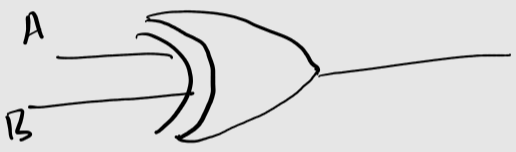
Sep 14

Circuits → Logic

XOR gate



A	B	A XOR B	A OR B
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	1

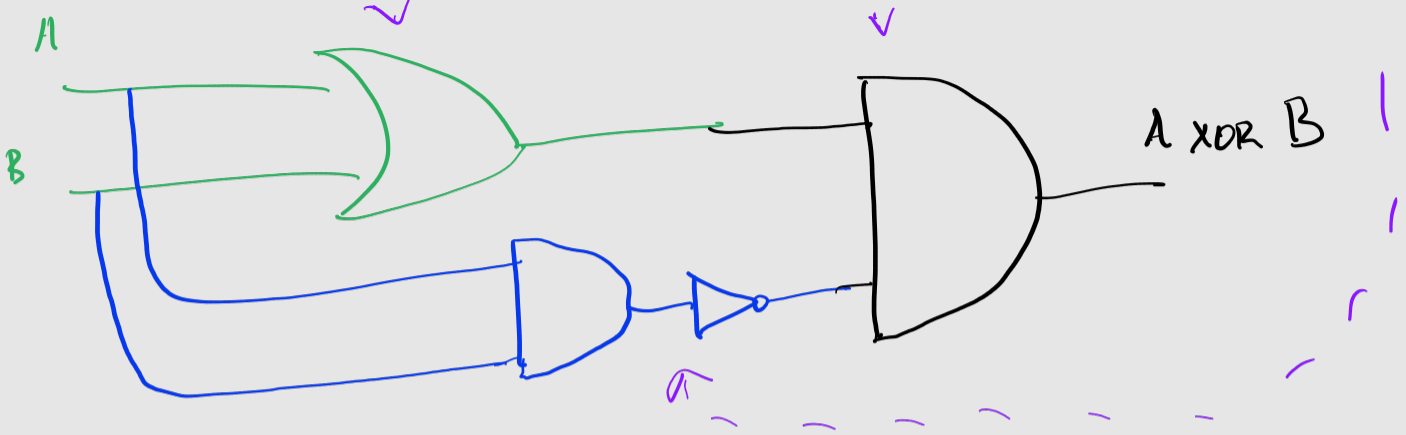
Either A or B is 1 and at the same time both must NOT be true.

