演習問題解答

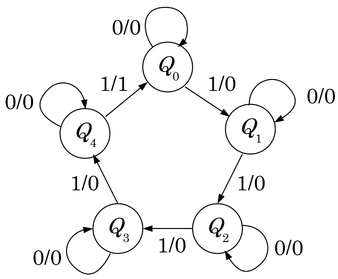
5.1

(1)

時点	0	1	2	3	4	5	6	7	8	9	10	11	12	13	$\cdots$
$\boldsymbol{x}$（入力）	0	1	1	0	1	1	1	1	0	1	0	1	1	1	$\cdots$
$\boldsymbol{q}$（現状態）	Q_0	Q_0	Q_1	Q_2	Q_2	Q_3	Q_4	Q_0	Q_1	Q_1	Q_2	Q_2	Q_3	Q_4	$\cdots$
$\boldsymbol{q}^{(1)}$（次状態）	Q_0	Q_1	Q_2	Q_2	Q_3	Q_4	Q_0	Q_1	Q_1	Q_2	Q_2	Q_3	Q_4	Q_0	$\cdots$
$\boldsymbol{z}$（出力）	0	0	0	0	0	0	1	0	0	0	0	0	0	1	$\cdots$

(2)

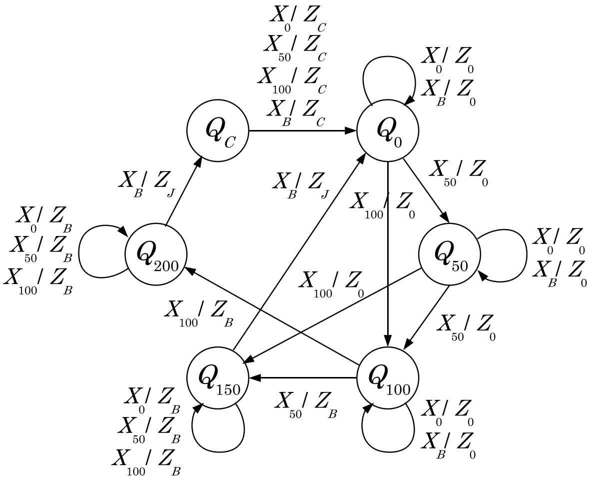
			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_0	Q_1	0	0
Q_1	Q_1	Q_2	0	0
Q_2	Q_2	Q_3	0	0
Q_3	Q_3	Q_4	0	0
Q_4	Q_4	Q_5	0	1



5.2　状態集合 $\boldsymbol{q} \in \boldsymbol{Q} = \{Q_0, Q_{50}, Q_{100}, Q_{150}, Q_{200}, Q_C\}$ とする．状態 Q_C はおつり 50 円を出力する状態である．また，状態 Q_0, Q_{50}, Q_{100} のときには，ジュースのボタンは点灯していないので，これらの状態でジュースのボタンが押されても状態は変化しない．

					$\boldsymbol{\omega}$			
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	X_0	X_{50}	X_{100}	X_B	X_0	X_{50}	X_{100}	X_B
Q_0	Q_0	Q_{50}	Q_{100}	Q_0	Z_0	Z_0	Z_0	Z_0
Q_{50}	Q_{50}	Q_{100}	Q_{150}	Q_{50}	Z_0	Z_0	Z_B	Z_{50}
Q_{100}	Q_{100}	Q_{150}	Q_{200}	Q_{100}	Z_0	Z_B	Z_B	Z_{100}
Q_{150}	Q_{150}	Q_{150}	Q_{150}	Q_0	Z_B	Z_B	Z_B	Z_J
Q_{200}	Q_{200}	Q_{200}	Q_{200}	Q_C	Z_B	Z_B	Z_B	Z_J
Q_C	Q_0	Q_0	Q_0	Q_0	Z_C	Z_C	Z_C	Z_C

2



5.3　状態遷移図は省略.

(1) 110111 検出器

			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_0	Q_1	0	0
Q_1	Q_0	Q_2	0	0
Q_2	Q_3	Q_2	0	0
Q_3	Q_0	Q_4	0	0
Q_4	Q_0	Q_5	0	0
Q_5	Q_3	Q_2	0	1

(2) 10101 検出器

			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_0	Q_1	0	0
Q_1	Q_2	Q_1	0	0
Q_2	Q_0	Q_3	0	0
Q_3	Q_4	Q_1	0	0
Q_4	Q_0	Q_3	0	1

(3) 00000 検出器

			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_1	Q_0	0	0
Q_1	Q_2	Q_0	0	0
Q_2	Q_3	Q_0	0	0
Q_3	Q_4	Q_0	0	0
Q_4	Q_4	Q_0	0	1

5.4

Q_1	4		
Q_2	1	4	
Q_3	1	2	1
	Q_0	Q_1	Q_2

第 1 種隣接度

Q_1	1		
Q_2	1	1	
Q_3	3	1	0
	Q_0	Q_1	Q_2

第 2 種隣接度

Q_1	2		
Q_2	1	2	
Q_3	1	1	2
	Q_0	Q_1	Q_2

第 3 種隣接度

Q_1	7		
Q_2	3	7	
Q_3	5	4	3
	Q_0	Q_1	Q_2

合計隣接度

(1)

	q_2q_1
Q_0	00
Q_1	01
Q_2	10
Q_3	11

$\Rightarrow$

					$\boldsymbol{\omega}$			
q_2q_1 \ x_2x_1	00	01	11	10	00	01	11	10
00	01	00	01	10	01	00	10	10
01	11	01	10	10	01	01	10	00
10	01	01	11	00	00	01	11	01
11	00	00	01	10	01	00	01	01

$q_2^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	0	1
01	1	0	1	1
11	0	0	0	1
10	0	0	1	0

z_2

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	1	1
01	0	0	1	0
11	0	0	0	0
10	0	0	1	0

$q_1^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	1	0	1	0
01	1	1	0	0
11	0	0	1	0
10	1	1	1	0

z_1

q_2q_1 \ x_2x_1	00	01	11	10
00	1	0	0	0
01	1	1	0	0
11	1	0	1	1
10	0	1	1	1

$$
\begin{aligned}
q_2^{(1)} &= \bar{q}_2x_2\bar{x}_1 \vee \bar{q}_2q_1\bar{x}_1 \vee \bar{q}_2q_1x_2 \vee q_1x_2\bar{x}_1 \vee q_2\bar{q}_1x_2x_1 \\
q_1^{(1)} &= \bar{q}_1\bar{x}_1\bar{x}_2 \vee \bar{q}_1x_2x_1 \vee \bar{q}_2q_1\bar{x}_2 \vee q_2x_2x_1 \vee q_2\bar{q}_1\bar{x}_2 \\
z_2 &= \bar{q}_2\bar{q}_1x_2 \vee \bar{q}_1x_2x_1 \vee \bar{q}_2x_2x_1 \\
z_1 &= q_2x_2 \vee \bar{q}_2\bar{x}_2\bar{x}_1 \vee \bar{q}_2q_1\bar{x}_2 \vee q_1\bar{x}_2\bar{x}_1 \vee q_2\bar{q}_1x_1
\end{aligned}
$$

