Week 9

Logic Gates

Logic Circuits Course
AIU-IE

Ch. 3

Logic Gates

Logic Gates

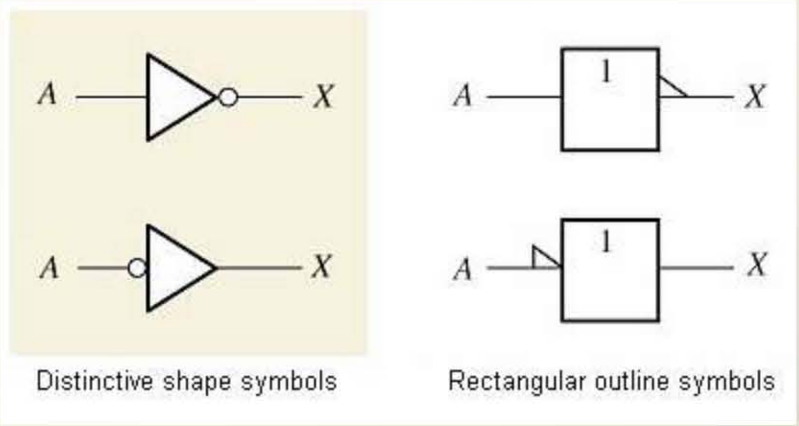
- The term gate

  is used to describe a circuit that performs a basic logic operation

Logic Gates

1. Inverter
2. AND Gate
3. OR Gate
4. NAND Gate
5. NOR Gate
6. Exclusive-OR Gate
7. Exclusive-NOR Gate
8. Fixed-Function Logic

