CS 254: Assignment 4

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Question 4

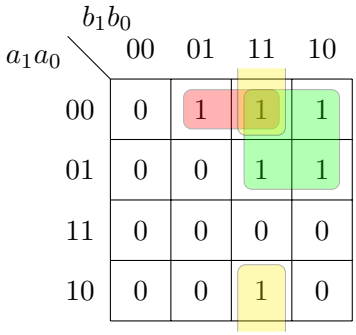
Truth Table

a_1	a_0	b_1	b_0	l	g	e
0	0	0	0	0	0	1
0	0	0	1	1	0	0
0	0	1	0	1	0	0
0	0	1	1	1	0	0
0	1	0	0	0	1	0
0	1	0	1	0	0	1
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	1	0
1	0	0	1	0	1	0
1	0	1	0	0	0	1
1	0	1	1	1	0	0
1	1	0	0	0	1	0
1	1	0	1	0	1	0
1	1	1	0	0	1	0
1	1	1	1	0	0	1

Table 1: Truth table for a 2-bit comparator

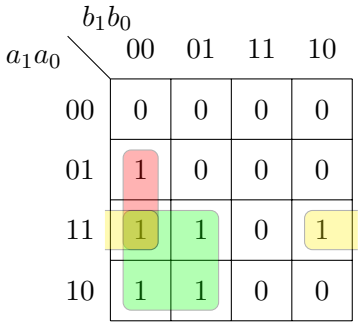
K-Maps

l ($a < b$)



Quad term: $\bar{a}_1\bar{a}_0b_1b_0 + \bar{a}_1\bar{a}_0b_1\bar{b}_0 + \bar{a}_1a_0b_1b_0 + \bar{a}_1a_0b_1\bar{b}_0 = \bar{a}_1\bar{a}_0b_1 + \bar{a}_1a_0b_1 = \bar{a}_1b_1$
Pair term 1: $\bar{a}_1\bar{a}_0\bar{b}_1b_0 + \bar{a}_1\bar{a}_0b_1b_0 = \bar{a}_1\bar{a}_0b_0$
Pair term 2: $\bar{a}_1\bar{a}_0b_1b_0 + a_1\bar{a}_0b_1b_0 = \bar{a}_0b_1b_0$
Minimized Expression: $\boxed{\bar{a}_1b_1 + \bar{a}_1\bar{a}_0b_0 + \bar{a}_0b_1b_0}$

g ($a > b$)



Quad term: $a_1a_0\bar{b}_1\bar{b}_0 + a_1a_0\bar{b}_1b_0 + a_1\bar{a}_0\bar{b}_1\bar{b}_0 + a_1\bar{a}_0\bar{b}_1b_0 = a_1a_0\bar{b}_1 + a_1\bar{a}_0\bar{b}_1 = a_1\bar{b}_1$
Pair term 1: $\bar{a}_1a_0\bar{b}_1\bar{b}_0 + a_1a_0\bar{b}_1\bar{b}_0 = a_0\bar{b}_1\bar{b}_0$
Pair term 2: $a_1a_0\bar{b}_1\bar{b}_0 + a_1a_0b_1\bar{b}_0 = a_1a_0\bar{b}_0$
Minimized Expression: $\boxed{a_1\bar{b}_1 + a_1a_0\bar{b}_0 + a_0\bar{b}_1\bar{b}_0}$

e $(a = b)$

a_1a_0 \ b_1b_0	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
10	0	0	0	1

Minimized expression: $\bar{a}_1\bar{a}_0\bar{b}_1\bar{b}_0 + \bar{a}_1a_0\bar{b}_1b_0 + a_1a_0b_1b_0 + a_1\bar{a}_0b_1\bar{b}_0$