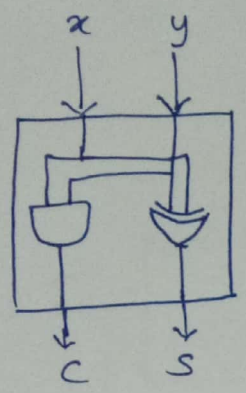
Half Adder



$S = x \oplus y$

$C = x \cdot y$

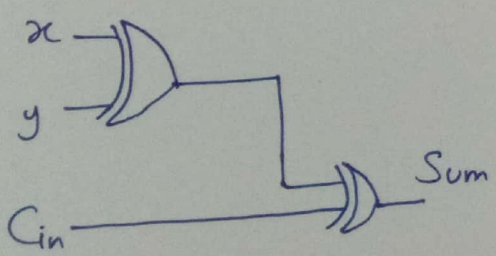
x	y	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	1	1

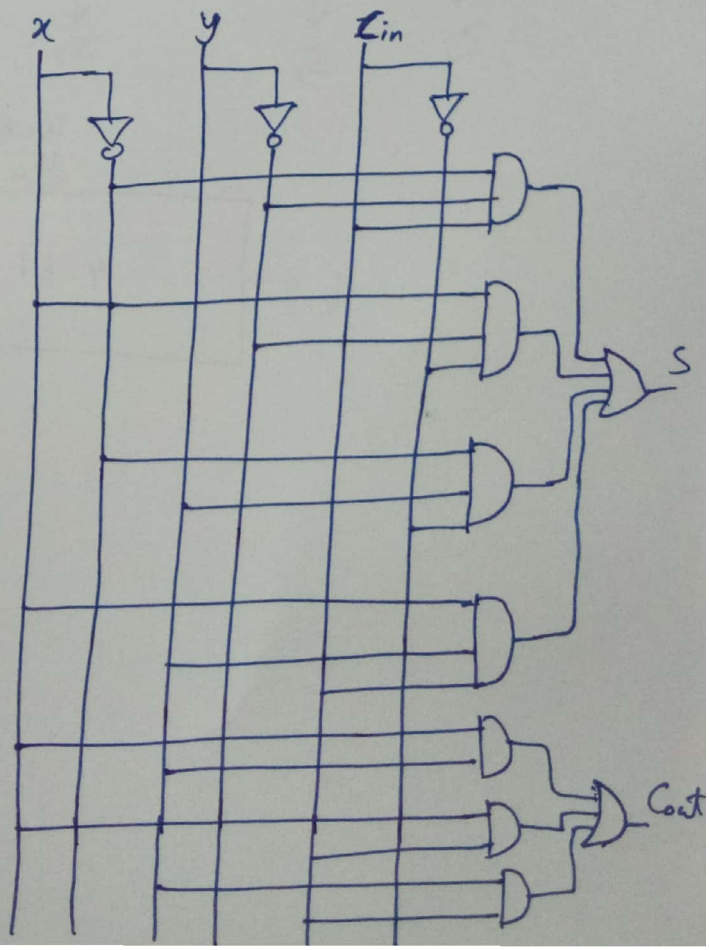
Full Adder

x	y	Cin	S	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

$Sum(S) = x \oplus y \oplus z$

$= \bar{x}\bar{y}C_{in} + x\bar{y}\bar{C}_{in} + \bar{x}y\bar{C}_{in} + xyC_{in}$

