

Cheat Sheet

Logical Equivalences

Identity: $p \wedge \mathbf{T} \equiv p$

$$p \vee \mathbf{F} \equiv p$$

Domination: $p \vee \mathbf{T} \equiv \mathbf{T}$

$$p \wedge \mathbf{F} \equiv \mathbf{F}$$

Idempotent: $p \vee p \equiv p$

$$p \wedge p \equiv p$$

Double negation: $\neg(\neg p) \equiv p$

Commutative: $p \vee q \equiv q \vee p$

$$p \wedge q \equiv q \wedge p$$

Associative: $(p \vee q) \vee r \equiv p \vee (q \vee r)$

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

Distributive: $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

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

De Morgan's: $\neg(p \wedge q) \equiv \neg p \vee \neg q$

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

Absorption: $p \vee (p \wedge q) \equiv p$

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

Negation: $p \vee \neg p \equiv \mathbf{T}$

$$p \wedge \neg p \equiv \mathbf{F}$$

Conditional Statements

$$p \rightarrow q \equiv \neg p \vee q$$

$$p \rightarrow q \equiv \neg q \rightarrow \neg p$$

$$p \vee q \equiv \neg p \rightarrow q$$

$$p \wedge q \equiv \neg(p \rightarrow \neg q)$$

$$(p \rightarrow q) \wedge (p \rightarrow r) \equiv p \rightarrow (q \wedge r)$$

$$(p \rightarrow r) \wedge (q \rightarrow r) \equiv (p \vee q) \rightarrow r$$

$$(p \rightarrow q) \vee (p \rightarrow r) \equiv p \rightarrow (q \vee r)$$

$$(p \rightarrow r) \vee (q \rightarrow r) \equiv (p \wedge q) \rightarrow r$$

Biconditional Statements

$$p \iff q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$$

$$p \iff q \equiv \neg p \iff \neg q$$

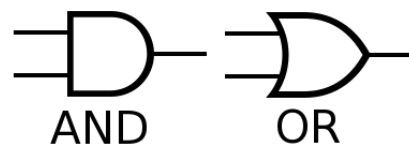
$$p \iff q \equiv (p \wedge q) \vee (\neg p \wedge \neg q)$$

$$\neg(p \iff q) \equiv p \iff \neg q$$

Rules of Inference

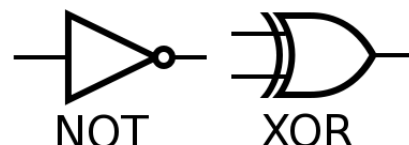
$\frac{p \quad p \rightarrow q}{\therefore q}$	Modus ponens
$\frac{\neg q \quad p \rightarrow q}{\therefore \neg p}$	Modus tollens
$\frac{p \rightarrow q \quad q \rightarrow r}{\therefore p \rightarrow r}$	Hypothetical syllogism
$\frac{p \vee q \quad \neg p}{\therefore q}$	Disjunctive syllogism
$\frac{p}{\therefore p \vee q}$	Addition
$\frac{p \wedge q}{\therefore p}$	Simplification
$\frac{p \quad q}{\therefore p \wedge q}$	Conjunction
$\frac{p \vee q \quad \neg p \vee r}{\therefore q \vee r}$	Resolution

Logic Gates



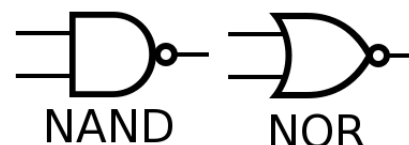
AND

OR



NOT

XOR



NAND

NOR