Ch12.3 Logic Gates (Week 10)

Introduction

Gates

- The basic element of circuits

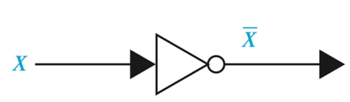
Combinational circuits or **gating networks**

- Circuits that depends only on the input, not on the current state of the circuit
- No memory capabilities

Basic Types of Gates

Inverter

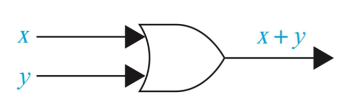
- produces the complement



Inverter

OR gate

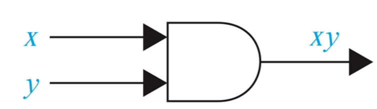
- produces sum of the values



OR gate

AND gate

- produces product of the values

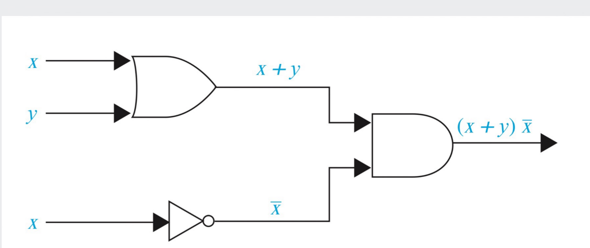


AND gate

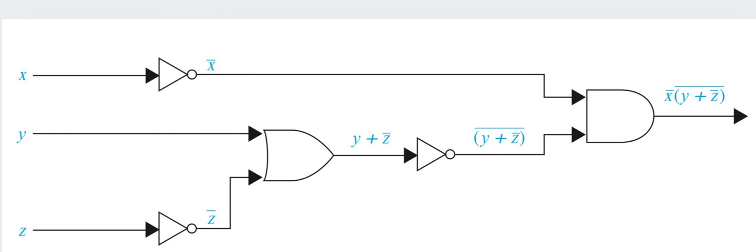
Combinations of Gates

▼ Example 1

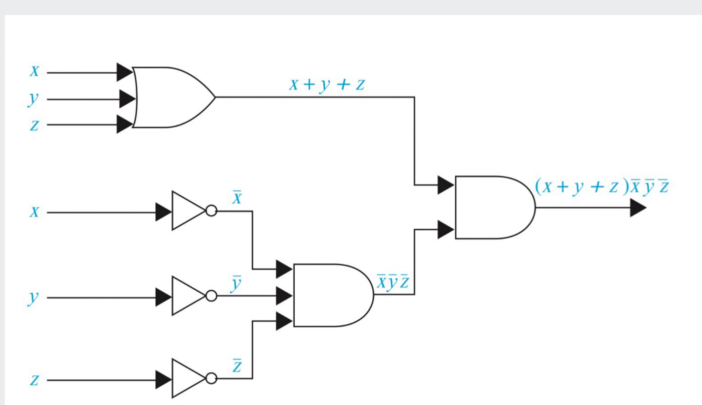
Construct circuits that produce (a) $(x+y)\,\overline{x}$ (b) $\overline{x}\ \overline{(y+\overline{z})}$ (c) $(x+y+z)(\overline{x}\,\overline{y}\,\overline{z})$.



(a) $(x+y)\,\overline{x}$



(b) $\overline{x}\ \overline{(y+\overline{z})}$

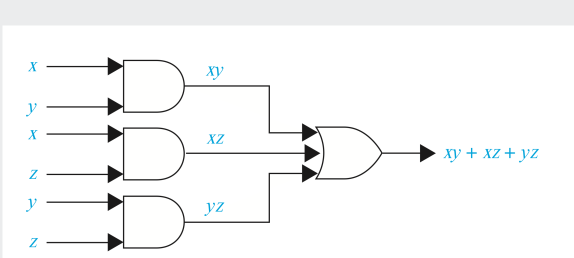


(c) $(x+y+z)(\overline{x}\,\overline{y}\,\overline{z})$

Examples of Circuits

▼ Example 2

A total of three individuals are voting for an organization, a proposal passed if it receives at least two yes votes. Design a circuit that determines whether a proposal passes.



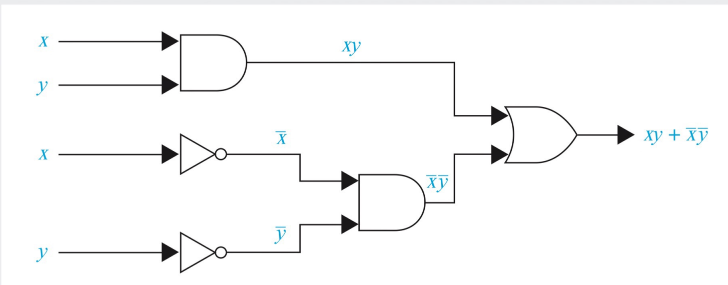
A Circuit for Majority Voting

▼ Example 3

Design circuits that switching any of the switches turns the light on when it is off and vice versa when there are two and three switches.