- 隣接状態対：$(Q_0, Q_1), (Q_0, Q_2), (Q_1, Q_3), (Q_2, Q_3)$
- 非隣接状態対：$(Q_0, Q_3), (Q_1, Q_2)$
- 隣接状態対の隣接度の総和 $= 17$
- 非隣接状態対の隣接度の総和 $= 12$
- 状態遷移関数と出力関数の NOT-AND 数 $= 18$
- 状態遷移関数と出力関数のリテラル数 $= 54$

4

(2)

	q_2q_1
Q_0	00
Q_1	01
Q_2	11
Q_3	10

$\Rightarrow$

	$\boldsymbol{\omega}$							
q_2q_1 \ x_2x_1	00	01	11	10	00	01	11	10
00	01	00	01	11	01	00	10	10
01	10	01	11	11	01	01	10	00
11	01	01	10	00	00	01	11	01
10	00	00	01	11	01	00	01	01

$q_2^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	0	1
01	1	0	1	1
11	0	0	1	0
10	0	0	0	1

z_2

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	1	1
01	0	0	1	0
11	0	0	1	0
10	0	0	0	0

$q_1^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	1	0	1	1
01	0	1	1	1
11	1	1	0	0
10	0	0	1	1

z_1

q_2q_1 \ x_2x_1	00	01	11	10
00	1	0	0	0
01	1	1	0	0
11	0	1	1	1
10	1	0	1	1

$$
\begin{aligned}
q_2^{(1)} &= \bar{q}_2x_2\bar{x}_1 \vee \bar{q}_1x_2\bar{x}_1 \vee q_1x_2x_1 \vee \bar{q}_2q_1\bar{x}_1 \\
q_1^{(1)} &= \bar{q}_2x_2 \vee \bar{q}_1x_2 \vee \bar{q}_2\bar{q}_1\bar{x}_1 \vee q_1\bar{x}_2x_1 \vee q_2q_1\bar{x}_2 \\
z_2 &= \bar{q}_2\bar{q}_1x_2 \vee q_1x_2x_1 \\
z_1 &= q_2x_2 \vee \bar{q}_2\bar{x}_2\bar{x}_1 \vee q_1\bar{x}_2x_1 \vee q_1\bar{q}_1\bar{x}_1
\end{aligned}
$$

- 隣接状態対：$(Q_0, Q_1), (Q_0, Q_3), (Q_1, Q_2), (Q_2, Q_3)$
- 非隣接状態対：$(Q_0, Q_2), (Q_1, Q_3)$
- 隣接状態対の隣接度の総和 $= 22$
- 非隣接状態対の隣接度の総和 $= 7$
- 状態遷移関数と出力関数の NOT-AND 数 $= 15$
- 状態遷移関数と出力関数のリテラル数 $= 42$

(3)

	q_2q_1
Q_0	01
Q_1	10
Q_2	11
Q_3	00

$\Rightarrow$

	$\boldsymbol{\omega}$							
q_2q_1 \ x_2x_1	00	01	11	10	00	01	11	10
01	10	01	10	11	01	00	10	10
10	00	10	11	11	01	01	10	00
11	10	10	00	01	00	01	11	01
00	01	01	10	11	01	00	01	01

$q_2^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	1	1
01	1	0	1	1
11	1	1	0	0
10	0	1	1	1

z_2

q_2q_1 \ x_2x_1	00	01	11	10
00	0	0	0	0
01	0	0	1	1
11	0	0	1	0
10	0	0	1	0

$q_1^{(1)}$

q_2q_1 \ x_2x_1	00	01	11	10
00	1	1	0	1
01	0	1	0	1
11	0	0	0	1
10	0	0	1	1

z_1

q_2q_1 \ x_2x_1	00	01	11	10
00	1	0	1	1
01	1	0	0	0
11	0	1	1	1
10	1	1	0	0

$$
\begin{aligned}
q_2^{(1)} &= \bar{q}_2x_2 \vee \bar{q}_1x_2 \vee q_1\bar{x}_2\bar{x}_1 \vee q_2\bar{x}_2x_1 \\
q_1^{(1)} &= x_2\bar{x}_1 \vee \bar{q}_2\bar{q}_1\bar{x}_2 \vee \bar{q}_2\bar{x}_2x_1 \vee q_2\bar{q}_1x_2 \\
z_2 &= \bar{q}_2q_1x_2 \vee q_2x_2x_1 \\
z_1 &= \bar{q}_2\bar{x}_2\bar{x}_1 \vee \bar{q}_2\bar{q}_1x_2 \vee q_2\bar{x}_2x_1 \vee q_2q_1x_2 \vee q_2\bar{q}_1\bar{x}_2
\end{aligned}
$$

- 隣接状態対：$(Q_0, Q_2), (Q_0, Q_3), (Q_1, Q_2), (Q_1, Q_3)$
- 非隣接状態対：$(Q_0, Q_1), (Q_2, Q_3)$
- 隣接状態対の隣接度の総和 $= 19$
- 非隣接状態対の隣接度の総和 $= 10$
- 状態遷移関数と出力関数の NOT-AND 数 $= 15$
- 状態遷移関数と出力関数のリテラル数 $= 42$

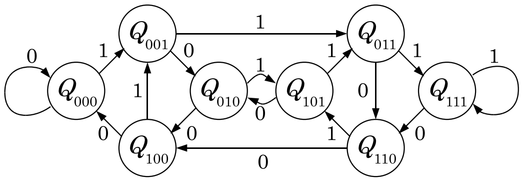
5.5

$$
\begin{aligned}
q_0^{(1)} &= q_0\bar{x}_2x_1 \vee q_2x_2\bar{x}_1 \vee q_3\bar{x}_2 \\
q_1^{(1)} &= q_0\bar{x}_2\bar{x}_1 \vee q_0x_2x_1 \vee q_1\bar{x}_2x_1 \vee q_2\bar{x}_2 \vee q_3x_2x_1 \\
q_2^{(1)} &= q_0x_2\bar{x}_1 \vee q_1x_2 \vee q_3x_2\bar{x}_1 \\
q_3^{(1)} &= q_1\bar{x}_2\bar{x}_1 \vee q_2x_2x_1 \\
z_2 &= q_0x_2 \vee q_1x_2x_1 \vee q_2x_2x_1 \\
z_1 &= q_0\bar{x}_2\bar{x}_1 \vee q_1\bar{x}_2 \vee q_2x_1 \vee q_2x_2 \vee q_3\bar{x}_1 \vee q_3x_2
\end{aligned}
$$

6

6.1

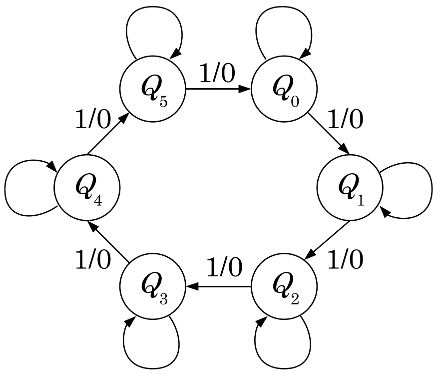
Q \ X	0	1
Q_{000}	Q_{000}	Q_{001}
Q_{001}	Q_{010}	Q_{011}
Q_{010}	Q_{100}	Q_{101}
Q_{011}	Q_{110}	Q_{111}
Q_{100}	Q_{000}	Q_{001}
Q_{101}	Q_{010}	Q_{011}
Q_{110}	Q_{100}	Q_{101}
Q_{111}	Q_{110}	Q_{111}



