

MATHEMATICAL LOGIC



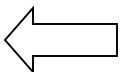
- the following statements are NOT propositions:
 - What did you say?
 - This sentence is false.
 - $x = 6$
- What is the “Liar Paradox”?



CONDITIONAL/IMPLICATION

- P is the hypothesis or premise
- Q is the conclusion
- truth table

P	Q	$P \rightarrow Q$
1	1	1
1	0	0
0	1	1
0	0	1





SAMPLE TRUTH TABLES

Show that $(P \leftrightarrow Q) \leftrightarrow ((P \wedge Q) \vee (\neg P \wedge \neg Q))$ is a tautology

P	Q	$P \leftrightarrow Q$	$P \wedge Q$	$\neg P \wedge \neg Q$	$(P \wedge Q) \vee (\neg P \wedge \neg Q)$	$(P \leftrightarrow Q) \leftrightarrow ((P \wedge Q) \vee (\neg P \wedge \neg Q))$
1	1	1	1	0	1	1
1	0	0	0	0	0	1
0	1	0	0	0	0	1
0	0	1	0	1	1	1



Precedence of the Logical Operators

Operator	Precedence/Priority Level
$\neg$	1
$\wedge$	2
$\vee$	3
$\rightarrow$	4
$\leftrightarrow$	5



Rules of Replacement

13. Identities

$$P \vee 1 \equiv 1$$

$$P \wedge 1 \equiv P$$

$$P \vee 0 \equiv P$$

$$P \wedge 0 \equiv 0$$

$$P \vee \neg P \equiv 1$$

$$P \wedge \neg P \equiv 0$$

$$\neg 0 \equiv 1$$

$$\neg 1 \equiv 0$$

14. Absorption

$$P \wedge (P \vee R) \Leftrightarrow P$$

$$P \vee (P \wedge R) \Leftrightarrow P$$