HW4 논리설계

1. $f(A.B.C) = \Pi M(0,4,6,7)$

(a) Express it in alegraic (maxterm)

A	B	C	f	
0	0	0	0	M_0
0	0	1	1	M_1
0	1	0	1	M_2
0	1	1	1	M_3
1	0	0	0	M_4
1	0	1	1	M_5
1	1	0	0	M_6
1	1	1	0	M_7

$f = M_0 \times M_4 \times M_6 \times M_7$

(b) Draw a k-map

C\AB	00	01	11	10
0	0	1	0	0
1	1	1	0	1

(c) Express it in minimum POS expressions.

$$f = (A'+B')(A'+C)(B+C)$$

2. Find minimum POS

(a) $f(a,b,c) = \Pi M(1,2,3,6)$

c \ ab	00	01	11	10
0	1	0	0	1
1	0	0	1	1

$f = (a+c)(a+b')(b'+c)$

(b) $f(a,b,c,d) = \Sigma m(4,6,9,10,11,12,13)$
$\qquad + \Sigma d(2,15)$

cd \ ab	00	01	11	10
00	0	1	1	0
01	0	0	1	1
11	0	0	×	1
10	×	1	0	1

f

cd \ ab	00	01	11	10
00	1	0	0	1
01	1	1	0	0
11	1	1	×	0
10	×	0	1	0

f'

① SOP 구하기

$f' = a'd + b'c'd' + abc$

② $(f')' = (SOP)$ 으로 POS 구하기

$f = (f')' = (a'd + b'c'd' + abc)'$

$\qquad = (a+d')(b+c+d)(a'+b'+c')$

$f = (a+d')(b+c+d)(a'+b'+c')$

(c) $f(a,b,c,d) = \Pi M(1,3,5,13) \cdot \Pi D(0,7,9)$

cd\ab	00	01	11	10
00	X	1	1	1
01	0	0	0	X
11	0	X	1	1
10	1	1	1	1

$f = (a+d')(c+d')$

3. Determine minimum SOP expression using the Quine-McClusky algorithm.

$f(a,b,c,d) = \sum m(4,5,6,8,9,10,13) + \sum d(0,7,15)$

Minterm ID   abcd   Merged   <STEP 1>

ID	abcd	Merged
0	0000	Y
4	0100	Y
8	1000	Y
5	0101	Y
6	0110	Y
9	1001	Y
10	1010	Y
7	0111	Y
13	1101	Y
15	1111	Y

MintermID	abcd	Merged
0.4	0×00	◯
0 8	×000	◯
4.5	010×	Y
4.6	01×0	Y
8.9	100×	◯
8.10	10×0	◯
5.7	01×1	Y
5.13	×101	Y
6.7	011×	Y
9.13	1×01	◯
7.15	×111	Y
13 15	11×1	Y

<STEP 3>

| 13 15 | 11×1 | Y | |

<STEP 3>

MintermID	abcd	Merged
4.5.6.7	01××	
4.6.5.7	01××	◯
5.7.13.15	×1×1	
5.13.7.15	×1×1	◯

$$PI = \{0×00, ×000, 100×, 10×0, 1×01, 01××, ×1×1\}$$
$$= \{p1, p2, p3, p4, p5, p6, p7\}$$

$p1 = \{0.4\}$ $p2 = \{0.8\}$

$p3 = \{8.9\}$ $p4 = \{8.10\}$

$p5 = \{9.13\}$ $p6 = \{4.5.6.7\}$

15) $p7 = \{5.7.13.15\}$

) $P7 = \{5, 7, 13, 15\}$ <STEP 4>

PI ID	Minterms						
	4	5	6	8	9	10	13
P1 = 0X00	1						
P2 = X000				1			
P3 = 100X				1	1		
P4 = 10X0				1		①	
P5 = 1X01					1		1
P6 = 01XX	1	1	①				
P7 = X1X1		1					1

<STEP 5>.

