Digital System Design and Lab: HW4

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(1)

Present State			Next State		
C	B	A	C^+	B^+	A^+
0	0	1	0	1	1
0	1	1	0	1	0
0	1	0	1	1	0
1	1	0	1	1	1
1	1	1	1	0	1
1	0	1	1	0	0
1	0	0	0	0	1

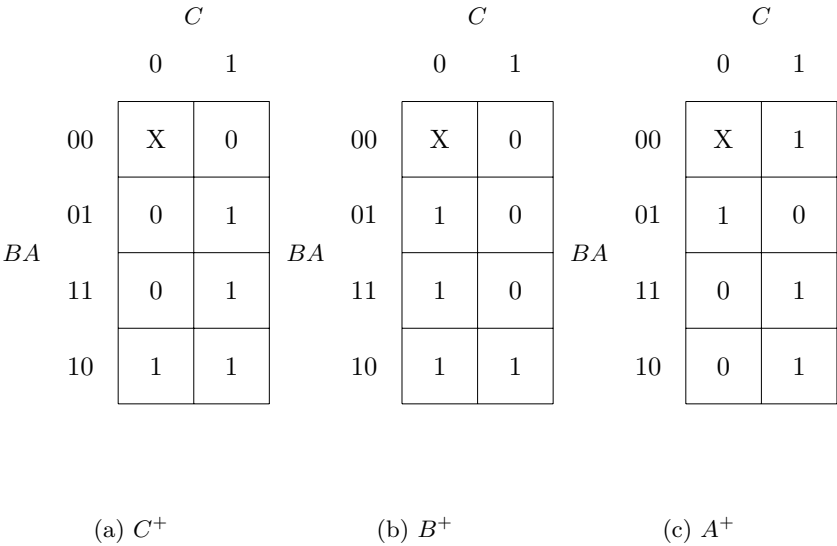(a) C^+ (b) B^+ (c) A^+

Figure 1: K-maps

(2)

The K-maps for D flip-flop are the same as the K-maps for C^+, B^+, and A^+ in (1), since we assign the values of D_C, D_B, and D_A to be C^+, B^+, and A^+ respectively.

Thus, the following D_C is the same as C^+:

C

	0	1
00	X	0
01	0	1
11	0	1
10	1	1

BA

Figure 2: D flip-flop (D_C)

The minimum SOP expression for D_C is:

$$D_C = AC + A'B$$

(3)

Since C is toggled for $CBA = \{010, 100\}$, we can derive the following K-map for T_C:

$$C$$

		0	1
	00	X	1
	01	0	0
BA	11	0	0
	10	1	0

Figure 3: T flip-flop (T_C)

The minimum SOP expression for T_C is:

$$T_C = A'B' + A'C'$$

(4)

From the truth table is subproblem (1), we have:

$$\{B, B^+\} = \begin{cases} \{0,0\} & \text{for } CBA = \{101, 100\} \rightarrow \{S, R\} = \{0, X\} \\ \{0,1\} & \text{for } CBA = \{001\} \rightarrow \{S, R\} = \{1, 0\} \\ \{1,0\} & \text{for } CBA = \{111\} \rightarrow \{S, R\} = \{0, 1\} \\ \{1,1\} & \text{for } CBA = \{011, 010, 110\} \rightarrow \{S, R\} = \{X, 0\} \end{cases}$$

(a) S_B (b) R_B

The minimum SOP expression for S_B, R_B are:

$$S_B = C'$$
$$R_B = AC$$

(5)

From the truth table is subproblem (1), we have:

$$\{A, A^+\} = \begin{cases} \{0,0\} & \text{for } CBA = \{010\} \to \{J, K\} = \{0, X\} \\ \{0,1\} & \text{for } CBA = \{110, 100\} \to \{J, K\} = \{1, X\} \\ \{1,0\} & \text{for } CBA = \{011, 101\} \to \{J, K\} = \{X, 1\} \\ \{1,1\} & \text{for } CBA = \{001, 111\} \to \{J, K\} = \{X, 0\} \end{cases}$$

(a) J_A (b) K_A

The minimum SOP expression for J_A, K_A are:

$$J_A = C$$
$$K_A = BC' + B'C$$