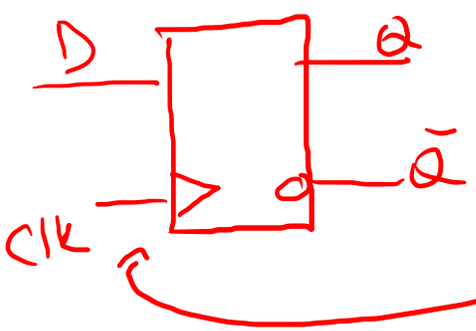
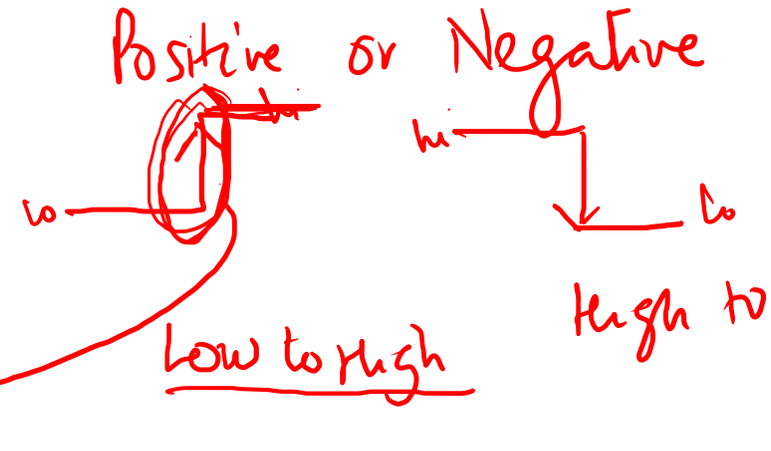
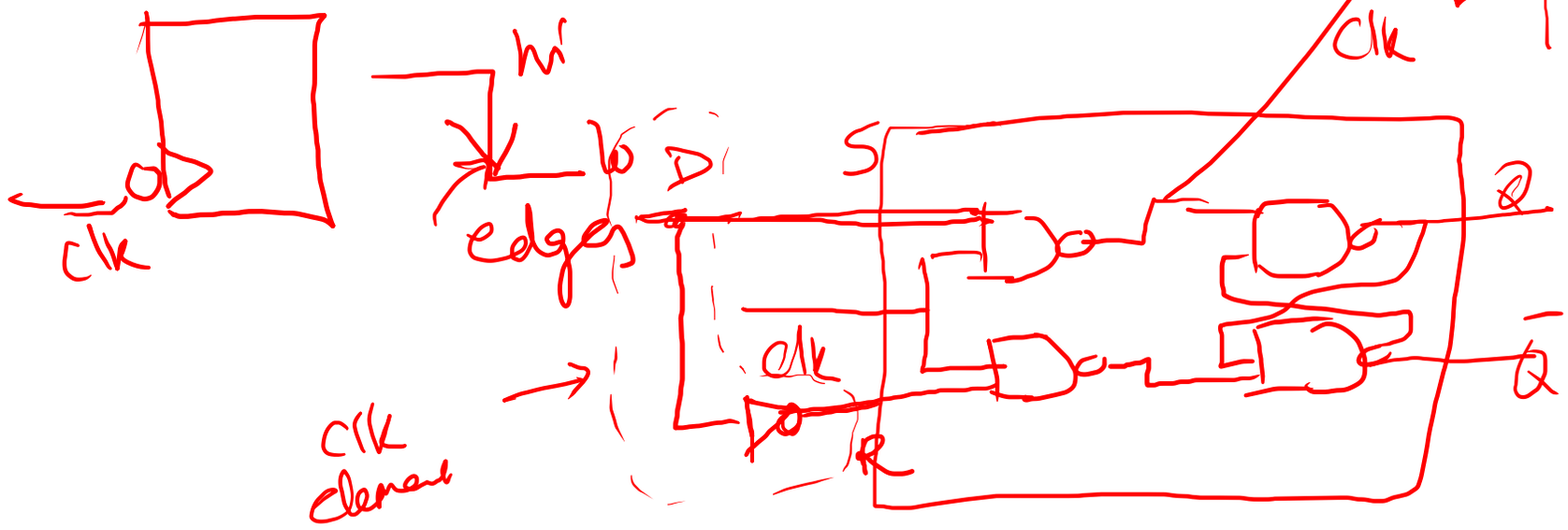
Clocking Event :