The Inverter



Distinctive shape symbols

Rectangular outline symbols

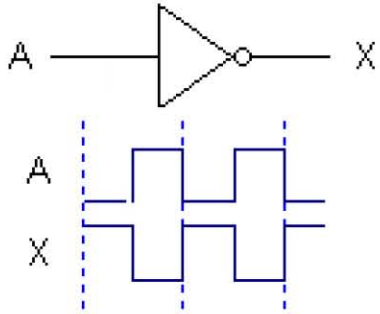
A	X
0	1
1	0

Truth table

$X = \overline{A}$

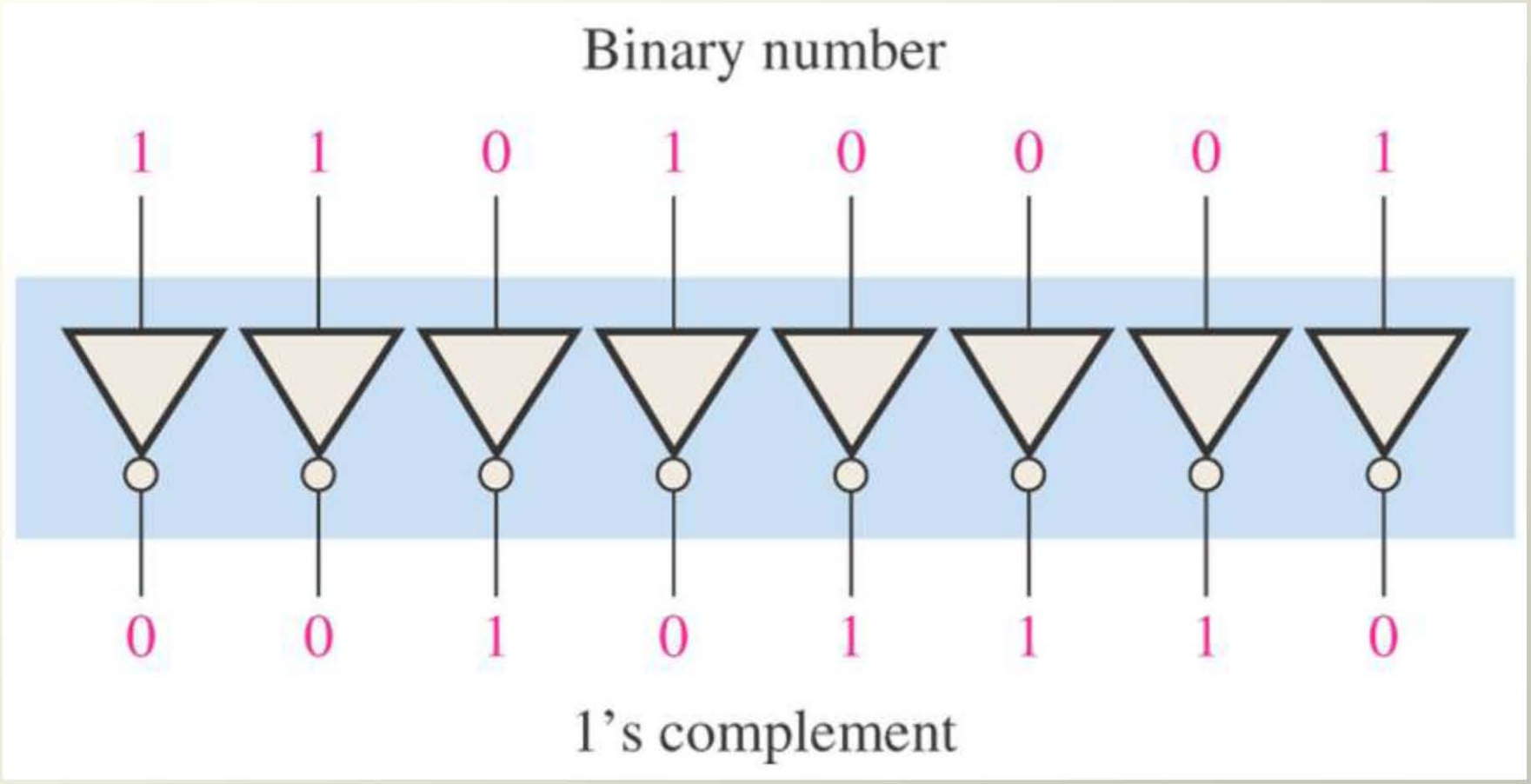
Boolean expression

0 = LOW
1 = HIGH

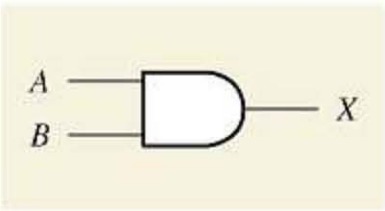


Pulsed waveforms

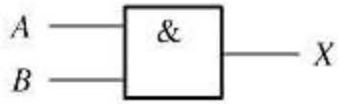
The output of an inverter is always the complement (opposite) of the input.


Binary number
1 1 0 1 0 0 0 1
0 0 1 0 1 1 1 0
1's complement

The AND Gate



Distinctive shape symbol



Rectangular outline symbol

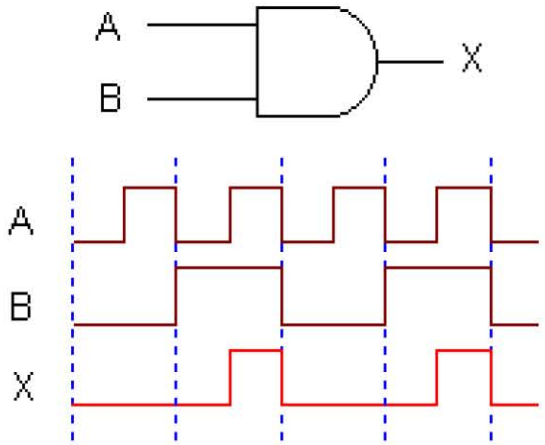
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

Truth table

0 = LOW
1 = HIGH

X = AB

Boolean expression

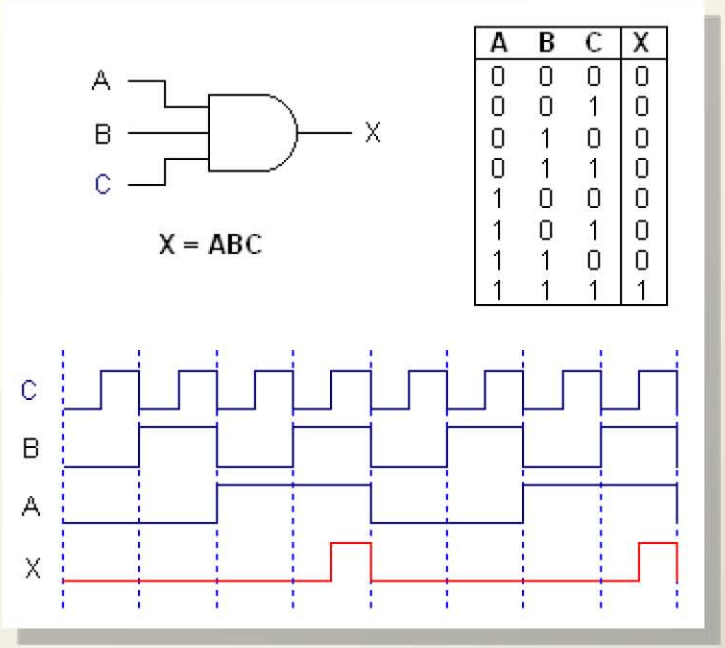


Pulsed waveforms

The output of an AND gate is HIGH only when all inputs are HIGH.