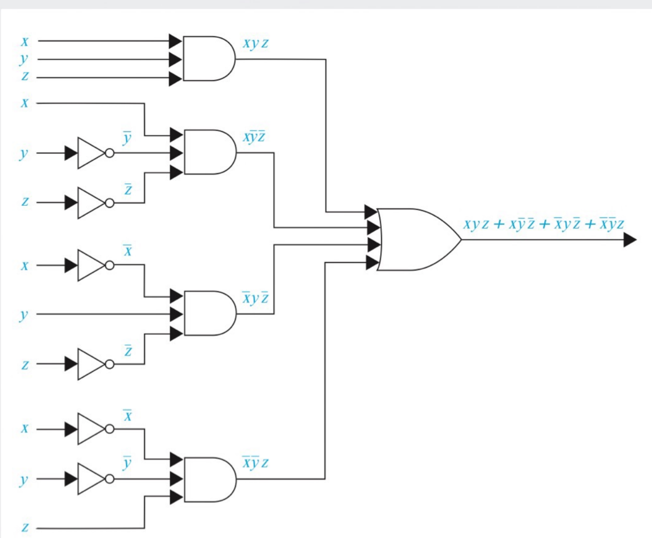
$x = 0$ is open, $x = 1$ is closed (same for y), $F(x, y) = 1$ light on, $F(x, y) = 0$ light off.

Arbitrarily decide that $F(1, 1) = 1$, and all other values are determined.



A Circuit for a Light Controlled by Two Switches

Arbitrarily decide that $F(1, 1, 1) = 1$, and all other values are determined.



A Circuit for a Fixture Controlled by Three Switches

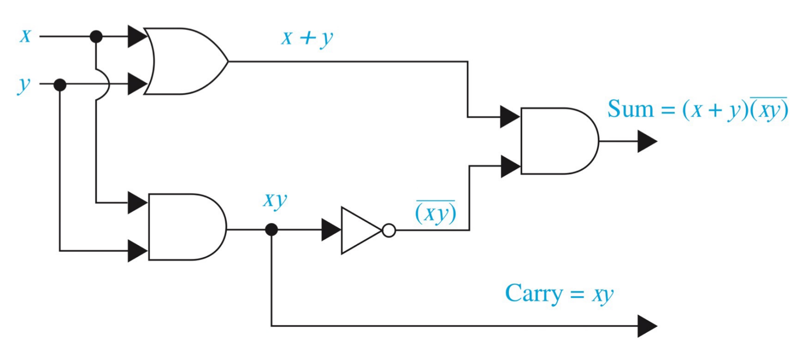
Adders

Multiple output circuit

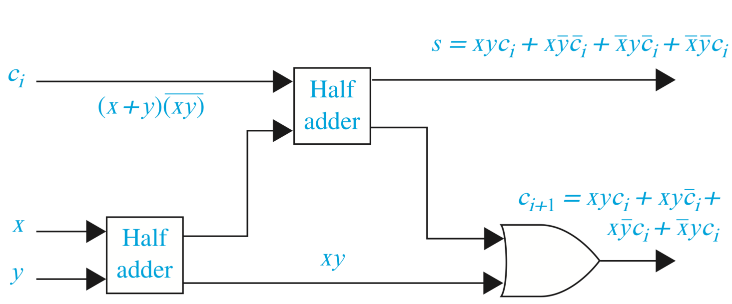
- s is the sum bit
- c is the carry bit

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

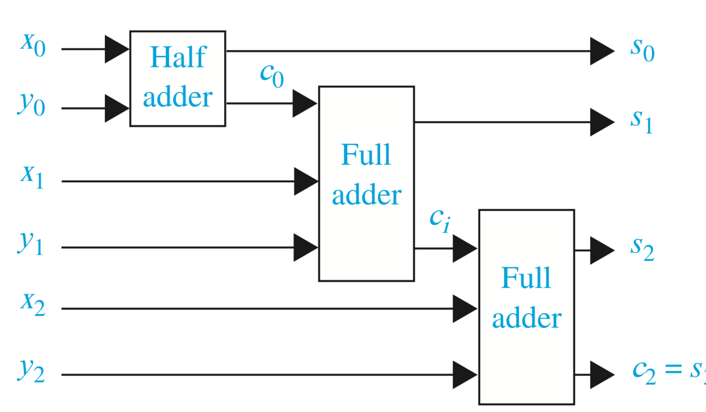
Input and Output for the Half Adder



Half Adder



Full Adder



Adding 2 Three-Bit integers with Full and Half Adders