State Diagram :

- State Tables : show relation between i/ps, o/ps, p.s. and n.s.
  - ↳ used for building state diagram

P.S			i/ps	N.S	o/ps
Q_A	Q_3	....	$X_1, X_2, \ldots$	$Q_{A+1}, Q_{3+1} \ldots$	$Y_0, Y_1, Y_2 \ldots$
0	0	-----	.....		
0	0	 1			

- A sequential circuit can contain memory elements → latches and flip-flops

  One can determine number of state in the state diagram from total number of memory elements. (depend what type of memory you using).

  Specific case: Let say a seq. circuit only contains two D flip flops

  1 flip flop has two state : 0 and 1 (for Q)

  $2^2 = 4$

  For seq. circuit only contains flip-flops with only Q and $\overline{Q}$

  number of states $= 2^n$ ← # of FF.

A FF can be represent by a diagram with no o/p.

↳ just p.s, inputs and n.s.

Example SS. for a JK FF.

Chara. Table.

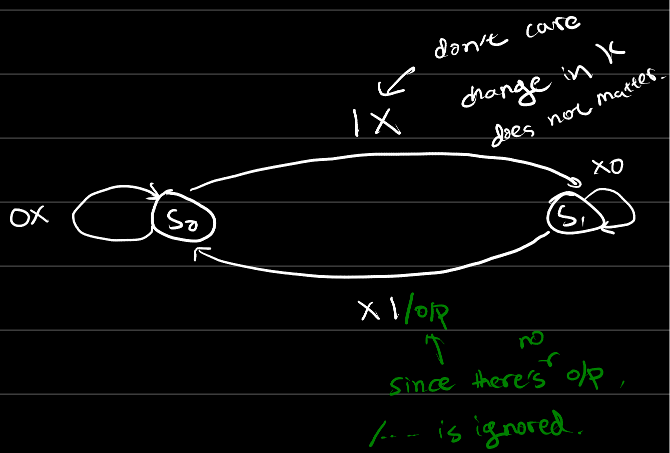
Q_n	J	K	Q_{n+1}
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

a JK FF only has two states

← state 0.

$\begin{cases} S_0 = 0 \\ S_1 = 1 \end{cases}$

↑ state 1

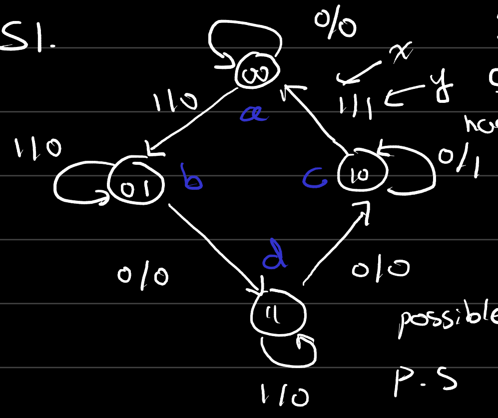


State Eq. LMS = RMS

↑ Q_{n+1} P.S & I/P

Designed Procedure for Clocked Seq. Circuits with Example

S1.



each state has 2 bits

S2. State table :-

possible P.S

P.S. Q_A	P.S. Q_B	N.S. $x=0$ Q_A^+	N.S. $x=0$ Q_B^+	N.S. $x=1$ Q_A^+	N.S. $x=1$ Q_B^+	Output (y) $x=0$	Output (y) $x=1$
0	0	0	0	0	1	0	0
0	1	1	1	0	1	0	0
1	0	1	0	0	0	1	1
1	1	1	0	1	1	0	0

the possible n.s after transiston from each p.s when input x is 0 ... is 1

o/p for each p.s → n.s when x = 0

o/p ... x = 1.

S3. Check the next state and o/p.
↳ if the next state and o/p for two p.s are the same. → this example is not possible.

S4. Assign state to the equivalent binary code

a = 00
b = 01
c = 10
d = 11

if each state is assigned to something other than binary code.

S5. 4 states → 2 FFs

\# of FF → 2^n = # of states

first FF → Q_A (letter symbol)

second FF → Q_B.

S6. implementation dependent. (This case T-FF)

S7. Excitation Table

P.S.					FF i/p		
Q_A	Q_B	x	Q_A^+	Q_B^+	T_A	T_B	y
0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0
0	1	0	1	1	1	0	0
0	1	1	0	1	0	0	0
1	0	0	1	0	0	0	1
1	0	1	0	0	1	0	1
1	1	0	1	0	0	1	0
1	1	1	1	1	0	0	0

obtain through n.s. truth table and *excitation table
the FF being used.