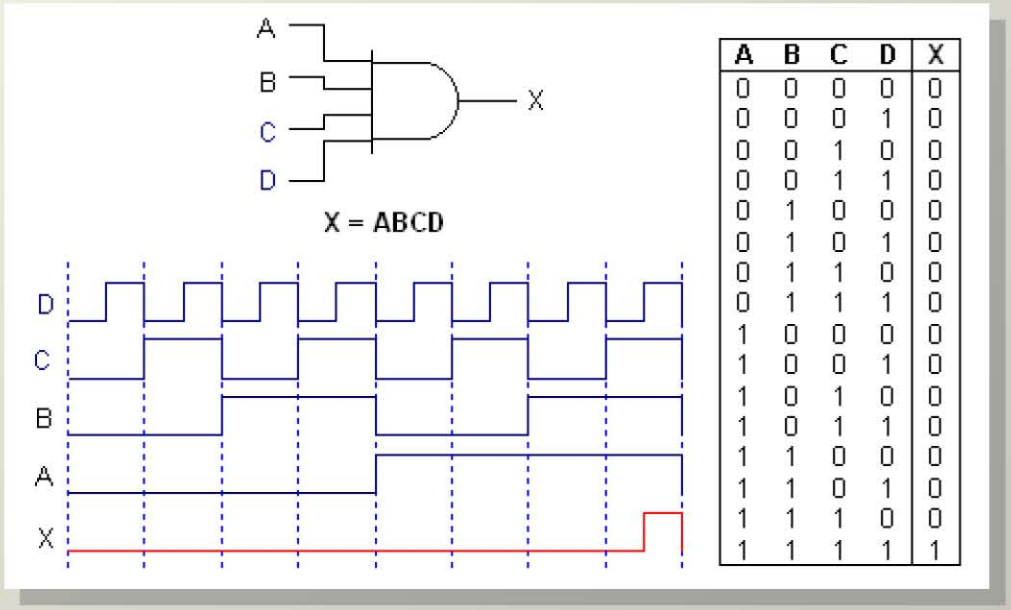
Timing diagram shows input output relationship

The AND Gate



A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

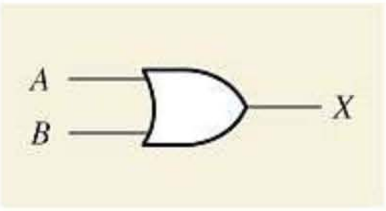
3-Input AND Gate



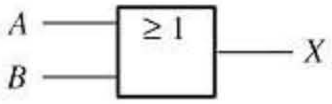
A	B	C	D	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

4-Input AND Gate

The OR Gate



Distinctive shape symbol



Rectangular outline symbol

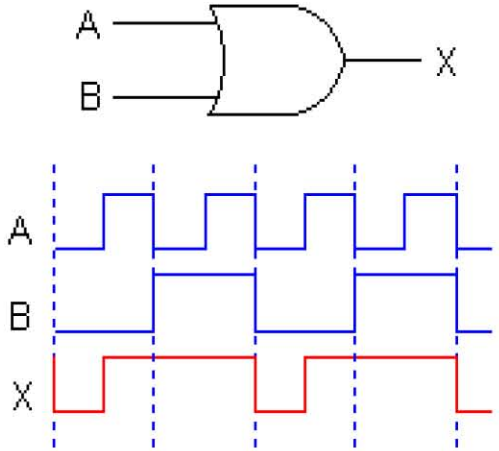
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

