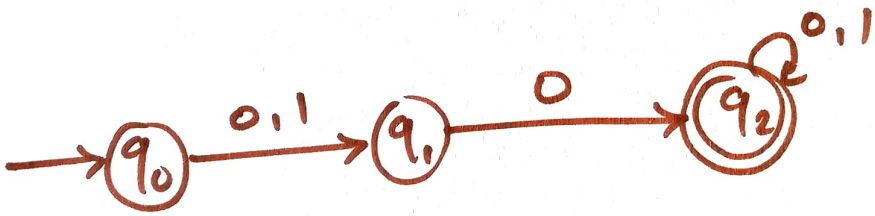
↳ second symbol from left end.

$L = \{00, 10, 001, 000, 0010, 0011, 1011, \cdots\}$

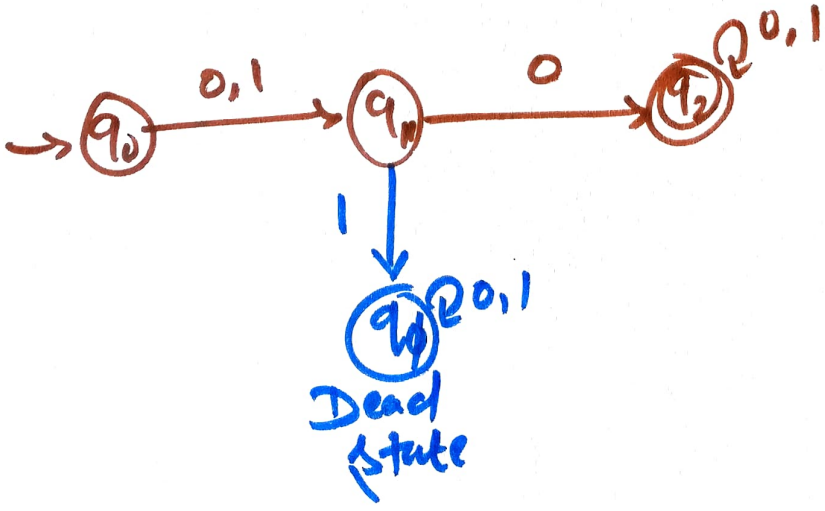




→ 00, 10 ✓



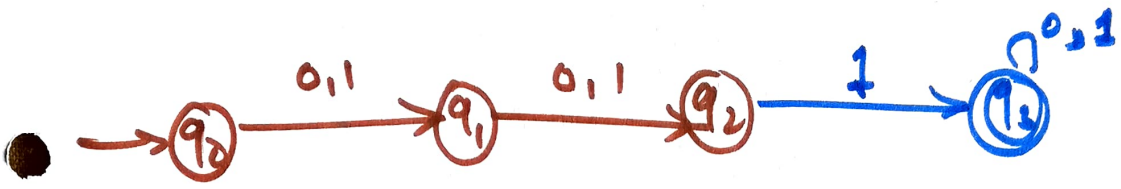
00, 10, 000, 101, 1011



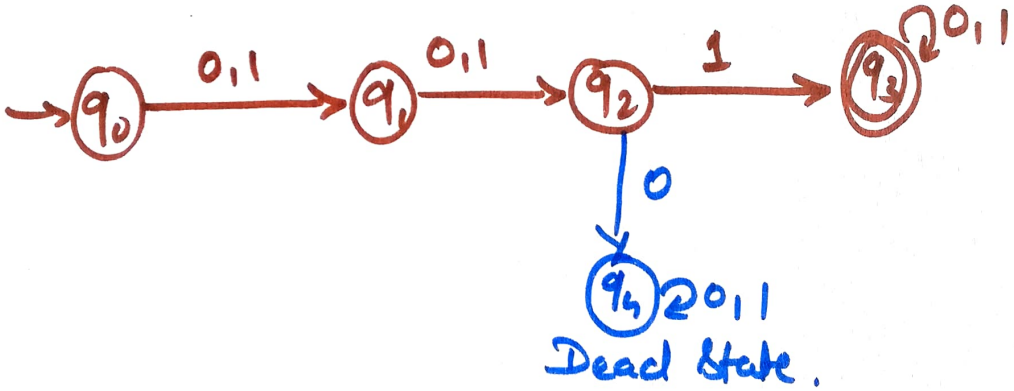
01, 0100, 0101 ✗

ii) $W = X\ X\ 1$ (X: 0 or 1)

$L = \{001, 111, 0010, 0011, 1110, 1111, \ldots\}$



001 ✓
111 ✓
0010 ✓
1010 ✓
1011 ✓



Note:- The minimal FA that accepts all the strings of 0's & 1's where the n^{th} symbol from left end is fixed, Contains exactly $|n+2|$ states