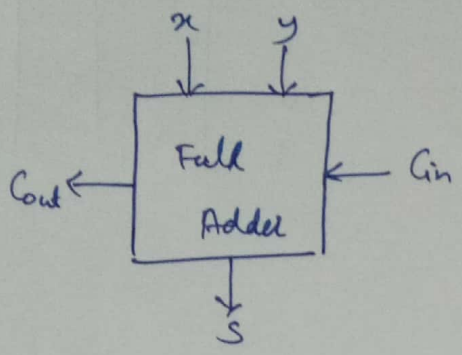




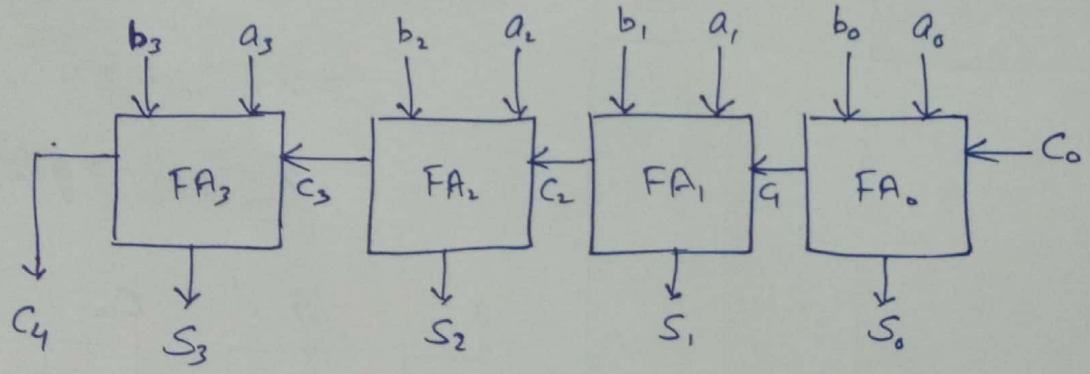
Carry out (C_{out}) = $xy\bar{C}_{in} + x\bar{y}C_{in} + \bar{x}yC_{in} + xyC_{in}$

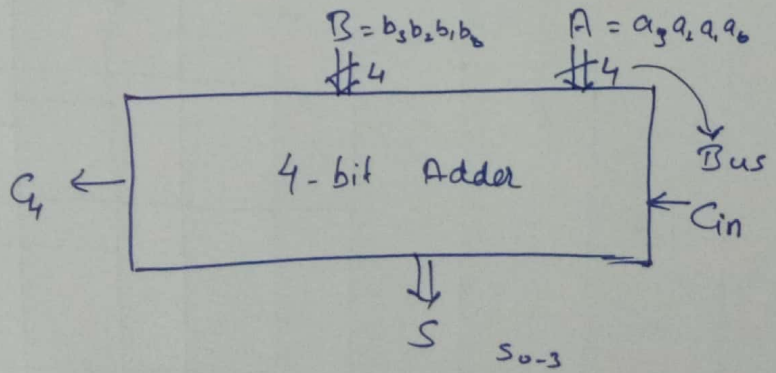
$= xy(\bar{C}_{in} + C_{in}) + xC_{in}(\bar{y} + y) + yC_{in}(x + \bar{x})$

$C_{out} = xy + yC_{in} + xC_{in}$



4-bit Adder

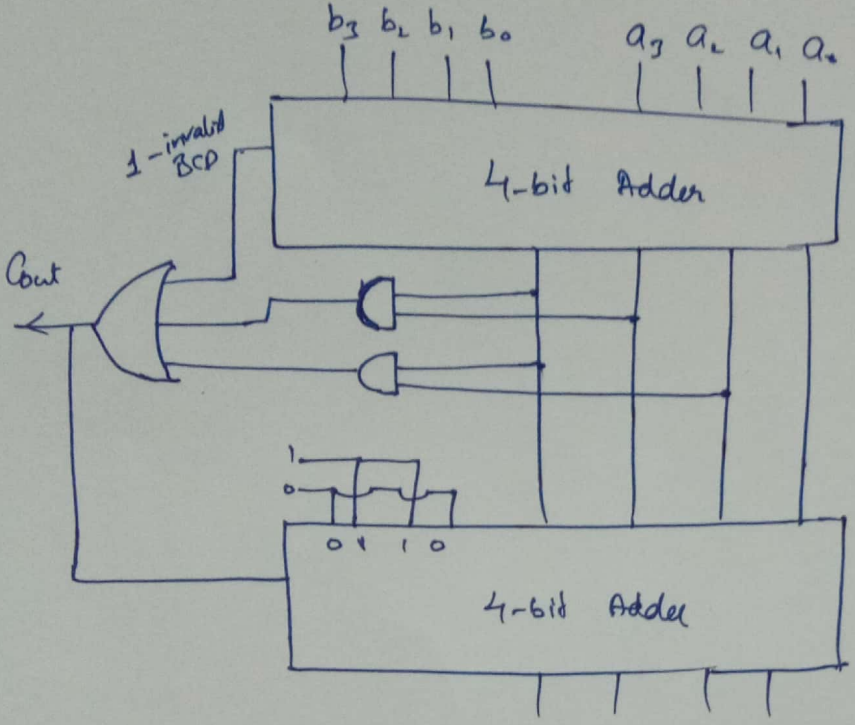




BCD - Adder

1 (Cin) 0-9, 0-9 } 0 to 18

(19) ← max output of addition of 2 BCD number



8 + 2 = 10

↙ ↓ ↓

1000 0010 0001 0000

(10) → 1010 + 6 → 0110 = 0001 0000

↓ BCD representation of (10)

0000 ⋮ 1001 } 0-9

1010 ⋮ 1111 } 10-15