Binary Adders

It is a Combinational logic Gates that use to add Two Binary Numbers.

Ex:

$$X = 0101$$
$$Y = 1010$$
$$1111$$

$$\begin{array}{r} 0 \\ 0+ \\ \hline 0 \end{array} \qquad \begin{array}{r} 0 \\ 1+ \\ \hline 1 \end{array} \qquad \begin{array}{r} 1 \\ 1+ \\ \hline 10 \end{array} \qquad \begin{array}{r} 1 \\ 0+ \\ \hline 1 \end{array}$$

$$\begin{array}{r} 1 \\ 1+ \\ \hline 10 \end{array}$$

Carry — Sum

Adders

- Half Adder
- Full Adder

1) Half Adder

* Truth Table:

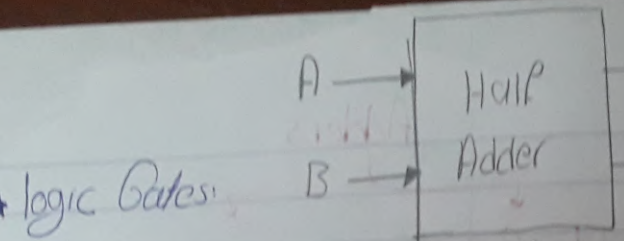
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(Sum) $S = A'B + AB' = A \oplus B$

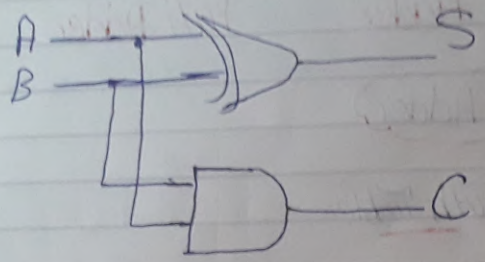
(Carry) $C = A \cdot B$

* Boolean Expression:

$S = A \oplus B \qquad C = AB$



★ logic Gates:



Half adder

↳ Combinational logic Gates That Add Two Binary Numbers (Two Digits) & produce Two output Sum & Carray

X = Two Bits →

⊕

Y = Two Bits →

Z = Two Bits

Carray ↙ ↘ Sum

★ Full Adder

↳ Combinational logic Gates that Add Two Binary Numbers (Two Bits) + Cin (1 Bit)

X = Two Bits.

⊕

Y = Two Bits

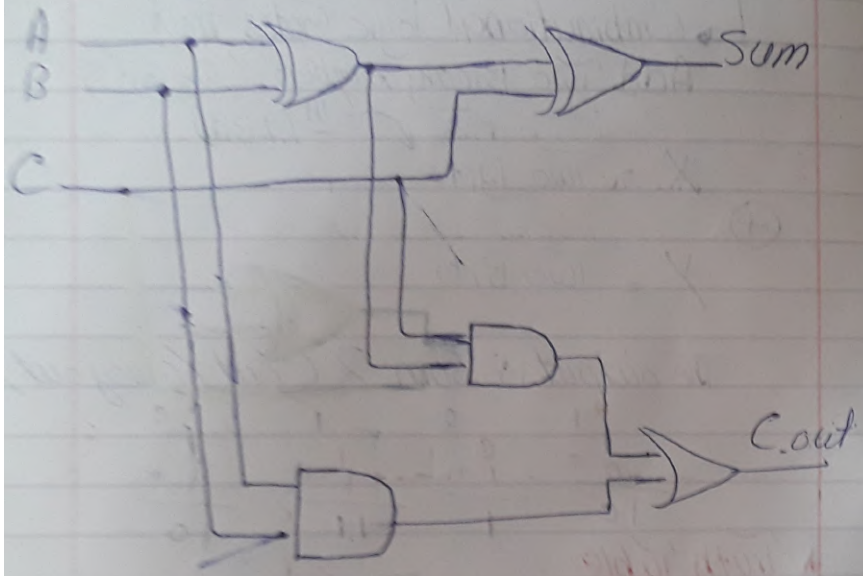
The output is Sum & Cout (carry out)

1 1	0	1	1
0	1	1	1
+ 0	+ 1	+ 1	+ 1
10	1	11	10

★ Truth Table:

A	B	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

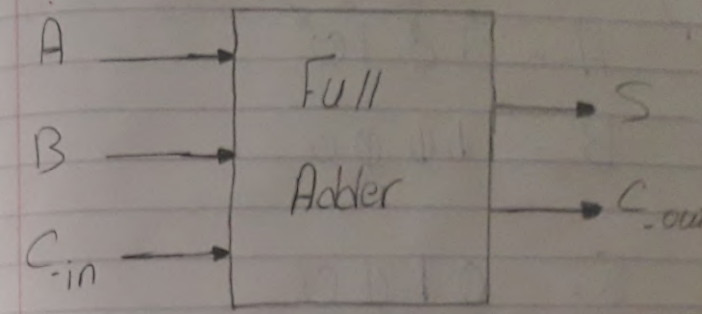
* logic Gates:

