Subject: John Hubbard — Verilog 0764 – HW 5a, 5b

Problems: 4.4.1 and 4.4.2

Date: Sun – 19 Oct 2014

	q_4	q_3	q_2	q_1	q_0	fmaj	fmin
	0	0	0	0	0	0	1
	0	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	0	1
	0	0	1	0	1	0	1
	0	0	1	1	0	0	1
✓	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	1
✓	0	1	0	1	1	1	0
	0	1	1	0	0	0	1
✓	0	1	1	0	1	1	0
✓	0	1	1	1	0	1	0
✓	0	1	1	1	1	1	0
	1	0	0	0	0	0	1
	1	0	0	0	1	0	1
	1	0	0	1	0	0	1
✓	1	0	0	1	1	1	0
	1	0	1	0	0	0	1
✓	1	0	1	0	1	1	0
✓	1	0	1	1	0	1	0
✓	1	0	1	1	1	1	0
	1	1	0	0	0	0	1
✓	1	1	0	0	1	1	0
✓	1	1	0	1	0	1	0
✓	1	1	0	1	1	1	0
✓	1	1	1	0	0	1	0
✓	1	1	1	0	1	1	0
✓	1	1	1	1	0	1	0
✓	1	1	1	1	1	1	0

Problems 4.4.1 (Majority circuit) and 4.4.2 (minority circuit).

