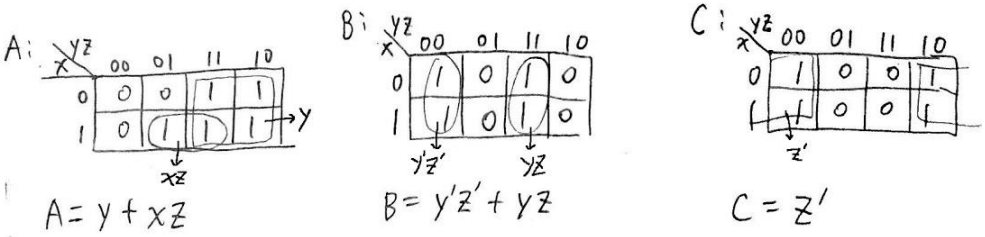
HW4-1 solution

1. (20%) Design a combinational circuit with three inputs, x (MSB), y, and z (LSB), and three outputs, A (MSB), B, and C (LSB). When the binary input is 0, 2 or 3, the binary output is three greater than the input (xyz=000 (0) => ABC=011 (3), xyz=010 (2) => ABC=101 (5).). When the binary input is 1, 4, 5, 6, or 7, the binary is one less than the input (xyz=110(6) => ABC=101 (5), xyz=100 (4) => ABC=011(1)).
   (a) Derive the truth table. (5%)
   (b) Derive the simplified Boolean expressions for A, B, and C using maps. (10%)
   (c) Draw the related logic diagram. (5%)

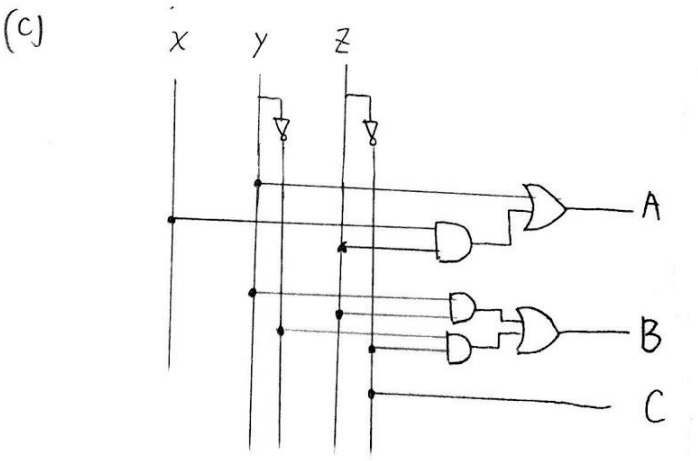
(a)

x	y	z	A	B	C
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	1	0	1
0	1	1	1	1	0
1	0	0	0	1	1
1	0	1	1	0	0
1	1	0	1	0	1
1	1	1	1	1	0

(b)



(c)

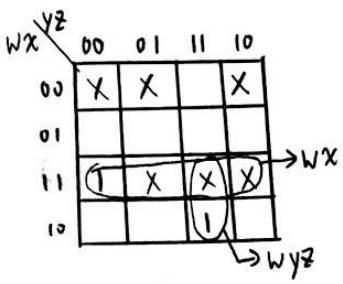


2. (10%) Design an excess-3-to-binary decoder using the unused combinations of the code as don't-care conditions.

2. Excess-3 to binary decoder
(wxyz) (b3b2b1b0)

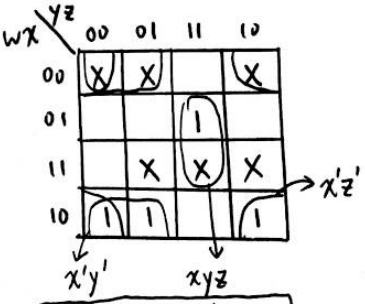
Excess-3				binary			
w	x	y	z	b3	b2	b1	b0
0	0	0	0	x	x	x	x
0	0	0	1	x	x	x	x
0	0	1	0	x	x	x	x
0	0	1	1	0	0	0	0
0	1	0	0	0	0	0	1
0	1	0	1	0	0	1	0
0	1	1	0	0	0	1	1
0	1	1	1	0	1	0	0
1	0	0	0	0	1	0	1
1	0	0	1	0	1	1	0
1	0	1	0	0	1	1	1
1	0	1	1	1	0	0	0
1	1	0	0	1	0	0	1
1	1	0	1	x	x	x	x
1	1	1	0	x	x	x	x
1	1	1	1	x	x	x	x