Truth table

0 = LOW
1 = HIGH

$X = A + B$

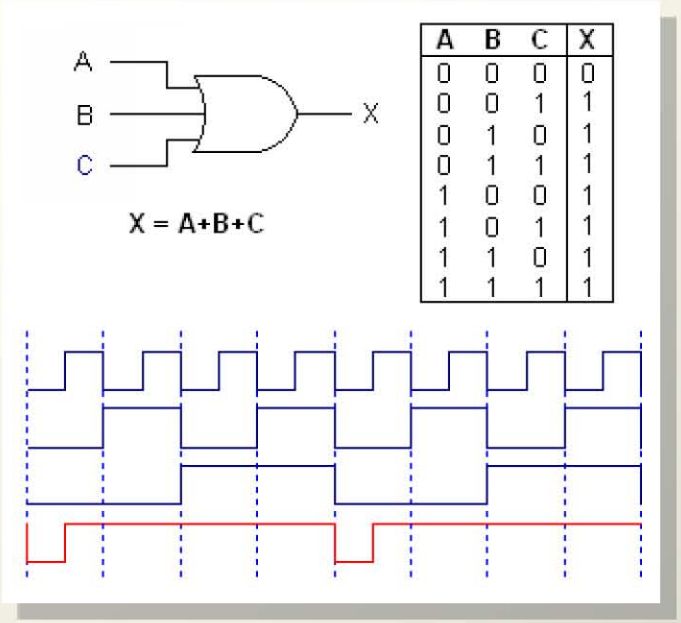
Boolean expression



Pulsed waveforms

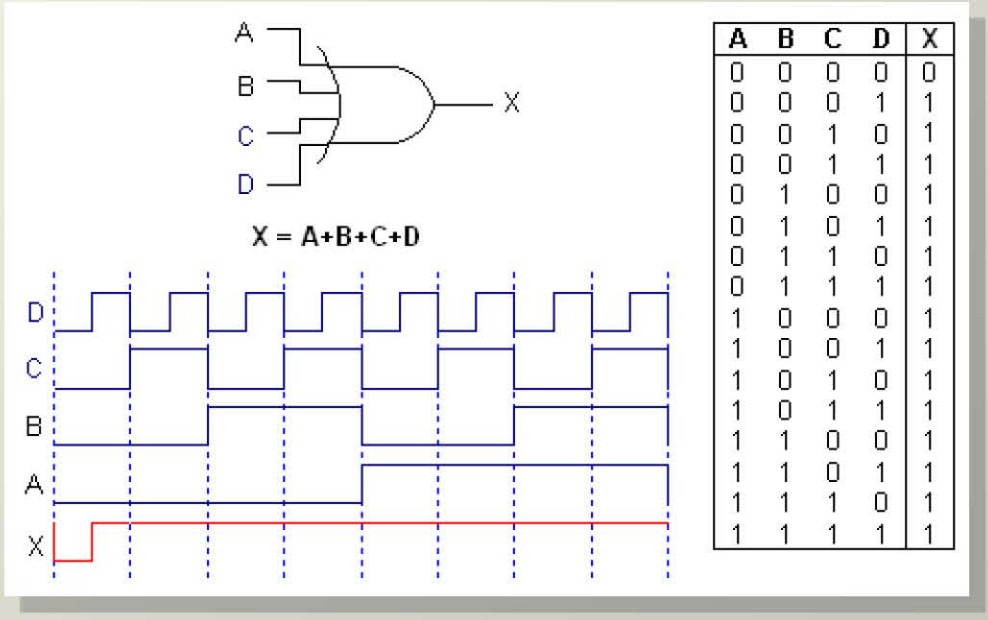
The output of an OR gate is HIGH whenever one or more inputs are HIGH

