Section 2.4: Logic Circuits and Boolean Algebra

Friday, January 17, 2020 10:56 AM

logic circuit: an electrical circuit with only two levels

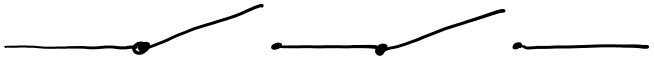
- one voltage is set at zero volts (grounded)
- the other is set to some other value, such as five volts

two values: 5 volts / zero volts
on / off
1 / 0

a little bit of background (will not be tested):

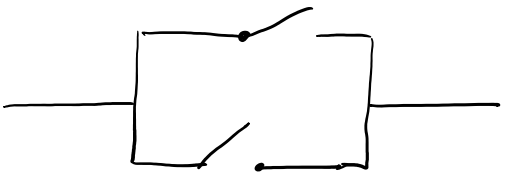
the circuit behaves like a switch:

Consider the two circuits below:



behaves like "and" - need

"and" - need both closed



behaves like "or" - need at least one closed

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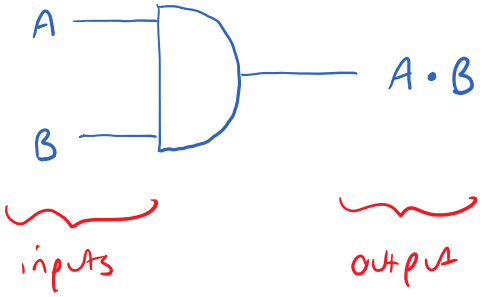
gate representation (this I will test)

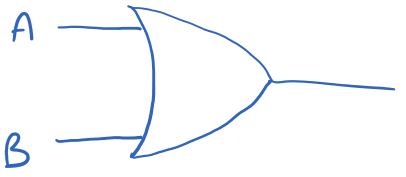
"and"



← the dot means "and"

↖ also okay to write just AB with no dot

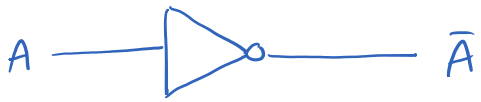
"or"



← "plus" means "or"

"not"

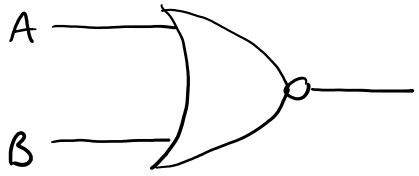
← the overline (or bar) "not"



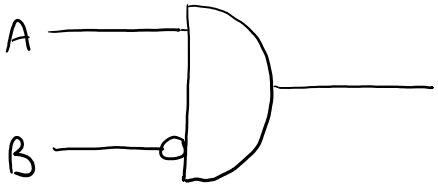
← the overline (or bar) means "not"

↑ we often omit the triangle entirely and just use the open circle to show negation

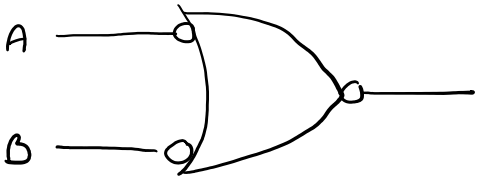
example: give the output for the following circuits



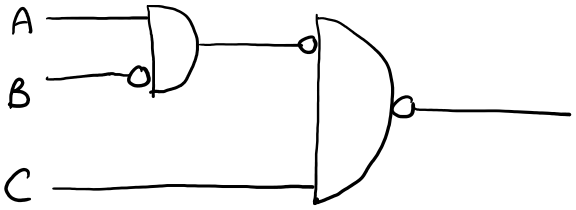
$\overline{A + B}$



$A\bar{B}$



$\overline{\bar{A} + \bar{B}}$

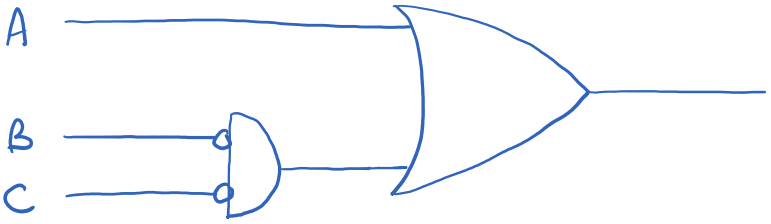


$\overline{A\bar{B}C}$

2020/01/21

draw the gate representation for $A + \bar{B}\bar{C}$

note: do "and" before "or", just as before



Boolean Algebra

- algebra in which the variables can only take on one of two possible values: 0 and 1

"and" symbol is a dot $\cdot$

or implied multiplication (no symbol)

$A \cdot B$, AB, $A \cdot 0$

"or" symbol is + (plus sign)

$A + B$

"not" symbol is —

$\bar{A}$ $\overline{AB}$

order of operations

"and" before "or" (just like before)

the negation bar behaves like brackets

you can use brackets to force the order that you want

example: which operation comes first?

(1) $A + BC$

"and" first, then "or"

(2) $(A + B)C$

"or" first, then "and"

(3) $\overline{A + B}\,C$

↑ "or", then "not", then "and"

(4) $A + \overline{B}C$

↑ "not", then "and", then "or"

(5) $\overline{AB}$

↑ "and", then "not"

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example: write the truth table for $A + \overline{B}\,\overline{C}$

A	B	C	$\overline{B}$	$\overline{C}$	$\overline{B}\,\overline{C}$	$A + \overline{B}\,\overline{C}$
0	0	0	1	1	1	1
0	0	1	1	0	0	0
0	1	0	0	1	0	0
0	1	1	0	0	0	0
1	0	0	1	1	1	1
1	0	1	1	0	0	1
1	1	0	0	1	0	1
1	1	1	0	0	0	1