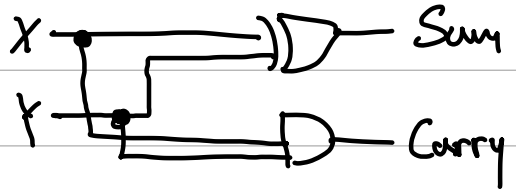
4. Combinational Logic

Adder

X	Y	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

$Sum = X \oplus Y$

$Carry = X \cdot Y$

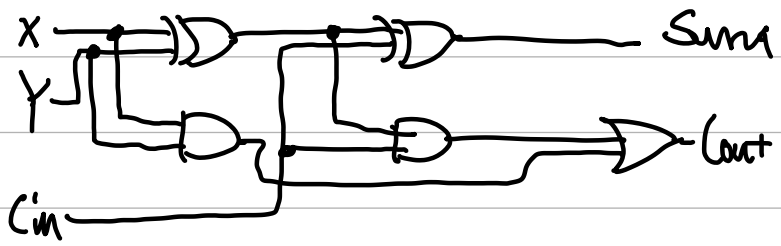


= half adder

X	Y	Cin	Sum	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$Sum = X \oplus Y \oplus Cin$

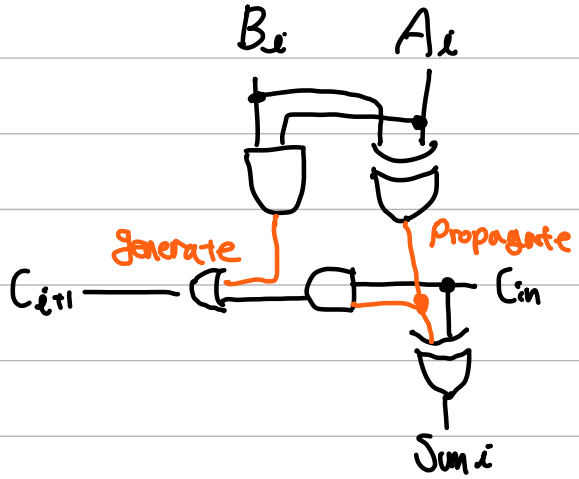
$Cout = (X \oplus Y) \cdot Cin + X \cdot Y$



이 Adder는 overflow 발생 가능!