The OR Gate



A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

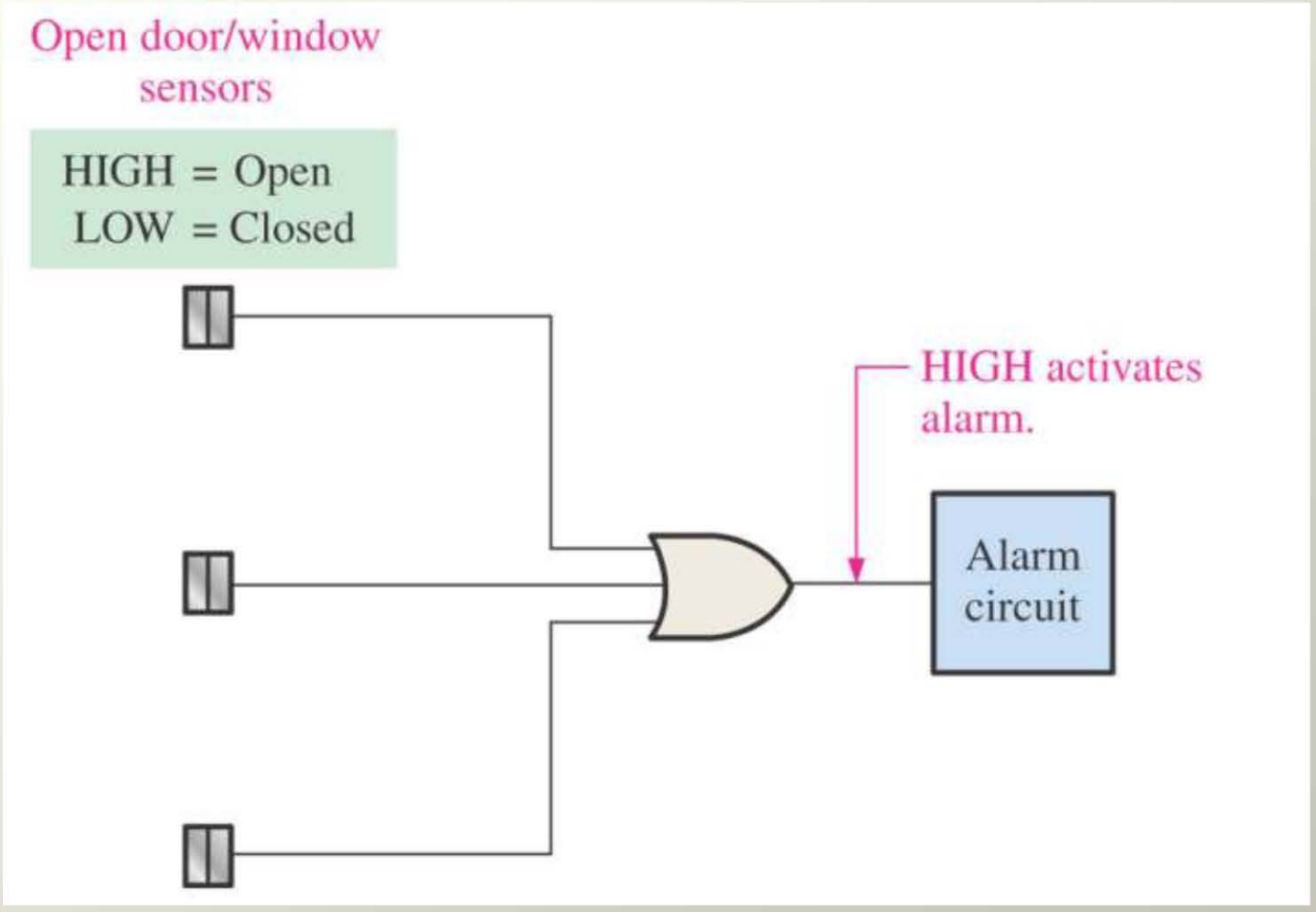
3-Input OR Gate



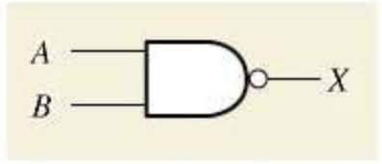
A	B	C	D	X
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

4-Input OR Gate

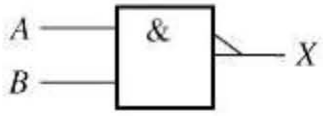
A simplified intrusion detection system using an OR gate.
Open door or window alarm



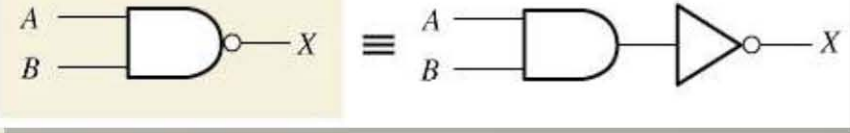
The NAND Gate



Distinctive shape symbol



Rectangular outline symbol



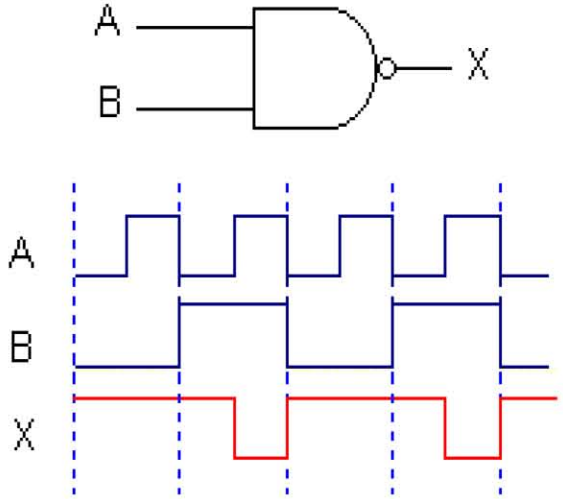
A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

