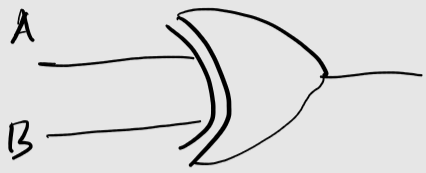
Sep 14

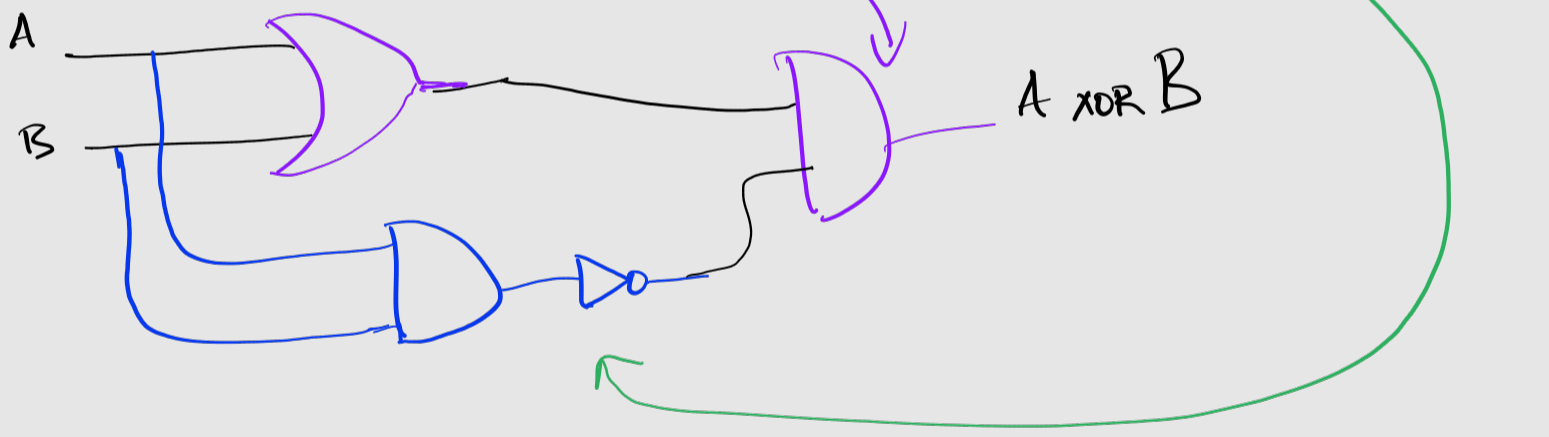
Circuits → Logic



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 of A & B is 1 and both A & B must not be 1.

OR gate — AND gat — AND gate — NOT gate after the AND gate.



NAND: NOT of AND of inputs



A	B	A NAND B
0	0	1
0	1	1

0	1	1
1	0	1
1	1	0

NOR: Not of OR of inputs



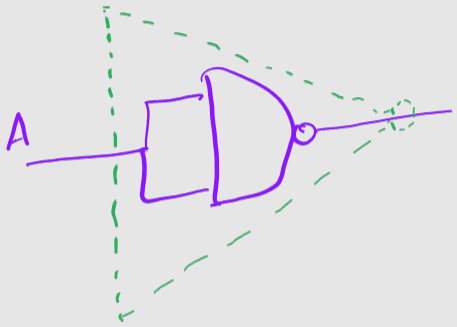
A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

XNOR - Not of XOR of inputs



You can get any circuit using

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



A	A NAND A	NOT A
0	1	1
1	0	0

NAND → NOT = AND

||

(AND → ~~NOT~~) → ~~NOT~~ = AND

Logic → Boolean Algebra

↳ Mathematical logic

Boolean variables

A variable which can only take True / False values.

a, b, c, d, etc. P, Q, R, etc.

Logical Operators

$a \wedge b$: AND gate

↳ $a \wedge b = T$ if $a = b = T$

otherwise it is F

$a \vee b$: OR gate

↳ $a \vee b = F$ if $a = b = F$
otherwise it is T

$\neg a$: NOT gate

negation
complement ↳ $\neg a = T$ if $a = F$ otherwise it is F

$\neg(a \wedge b)$: NAND

$a \oplus b$: XOR gate

$\neg(a \vee b)$: NOR

Laws of Boolean Algebra / Properties of Logical Operators

① Commutative law (order between "variables units" P, $\neg P$, $(a \vee b \wedge c)$, etc. doesn't matter)

$p \wedge q = q \wedge p$

$p \vee q = q \vee p$

② Associative Law

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

$2 + 3 + 4 \rightarrow (2+3)+4$
$\rightarrow 2+(3+4)$

/ precedence order doesn't

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

(Parenthesis doesn't matter as long as all operations are same)

$2+3\times4 \rightarrow 2+(3\times4)$

$\rightarrow (2+3)\times4$

$2\times4 + 3\times4$

(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 Law

$$p \wedge T = p$$

$$p \vee F = p$$

(5) Annihilator Law

$$p \wedge F = F$$

$$p \vee T = T$$

(6) Idempotence Law

$$p \wedge p = p$$

$$p \vee p = p$$

(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 Law

$$\neg\neg p = p$$

(10) De Morgan's Law

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

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