6.2

(1)

Q \ X	0	1	ω 0	ω 1
Q_0	Q_0	Q_1	0	0
Q_1	Q_1	Q_2	0	0
Q_2	Q_2	Q_3	0	0
Q_3	Q_3	Q_4	0	0
Q_4	Q_4	Q_5	0	0
Q_5	Q_5	Q_0	0	1



(2)

$q_3q_2q_1$ \ x	0	1	ω 0	ω 1
000	000	001	0	0
001	001	010	0	0
010	010	011	0	0
011	011	100	0	0
100	100	101	0	0
101	101	000	0	1

d_3

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	*	*	*	*
10	1	1	0	1

d_2

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	0	1	0
01	1	1	0	1
11	*	*	*	*
10	0	0	0	0

d_1

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	*	*	*	*
10	0	1	0	1

$$
\begin{aligned}
d_3 &= q_3\bar{x} \vee q_3\bar{q}_1 \vee q_2q_1x \\
d_2 &= q_2\bar{x} \vee q_2\bar{q}_1 \vee \bar{q}_3\bar{q}_2q_1x \\
d_1 &= \bar{q}_1x \vee q_1\bar{x}
\end{aligned}
$$

(3)

s_3

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	*	*	*	*
10	*	*	0	*

s_2

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	0	1	0
01	*	*	0	*
11	*	*	*	*
10	0	0	0	0

s_1

$q_3q_2 \backslash q_1x$	00	01	11	10
00	0	1	0	*
01	0	1	0	*
11	*	*	*	*
10	0	1	0	*

r_3

$q_3q_2 \backslash q_1x$	00	01	11	10
00	*	*	*	*
01	*	*	0	*
11	*	*	*	*
10	0	0	1	0

r_2

$q_3q_2 \backslash q_1x$	00	01	11	10
00	*	*	0	*
01	0	0	1	0
11	*	*	*	*
10	*	*	*	*

r_1

$q_3q_2 \backslash q_1x$	00	01	11	10
00	*	0	1	0
01	*	0	1	0
11	*	*	*	*
10	*	0	1	0

$$
\begin{aligned}
s_3 &= q_2q_1x \\
r_3 &= q_3q_1x \\
s_2 &= \bar{q}_3\bar{q}_2q_1x \\
r_2 &= q_2q_1x \\
s_1 &= \bar{q}_1x \\
r_1 &= q_1x
\end{aligned}
$$

j_3

q_3q_2 \ q_1x	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	*	*	*	*
10	*	*	*	*

j_2

q_3q_2 \ q_1x	00	01	11	10
00	0	0	1	0
01	*	*	*	*
11	*	*	*	*
10	0	0	0	0

j_1

q_3q_2 \ q_1x	00	01	11	10
00	0	1	*	*
01	0	1	*	*
11	*	*	*	*
10	0	1	*	*

k_3

q_3q_2 \ q_1x	00	01	11	10
00	*	*	*	*
01	*	*	*	*
11	*	*	*	*
10	0	0	1	0

k_2

q_3q_2 \ q_1x	00	01	11	10
00	*	*	*	*
01	0	0	1	0
11	*	*	*	*
10	*	*	*	*

k_1

q_3q_2 \ q_1x	00	01	11	10
00	*	*	1	0
01	*	*	1	0
11	*	*	*	*
10	*	*	1	0

$$
\begin{aligned}
j_3 &= q_2q_1x \\
k_3 &= q_1x \\
j_2 &= \bar{q}_3q_1x \\
k_2 &= q_1x \\
j_1 &= x \\
k_1 &= x
\end{aligned}
$$

t_3

q_3q_2 \ q_1x	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	*	*	*	*
10	0	0	1	0

t_2

q_3q_2 \ q_1x	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	*	*	*	*
10	0	0	0	0

t_1

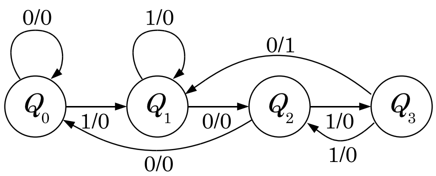
q_3q_2 \ q_1x	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	*	*	*	*
10	0	1	1	0

$$
\begin{aligned}
t_3 &= q_2q_1x \vee q_3q_1x \\
t_2 &= \bar{q}_3q_1x \\
t_1 &= x
\end{aligned}
$$

6.3

(1)

			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_0	Q_1	0	0
Q_1	Q_2	Q_1	0	0
Q_2	Q_0	Q_3	0	0
Q_3	Q_2	Q_1	1	0



(2)

			ω	
x / q_2q_1	0	1	0	1
00	00	01	0	0
01	11	01	0	0
11	00	10	0	0
10	11	01	1	0

d_2

x / q_2q_1	0	1
00	0	0
01	1	0
11	0	1
10	1	0

d_1

x / q_2q_1	0	1
00	0	1
01	1	1
11	0	0
10	1	1

$$
\begin{aligned}
d_2 &= \bar{q}_2 q_1 \bar{x} \vee q_2 q_1 x \vee q_2 \bar{q}_1 \bar{x} \\
d_1 &= \bar{q}_2 x \vee \bar{q}_2 q_1 \vee q_2 \bar{q}_1
\end{aligned}
$$

s_2

x / q_2q_1	0	1
00	0	0
01	1	0
11	0	*
10	*	0

r_2

x / q_2q_1	0	1
00	*	*
01	0	*
11	1	0
10	0	1

s_1

x / q_2q_1	0	1
00	0	1
01	*	*
11	0	0
10	1	1

r_1

x / q_2q_1	0	1
00	*	0
01	0	0
11	1	1
10	0	0

$$
\begin{aligned}
s_2 &= \bar{q}_2 q_1 \bar{x} \\
r_2 &= \bar{q}_1 x \vee q_2 q_1 \bar{x} \\
s_1 &= \bar{q}_1 x \vee q_2 \bar{q}_1 \\
r_1 &= q_2 q_1
\end{aligned}
$$

j_2

x / q_2q_1	0	1
00	0	0
01	1	0
11	*	*
10	*	*

k_2

x / q_2q_1	0	1
00	*	*
01	*	*
11	1	0
10	0	1

j_1

x / q_2q_1	0	1
00	0	1
01	*	*
11	*	*
10	1	1

k_1

x / q_2q_1	0	1
00	*	*
01	*	*
11	1	1
10	0	0

$$\begin{aligned} j_2 &= q_1\bar{x} \\ k_2 &= \bar{q}_1 x \vee q_1\bar{x} \\ j_1 &= x \vee q_2 \\ k_1 &= q_1 \end{aligned}$$

t_2

x \ q_2q_1	0	1
00	0	0
01	1	0
11	1	0
10	0	1

t_1

x \ q_2q_1	0	1
00	0	1
01	0	0
11	1	1
10	1	1

$$\begin{aligned} t_2 &= q_1\bar{x} \vee q_2\bar{q}_1 x \\ t_1 &= \bar{q}_1 x \vee q_2 \end{aligned}$$

(3)　D フリップフロップによるワン・ホット・コード割当ての論理式：

$$\begin{aligned} q_0^{(1)} &= q_0\bar{x} \vee q_2\bar{x} \\ q_1^{(1)} &= q_0 x \vee q_1 x \vee q_3 x \\ q_2^{(1)} &= q_1\bar{x} \vee q_3\bar{x} \\ q_3^{(1)} &= q_2 x \end{aligned}$$

