

State table with unused states

from RS excitation table

We notice that we are missing 000 →

we are missing states 0, 6, 7 (for both by a 1 and 0 transitions), which will become don't cares

We are also missing 110 and 111

Present state			Input X	Next state			flip flop outputs						output y
A	B	C		A	B	C	S _A	R _A	S _B	R _B	S _C	R _C	
2	0	0	1	0	0	1	0	x	0	x	x	0	0
3	0	0	1	1	0	1	0	x	1	0	0	1	0
4	0	1	0	0	0	1	0	x	x	0	1	0	0
5	0	1	0	1	1	0	1	0	0	1	0	x	0
6	0	1	1	0	0	1	0	x	0	1	x	0	0
7	0	1	1	1	1	0	1	0	0	1	0	1	0
8	1	0	0	0	1	0	1	0	0	x	1	0	0
9	1	0	0	1	1	0	1	0	0	x	0	x	1
10	1	0	1	0	0	1	0	1	0	x	x	0	0
11	1	0	1	1	1	0	1	0	0	x	0	1	1

S_A

AB \ CX	00	01	11	10
00	x	x		
01		1	1	
11	x	x	x	x
10	x	x	x	

$S_A = BX$

R_A

AB \ CX	00	01	11	10
00	x	x	x	x
01	x			x
11	x	x	x	x
10				1

$R_A = CX'$

S_B

AB \ CX	00	01	11	10
00	x	x	1	
01	x			
11	x	x	x	x
10				

$S_B = A'B'X$

R_B

AB \ CX	00	01	11	10
00	x	x		x
01		1	1	1
11	x	x	x	x
10	x	x	x	x

$R_B = BX + BC$

S_C

AB \ CX	00	01	11	10
00	x	x		x
01	1			x
11	x	x	x	x
10	1			x

$S_C = X'$

R_C

AB \ CX	00	01	11	10
00	x	x	1	
01		x	1	
11	x	x	x	x
10		x	1	

$R_C = X$

* Is the circuit self correcting?
- A self-correcting circuit is one that, if it enters an unused or invalid state (due to noise, glitches, or other errors), can transition back to a valid state without external intervention. This is typically achieved by defining explicit transitions for all unused states to ensure the circuit returns to a valid state.

eg: unused state 000:

A	B	C	X
0	0	0	0

$S_A = 0$
 $R_A = 0$ } no change

$S_B = 0$
 $R_B = 0$ } no change

$S_C = 1$
 $R_C = 0$ } 1

Set flipflop C to 1

000 → 001

A	B	C	X
0	0	0	1

$S_A = 0$
 $R_A = 0$ } no change

$S_B = 1$
 $R_B = 0$ } 1

$S_C = 0$
 $R_C = 1$ } 0

Set flipflop B to 1,
Reset f/f C to 0

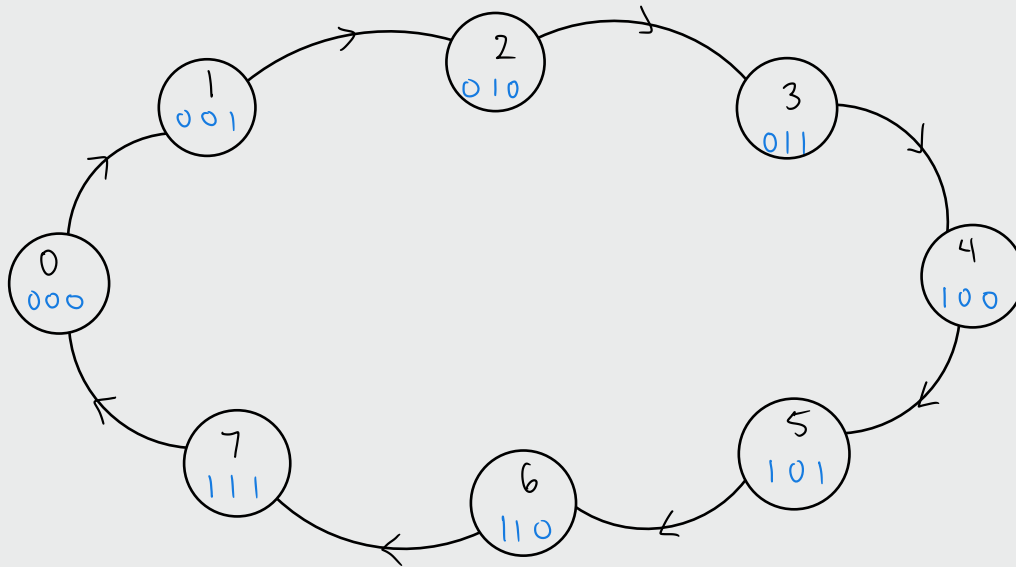
000 → 010

Synchronous Counters

A sequential circuit that goes through a predefined sequence of states upon application of input pulses is called a counter.

Counters are useful for generating timing sequences to control operations in a digital system. No external input, no external output.

eg. $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 6 \rightarrow 7$



$Q(t)$ present state			$Q(t+1)$ Next state					
A	B	C	A	B	C	T_A	T_B	T_C
0	0	0	0	0	1	0	0	1
0	0	1	0	1	0	0	1	1
0	1	0	0	1	1	0	0	1
0	1	1	1	0	0	1	1	1
1	0	0	1	0	1	0	0	1
1	0	1	1	1	0	0	1	1
1	1	0	1	1	1	0	0	1
1	1	1	0	0	0	1	1	1

A **T** flip flop is generally considered to be the better choice for building Synchronous counters

$T = 0$ no change

$T = 1$ $Q(t)'$