



Technische Informatik I im WS 2004/2005

Musterlösungen zum 3. Übungsblatt

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Lösung 1

1. Funktionstabelle:

d	c	b	a	y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

2. Minterme:

$$m_3 = \bar{d}\bar{c}ba$$

$$m_5 = \bar{d}\bar{c}\bar{b}a$$

$$m_6 = \bar{d}cb\bar{a}$$

$$m_7 = \bar{d}cba$$

$$m_9 = d\bar{c}\bar{b}a$$

$$m_{10} = d\bar{c}\bar{b}\bar{a}$$

$$m_{12} = dc\bar{b}\bar{a}$$

$$m_{13} = dc\bar{b}a$$

$$m_{14} = dcb\bar{a}$$

Maxterme:

$$M_0 = (d \vee c \vee b \vee a)$$

$$M_1 = (d \vee c \vee b \vee \bar{a})$$

$$M_2 = (d \vee c \vee \bar{b} \vee a)$$

$$M_4 = (d \vee \bar{c} \vee b \vee a)$$

$$M_8 = (\bar{d} \vee c \vee b \vee a)$$

$$M_{11} = (\bar{d} \vee c \vee \bar{b} \vee \bar{a})$$

$$M_{15} = (\bar{d} \vee \bar{c} \vee \bar{b} \vee \bar{a})$$

3. DNF:

$$y = \bigvee(\text{alle Minterme}) = m_3 \vee m_5 \vee m_6 \vee m_7 \vee m_9 \vee m_{10} \vee m_{12} \vee m_{13} \vee m_{14}$$

KNF:

$$y = \bigwedge(\text{alle Maxterme}) = M_0 \wedge M_1 \wedge M_2 \wedge M_4 \wedge M_8 \wedge M_{11} \wedge M_{15}$$

Lösung 2

1. Funktionstabelle

c	b	a	f	\bar{f}
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	1
1	0	1	0	1
1	1	0	1	0
1	1	1	1	0

2. Konjunktive Normalformen:

$$\begin{aligned}
 f(c, b, a) &= \text{MAXt}(0, 4, 5) &= (c \vee b \vee a) \cdot (\bar{c} \vee b \vee a) \cdot (\bar{c} \vee b \vee \bar{a}) \\
 \bar{f}(c, b, a) &= \text{MAXt}(1, 2, 3, 6, 7) &= (c \vee b \vee \bar{a}) \cdot (c \vee \bar{b} \vee a) \cdot (c \vee \bar{b} \vee \bar{a}) \cdot \\
 & & (\bar{c} \vee \bar{b} \vee a) \cdot (\bar{c} \vee \bar{b} \vee \bar{a})
 \end{aligned}$$

3. Disjunktive Normalform von \bar{f} :

$$\bar{f}(c, b, a) = \text{MINt}(0, 4, 5) = \bar{c} \bar{b} \bar{a} \vee c \bar{b} \bar{a} \vee c \bar{b} a$$

4. Vereinfachung den DNF und KNF:

DNF:

$$\begin{aligned}
 f(c, b, a) &= \text{MINt}(1, 2, 3, 6, 7) = \bar{c} \bar{b} a \vee \bar{c} b \bar{a} \vee \underbrace{\bar{c} b a}_{= \bar{c} b a \vee \bar{c} b a} \vee c b \bar{a} \vee c b a \\
 &= \bar{c} \bar{b} a \vee \bar{c} b a \vee \bar{c} b \bar{a} \vee c b \bar{a} \vee \bar{c} b a \vee c b a \\
 &= \bar{c} a (\bar{b} \vee b) \vee b \bar{a} (\bar{c} \vee c) \vee b a (c \vee \bar{c}) \\
 &= \bar{c} a \vee b \bar{a} \vee b a \\
 &= \bar{c} a \vee b
 \end{aligned}$$