← By inspection, fmin = $\overline{(fmaj)}$

$f_{maj} =$

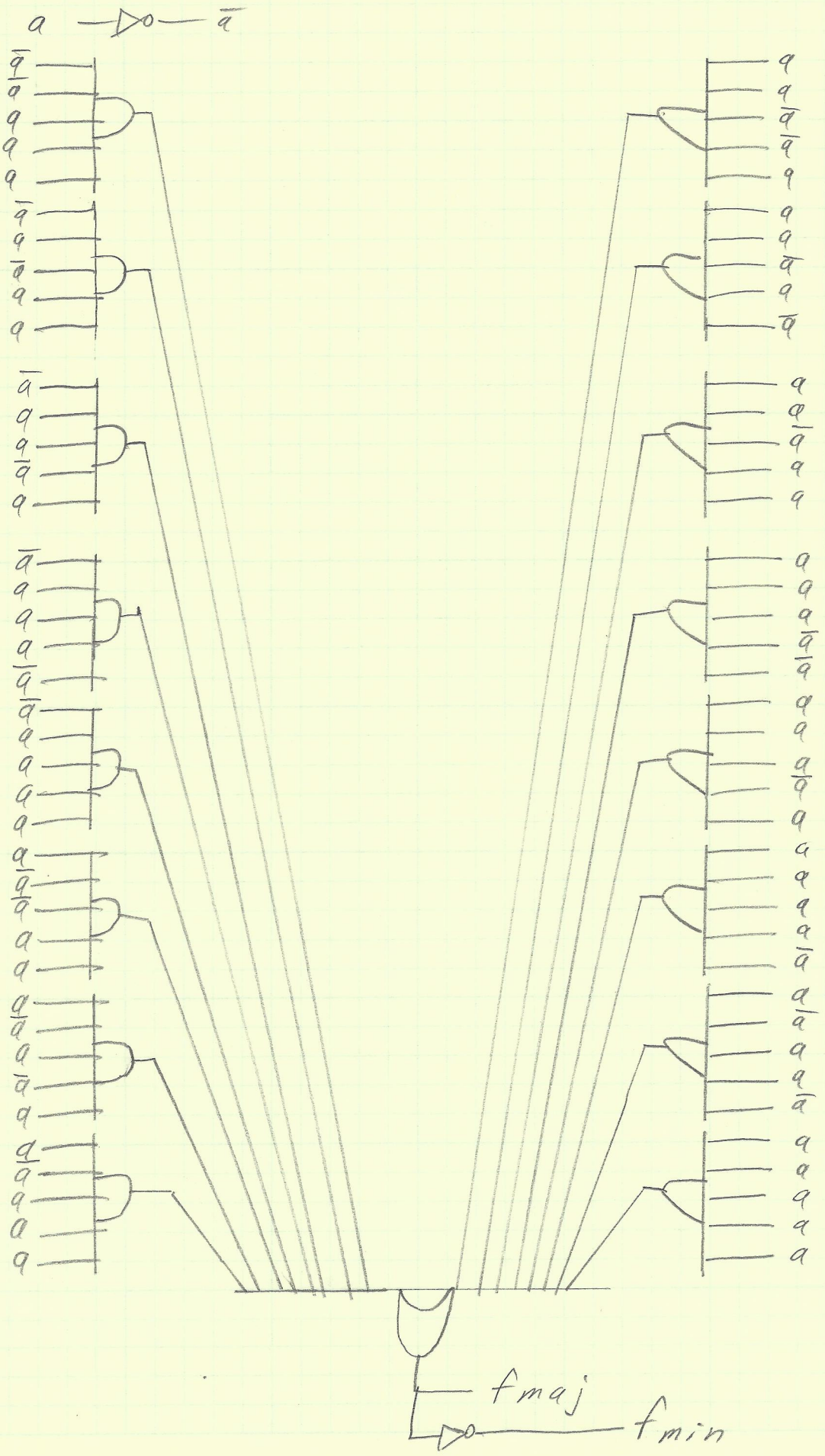
Answer for problem 4.4.1

$\bar{a}$	$\bar{a}$	a	a	a	+	$\bar{a}$	a	$\bar{a}$	a	a	+
$\bar{a}$	a	a	$\bar{a}$	a	+	$\bar{a}$	a	$\bar{a}$	a	$\bar{a}$	+
$\bar{a}$	a	a	a	a	+	a	$\bar{a}$	$\bar{a}$	a	a	+
a	$\bar{a}$	a	$\bar{a}$	a	+	a	$\bar{a}$	a	a	a	+
a	a	$\bar{a}$	$\bar{a}$	a	+	a	a	$\bar{a}$	a	$\bar{a}$	+
a	a	$\bar{a}$	a	a	+	$\bar{a}$	a	a	$\bar{a}$	$\bar{a}$	+
a	a	a	$\bar{a}$	a	+	a	a	a	a	$\bar{a}$	+
a	$\bar{a}$	a	a	$\bar{a}$	+	a	a	a	a	a	

Missed one

$f_{min} = \overline{f_{maj}}$ (Answer for problem 4.4.2)

Verilog 0764 | Problem 5 4.4.1 & 4.4.2 (con) | John Hubbard



Verilog 0764	Problem 4.4.3	John Hubbard

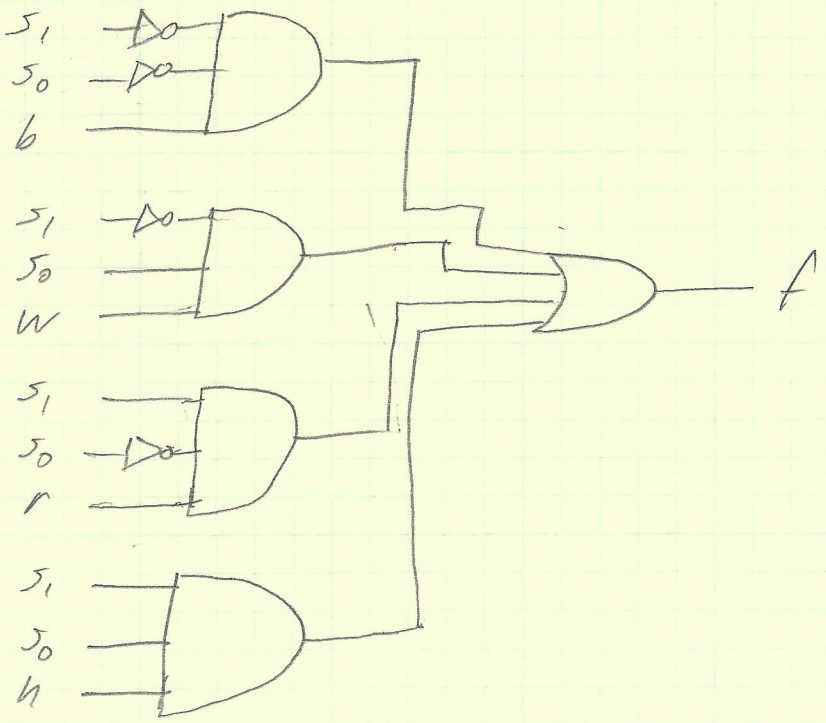
Liquid vending machine: 4 items, so $2^2 = 4$, so $\boxed{2}$ inputs are required to choose a selection.

