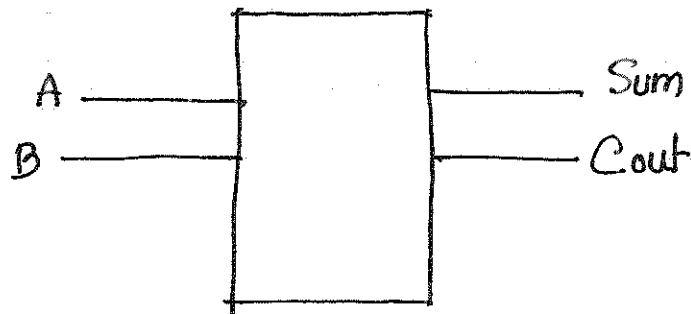


Arithmetic circuits:

Design a half adder



A	B	Sum	Cout
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

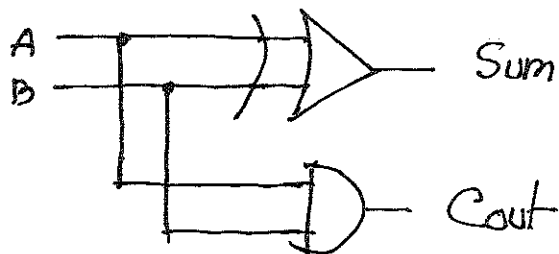
	B	0	1
A	0	0	1
1	1	1	0

$$\text{Sum} = AB' + A'B$$

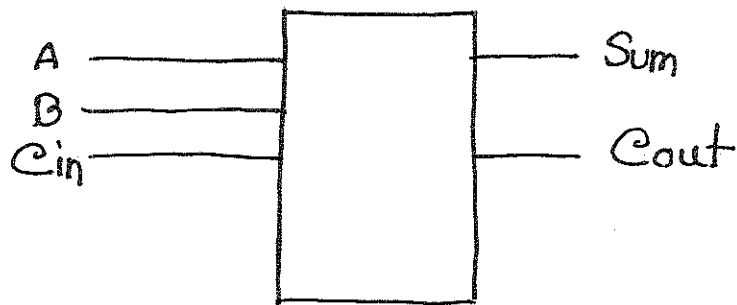
$$= A \oplus B$$

	B	0	1
A	0	0	0
1	1	0	1

$$\text{Cout} = AB$$



Design a full adder:



Full adder block diagram

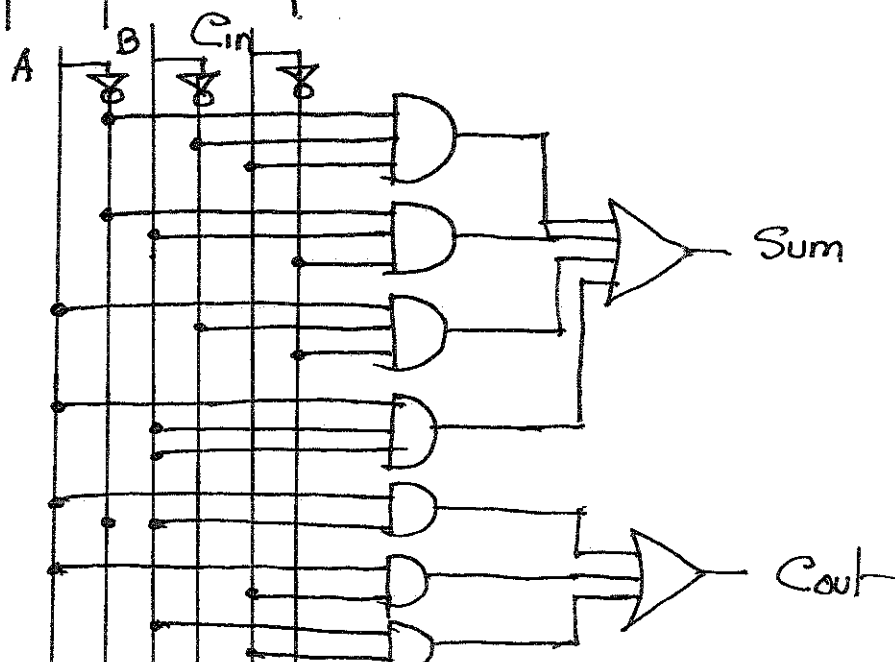
A	B	C_{in}	Sum	C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