OR gate

AND gate

flip AND via NOT gat

AND gate



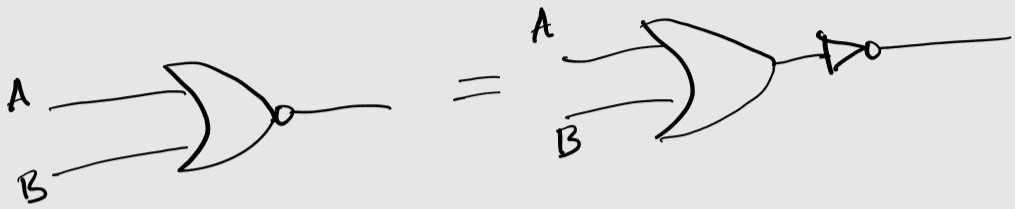
NAND : Not of AND of inputs

A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

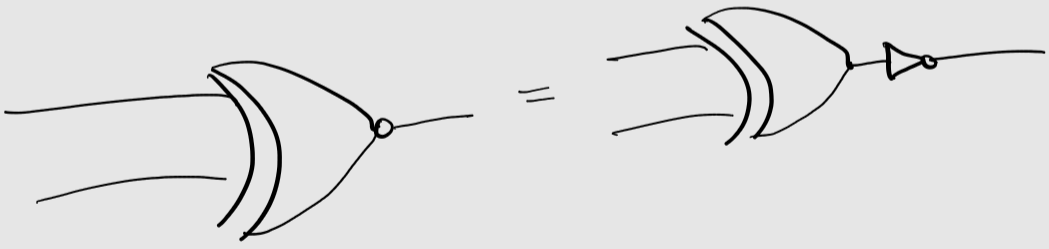


NOR : Not of OR of inputs

A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

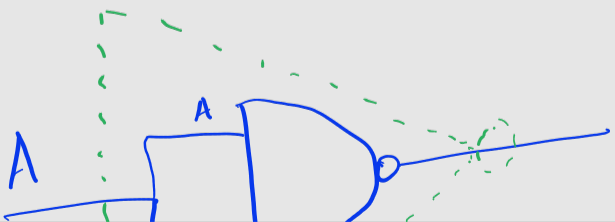


XNOR: Not of XOR of inputs

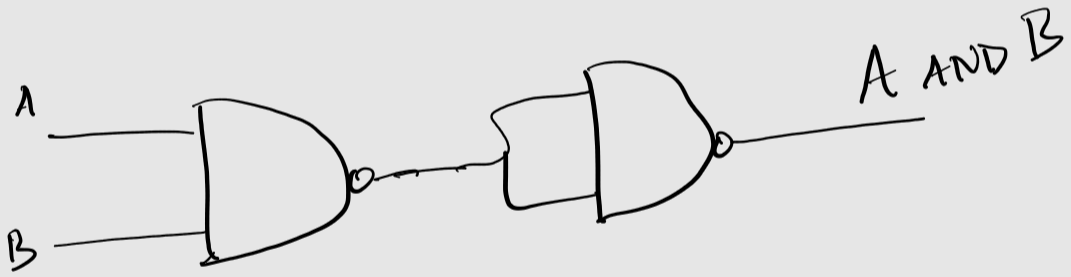


Any logical circuit can be drawn using

- {AND, OR, NOT}
- {AND, NOT} / {OR, NOT}
- {NAND} / {NOR}



A	A	A NAND A
0	0	1
1	1	0



Logic → Boolean Algebra
↳ Mathematical logic

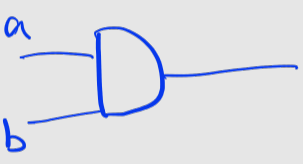
Boolean Variable

A variable which only takes True / False values

a, b, c, d, etc

Logical Operators

$a \wedge b$ =



$a \vee b$ =



$\neg a$ =



$\neg(a \wedge b)$ =



$a \oplus b$ =



$a \wedge b \longrightarrow a \wedge b = T$ if $a = b = T$
else F

$a \vee b \longrightarrow a \vee b = F$ if $a = b = F$
else T

$\neg a \longrightarrow \neg a = T$ if $a = F$
else F

Negation / Complement

Laws of Boolean Algebra / Properties of Logical Operators

① Commutative Law (two "variable units" move around)

$p \wedge q = q \wedge p$

$p \vee q = q \vee p$

② Associative Law (multiple "variable units"; same operation → precedence doesn't matter)

$(p \wedge q) \wedge r = p \wedge (q \wedge r)$

$(p \vee q) \vee r = p \vee (q \vee r)$

(two diff. operators)

③ Distributive Law

$$p \wedge (q \vee r) = (p \wedge q) \vee (p \wedge r)$$

$$p \vee (q \wedge r) = (p \vee q) \wedge (p \vee r)$$

④ Identity Laws

$$p \wedge T = p$$

$$p \vee F = p$$

⑤ Annihilator Laws

$$p \wedge F = F$$

$$p \vee T = T$$

⑥ Idempotence Laws

$$p \wedge p = p$$

$$p \vee p = p$$

⑦ Complement Law

$$p \wedge \neg p = F$$

$$p \vee \neg p = T$$

⑧ Absorption Law

$$p \wedge (p \vee q) = p$$

$$p \vee (p \wedge q) = p$$

(9) Double Negation

$$\neg\neg p = p$$

(10) De Morgan's Law

$$\neg(p \wedge q) = \neg p \vee \neg q$$

$$\neg(p \vee q) = \neg p \wedge \neg q$$