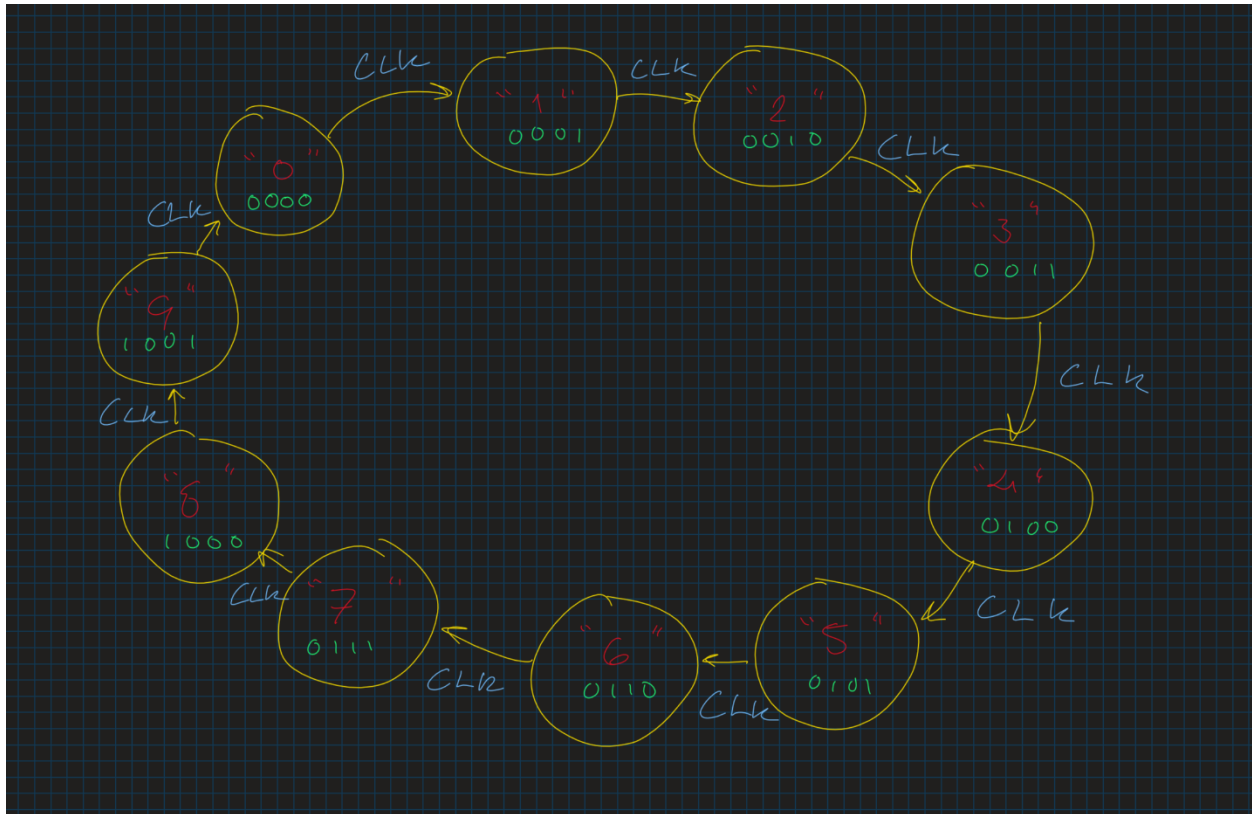


Finite State Machine



No other possible state transitions besides going to the following number.

BCD to 7-segment decoder

Truth tables

State	encoding	State	abc d	Output
0	0000	0000	0000	1111110
1	0001	0001	0110000	1101000
2	0010	0010	0101101	1011011
3	0011	0011	0111001	1011011
4	0100	0100	0110011	1011011
5	0101	0101	1011111	1011111
6	0110	0110	1011111	1011111
7	0111	0111	1110000	1110000
8	1000	1000	1111111	1111111
9	1001	1001	1111011	1111011
10	1010	1010	xxxxxxx	xxxxxxx
11	1011	1011	xxxxxxx	xxxxxxx
12	1100	1100	xxxxxxx	xxxxxxx
13	1101	1101	xxxxxxx	xxxxxxx
14	1110	1110	xxxxxxx	xxxxxxx
15	1111	1111	xxxxxxx	xxxxxxx

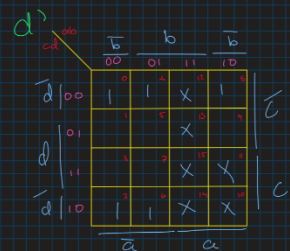
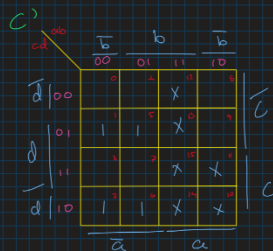
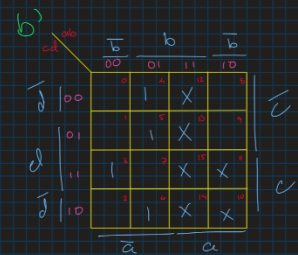
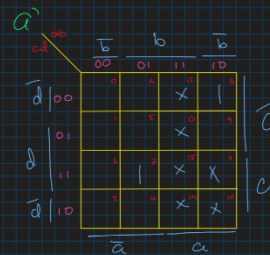
K-maps and simplification