Clk transition : Positive or Negative



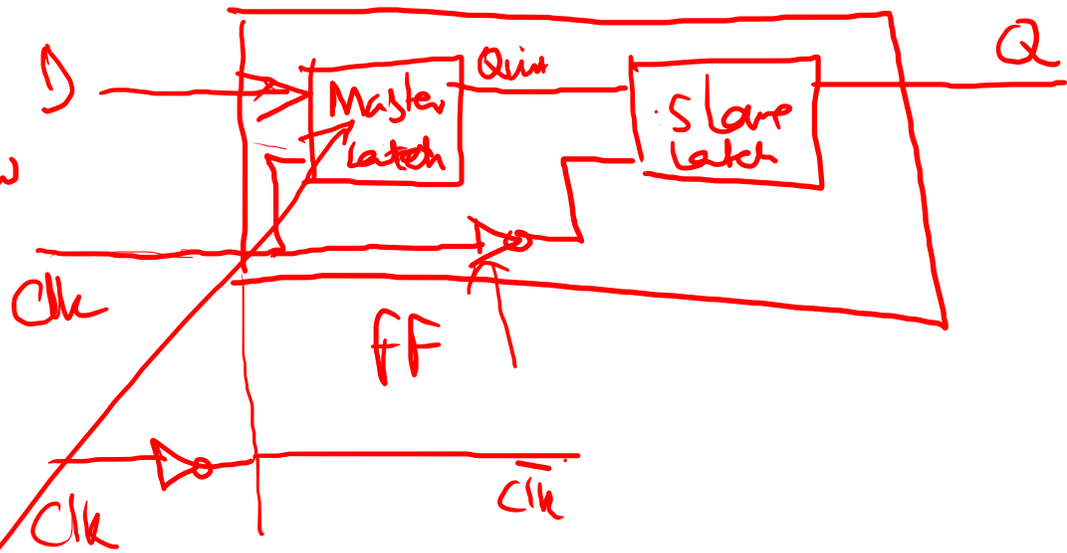


if (Clk'event and Clk = '1')



ff :

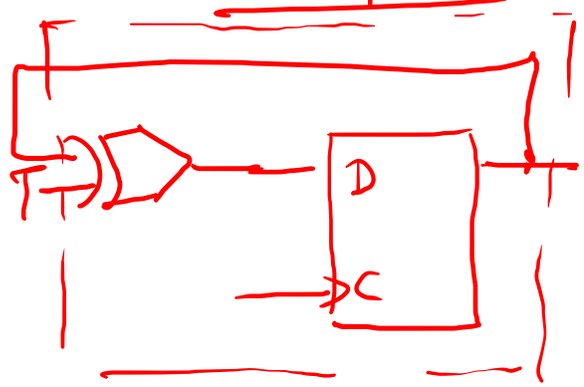
Comes Master latch + Slave latch



D	clk	Q
0	↑	0
1	↑	1

J	K	Clk	Q	Q'
0	0	↑	Q_0	Q_0'
0	1	↑	0	1
1	0	↑	1	0
1	1	↑	Toggles	

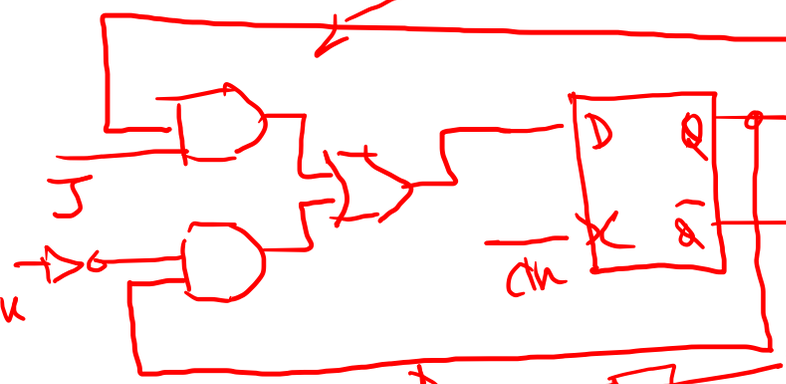
T flip flop:



