Logic

COMP 1805

Winter 2023

Understanding how statements work. Foundations are known as propositions (a declarative sentence that is either true or false). Math equations involving variables are not propositions(within reason).

1 Operations

1.1 Negation

Negation: if p is a proposition.

Negation of p, denoted by $\neg p$ is statement: It is not the case that p

P	$\neg p$
T	F
F	T

1.2 AND

If p and q are propositions. Proposition p and q are denoted by $p \wedge q$, os a statement which is true if both p and q are true, otherwise false. "$\wedge$" is called conjunction

P	Q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

1.3 OR

if p and q are propositions. Disjunction of p and q, denoted by $p \vee q$ is the proposition p or q.

P	Q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

XOR is the same as OR, only that both cannot be True (if they are both the same bool then False). Denoted by $p \oplus q$

1.4 Implication

If p and q are two propositions. Proposition $p \to q$ is statement of "if p then q" and its truth value is False if p is True and q is False, otherwise True.

P	Q	$p \to q$
T	T	T
T	F	F
F	T	T
F	F	T

Converse of $p \to q$: $q \to p$
Contraposition of $p \to q$: $q \to \neg p$
Reverse of $p \to q$: $\neg p \to \neg q$

Definition 1. When two compound propositions have the same truth value for each assignment of values to the atomic proposition we say they are equivalent.

1.5 Bi-implication (if and only if)

if p and q are two propositions. Proposition $p \longleftrightarrow q$ is statement of "p if and only if$q$" and its truth value is true if p and q have same truth value, otherwise false.

P	Q	$p \longleftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T