

The 16 Logic Gates

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p	F	F	T	T		
q	F	T	F	T	Description	Expression
0	F	F	F	F	contradiction	$\neg p \wedge p$
1	F	F	F	T	conjunction AND	$p \wedge q$
2	F	F	T	F	non implication $\neg (p \Rightarrow q)$	$p \wedge \neg q$
3	F	F	T	T	p amplifier	p
4	F	T	F	F	non implication $\neg (q \Rightarrow p)$	$\neg p \wedge q$
5	F	T	F	T	q amplifier	q
6	F	T	T	F	exclusive disjunction XOR	$p \underline{\vee} q$
7	F	T	T	T	inclusive disjunction OR	$p \vee q$
8	T	F	F	F	joint denial NOR	$\neg (p \vee q)$
9	T	F	F	T	equivalence $p \Leftrightarrow q$ XNOR	$\neg (p \underline{\vee} q)$
10	T	F	T	F	negation (q inverter)	$\neg q$
11	T	F	T	T	implication $q \Rightarrow p$	$p \vee \neg q$
12	T	T	F	F	negation (p inverter)	$\neg p$
13	T	T	F	T	implication $p \Rightarrow q$	$\neg p \vee q$
14	T	T	T	F	incompatible NAND	$\neg p \vee \neg q$
15	T	T	T	T	tautology	$p \vee \neg p$

The de Morgan Rule is $\neg (p \vee q) \equiv \neg p \wedge \neg q$

The "Switcheroo" Rule is $p \Rightarrow q \equiv \neg p \vee q$

The "Switcherin" Rule is $\neg (p \Rightarrow q) \equiv p \wedge \neg q$

The Switcherin Rule is really the Switcheroo Rule followed by de Morgan

For $p \Rightarrow q$ the inverse is $\neg p \Rightarrow \neg q$, the converse is $q \Rightarrow p$

So the inverse and the converse are functionally identical.

The contrapositive of $p \Rightarrow q$ is $\neg q \Rightarrow \neg p \equiv p \Rightarrow q$

Tautology is an application of the *tertium non datur* principle

The tricky Venn diagram is **XOR** $\equiv (P \cap Q') \cup (P' \cap Q)$

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