Truth table

0 = LOW
1 = HIGH

$X = \overline{AB}$

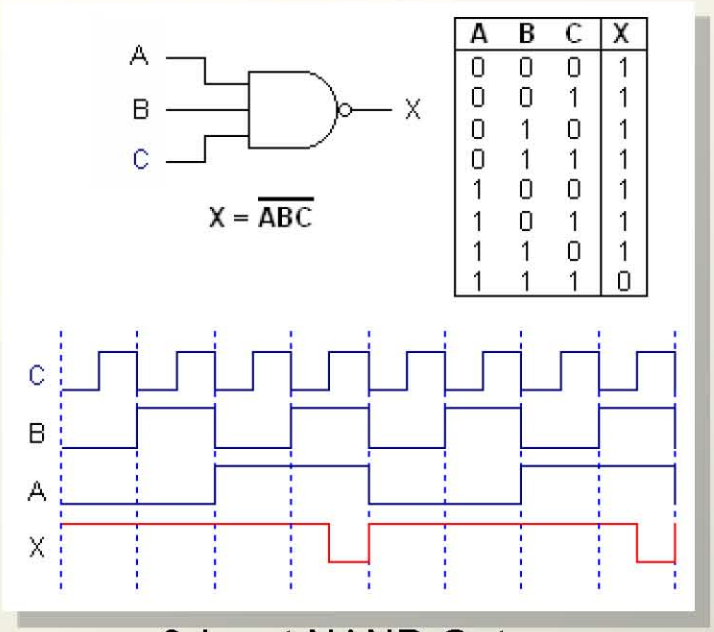
Boolean expression



Pulsed waveforms

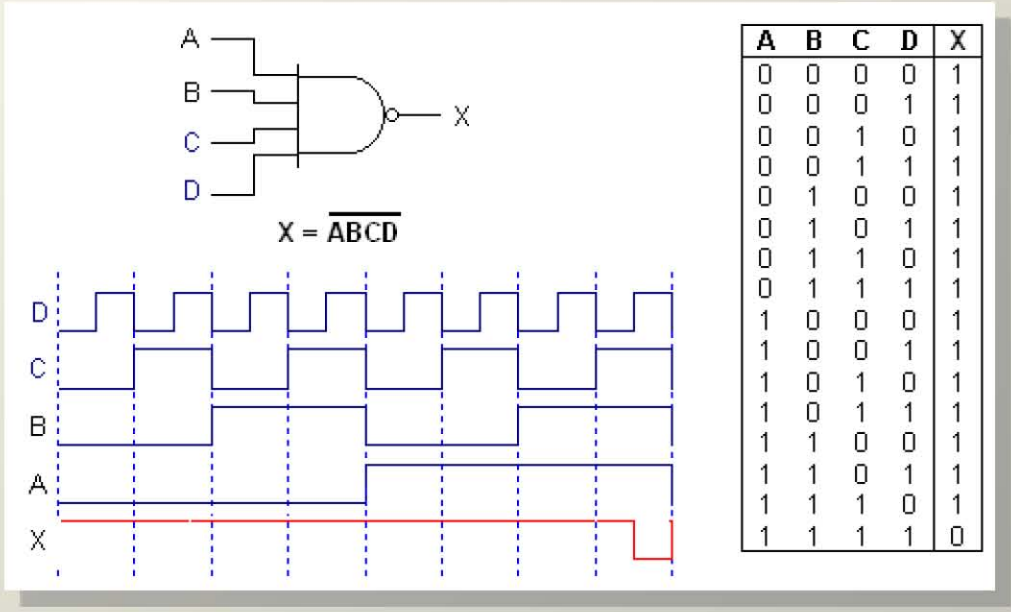
The output of a NAND gate is HIGH whenever one or more inputs are LOW.