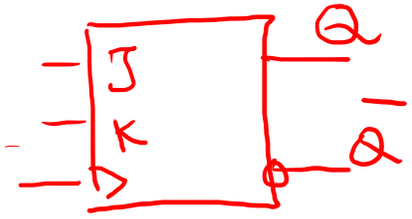
T	Clk	Q	Q'
0	↑	Q_0	Q_0'
1	↑	Toggle	

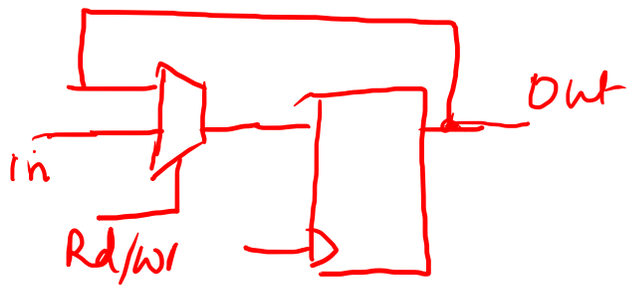
T=0 ⇒ Keep the current

T=1 ⇒ Inversion happens
1→0, 0→1

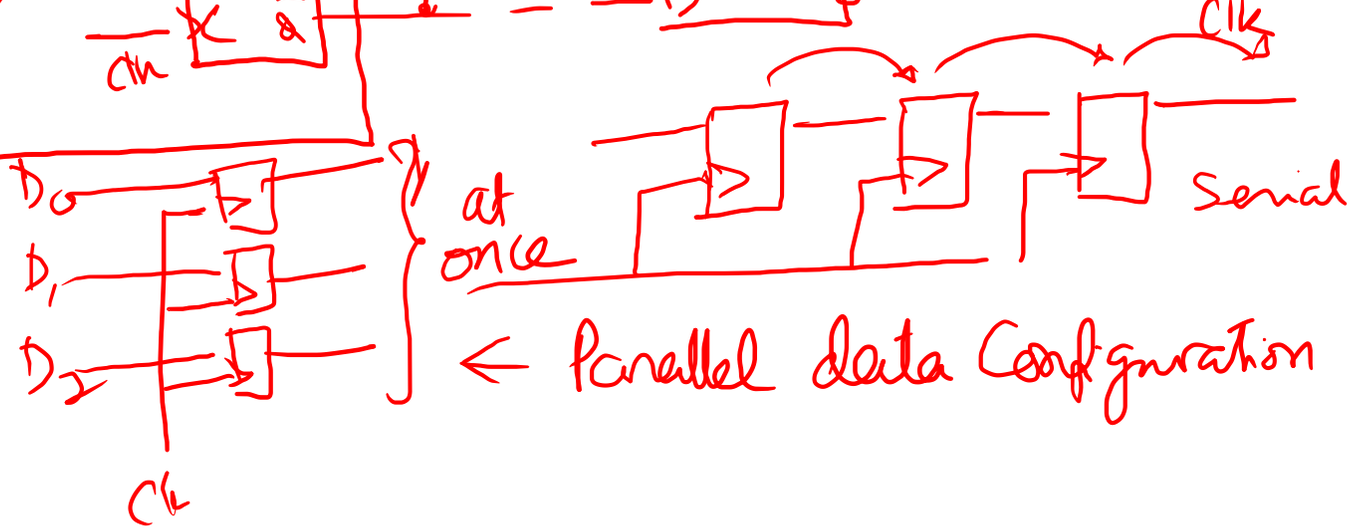


≃



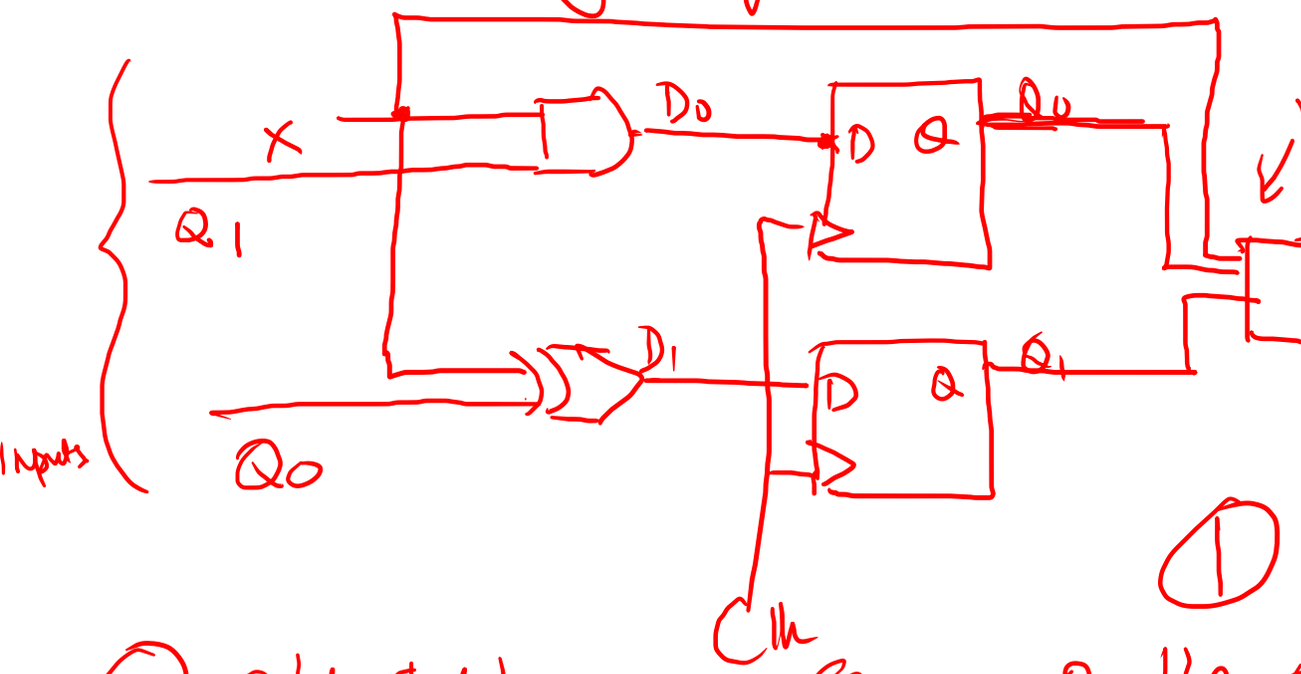


Manolilletti



← Parallel data Configuration.