find EPI's

→ P4 = 10X0 , P6 = 01XX 이므로

PI's fully covered = {P4, P6}

$f = ab'd' + a'b$

<1bit Full adder>
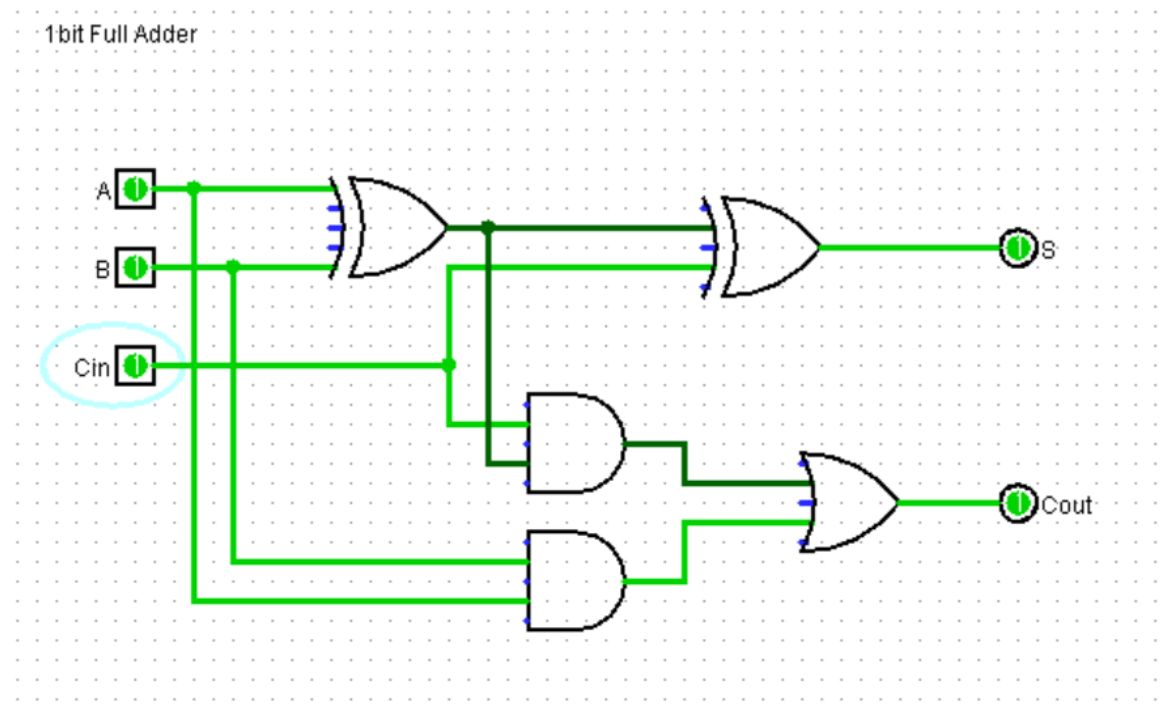
1bit Full Adder

구현한 1bit Full adder가 정상적으로 작동하는지 확인

A	B	Cin	Cout	S
0	0	0	0	0
1	0	0	0	1
0	0	0	0	0
0	1	0	0	1
1	1	0	1	0
1	1	1	1	1

<4bit Full adder>
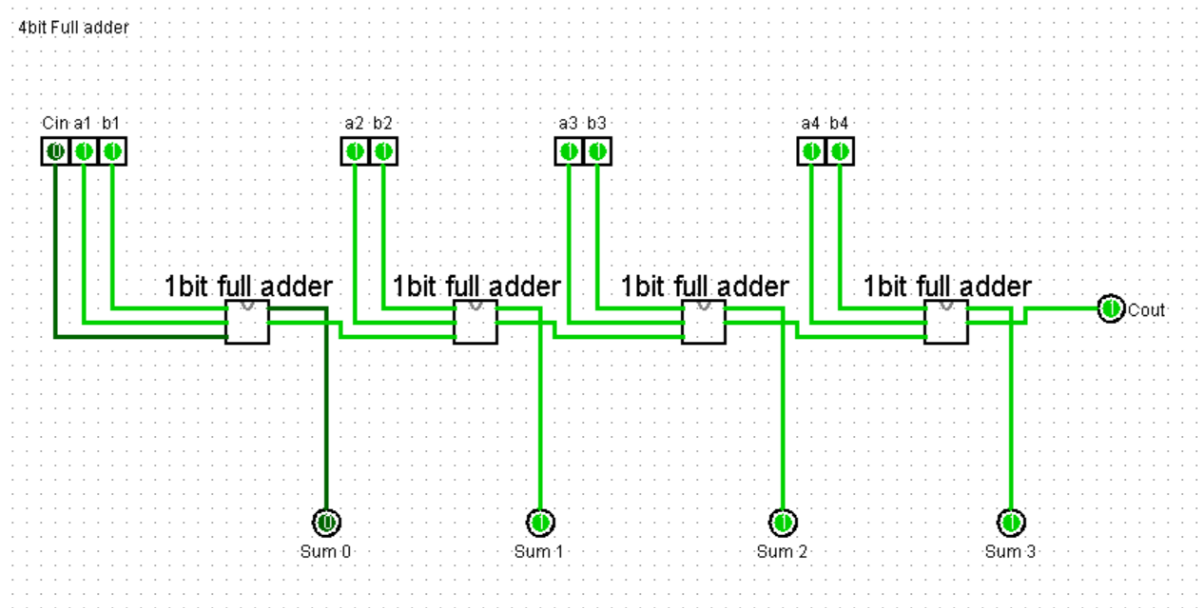
4bit Full Adder에서 **1bit Full adder 정상적 작동 확인** 및

Carry가 있는 경우에도 다음 회로로 넘어가서 작동하는지 확인 여부

(Carry가 발생한 마지막 케이스의 경우 Sum1에 1이 잘 작동했다)

a1	b1	Cin	Sum 0	Sum 1
0	0	0	0	0
1	0	0	1	0
0	0	0	0	0
0	1	0	1	0
1	1	0	0	1
1	1	1	1	1

Random한 몇 개의 test vector로 테스트 진행

a1	b1	a2	b2	b3	Sum 0	Sum 1	Sum 2	Sum 3
0	0	0	0	0				
0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0
1	1	0	0	0	0	1	0	0
1	1	0	1	0	0	0	1	0
1	1	1	1	0	0	1	1	0
1	1	1	1	0	0	1	0	1
1	1	1	1	1	0	1	1	1
1	1	1	1	1	0	1	1	0
1	1	1	1	1	0	1	1	1