The NAND Gate



A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

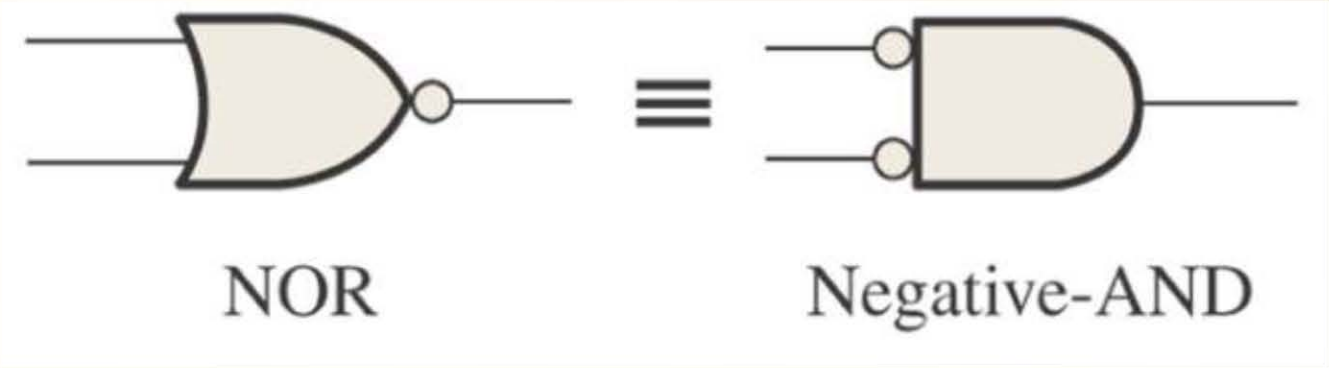
3-Input NAND Gate



A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

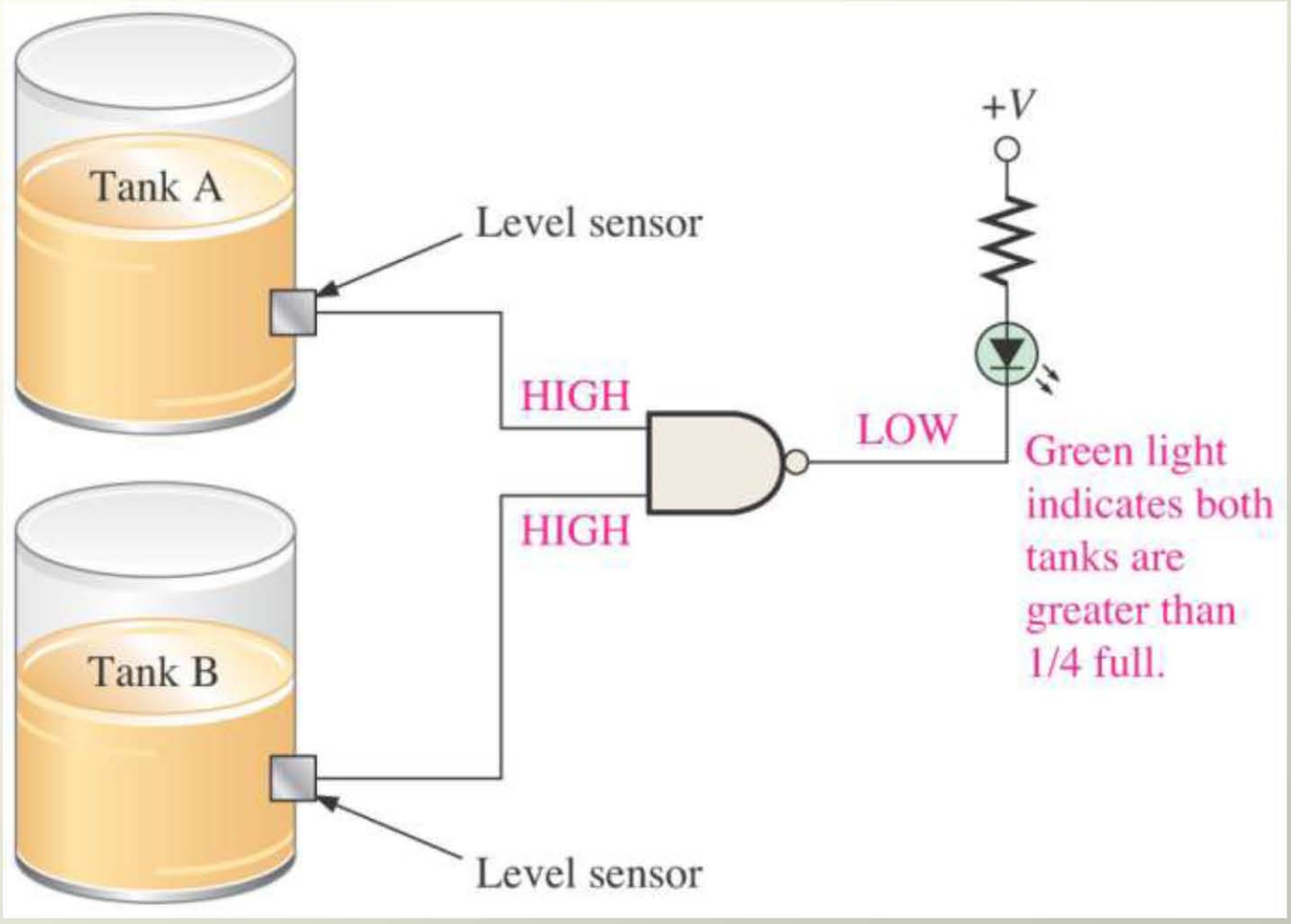
4-Input NAND Gate

The NAND Gate



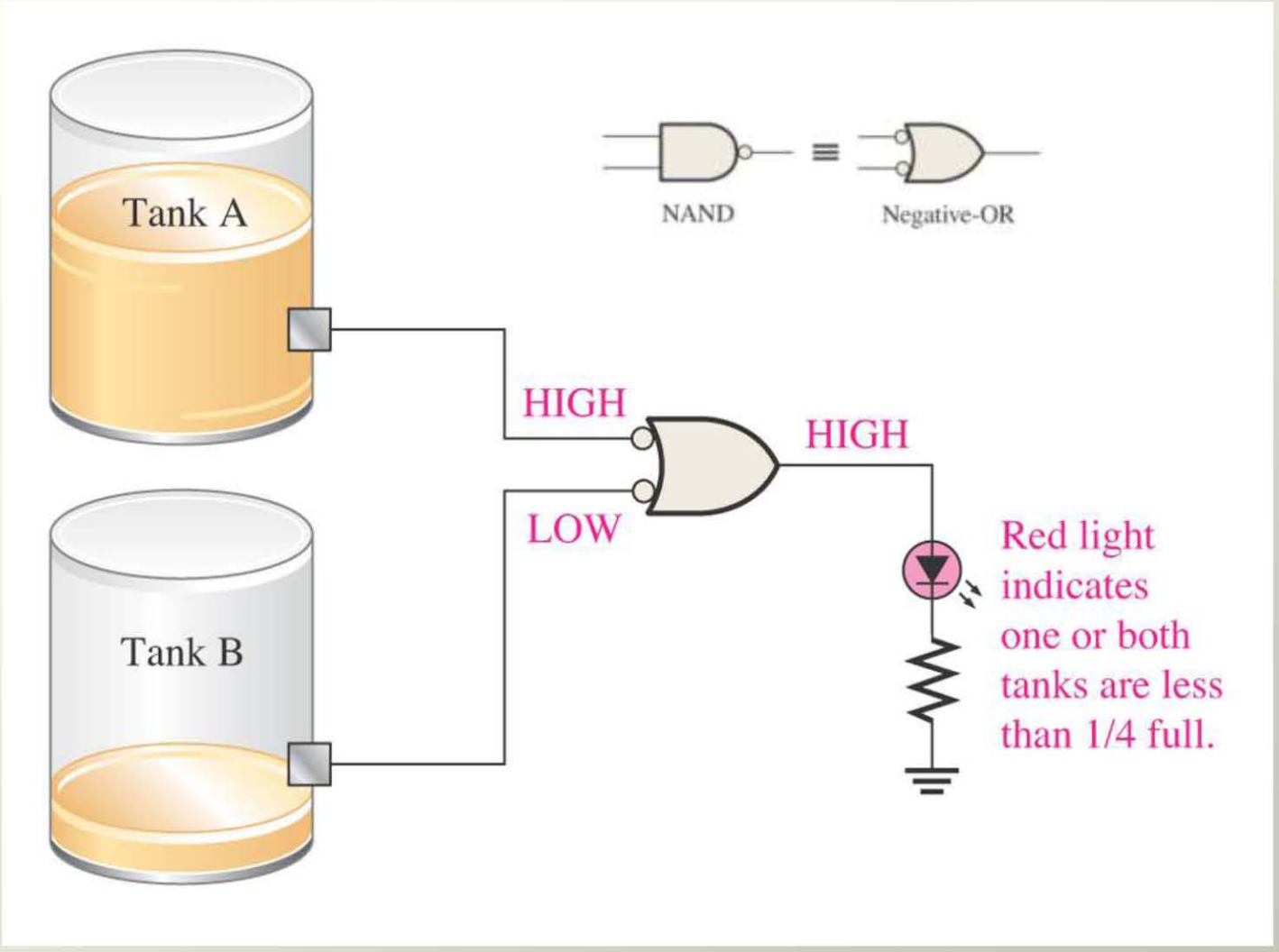
Standard symbols representing the two equivalent operations of a NOR gate.

Liquid Level detector, green light off



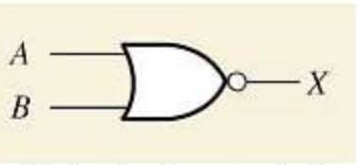
The Level sensors produce High level of 5 volt when the tanks are more than one-quarter full.