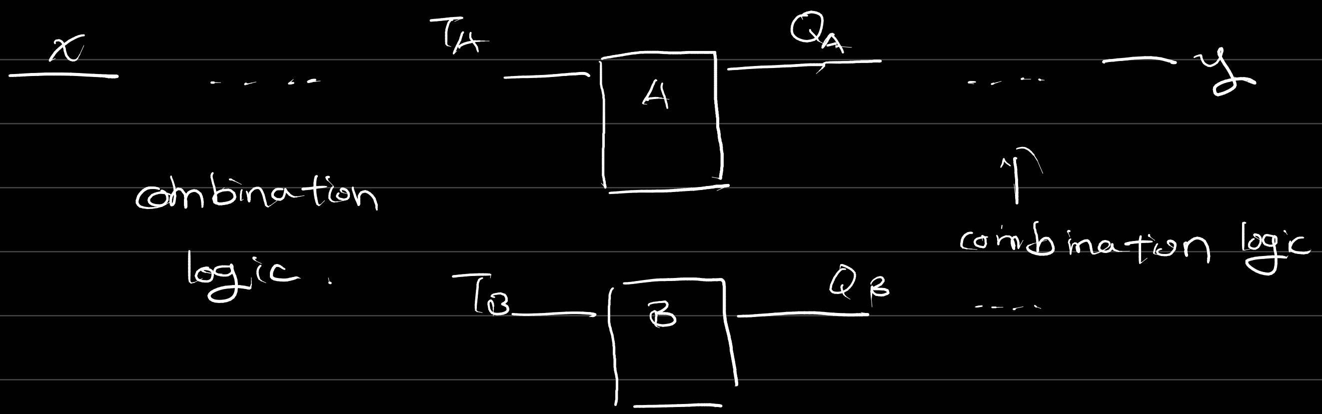
clk	T	Q_{n+1}
0	x	Q_n
1	0	Q_n
1	1	$\overline{Q_n}$

Q_n	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

S8. $T_A = \bar{Q}_A Q_B \bar{x} + Q_A \overline{Q_B} x$ Use K-map if necessary.

$T_B = \bar{Q}_A \bar{Q}_B x + Q_A Q_B \bar{x}$

$y = Q_A \bar{Q}_B \bar{x} + Q_A \bar{Q}_B x$

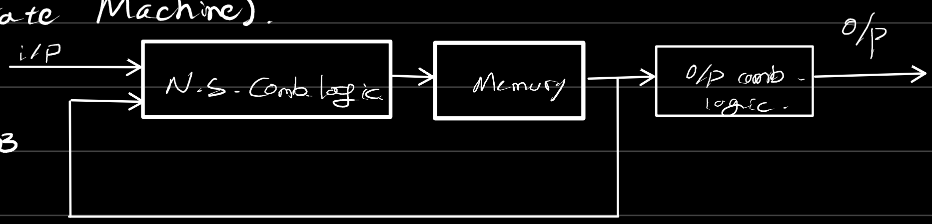


Moore's Circuit (Moore State Machine).

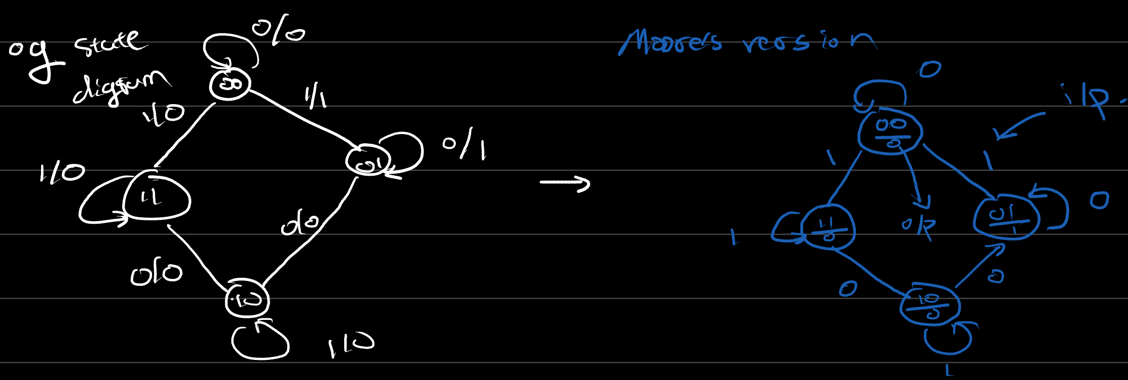
o/ps only depend on p.s.

Ex : $Y = \bar{Q}_A + Q_B$

↑ ↗ output of FF.



Moore State Diagram (random Example)



Mealy State Machine

o/p depend on p.s. and i/p.