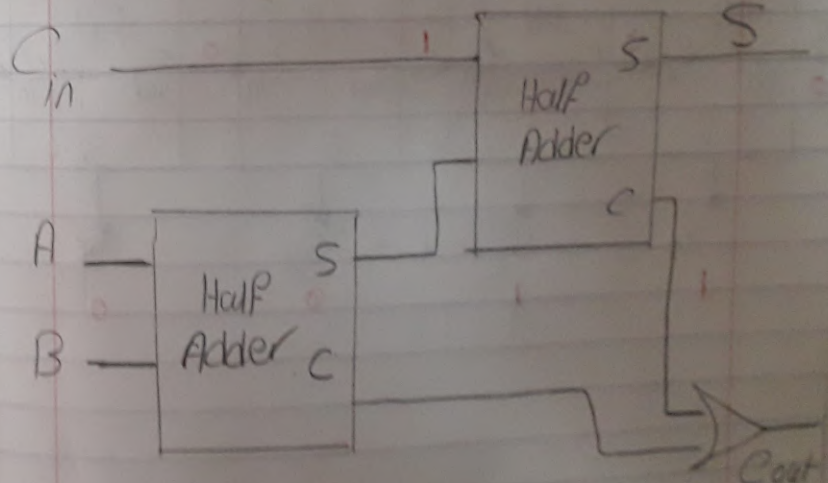


Boolean Expression:

$$S = (A \oplus B) \oplus C_{in}$$

$$C_{out} = SC_{in} + AB$$





4. Bit Binary Adder:

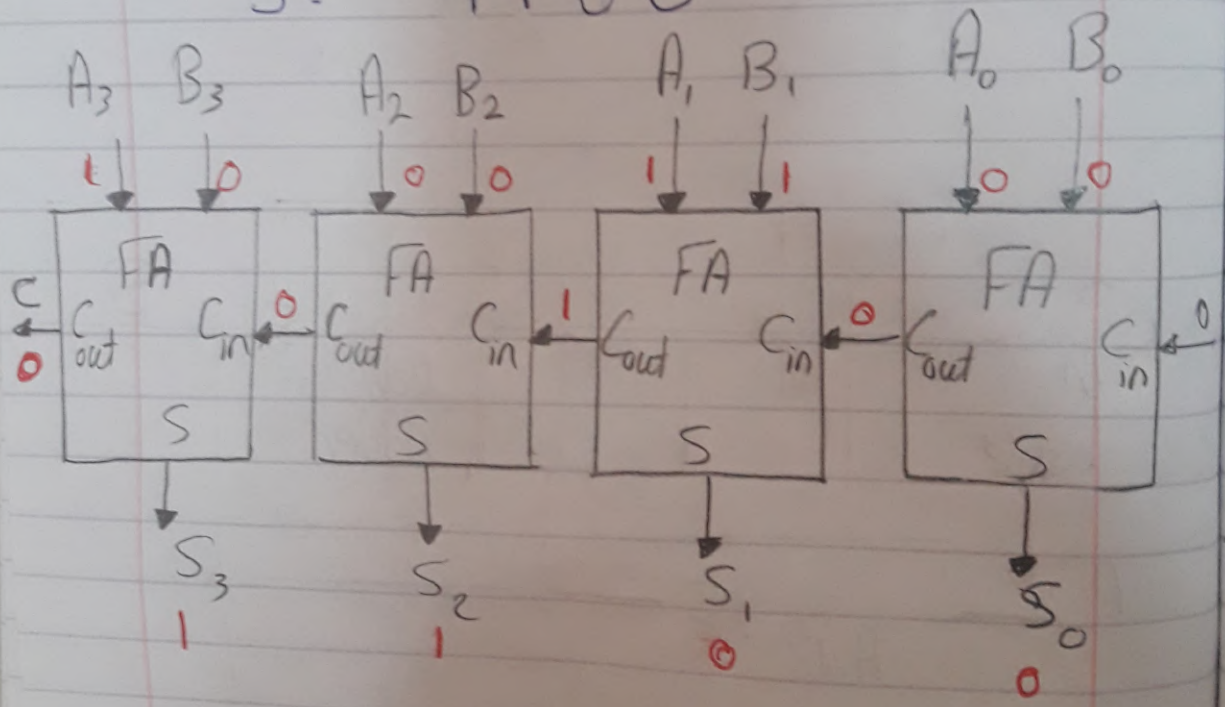
Ex

$C_{in} = 0$

A = 1 0 1 0

B = 0 0 1 0

S: 1 1 0 0



Questions

4.11 Using four Half Adder

a) Design a four Bit Combinational Circuit Incrementer (a circuit that adds 1 to a four Bit Binary number)

~~b) Design a four Bit Combinational Circuit decrementer (a circuit that subtract 1 from a four Bit Binary numbers).~~

Ex:

$$A = 1010 + 1 = 1011$$