When the volume of chemical drop to one-quarter full, the sensor puts out a Low level of 0 volt

Liquid Level detector, Red light on

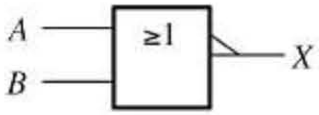


the volume of chemical drop to one-quarter full, the sensor puts out a Low level of 0 volt

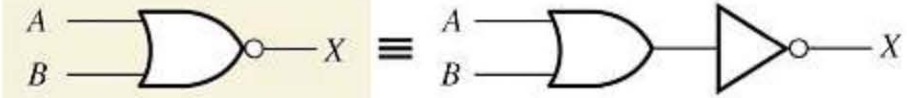
The NOR Gate



Distinctive shape symbol



Rectangular outline symbol



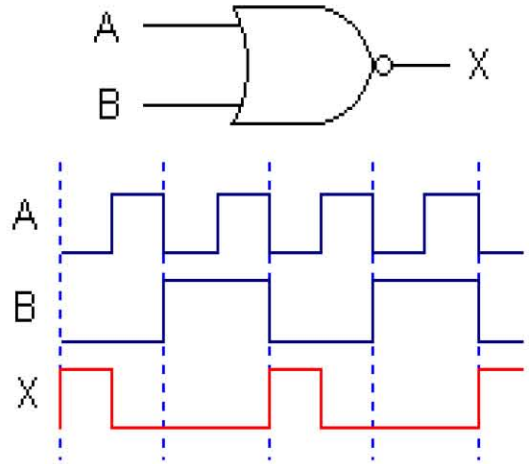
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Truth table

0 = LOW
1 = HIGH

$X = \overline{A + B}$

Boolean expression



Pulsed waveforms

The output of a NOR gate is LOW whenever one or more inputs are HIGH.