이것은 4bit Adder를 만들었을 때 Cout이 | 나타낸 결과가 5 bit

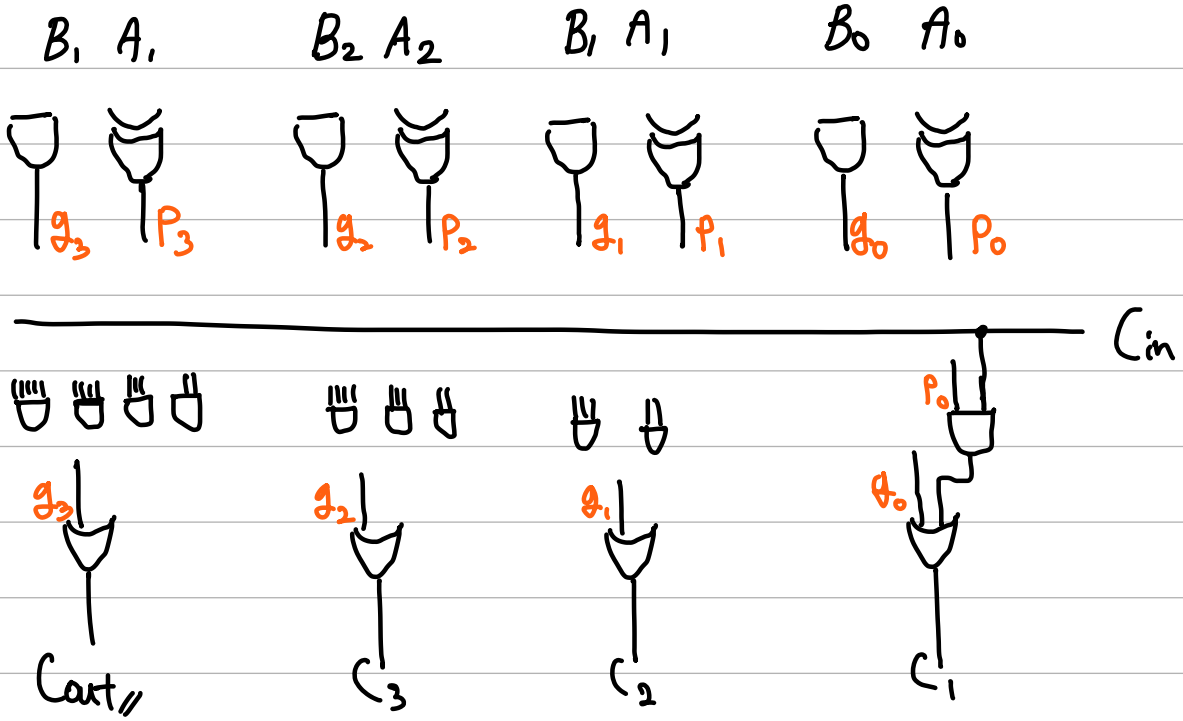
4bit lookahead adder

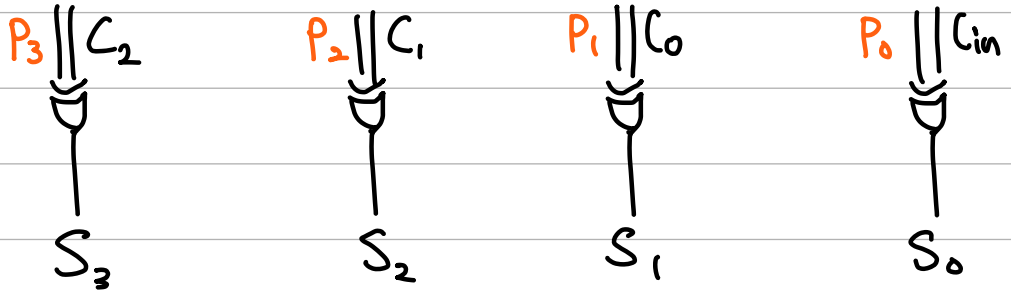


$$C_{i+1} = g_i + P_i C_i$$

$$\vdots$$

Carry를 두단계 만에 생성가능!





Subtraction

뺄셈 대신 Signed 된 수 끼리 더하는 방식!

signed 1's complement

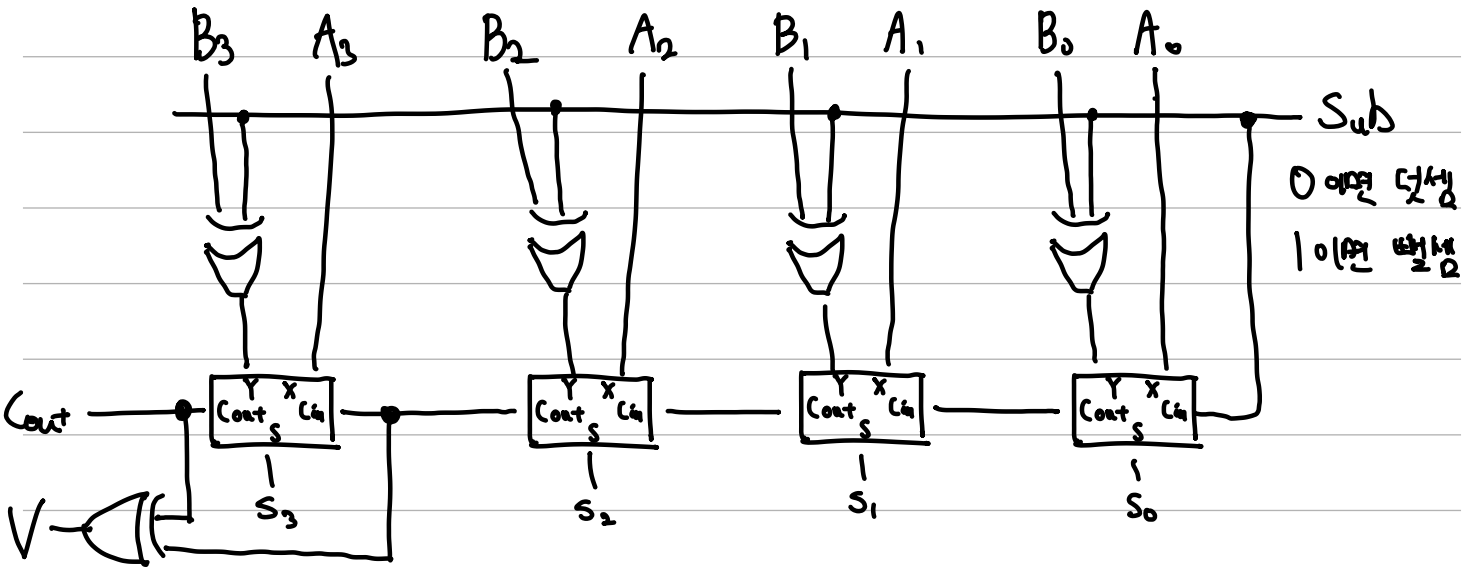
```
  0111   (+7)
+ 1011   (-4)
------
 10010
+    1   ← Carry Out을 다시 더해 줍니다!
------
  0011   (+3)
```

Signed 2's complement

```
  0111   (+7)      7>-4
+ 1100   (-4)
------
 10011   (+3)
```

Carry Out 무시

Adder - Subtractor



V for signed overflow : ┌ 둘다 0, 0인 수를 더했는데 1이 나옴.
└ 둘다 1, 1인 수를 더했는데 0이 나옴.

+	Cin	Sum	Cout	
0	0	1	1	0 → 부호오류
0	1			
1	0			
1	1	0	0	1 → 부호오류

(Cout ⊕ Cin = 0 이면 정상!
1 이면 오류!