ここで，各式の両辺に $\oplus q_i$ を付加すると，

$$\begin{aligned} q_0^{(1)} \oplus q_0 &= (q_0\bar{x} \vee q_2\bar{x}) \oplus q_0 \\ &= (q_0\bar{x} \vee q_2\bar{x}) \cdot \bar{q}_0 \vee (\overline{q_0\bar{x} \vee q_2\bar{x}}) \cdot q_0 \\ &= q_2\bar{q}_0\bar{x} \vee (\bar{q}_0 \vee x) \cdot (\bar{q}_2 \vee x) \cdot q_0 \\ &= q_2\bar{q}_0\bar{x} \vee q_0 x \\ q_1^{(1)} \oplus q_1 &= (q_0 x \vee q_1 x \vee q_3 x) \oplus q_1 \\ &= (q_0 x \vee q_1 x \vee q_3 x) \cdot \bar{q}_1 \vee (\overline{q_0 x \vee q_1 x \vee q_3 x}) \cdot q_1 \\ &= q_0\bar{q}_1 x \vee q_3\bar{q}_1 x \vee (\bar{q}_0 \vee \bar{x}) \cdot (\bar{q}_1 \vee \bar{x}) \cdot (\bar{q}_3 \vee \bar{x}) \cdot q_1 \\ &= q_0\bar{q}_1 x \vee q_3\bar{q}_1 x \vee q_1\bar{x} \\ q_2^{(1)} \oplus q_2 &= (q_1\bar{x} \vee q_3\bar{x}) \oplus q_2 \\ &= (q_1\bar{x} \vee q_3\bar{x}) \cdot \bar{q}_2 \vee (\overline{q_1\bar{x} \vee q_3\bar{x}}) \cdot q_2 \\ &= \bar{q}_2 q_1\bar{x} \vee q_3\bar{q}_2\bar{x} \vee (\bar{q}_1 \vee x) \cdot (\bar{q}_3 \vee x) \cdot q_2 \\ &= \bar{q}_2 q_1\bar{x} \vee q_3\bar{q}_2\bar{x} \vee q_2 x \vee \bar{q}_3 q_2\bar{q}_1 \\ q_3^{(1)} \oplus q_3 &= (q_2 x) \oplus q_3 \\ &= (q_2 x) \cdot \bar{q}_3 \vee (\overline{q_2 x}) \cdot q_3 \\ &= \bar{q}_3 q_2 x \vee q_3\bar{x} \vee q_3\bar{q}_2 \end{aligned}$$

よって，

$$
\begin{aligned}
t_0 &= q_2\bar{q}_0\bar{x} \vee q_0x\\
t_1 &= q_0\bar{q}_1x \vee q_3\bar{q}_1x \vee q_1\bar{x}\\
t_2 &= \bar{q}_2q_1\bar{x} \vee q_3\bar{q}_2\bar{x} \vee q_2x \vee \bar{q}_3q_2\bar{q}_1\\
t_3 &= \bar{q}_3q_2x \vee q_3\bar{x} \vee q_3\bar{q}_2
\end{aligned}
$$

6.4

式 6.11 を式 6.19 に適用すると，

$$
\begin{aligned}
q_2^{(1)} &= j_2\cdot\bar{q}_2 \vee \bar{k}_2q_2\\
&= (x_2x_1 \vee q_1x_2)\cdot\bar{q}_2 \vee (\overline{\bar{x}_2\bar{x}_1 \vee \bar{q}_1x_1})\cdot q_2\\
&= \bar{q}_2x_2x_1 \vee \bar{q}_2q_1x_2 \vee (x_2 \vee x_1)\cdot(q_1 \vee \bar{x}_1)\cdot q_2\\
&= \bar{q}_2x_2x_1 \vee \bar{q}_2q_1x_2 \vee q_2q_1x_2 \vee q_2q_1x_1 \vee q_2x_2\bar{x}_1\\
&= \bar{q}_2x_2x_1 \vee q_1x_2 \vee q_2q_1x_1 \vee q_2x_2\bar{x}_1\\
&\quad (\because \bar{q}_2q_1x_2 \vee q_2q_1x_2 = q_1x_2)
\end{aligned}
$$

$$
\begin{aligned}
q_1^{(1)} &= j_1\cdot\bar{q}_1 \vee \bar{k}_1q_1\\
&= (x_1 \vee \bar{q}_2x_2)\cdot\bar{q}_1 \vee (\overline{\bar{x}_2x_1 \vee q_2\bar{x}_2 \vee \bar{q}_2x_2\bar{x}_1})\cdot q_1\\
&= \bar{q}_1x_1 \vee \bar{q}_2\bar{q}_1x_2 \vee (x_2 \vee \bar{x}_1)\cdot(\bar{q}_2 \vee x_2)\cdot(q_2 \vee \bar{x}_2 \vee x_1)\cdot q_1\\
&= \bar{q}_1x_1 \vee \bar{q}_2\bar{q}_1x_2 \vee (x_2 \vee \bar{q}_2\bar{x}_1)\cdot(q_2 \vee \bar{x}_2 \vee x_1)\cdot q_1\\
&= \bar{q}_1x_1 \vee \bar{q}_2\bar{q}_1x_2 \vee q_2q_1x_2 \vee q_1x_2x_1 \vee \bar{q}_2q_1\bar{x}_2\bar{x}_1\\
&= \bar{q}_1x_1 \vee \bar{q}_2\bar{q}_1x_2 \vee q_2q_1x_2 \vee x_2x_1 \vee \bar{q}_2q_1\bar{x}_2\bar{x}_1\\
&\quad (\because \bar{q}_1x_1 \vee q_1x_2x_1 = (\bar{q}_1 \vee q_1x_2)\cdot x_1 = (\bar{q}_1 \vee x_2)\cdot x_1 = \bar{q}_1x_1 \vee x_2x_1)
\end{aligned}
$$

また，j_i, k_i のカルノー図から d_i のカルノー図を作成することもできる．

- d_i のカルノー図の $q_i = 0$ の場合の 8 つのマスの値は，j_i のカルノー図の値をそのまま設定する．
- d_i のカルノー図の $q_i = 1$ の場合の 8 つのマスの値は，k_i のカルノー図の値を「反転」させて設定する．

j_2

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	0	0	1	0
01	0	0	1	1
11	*	*	*	*
10	*	*	*	*

k_2

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	*	*	*	*
01	*	*	*	*
11	1	0	0	0
10	1	1	1	0

d_2

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	0	0	1	0
01	0	0	1	1
11	0	1	1	1
10	0	0	0	1

j_1

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	0	1	1	1
01	*	*	*	*
11	*	*	*	*
10	0	1	1	0

k_1

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	*	*	*	*
01	0	1	0	1
11	1	1	0	0
10	*	*	*	*

d_1

$q_2q_1 \backslash x_2x_1$	00	01	11	10
00	0	1	1	1
01	1	0	1	0
11	0	0	1	1
10	0	1	1	0

12

7.1

(1)