A	BC_{in}			
	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$$Sum = A'B'C_{in} + A'BC_{in}' + AB'C_{in}' + ABC_{in}$$

A	BC_{in}			
	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$$C_{out} = AB + AC_{in} + BC_{in}$$



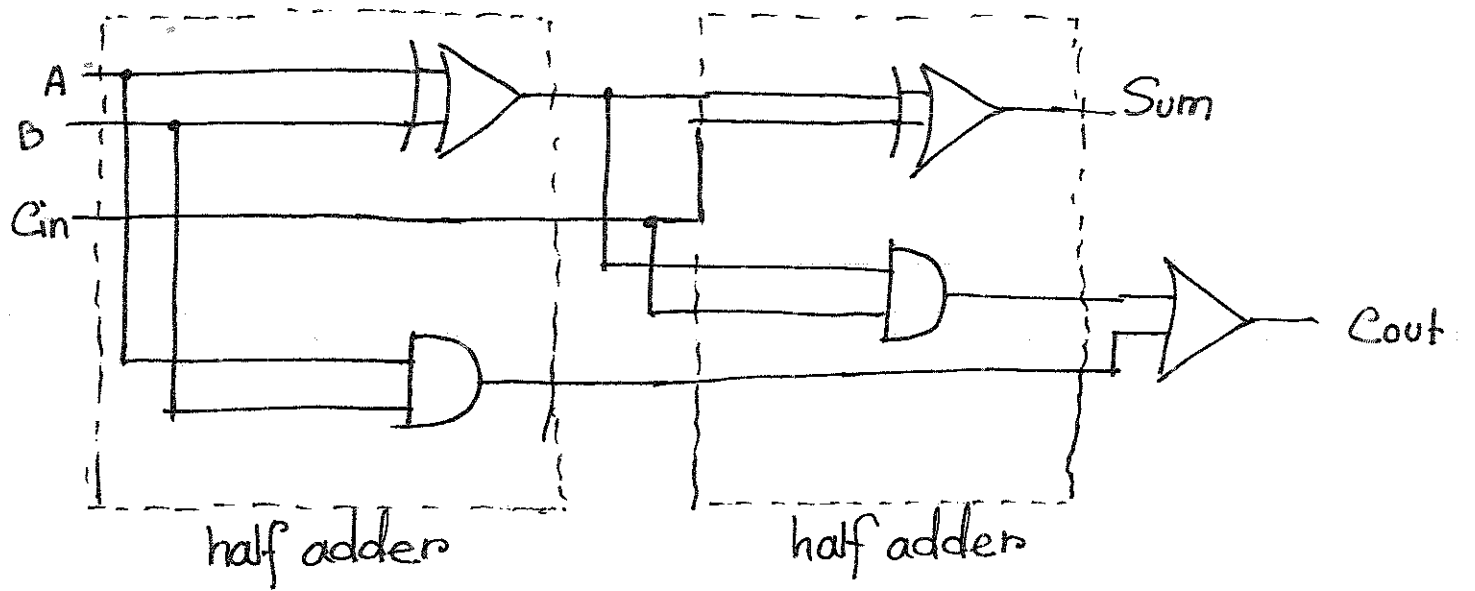
Design a full-adder with two half-adders.

BCin		00	01	11	10
A	0	0	1	0	1
	1	1	0	1	0

$$\begin{aligned}
 \text{Sum} &= A'B'Cin + A'BCin' + AB'Cin' + ABCin \\
 &= Cin(A'B' + AB) + Cin'(A'B + AB') \\
 &= Cin(A'B' + AB) + Cin'(A \oplus B) \\
 &= Cin((A+B) \cdot (A'+B'))' + Cin'(A \oplus B) \\
 &= Cin(AA' + AB' + A'B + BB') + Cin'(A \oplus B) \\
 &= Cin(AB' + A'B)' + Cin'(A \oplus B) \\
 &= Cin(A \oplus B)' + Cin'(A \oplus B) \\
 &= A \oplus B \oplus Cin
 \end{aligned}$$

BCin		00	01	11	10
A	0	0	0	1	0
	1	0	1	1	1

$$\begin{aligned}
 \text{Cout} &= AB'Cin + A'BCin + AB \\
 &= Cin(AB' + A'B) + AB \\
 &= Cin(A \oplus B) + AB
 \end{aligned}$$



Full-adder logic diagram