b = beer
w = wine
r = rum
h = whiskey

Select lines

S_1	S_0	f (output)
0	0	b
0	1	w
1	0	r
1	1	h

$$f = \bar{S}_1 \bar{S}_0 b + \bar{S}_1 S_0 w + S_1 \bar{S}_0 r + S_1 S_0 h$$

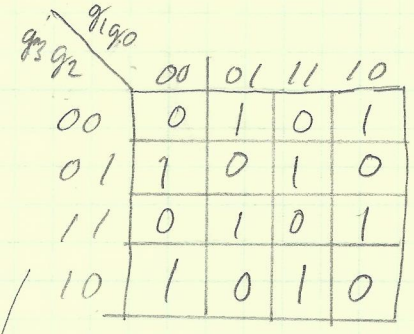


Verilog 0764	Problem 4.4.4	John Hubbard

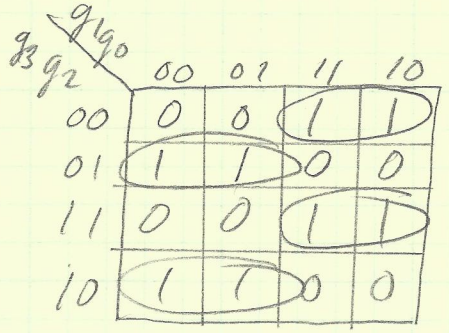
Problem: create a Gray code to Binary convertor

Binary $b_3 - b_0$	Gray $g_3 - g_0$
0000	0000
0001	0001
0010	0011
0011	0010
0100	0110
0101	0111
0110	0101
0111	0100
1000	1100
1001	1101
1010	1111
1011	1110
1100	1010
1101	1011
1110	1001
1111	1000