	$\boldsymbol{Q} \backslash \boldsymbol{X}$	0	1
$B_0^{(1)}$	Q_0	$B_0^{(1)}$	$B_1^{(1)}$
	Q_1	$B_0^{(1)}$	$B_1^{(1)}$
	Q_2	$B_0^{(1)}$	$B_1^{(1)}$
	Q_5	$B_0^{(1)}$	$B_1^{(1)}$
	Q_8	$B_0^{(1)}$	$B_1^{(1)}$
$B_1^{(1)}$	Q_3	$B_0^{(1)}$	$B_1^{(1)}$
	Q_4	$B_1^{(1)}$	$B_0^{(1)}$
	Q_6	$B_1^{(1)}$	$B_0^{(1)}$
	Q_7	$B_0^{(1)}$	$B_1^{(1)}$

	$\boldsymbol{Q} \backslash \boldsymbol{X}$	0	1
$B_0^{(2)}$	Q_0	$B_0^{(2)}$	$B_2^{(2)}$
	Q_1	$B_0^{(2)}$	$B_1^{(2)}$
	Q_2	$B_0^{(2)}$	$B_2^{(2)}$
	Q_5	$B_0^{(2)}$	$B_1^{(2)}$
	Q_8	$B_0^{(2)}$	$B_1^{(2)}$
$B_1^{(2)}$	Q_3	$B_0^{(2)}$	$B_1^{(2)}$
	Q_7	$B_0^{(2)}$	$B_1^{(2)}$
$B_2^{(2)}$	Q_4	$B_1^{(2)}$	$B_0^{(2)}$
	Q_6	$B_1^{(2)}$	$B_0^{(2)}$

	$\boldsymbol{Q} \backslash \boldsymbol{X}$	0	1
$B_0^{(3)}$	Q_0	$B_3^{(3)}$	$B_2^{(3)}$
	Q_2	$B_0^{(3)}$	$B_2^{(3)}$
$B_3^{(3)}$	Q_1	$B_3^{(3)}$	$B_1^{(3)}$
	Q_5	$B_3^{(3)}$	$B_1^{(3)}$
	Q_8	$B_3^{(3)}$	$B_1^{(3)}$
$B_1^{(3)}$	Q_3	$B_0^{(3)}$	$B_1^{(3)}$
	Q_7	$B_0^{(3)}$	$B_1^{(3)}$
$B_2^{(3)}$	Q_4	$B_1^{(3)}$	$B_0^{(3)}$
	Q_6	$B_1^{(3)}$	$B_0^{(3)}$

	$\boldsymbol{Q} \backslash \boldsymbol{X}$	0	1
$B_0^{(4)}$	Q_0	$B_3^{(4)}$	$B_2^{(4)}$
$B_4^{(4)}$	Q_2	$B_4^{(4)}$	$B_2^{(4)}$
$B_3^{(4)}$	Q_1	$B_3^{(4)}$	$B_1^{(4)}$
	Q_5	$B_3^{(4)}$	$B_1^{(4)}$
	Q_8	$B_3^{(4)}$	$B_1^{(4)}$
$B_1^{(4)}$	Q_3	$B_0^{(4)}$	$B_1^{(4)}$
	Q_7	$B_0^{(4)}$	$B_1^{(4)}$
$B_2^{(4)}$	Q_4	$B_1^{(4)}$	$B_4^{(4)}$
	Q_6	$B_1^{(4)}$	$B_4^{(4)}$

$$
\begin{aligned}
B_0 &= \{Q_0\} \\
B_1 &= \{Q_3, Q_7\} && (Q_3 \equiv Q_7) \\
B_2 &= \{Q_4, Q_6\} && (Q_4 \equiv Q_6) \\
B_3 &= \{Q_1, Q_5, Q_8\} && (Q_1 \equiv Q_5 \equiv Q_8) \\
B_4 &= \{Q_2\}
\end{aligned}
$$

(2)

			$\boldsymbol{\omega}$	
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	0	1
Q_0	Q_1	Q_4	0	0
Q_1	Q_1	Q_3	0	0
Q_2	Q_2	Q_4	0	0
Q_3	Q_0	Q_3	0	1
Q_4	Q_4	Q_2	0	1

(3)　各部分等価状態集合を区別する最短入力系列の先頭入力：

$$
\begin{array}{rcl}
\boldsymbol{x}_D^{(0)}(B_0^{(1)}, B_1^{(1)}) & = & 1 \\
\boldsymbol{x}_D^{(0)}(B_1^{(2)}, B_2^{(2)}) & = & 0, 1 \\
\boldsymbol{x}_D^{(0)}(B_0^{(3)}, B_3^{(3)}) & = & 1 \\
\boldsymbol{x}_D^{(0)}(B_0^{(4)}, B_4^{(4)}) & = & 0
\end{array}
$$

各部分等価状態集合を区別する最短入力系列：

$$
\begin{array}{rcll}
\tilde{\boldsymbol{x}}_D(B_0^{(1)}, B_1^{(1)}) & = & \boldsymbol{x}_D^{(0)}(B_0^{(1)}, B_1^{(1)}) & = \; 1 \\
\tilde{\boldsymbol{x}}_D(B_1^{(2)}, B_2^{(2)}) & = & \boldsymbol{x}_D^{(0)}(B_1^{(2)}, B_2^{(2)}) \, \tilde{\boldsymbol{x}}_D(B_0^{(1)}, B_1^{(1)}) & = \; 01, 11 \\
\tilde{\boldsymbol{x}}_D(B_0^{(3)}, B_3^{(3)}) & = & \boldsymbol{x}_D^{(0)}(B_0^{(3)}, B_3^{(3)}) \, \tilde{\boldsymbol{x}}_D(B_1^{(2)}, B_2^{(2)}) & = \; 101, 111 \\
\tilde{\boldsymbol{x}}_D(B_0^{(4)}, B_4^{(4)}) & = & \boldsymbol{x}_D^{(0)}(B_0^{(4)}, B_4^{(4)}) \, \tilde{\boldsymbol{x}}_D(B_0^{(3)}, B_3^{(3)}) & = \; 0101, 0111
\end{array}
$$

それぞれの状態対を区別する最短入力系列：

$$
\begin{array}{rcccl}
\tilde{\boldsymbol{x}}_D(Q_0, Q_1) & = & \tilde{\boldsymbol{x}}_D(B_0^{(3)}, B_3^{(3)}) & = & 101, 111 \\
\tilde{\boldsymbol{x}}_D(Q_3, Q_4) & = & \tilde{\boldsymbol{x}}_D(B_1^{(2)}, B_2^{(2)}) & = & 01, 11 \\
\tilde{\boldsymbol{x}}_D(Q_0, Q_2) & = & \tilde{\boldsymbol{x}}_D(B_0^{(4)}, B_4^{(4)}) & = & 0101, 0111
\end{array}
$$

7.2

(1)

$x_5x_4x_3x_2$ \ x_1	0	1	$\boldsymbol{\omega}$ 0	1
0000	0000	0001	0	0
0001	0010	0011	0	0
0010	0100	0101	0	0
0011	0110	0111	0	0
0100	1000	1001	0	0
0101	1010	1011	0	0
0110	1100	1101	0	0
0111	1110	1111	0	0
1000	0000	0001	0	0
1001	0010	0011	0	0
1010	0100	0101	0	0
1011	0110	0111	0	0
1100	1000	1001	0	1
1101	1010	1011	0	0
1110	1100	1101	0	0
1111	1110	1111	0	0

(2)