Analysing Sequential Circuits:



Equations:

$$Y(t) = x(t) \cdot Q_0(t) \cdot Q_1(t)$$ // output equations

Instantaneous ↑ time

$$Q_0(t+1) = D_0(t) = x(t) \cdot Q_1(t)$$

$$Q_1(\underbrace{t+1}_{t+1}) = D_1(t) = \underbrace{x(t)}_{t} \oplus Q_0(t)$$

outputs

① State equations.

② State Table — Sequence of I/p, O/p, ff states.

→ PS (Present state) - States current value of Flip Flops

→ NS (Next state) - indicates the states after the next rising clk edge.

→ Output : Output value at current clk edge

② In the state table

- all possible i/p combinations will be defined.
- all possible State combinations will be defined.

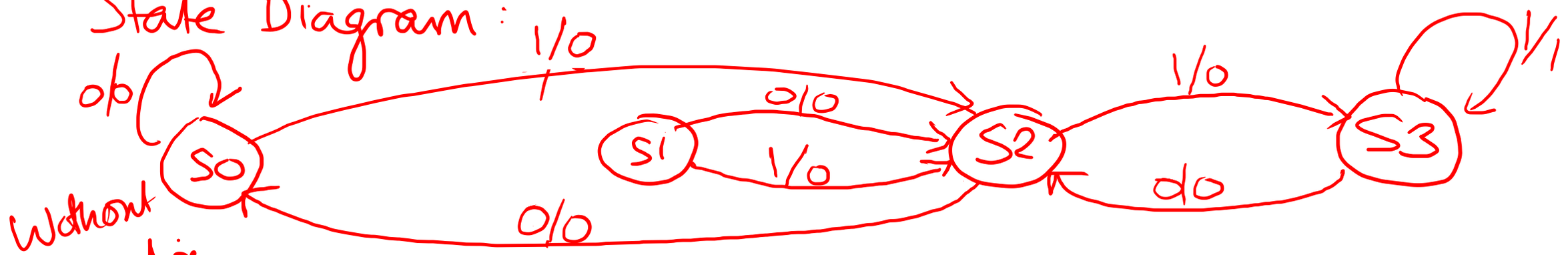
(Present state) PS	Nps x=0	Nps x=1	Output x=0	Output x=1
S_0	S_0	S_2	0	0
S_1	S_2	S_2	0	0
S_2	S_0	S_3	0	0
S_3	S_2	S_3	0	1

inputs
X

$S_0 = 00$
$S_1 = 01$
$S_2 = 10$
$S_3 = 11$

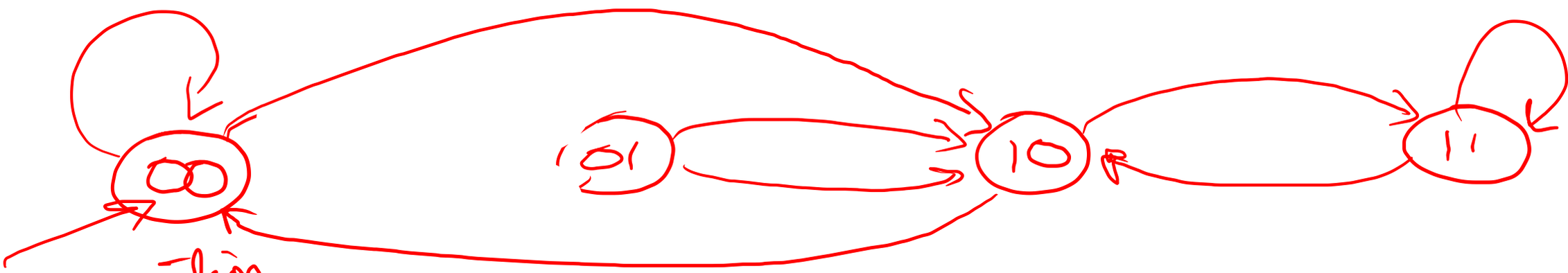
En Code or Enumerate the State combinations.

(3) State Diagram :



Without Enumeration.