			$a = a + c + \overline{b}d + \overline{b}c\overline{d}$
			$b = \overline{b} + \overline{c}\overline{d} + cd$
			$c = \overline{c} + d + b$
			$d = a + c\overline{d} + \overline{b}c + \overline{d}\overline{b} + b\overline{c}d$
			$e = c\overline{d} + \overline{b}\overline{d}$
			$f = a + \overline{c}\overline{d} + b\overline{c} + b\overline{c}\overline{d}$
			$g = a + \overline{d} + \overline{b}\overline{c} + b\overline{c}$

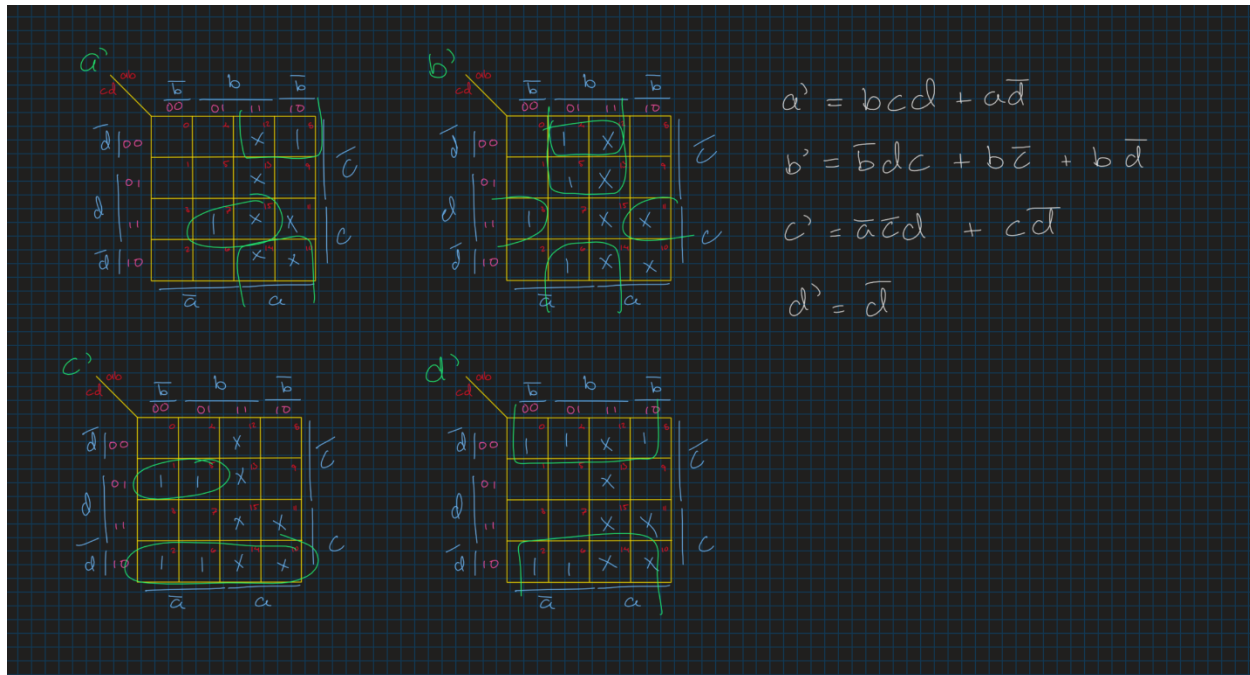
Counter Circuit

Truth tables

State	encoding	State	Output	Next state
	abcd	abcd	abcde	a' b' c' d'
0	0000	0000	111110	0 0 0 1
1	0001	0001	011000	0 0 1 0
2	0010	0010	110110	0 0 1 1
3	0011	0011	111100	0 1 0 0
4	0100	0100	011001	0 1 0 1
5	0101	0101	101101	0 1 1 0
6	0110	0110	101111	0 1 1 1
7	0111	0111	111000	1 0 0 0
8	1000	1000	111111	1 0 0 1
9	1001	1001	111101	0 0 0 0
10	1010	1010	xxxxxx	x x x x
11	1011	1011	xxxxxx	x x x x
12	1100	1100	xxxxxx	x x x x
13	1101	1101	xxxxxx	x x x x
14	1110	1110	xxxxxx	x x x x
15	1111	1111	xxxxxx	x x x x



K-maps and Simplification



Explanation

The X's represent unreachable states and are allowed to be don't-care values in the k-map and truth table. This helped simplification by allowing for more spaces to be included when looking for minterms. The FSM was simple, as each state followed the next with no possible branching. The truth tables of the counter were then derived using the FSM, and the truth tables for the decoder was taken from assignment sheet.