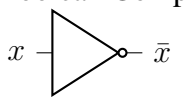
12.3 Logic Gates

Circuits can be constructed by using *gates*.

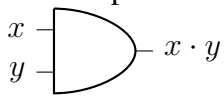
Inverter

Boolean Complement



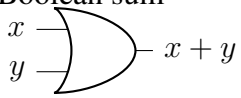
AND Gate

Boolean product



OR Gate

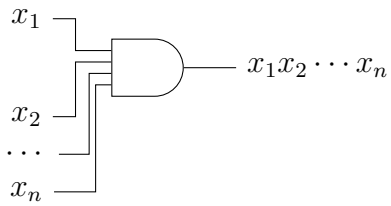
Boolean sum



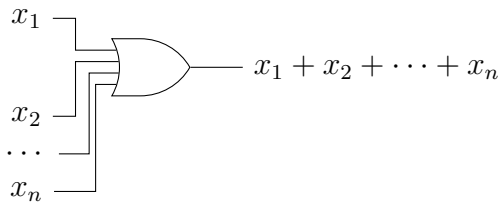
Multi-input AND, OR Gates

AND and OR gates can be extended to arbitrary n inputs.

AND Gate

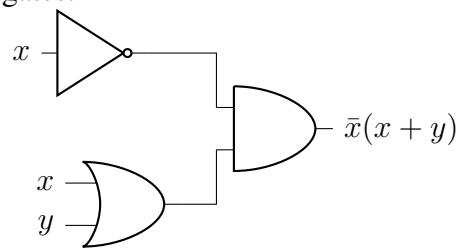


OR Gate



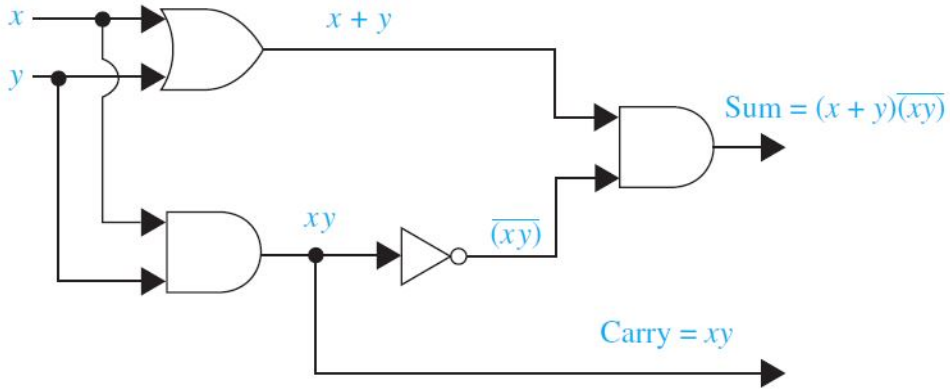
Combination of Gates

Combinational circuits can be constructed using a combination of inverters, OR gates, and AND gates.



Half Adder

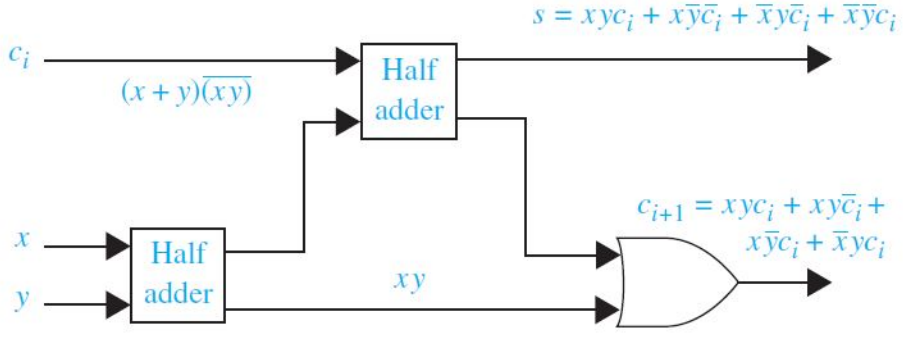
Adds two bits together without a carry bit.



Input		Output	
x	y	s	c
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Full Adder

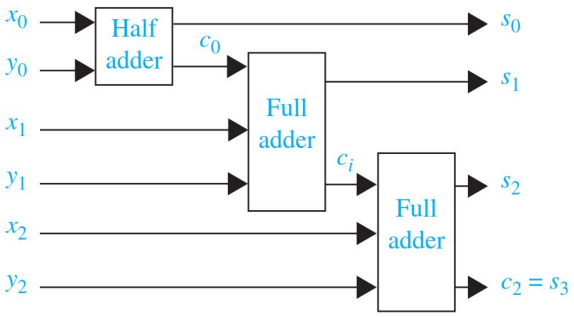
Adds two bits together with a carry bit.



Input			Output	
x	y	c_i	s	c_{i+1}
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

Adders

You can find the sum of n bit integers by using a combination of a half adder and multiple full adders. Below finds the sum of two three bit integers $(x_2x_1x_0)_2$ and $(y_2y_1y_0)_2$ to produce the sum $(s_3s_2s_1s_0)_2$.



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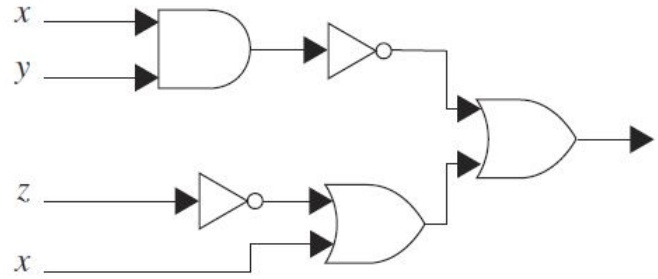
Find the output of the given circuit.



The output of the circuit is $\overline{xy} + (\bar{z} + x)$

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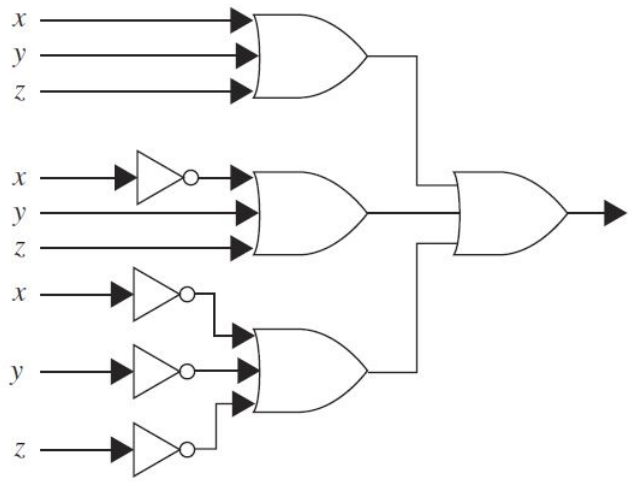
Find the output of the given circuit.



The output of the circuit is $(x + y + z) + (\bar{x} + y + z) + (\bar{x} + \bar{y} + \bar{z})$