Section 2.4: Logic Circuits and Boolean Algebra

Wednesday, September 20, 2023 11:04 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

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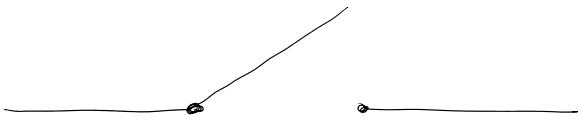
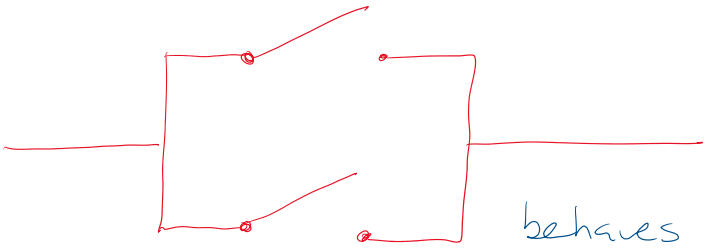
a little bit of background (will not be tested)

the circuit behaves like a switch



consider the two circuits below:

behaves like "and" - both switches must be closed for current to flow



current to flow

behaves like "or"
- at least one switch must be closed for current to flow

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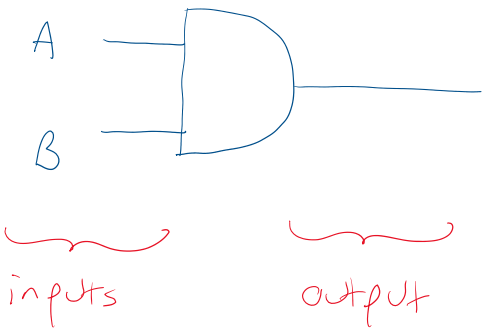
gate representation (this I will test)

"and"



the dot means "and"

okay to just write AB without the dot

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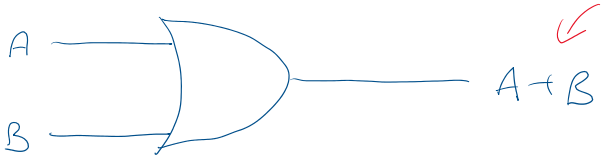
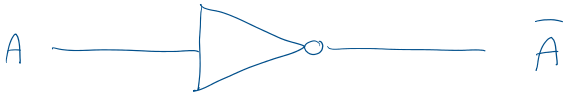
"or"



plus sign means "or"

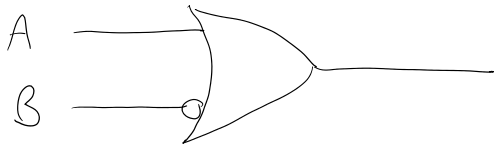
"not"



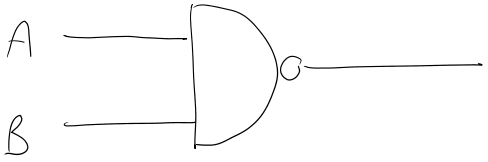
actually, we often omit

actually, we often omit the triangle and just use the open circle for negation

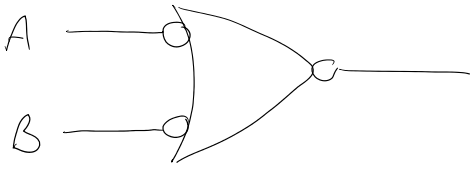
examples: give the otpt for the following circuits:



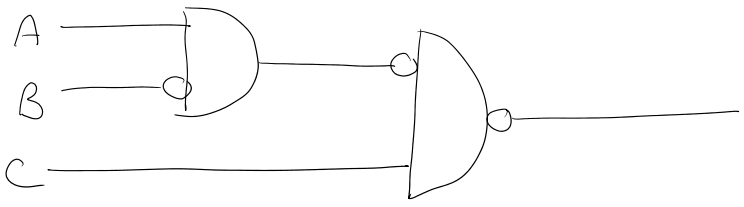
$A + \bar{B}$



$\overline{AB}$



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

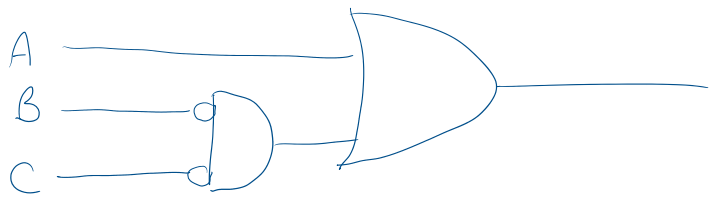


$\overline{\overline{AB}\,C}$

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

note: do "and" before "or"

answer:



Boolean algebra

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

"and" symbol is a dot (or implied multiplication with no symbol)

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

"or" symbol is plus sign (+)

"not" symbol is overline (—)

$\overline{A}$, $\overline{AB}$

order of operations

- "and" before "or"
- negation bar behaves like brackets
- you can use brackets to force the order that you want

examples: what is the order of operations?

1) $A + BA$ — "and" ... "or"

a) $A + BC$ — "and", then "or"

b) $A + \overline{BC}$ — "and", then "not", then "or"

c) $\overline{A+B}\,C$ — "or", then "not", then "and"

d) $(A+\overline{B})C$ — "not", then "or", then "and"

e) $\overline{A + BC}$ — "and", then "or", then "not"

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

answer:

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