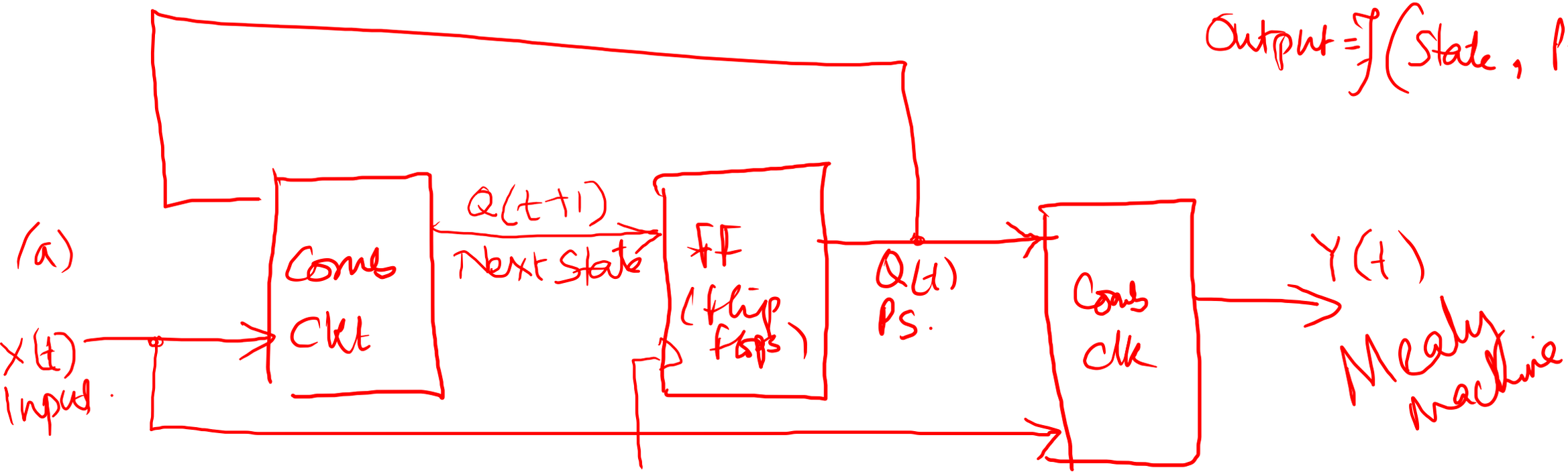
or



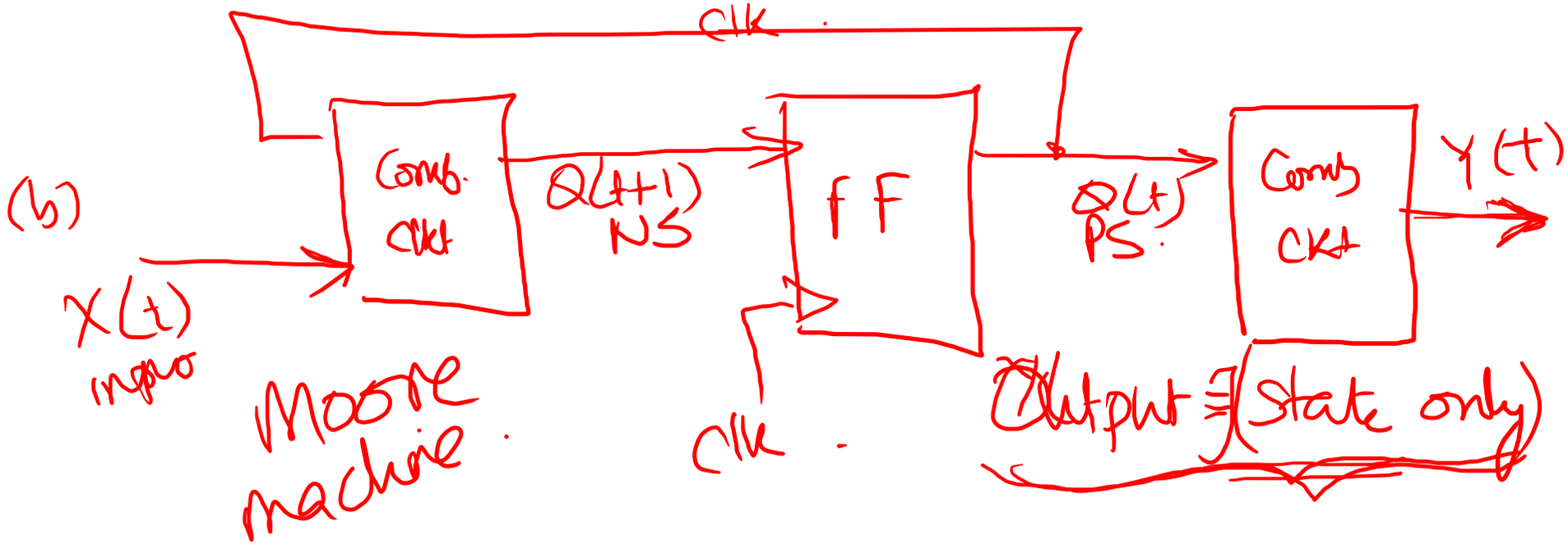
Enumeration or Encoding.