	$x_5x_4x_3x_2$ \ x_1	0	1
$B_0^{(1)}$	0000	$B_0^{(1)}$	$B_0^{(1)}$
	0001	$B_0^{(1)}$	$B_0^{(1)}$
	0010	$B_0^{(1)}$	$B_0^{(1)}$
	0011	$B_0^{(1)}$	$B_0^{(1)}$
	0100	$B_0^{(1)}$	$B_0^{(1)}$
	0101	$B_0^{(1)}$	$B_0^{(1)}$
	0110	$B_1^{(1)}$	$B_0^{(1)}$
	0111	$B_0^{(1)}$	$B_0^{(1)}$
	1000	$B_0^{(1)}$	$B_0^{(1)}$
	1001	$B_0^{(1)}$	$B_0^{(1)}$
	1010	$B_0^{(1)}$	$B_0^{(1)}$
	1011	$B_0^{(1)}$	$B_0^{(1)}$
	1101	$B_0^{(1)}$	$B_0^{(1)}$
	1110	$B_1^{(1)}$	$B_0^{(1)}$
	1111	$B_0^{(1)}$	$B_0^{(1)}$
$B_1^{(1)}$	1100	$B_0^{(1)}$	$B_0^{(1)}$

	$x_5x_4x_3x_2$ \ x_1	0	1
$B_0^{(2)}$	0000	$B_0^{(2)}$	$B_0^{(2)}$
	0001	$B_0^{(2)}$	$B_0^{(2)}$
	0010	$B_0^{(2)}$	$B_0^{(2)}$
	0011	$B_2^{(2)}$	$B_0^{(2)}$
	0100	$B_0^{(2)}$	$B_0^{(2)}$
	0101	$B_0^{(2)}$	$B_0^{(2)}$
	0111	$B_2^{(2)}$	$B_0^{(2)}$
	1000	$B_0^{(2)}$	$B_0^{(2)}$
	1001	$B_0^{(2)}$	$B_0^{(2)}$
	1010	$B_0^{(2)}$	$B_0^{(2)}$
	1011	$B_2^{(2)}$	$B_0^{(2)}$
	1101	$B_0^{(2)}$	$B_0^{(2)}$
	1111	$B_2^{(2)}$	$B_0^{(2)}$
$B_2^{(2)}$	1110	$B_1^{(2)}$	$B_0^{(2)}$
	0110	$B_1^{(2)}$	$B_0^{(2)}$
$B_1^{(2)}$	1100	$B_0^{(2)}$	$B_0^{(2)}$

	x_1 \ $x_5x_4x_3x_2$	0	1
$B_0^{(3)}$	0000	$B_0^{(3)}$	$B_0^{(3)}$
	0001	$B_0^{(3)}$	$B_3^{(3)}$
	0010	$B_0^{(3)}$	$B_0^{(3)}$
	0100	$B_0^{(3)}$	$B_0^{(3)}$
	0101	$B_0^{(3)}$	$B_3^{(3)}$
	1000	$B_0^{(3)}$	$B_0^{(3)}$
	1001	$B_0^{(3)}$	$B_3^{(3)}$
	1010	$B_0^{(3)}$	$B_0^{(3)}$
	1101	$B_0^{(3)}$	$B_3^{(3)}$
$B_3^{(3)}$	0011	$B_2^{(3)}$	$B_3^{(3)}$
	0111	$B_2^{(3)}$	$B_3^{(3)}$
	1011	$B_2^{(3)}$	$B_3^{(3)}$
	1111	$B_2^{(3)}$	$B_3^{(3)}$
$B_2^{(3)}$	1110	$B_1^{(3)}$	$B_0^{(3)}$
	0110	$B_1^{(3)}$	$B_0^{(3)}$
$B_1^{(3)}$	1100	$B_0^{(3)}$	$B_0^{(3)}$

	x_1 \ $x_5x_4x_3x_2$	0	1
$B_0^{(4)}$	0000	$B_0^{(4)}$	$B_4^{(4)}$
	0010	$B_0^{(4)}$	$B_4^{(4)}$
	0100	$B_0^{(4)}$	$B_4^{(4)}$
	1000	$B_0^{(4)}$	$B_4^{(4)}$
	1010	$B_0^{(4)}$	$B_4^{(4)}$
$B_4^{(4)}$	0001	$B_0^{(4)}$	$B_3^{(4)}$
	0101	$B_0^{(4)}$	$B_3^{(4)}$
	1001	$B_0^{(4)}$	$B_3^{(4)}$
	1101	$B_0^{(4)}$	$B_3^{(4)}$
$B_3^{(4)}$	0011	$B_2^{(4)}$	$B_3^{(4)}$
	0111	$B_2^{(4)}$	$B_3^{(4)}$
	1011	$B_2^{(4)}$	$B_3^{(4)}$
	1111	$B_2^{(4)}$	$B_3^{(4)}$
$B_2^{(4)}$	1110	$B_1^{(4)}$	$B_0^{(4)}$
	0110	$B_1^{(4)}$	$B_0^{(4)}$
$B_1^{(4)}$	1100	$B_0^{(4)}$	$B_4^{(4)}$

			$\boldsymbol{\omega}$	
$\boldsymbol{X}$ \ $\boldsymbol{Q}$	0	1	0	1
Q_0	Q_0	Q_4	0	0
Q_1	Q_0	Q_4	0	1
Q_2	Q_1	Q_0	0	0
Q_3	Q_2	Q_3	0	0
Q_4	Q_0	Q_3	0	0

(3) (a) 判定系列： $(0, Q_0) = \ (0, Q_4) = Q_0, \boldsymbol{\omega}(0, Q_0) = \boldsymbol{\omega}(0, Q_4) = 0$ なので，0 で始まる入力系列は Q_0 と Q_4 を区別できない．また， $(1, Q_3) = \ (1, Q_4) = Q_3, \boldsymbol{\omega}(1, Q_3) = \boldsymbol{\omega}(0, Q_4) = 1$ なので，1 で始まる入力系列は Q_3 と Q_4 を区別できない．以上より，判定系列は存在しない．

(b)　同期化系列：$\tilde{\boldsymbol{x}}_S = 000$

$$
\begin{array}{l}
Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \\
Q_1 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \\
Q_2 \xrightarrow{0/0} Q_1 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \\
Q_3 \xrightarrow{0/0} Q_2 \xrightarrow{0/0} Q_1 \xrightarrow{0/0} Q_0 \\
Q_4 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{0/0} Q_0
\end{array}
$$

$\tilde{\boldsymbol{x}}_S = 000$ の最終状態は Q_0 になる．

(c)　ホーミング系列：$\tilde{\boldsymbol{x}}_H = 01$

$$
\begin{array}{l}
Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{1/0} Q_0 \\
Q_1 \xrightarrow{0/0} Q_0 \xrightarrow{1/0} Q_0 \\
Q_2 \xrightarrow{0/0} Q_1 \xrightarrow{1/1} Q_4 \\
Q_3 \xrightarrow{0/0} Q_2 \xrightarrow{1/0} Q_0 \\
Q_4 \xrightarrow{0/0} Q_0 \xrightarrow{1/0} Q_0
\end{array}
$$

出力系列が 00 ならば最終状態は Q_0 であり，01 ならば最終状態は Q_4 である．この他，同期化系列 $\tilde{\boldsymbol{x}}_S = 000$ もホーミング系列である．

