State table with unused states

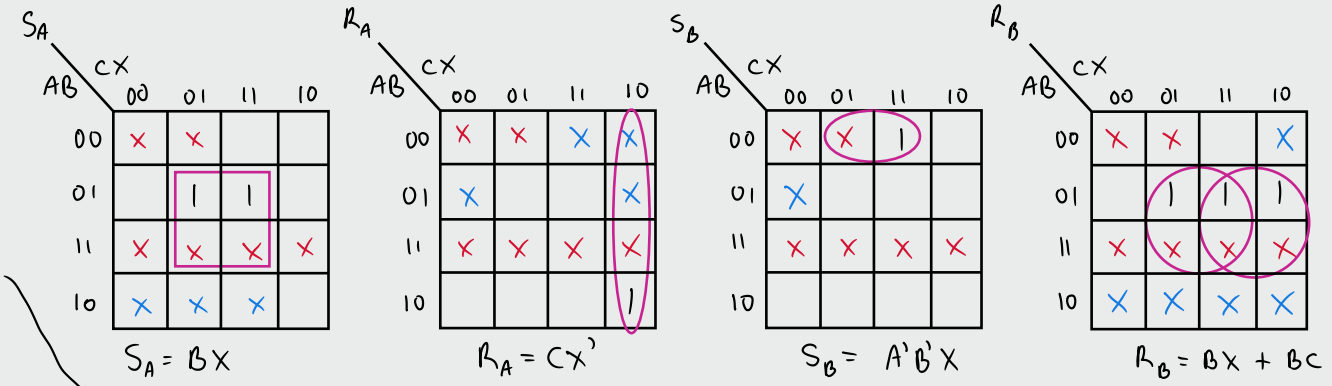
from RS excitation table

	Present state A B C	Input x	Next state A B C	flip flop outputs S_A R_A S_B R_B S_C R_C	output y
2	0 0 1	0	0 0 1	0 x 0 x x 0	0
3	0 0 1	1	0 1 0	0 x 1 0 0 1	0
4	0 1 0	0	0 1 1	0 x x 0 1 0	0
5	0 1 0	1	1 0 0	1 0 0 1 0 x	0
6	0 1 1	0	0 0 1	0 x 0 1 x 0	0
7	0 1 1	1	1 0 0	1 0 0 1 0 1	0
8	1 0 0	0	1 0 1	x 0 0 x 1 0	0
9	1 0 0	1	1 0 0	x 0 0 x 0 x	1
10	1 0 1	0	0 0 1	0 1 0 x x 0	0
11	1 0 1	1	1 0 0	x 0 0 x 0 1	1

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

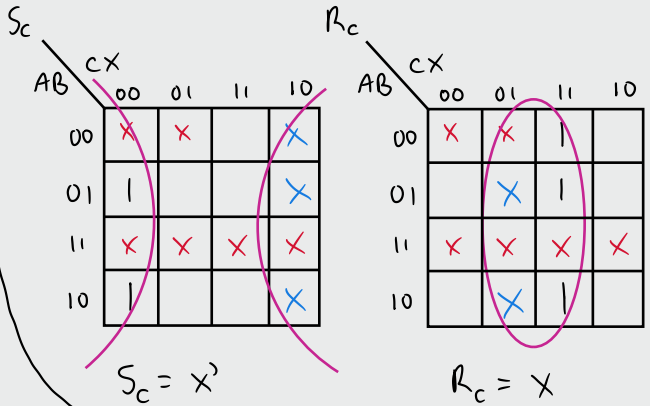
we are also missing and 110 111



* 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:



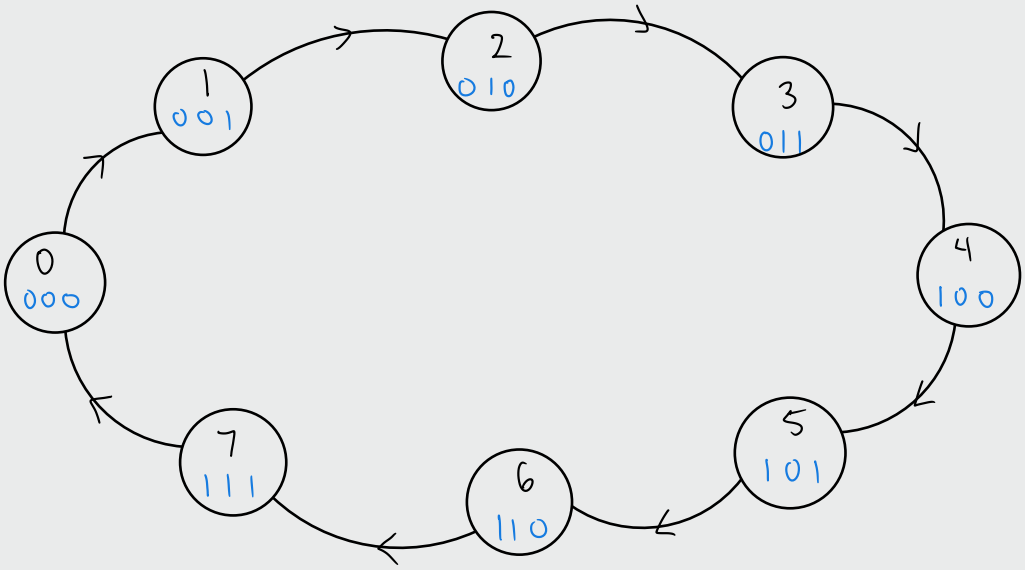
A B C	X					
0 0 0	0	$S_A = 0$, $R_A = 0$] no change	$S_B = 0$, $R_B = 0$] no change	$S_C = 1$, $R_C = 0$] 1	Set flip flop C to 1	000 → 001
0 0 0	1	$S_A = 0$, $R_A = 0$] no change	$S_B = 1$, $R_B = 0$] 1	$S_C = 0$, $R_C = 1$] 0	Set flip flop B to 1, Reset f/f C to 0	000 → 010

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 A B C	Q(t+1) Next state 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

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