Output = f (State, Present I/p)

(a)



(b)



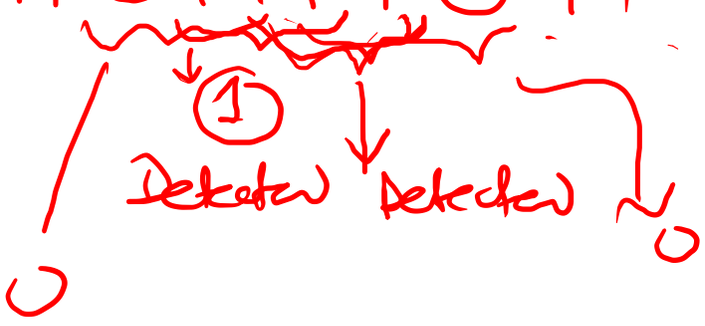
Since the Outputs only depend on the PS
the outputs cannot change during the clk pulse if the i/p variables change.

Methodology:

1. Write down the state equations
   Analyse the combinational circuit (O/P)
2. Substitute these equations into ff char. table giving equations for the transitions eg. $Q_1(t+1) = f(D_1)$
3. Find the O/p equations $Y = f'(Q, \text{inputs})$
4. Construct a State transition table, O/p table from the above transition (2) and O/p equations (3)
5. Draw the State diagram (Graph) of the state table (1)

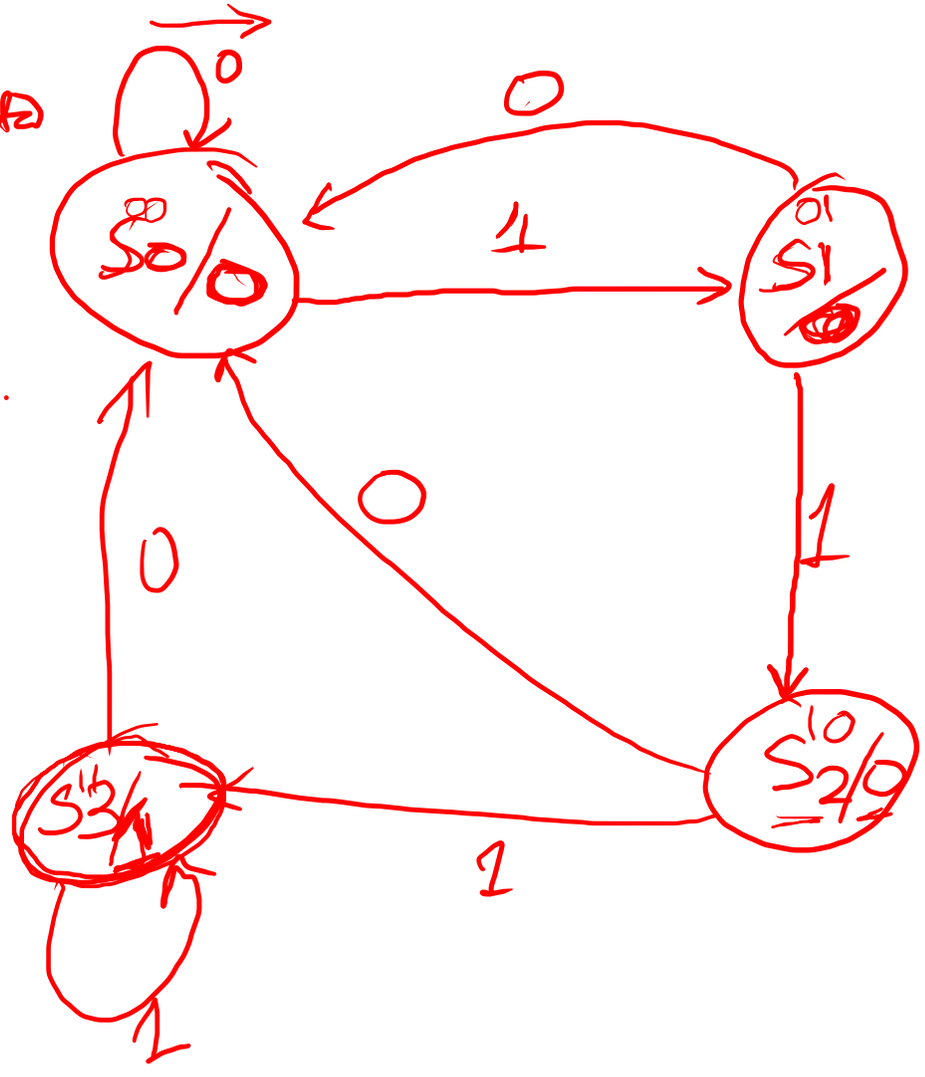
Example: Detection of 3 Consecutive 1 (in the inputs)

0 0 0 1 0 1 1 0 1 1 0 1 1 1 1 0 1 1



S0 - Zero 1' detected
S1 - one 1 detected
S2 - two 1' detected
S3 - 3 '1' detected.