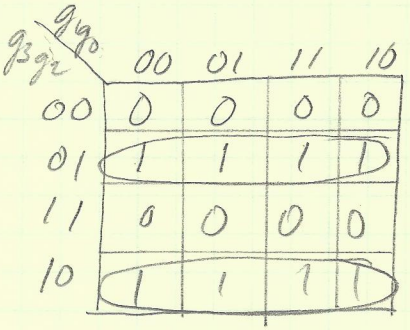
$b_3 = g_3$



b_0

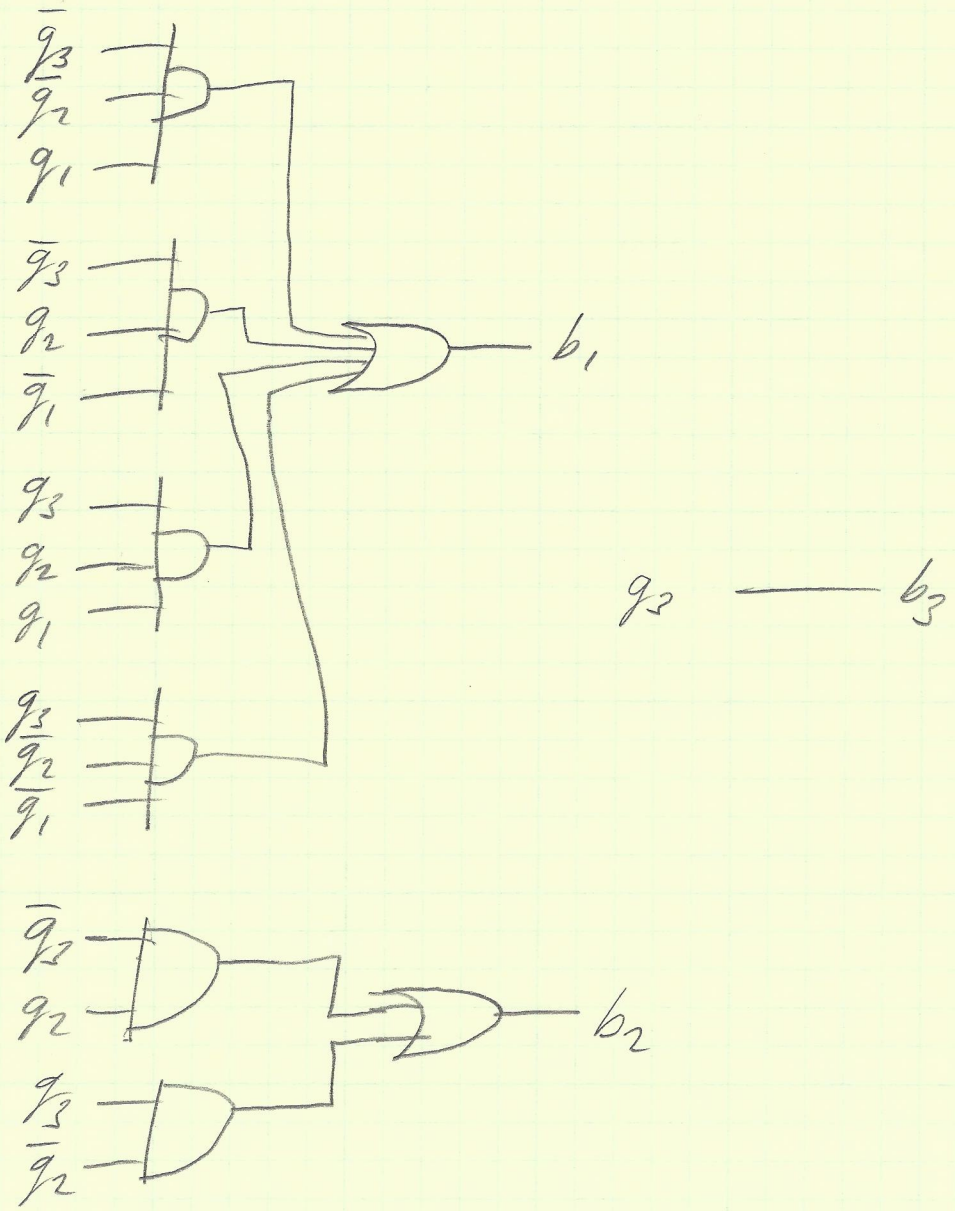


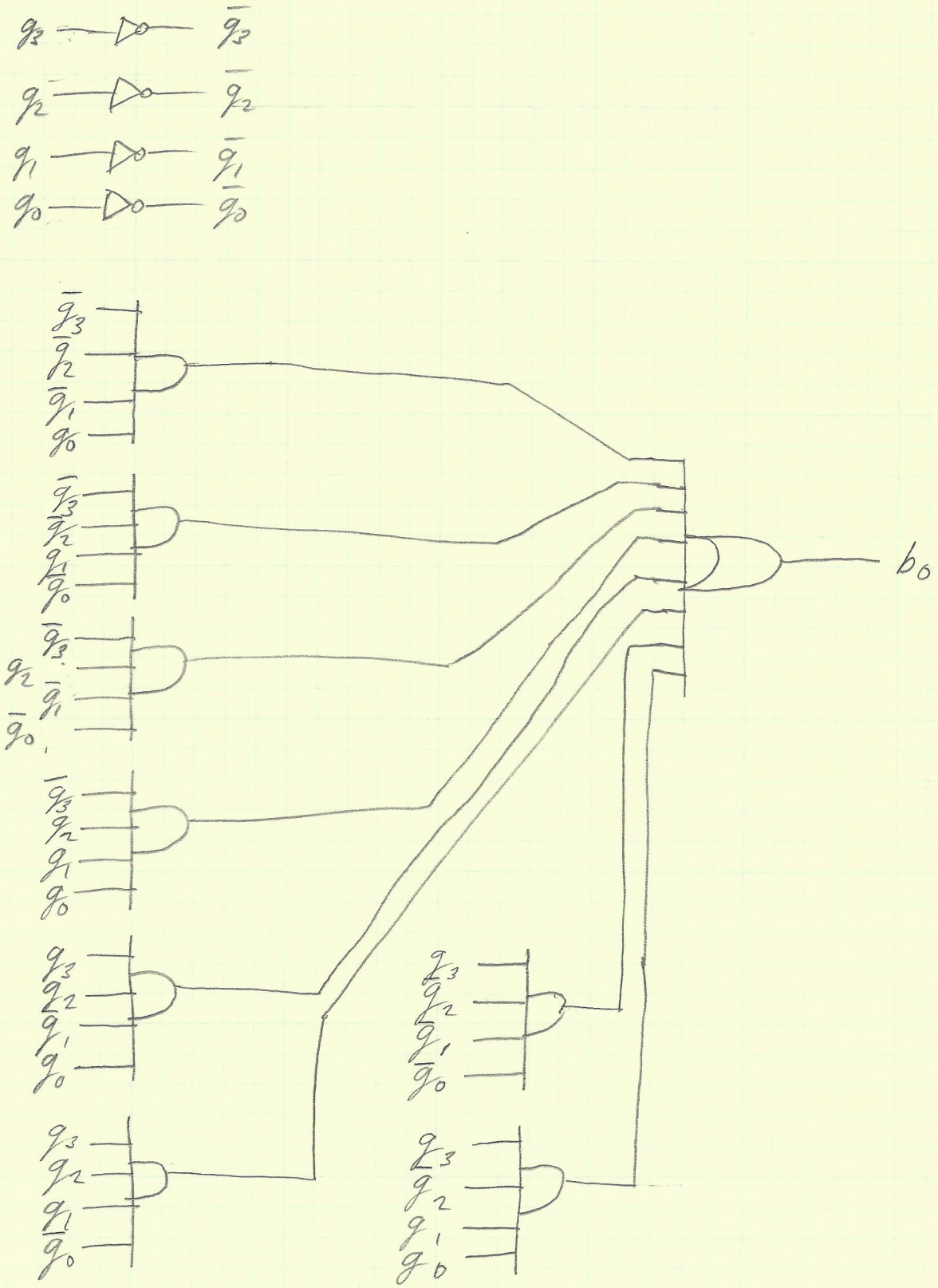
$$b_1 = \bar{g}_3\bar{g}_2 g_1 + \bar{g}_3 g_2 \bar{g}_1 + g_3 g_2 g_1 + g_3 \bar{g}_2 \bar{g}_1$$



$$b_2 = \bar{g}_3 g_2 + g_3 \bar{g}_2$$

$$b_0 = \bar{g}_3\bar{g}_2\bar{g}_1 g_0 + \bar{g}_3\bar{g}_2 g_1\bar{g}_0 + \bar{g}_3 g_2\bar{g}_1\bar{g}_0 + \bar{g}_3 g_2 g_1 g_0 + g_3 g_2\bar{g}_1 g_0 + g_3 g_2 g_1\bar{g}_0 + g_3\bar{g}_2\bar{g}_1\bar{g}_0 + g_3\bar{g}_2 g_1 g_0$$





Verilog 0764	Problem 4.4.5	John Hubbard

Problem: write a Binary to Gray code converter

Binary $b_3 - b_0$	Gray $g_3 - g_0$
0000	0000
0001	0001
0010	0011
0011	0010
0100	0110
0101	0111
0110	0101
0111	0100
1000	1100
1001	1101
1010	1111
1011	1110
1100	1010
1101	1011
1110	1001
1111	1000

$g_3 = b_3$

$b_3 b_2$ \ $b_1 b_0$	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

g_2

$g_2 = \bar{b_3} b_2 + b_3 \bar{b_2}$

$b_3 b_2$ \ $b_1 b_0$	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

g_1

$g_1 = b_2 \bar{b_1} + b_1 \bar{b_2}$

$b_3 b_2$ \ $b_1 b_0$	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

$g_0 = \bar{b_1} b_0 + b_1 \bar{b_0}$