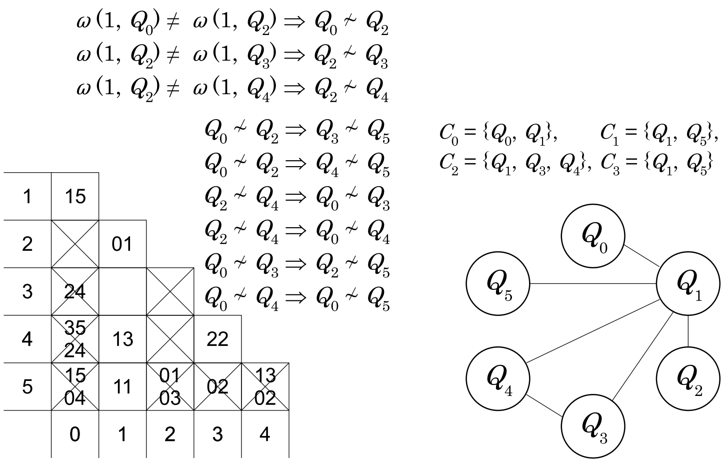
7.3

表 7.8 の状態遷移表では，いずれの入力 $x = 0, 1$ においても，異なる 2 つの状態の遷移先は必ず異なる，という性質を持っている．すなわち，式 7.33 の式が成り立つ．よって 同期化系列は存在しない．$\tilde{\boldsymbol{x}}_D = 101011$ は判定系列でありホーミング系列でもある．

$$
\begin{array}{l}
Q_0 \xrightarrow{1/1} Q_2 \xrightarrow{0/0} Q_4 \xrightarrow{1/0} Q_4 \xrightarrow{0/0} Q_1 \xrightarrow{1/0} Q_3 \xrightarrow{1/1} Q_1 \\
Q_1 \xrightarrow{1/0} Q_3 \xrightarrow{0/0} Q_3 \xrightarrow{1/1} Q_1 \xrightarrow{0/0} Q_2 \xrightarrow{1/0} Q_0 \xrightarrow{1/1} Q_2 \\
Q_2 \xrightarrow{1/0} Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{1/1} Q_2 \xrightarrow{0/0} Q_4 \xrightarrow{1/0} Q_4 \xrightarrow{1/0} Q_4 \\
Q_3 \xrightarrow{1/1} Q_1 \xrightarrow{0/0} Q_2 \xrightarrow{1/0} Q_0 \xrightarrow{0/0} Q_0 \xrightarrow{1/1} Q_2 \xrightarrow{1/0} Q_0 \\
Q_4 \xrightarrow{1/0} Q_4 \xrightarrow{0/0} Q_1 \xrightarrow{1/0} Q_3 \xrightarrow{0/0} Q_3 \xrightarrow{1/1} Q_1 \xrightarrow{1/0} Q_3
\end{array}
$$

初期状態	出力系列
Q_0	100001
Q_1	001001
Q_2	001000
Q_3	100010
Q_4	000010

8.1



(1) インプリケーションテーブル　　(2) 両立性グラフ

(1)

$$Q_0 \nsim Q_2,\ Q_0 \nsim Q_3,\ Q_0 \nsim Q_4,\ Q_0 \nsim Q_5,\ Q_2 \nsim Q_3,\ Q_2 \nsim Q_4,$$
$$Q_2 \nsim Q_5,\ Q_3 \nsim Q_5,\ Q_4 \nsim Q_5$$

$$Q_0 \sim Q_1,\ Q_1 \sim Q_2,\ Q_1 \sim Q_3,\ Q_1 \sim Q_4,\ Q_1 \sim Q_5,\ Q_3 \sim Q_4$$

(2)

$$\begin{aligned}
\boldsymbol{C}_0 &= \{Q_0, Q_1\} \\
\boldsymbol{C}_1 &= \{Q_1, Q_2\} \\
\boldsymbol{C}_2 &= \{Q_1, Q_3, Q_4\} \\
\boldsymbol{C}_3 &= \{Q_1, Q_5\}
\end{aligned}$$

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(3)

$\boldsymbol{Q}$ \ $\boldsymbol{X}$	0	1	$\boldsymbol{\omega}$ 0	1
Q_0 ($\boldsymbol{C}_0$)	Q_5	Q_4	0	1
Q_1 ($\boldsymbol{C}_0$)	Q_1	*	0	*
Q_1 ($\boldsymbol{C}_1$)	Q_1	*	0	*
Q_2 ($\boldsymbol{C}_1$)	Q_0	Q_3	0	0
Q_1 ($\boldsymbol{C}_2$)	Q_1	*	0	*
Q_3 ($\boldsymbol{C}_2$)	*	Q_2	*	1
Q_4 ($\boldsymbol{C}_2$)	Q_3	Q_2	0	1
Q_1 ($\boldsymbol{C}_3$)	Q_1	*	0	*
Q_5 ($\boldsymbol{C}_3$)	Q_1	Q_0	0	*

(a) 両立的状態集合による
状態遷移表の並べ替え

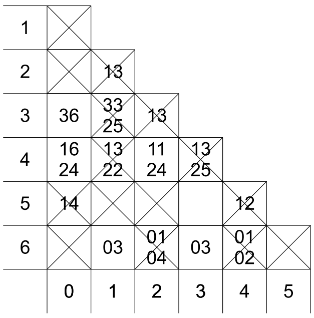
$\hat{\boldsymbol{Q}}$ \ $\boldsymbol{X}$	0	1	$\boldsymbol{\omega}$ 0	1
$\hat{Q}_0$	$\hat{Q}_3$	$\hat{Q}_2$	0	1
$\hat{Q}_1$	$\hat{Q}_0$	$\hat{Q}_2$	0	0
$\hat{Q}_2$	$\hat{Q}_2$	$\hat{Q}_1$	0	1
$\hat{Q}_3$	$\hat{Q}_0 \vee \hat{Q}_1$ $\vee \hat{Q}_2 \vee \hat{Q}_3$	$\hat{Q}_0$	0	*

(b) 状態の両立性に基づいて
簡単化された状態遷移表

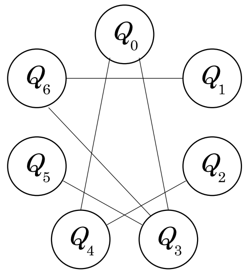
8.2

$\omega(1, Q_0) \neq \omega(1, Q_1) \Rightarrow Q_0 \nsim Q_1$
$\omega(1, Q_0) \neq \omega(1, Q_2) \Rightarrow Q_0 \nsim Q_2$
$\omega(1, Q_0) \neq \omega(1, Q_6) \Rightarrow Q_0 \nsim Q_6$
$\omega(1, Q_1) \neq \omega(1, Q_5) \Rightarrow Q_1 \nsim Q_5$
$\omega(1, Q_2) \neq \omega(1, Q_5) \Rightarrow Q_2 \nsim Q_5$
$\omega(1, Q_5) \neq \omega(1, Q_6) \Rightarrow Q_5 \nsim Q_6$