① b_3



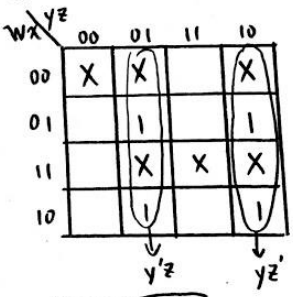
$b_3 = wx + wyz$

② b_2



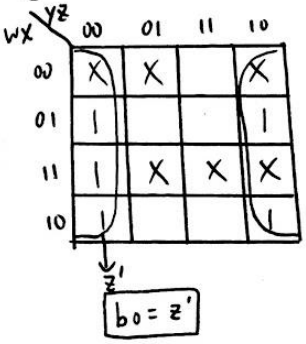
$b_2 = x'y' + x'z' + xyz$

③ b_1



$b_1 = y'z + yz'$

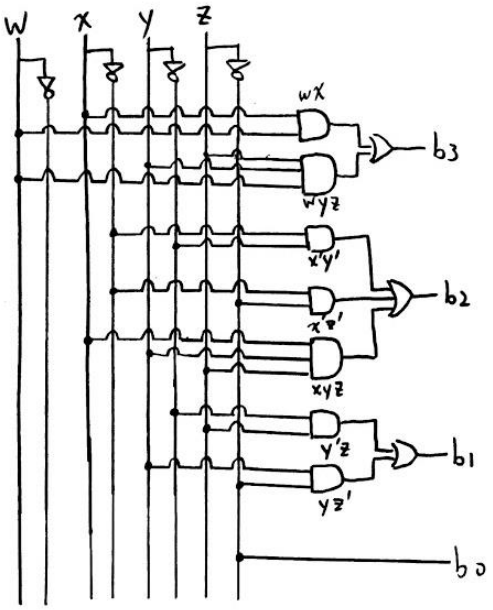
④ b_0



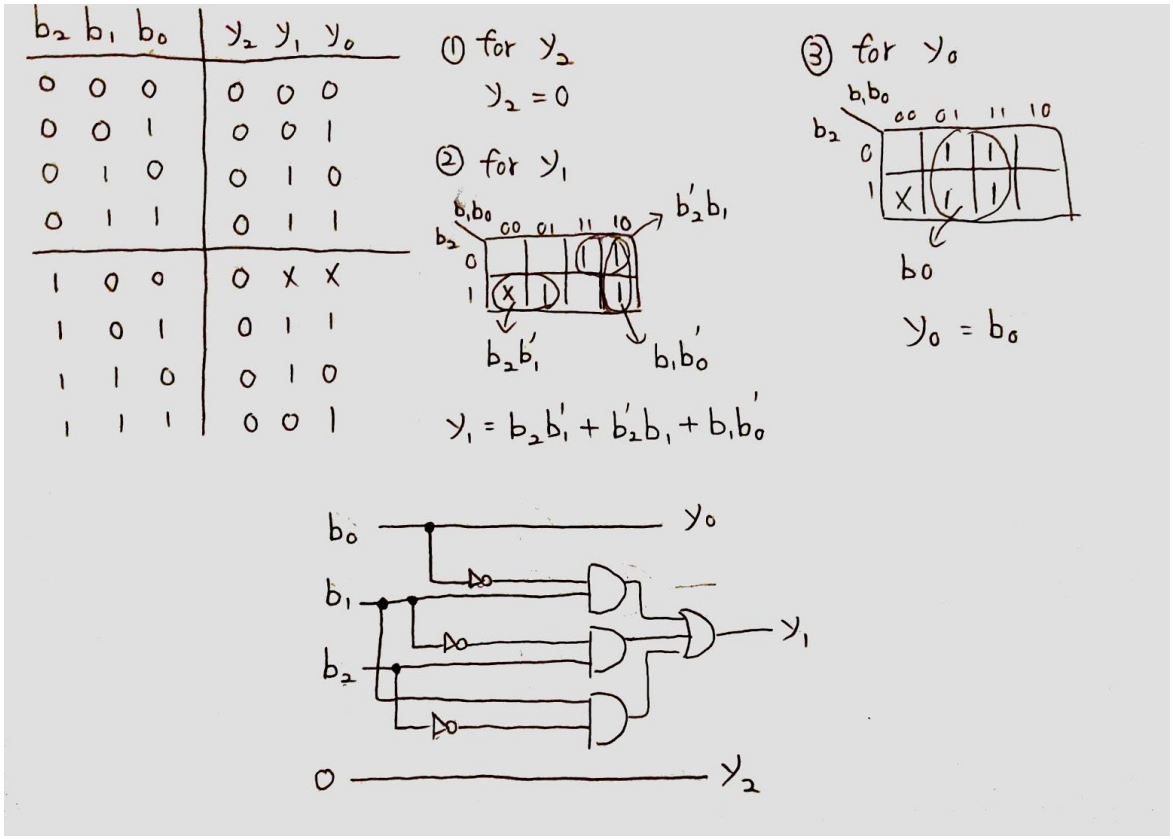
$b_0 = z'$

$$\begin{cases} b_3 = wx + wyz \\ b_2 = x'y' + x'z' + xyz \\ b_1 = y'z + yz' \\ b_0 = z' \end{cases}$$

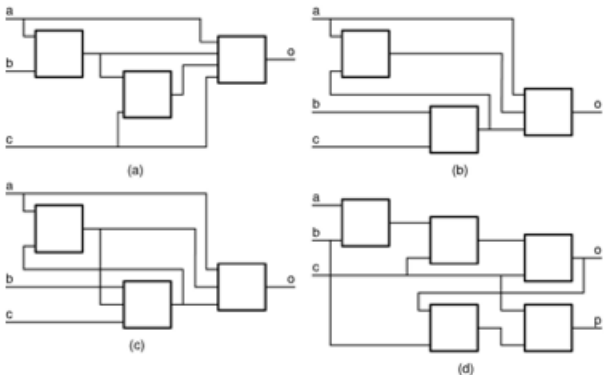
題目未要求電路圖
做到 Boolean 即可算對



3. (10%) Design a 3-bit absolute value calculator. (Z=|z|).



4. (10%) Which of the following circuits are combinational? Each box in the figure is itself a combinational circuit.



Ans:

c 的 feedback 會出現 loop，故只有 c 不為 Combinational circuits