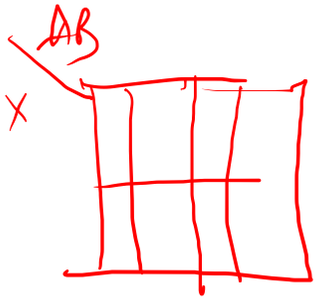
Mealy m/c



State Diagram

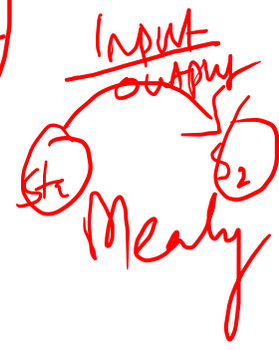
② State Table:

Present State A	Present State B	Input X	Next State A^+	Next State B^+	Output Y
0	0 (S_0)	0	0	0 (S_0)	0
0	0	1	0	1 (S_1)	0
0	1 (S_1)	0	0	0 (S_0)	0
0	1 (S_1)	1	1	0 (S_2)	0
1	0 S_2	0	0	0 (S_0)	0
1	0 S_2	1	1	1 (S_3)	0
1	1 S_3	0	0	0 S_0	1
1	1 S_3	1	1	1 S_3	1



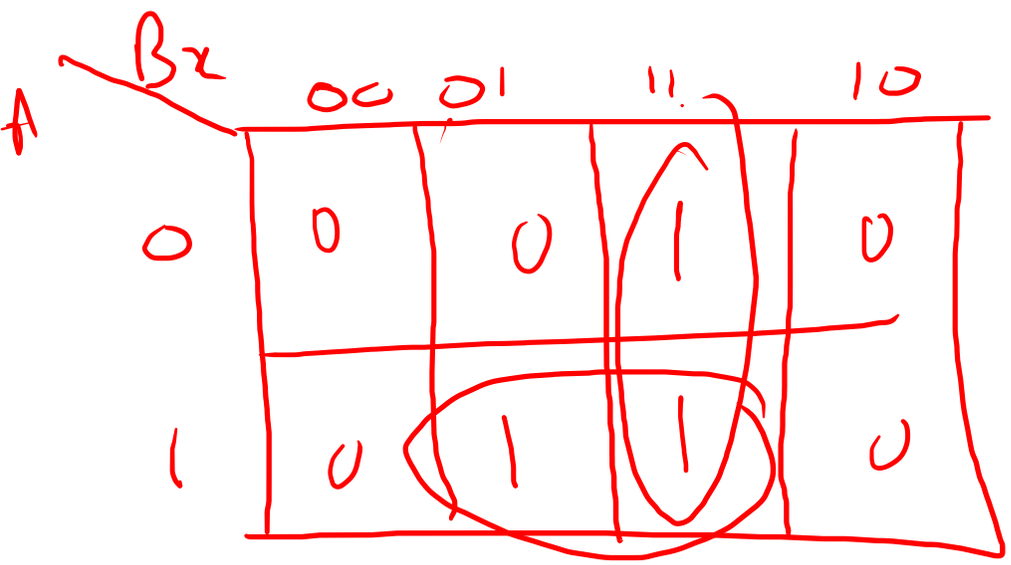
Input variables for the K map.