KNF:

$$\begin{aligned}
 f(c, b, a) &= \text{MAXt}(0, 4, 5) = (c \vee b \vee a) \cdot (\bar{c} \vee b \vee a) \cdot (\bar{c} \vee b \vee \bar{a}) \\
 &= (c \vee b \vee a) \cdot ((\bar{c} \vee b) \vee a \bar{a}) \\
 &= (c \vee b \vee a) \cdot (\bar{c} \vee b) \\
 &= (c \vee b) \cdot (\bar{c} \vee b) \vee a (\bar{c} \vee b) \\
 &= (b \vee a) \cdot (\bar{c} \vee b)
 \end{aligned}$$

Lösung 3

Die Schaltfunktionen der Ausgangsgrößen GR , KL und GL :

A_1	A_0	B_1	B_0	GR	KL	GL
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	0	1

$$\begin{aligned}
 GR(A_1, A_0, B_1, B_0) &= \text{MINt}(4, 8, 9, 12, 13, 14) \\
 &= \overline{A_1} A_0 \overline{B_1} \overline{B_0} \vee A_1 \overline{A_0} \overline{B_1} \overline{B_0} \vee A_1 \overline{A_0} \overline{B_1} B_0 \vee \\
 &\quad \underbrace{A_1 A_0 \overline{B_1} \overline{B_0}}_{m_{12}(=m_{12} \vee m_{12})} \vee A_1 A_0 \overline{B_1} B_0 \vee A_1 A_0 B_1 \overline{B_0} \\
 &= \overline{A_1} A_0 \overline{B_1} \overline{B_0} \vee A_1 A_0 \overline{B_1} \overline{B_0} \vee \\
 &\quad A_1 \overline{A_0} \overline{B_1} \overline{B_0} \vee A_1 \overline{A_0} \overline{B_1} B_0 \vee \\
 &\quad A_1 A_0 \overline{B_1} \overline{B_0} \vee A_1 A_0 \overline{B_1} B_0 \vee \\
 &\quad A_1 A_0 \overline{B_1} \overline{B_0} \vee A_1 A_0 B_1 \overline{B_0} \\
 &= A_0 \overline{B_1} \overline{B_0} \vee A_1 \overline{A_0} \overline{B_1} \vee A_1 A_0 \overline{B_1} \vee A_1 A_0 \overline{B_0} \\
 &= A_0 \overline{B_1} \overline{B_0} \vee A_1 \overline{B_1} \vee A_1 A_0 \overline{B_0}
 \end{aligned}$$

Da der Vergleich $A < B$ mit dem Vergleich $B > A$ identisch ist, erhält man durch Vertauschung von B_i und A_i in obiger Gleichung die Schaltfunktion für KL :

$$KL(A_1, A_0, B_1, B_0) = B_0 \overline{A_1} \overline{A_0} \vee B_1 \overline{A_1} \vee B_1 B_0 \overline{A_0}$$

Für $GL(A_1, A_0, B_1, B_0)$ gilt:

$$GL(A_1, A_0, B_1, B_0) = \overline{(GR \vee KL)}$$

Lösung 4KNF von $f(w, x, y, z)$:

$$\begin{aligned} f(w, x, y, z) &= \text{MAXt}(1, 2, 6, 7, 9, 10) \\ &= (w \vee x \vee y \vee \bar{z}) \cdot (w \vee x \vee \bar{y} \vee z) \cdot (w \vee \bar{x} \vee \bar{y} \vee z) \cdot \\ &\quad (w \vee \bar{x} \vee \bar{y} \vee \bar{z}) \cdot (\bar{w} \vee x \vee y \vee \bar{z}) \cdot (\bar{w} \vee x \vee \bar{y} \vee z) \end{aligned}$$

DNF von $f(w, x, y, z)$:

$$\begin{aligned} f(w, x, y, z) &= \text{MINt}(0, 3, 4, 5, 8, 11, 12, 13, 14, 15) \\ &= \bar{w} \bar{x} \bar{y} \bar{z} \vee \bar{w} \bar{x} y z \vee \bar{w} x \bar{y} \bar{z} \vee \bar{w} x \bar{y} z \vee w \bar{x} \bar{y} \bar{z} \\ &\quad \vee w \bar{x} y z \vee w x \bar{y} \bar{z} \vee w x \bar{y} z \vee w x y \bar{z} \vee w x y z \end{aligned}$$