Chapter 3
Logic / Section 3

Conditional

A conditional statement is often times compared to making a deal.

Ex = If Tom makes an A+ on the test, then I'll buy him ice cream. = $P \rightarrow Q$

P	Q	$P \rightarrow Q$
T	T	T
T	F	F
F	T	T
F	F	T

In case 1it is true for both parts were met.

As you can see in case 2 it is false, because I failed to keep my end of the deal.

In case 3 though you see that I keep my end of the deal even though Tom didn't keep his up his, yet the case is still true.

In case 4 Tom failed to met his end so I didn't complete my end, and the case true.
A conditional statement p q is true in every case except when p is true and q is false.

$P \rightarrow Q$

P	Q	$P \rightarrow Q$
T	T	T
T	F	F
F	T	T
F	F	T

$\sim P \rightarrow Q$

P	Q	$\sim P$	$\sim P \rightarrow Q$
T	T	F	T
T	F	F	T
F	T	T	T
F	F	T	F

$P \rightarrow \sim Q$

P	Q	$\sim Q$	$P \rightarrow \sim Q$
T	T	F	F
T	F	T	T
F	T	F	T
F	F	T	T

Biconditional

Biconditional is a "if and only if" statement. $P \leftrightarrow Q$
A biconditional is the statement that can be written two ways. $P \leftrightarrow Q$ or $(P \rightarrow Q) \wedge (Q \rightarrow P)$
Ex = The printer works if and only if it has ink. P Q

$P \leftrightarrow Q$

P	Q	$P \leftrightarrow Q$
T	T	T
T	F	F
F	T	F
F	F	T

$(P \rightarrow Q) \wedge (Q \rightarrow P)$

P	Q	$P \rightarrow Q$	$Q \rightarrow P$	$(P \rightarrow Q) \wedge (Q \rightarrow P)$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

In both truth tables cases 1 and 4 are true, because in a biconditional statement P Q, is true **only** when P and Q have the same value, that is when both are true or both are false.

$P \leftrightarrow Q$

P	Q	$P \leftrightarrow Q$
T	T	T
T	F	F
F	T	F
F	F	T

$\sim P \leftrightarrow Q$

P	Q	$\sim P$	$\sim P \leftrightarrow Q$
T	T	F	F
T	F	F	T
F	T	T	T
F	F	T	F

$P \leftrightarrow \sim Q$

P	Q	$\sim Q$	$P \leftrightarrow \sim Q$
T	T	F	F
T	F	T	T
F	T	F	T
F	F	T	F

NEGATIONS

When you negate a conditional it becomes a biconditional. $\sim(P \rightarrow Q) = \sim P \leftrightarrow \sim Q$
When you negate a biconditional is becomes a conditional. $\sim(P \leftrightarrow Q) = \sim P \rightarrow \sim Q$