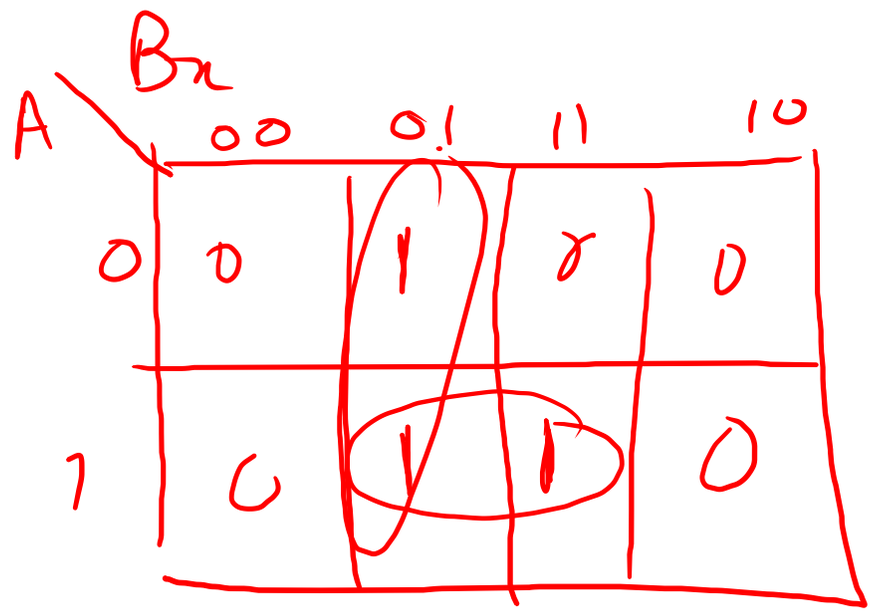
$S0 = 00$
$S1 = 01$
$S2 = 10$
$S3 = 11$

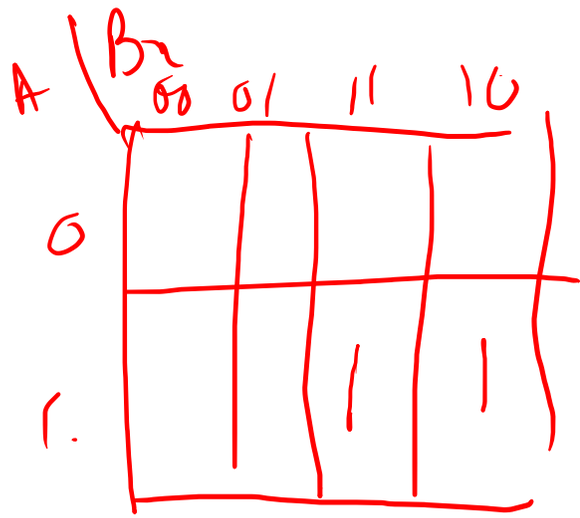


(Moore)

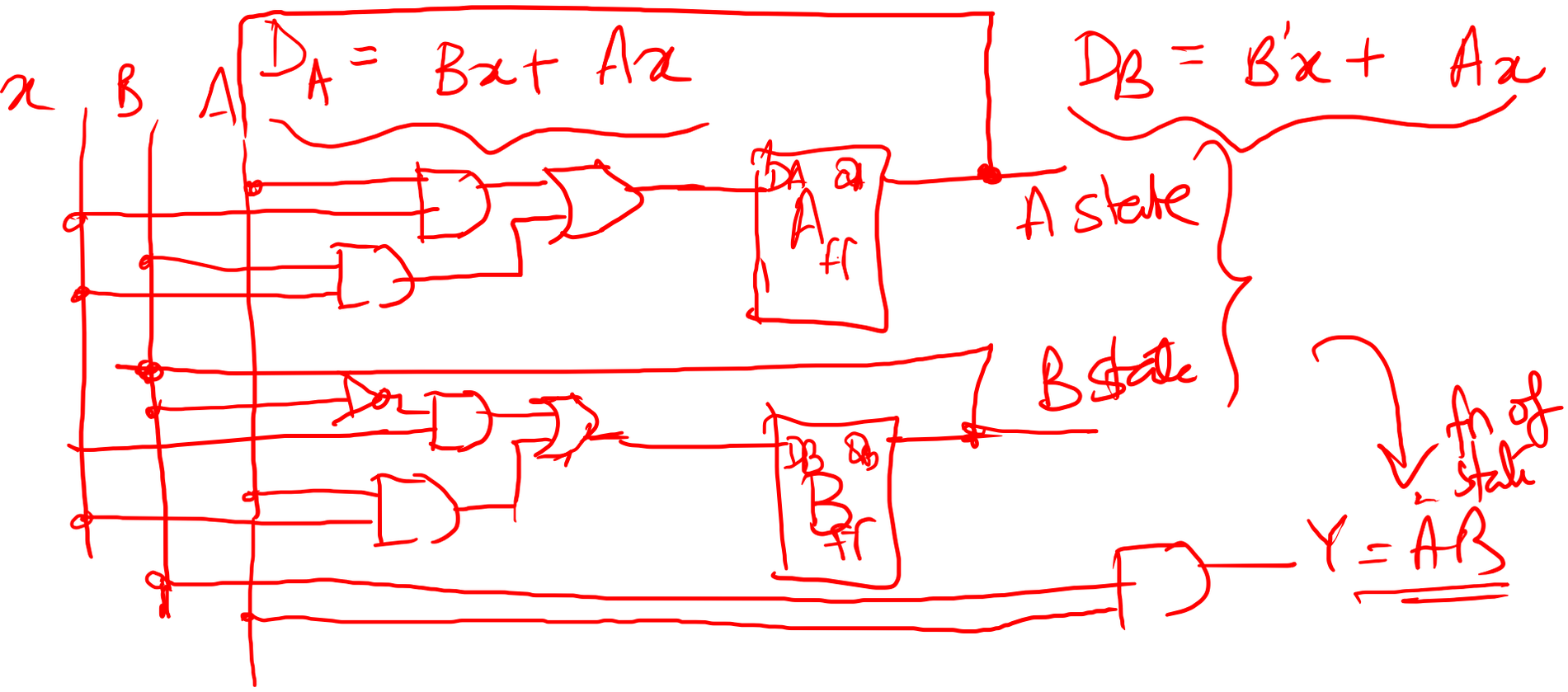
Because the output is only dependent on states.


Bx
A
00 01 11 10
0 0 0 1 0
1 0 1 1 0


Bx
A
00 01 11 10
0 0 1 x 0
1 0 1 1 0


Bx
A
00 01 11 10
0
1 1 1

$Y = AB$


x
B
A
$D_A = Bx + Ax$
$D_B = B'x + Ax$
A state
B state
Next state of A and B
$Y = AB$