$Q_0 \nsim Q_1 \Rightarrow Q_2 \nsim Q_6$
$Q_0 \nsim Q_1 \Rightarrow Q_4 \nsim Q_6$
$Q_2 \nsim Q_5 \Rightarrow Q_1 \nsim Q_3$
$Q_2 \nsim Q_5 \Rightarrow Q_3 \nsim Q_4$
$Q_0 \nsim Q_3 \Rightarrow Q_2 \nsim Q_5$
$Q_0 \nsim Q_4 \Rightarrow Q_0 \nsim Q_5$
$Q_1 \sim Q_3 \Rightarrow Q_1 \sim Q_2$
$Q_1 \sim Q_3 \Rightarrow Q_1 \sim Q_4$
$Q_1 \sim Q_3 \Rightarrow Q_2 \sim Q_3$
$Q_1 \sim Q_2 \Rightarrow Q_4 \sim Q_5$
$Q_1 \sim Q_4 \Rightarrow Q_0 \sim Q_5$



(1) インプリケーションテーブル



(2) 両立性グラフ

(1)

$$Q_0 \nsim Q_1,\ Q_0 \nsim Q_2,\ Q_0 \nsim Q_5,\ Q_0 \nsim Q_6,\ Q_1 \nsim Q_2,\ Q_1 \nsim Q_3,$$
$$Q_1 \nsim Q_4,\ Q_1 \nsim Q_5,\ Q_2 \nsim Q_3,\ Q_2 \nsim Q_5,\ Q_2 \nsim Q_6,\ Q_3 \nsim Q_4,$$
$$Q_4 \nsim Q_5,\ Q_4 \nsim Q_5,\ Q_5 \nsim Q_6$$

$$Q_0 \sim Q_3,\ Q_0 \sim Q_4,\ Q_1 \sim Q_6,\ Q_2 \sim Q_4,\ Q_3 \sim Q_5,\ Q_3 \sim Q_6$$

(2)

$$\begin{aligned} \boldsymbol{C}_0 &= \{Q_0, Q_3\} \\ \boldsymbol{C}_1 &= \{Q_0, Q_4\} \\ \boldsymbol{C}_2 &= \{Q_1, Q_6\} \\ \boldsymbol{C}_3 &= \{Q_2, Q_4\} \\ \boldsymbol{C}_4 &= \{Q_3, Q_5\} \\ \boldsymbol{C}_5 &= \{Q_3, Q_6\} \end{aligned}$$

(3)

				$\boldsymbol{\omega}$		
$\boldsymbol{Q}$ \ $\boldsymbol{X}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$
Q_0 ($\boldsymbol{C}_0$)	Q_6	*	Q_4	0	*	0
Q_3 ($\boldsymbol{C}_0$)	Q_3	Q_5	*	0	1	*
Q_0 ($\boldsymbol{C}_1$)	Q_6	*	Q_4	0	*	0
Q_4 ($\boldsymbol{C}_1$)	Q_1	Q_2	Q_2	*	1	*
Q_1 ($\boldsymbol{C}_2$)	Q_3	Q_2	*	0	1	1
Q_6 ($\boldsymbol{C}_2$)	Q_0	*	Q_0	*	*	1
Q_2 ($\boldsymbol{C}_3$)	Q_1	*	Q_4	0	*	1
Q_4 ($\boldsymbol{C}_3$)	Q_1	Q_2	Q_2	*	1	*
Q_3 ($\boldsymbol{C}_4$)	Q_3	Q_5	*	0	1	*
Q_5 ($\boldsymbol{C}_4$)	*	*	Q_1	*	*	0
Q_3 ($\boldsymbol{C}_5$)	Q_3	Q_5	*	0	1	*
Q_6 ($\boldsymbol{C}_5$)	Q_0	*	Q_0	*	*	1

(a) 両立的状態集合による
状態遷移表の並べ替え

				$\boldsymbol{\omega}$		
$\hat{\boldsymbol{Q}}$ \ $\boldsymbol{X}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$
$\hat{Q}_0$	$\hat{Q}_5$	$\hat{Q}_4$	$\hat{Q}_1 \vee \hat{Q}_3$	0	1	0
$\hat{Q}_1$	$\hat{Q}_2$	$\hat{Q}_3$	$\hat{Q}_3$	0	1	0
$\hat{Q}_2$	$\hat{Q}_0$	$\hat{Q}_3$	$\hat{Q}_0 \vee \hat{Q}_1$	0	1	1
$\hat{Q}_3$	$\hat{Q}_2$	$\hat{Q}_3$	$\hat{Q}_3$	0	1	1
$\hat{Q}_4$	$\hat{Q}_0 \vee \hat{Q}_4 \vee \hat{Q}_5$	$\hat{Q}_4$	$\hat{Q}_2$	0	1	0
$\hat{Q}_5$	$\hat{Q}_0$	$\hat{Q}_4$	$\hat{Q}_0 \vee \hat{Q}_1$	0	1	1

(b) 状態の両立性に基づいて
簡単化された状態遷移表

(4) $\boldsymbol{C}_1 = \{Q_0, Q_4\}$ が包含する次状態集合は ${}_c(\boldsymbol{c}, \boldsymbol{C}_0) = \{Q_4\}$, ${}_c(\boldsymbol{c}, \boldsymbol{C}_2) = \{Q_0\}$, ${}_c(\boldsymbol{c}, \boldsymbol{C}_5) = \{Q_0\}$ であるが，いずれも他の両立的状態集合によって包含されるので，$\boldsymbol{C}_1$ を定義 8.7 の $\boldsymbol{Q}_c$ から取り除いても構わない．

				$\boldsymbol{\omega}$		
$\boldsymbol{X}$ \ $\boldsymbol{Q}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$
Q_0 ($\boldsymbol{C}_0$)	Q_6	*	Q_4	0	*	0
Q_3 ($\boldsymbol{C}_0$)	Q_3	Q_5	*	0	1	*
Q_1 ($\boldsymbol{C}_2$)	Q_3	Q_2	*	0	1	1
Q_6 ($\boldsymbol{C}_2$)	Q_0	*	Q_0	*	*	1
Q_2 ($\boldsymbol{C}_3$)	Q_1	*	Q_4	0	*	1
Q_4 ($\boldsymbol{C}_3$)	Q_1	Q_2	Q_2	*	1	*
Q_3 ($\boldsymbol{C}_4$)	Q_3	Q_5	*	0	1	*
Q_5 ($\boldsymbol{C}_4$)	*	*	Q_1	*	*	0
Q_3 ($\boldsymbol{C}_5$)	Q_3	Q_5	*	0	1	*
Q_6 ($\boldsymbol{C}_5$)	Q_0	*	Q_0	*	*	1

(a) 両立的状態集合による
状態遷移表の並べ替え

				$\boldsymbol{\omega}$		
$\boldsymbol{X}$ \ $\hat{\boldsymbol{Q}}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$
$\hat{Q}_0$	$\hat{Q}_5$	$\hat{Q}_4$	$\hat{Q}_3$	0	1	0
$\hat{Q}_2$	$\hat{Q}_0$	$\hat{Q}_3$	$\hat{Q}_0$	0	1	1
$\hat{Q}_3$	$\hat{Q}_2$	$\hat{Q}_3$	$\hat{Q}_3$	0	1	1
$\hat{Q}_4$	$\hat{Q}_0$ $\vee\hat{Q}_4$ $\vee\hat{Q}_5$	$\hat{Q}_4$	$\hat{Q}_2$	0	1	0
$\hat{Q}_5$	$\hat{Q}_0$	$\hat{Q}_4$	$\hat{Q}_0$	0	1	1

(b) 状態の両立性に基づいて
簡単化された状態遷移表