

R = "It is raining"

P = "I ate eggs for breakfast"

Q = "I ate cereal for breakfast"

"Either it is raining, or I had eggs and not cereal for breakfast."

$$R \vee (P \wedge \neg Q)$$

$$(R \vee P) \wedge \neg Q$$

R = T
P = F
Q = T

## Implication

Def'n If P, Q are propositions, then the implication (or conditional) "if P then Q", written  $P \rightarrow Q$  is also a proposition.

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

ex. P = "You complete all requirements for an A."  
Q = "You get an A."

There are lots of ways to express  $P \rightarrow Q$  in English.

- "if P, (then) Q"
- "whenever P, Q"
- "Q if P"

BTW, also lots of ways to express  $P \wedge Q$ :

- "P and Q"
- "P but Q"

Def'n If  $P, Q$  are propositions, the biconditional "P if and only if Q", written  $P \leftrightarrow Q$ , is also a proposition

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

$P \leftrightarrow Q$  is true when

- $P$  and  $Q$  are the same
- $P \rightarrow Q$  and  $Q \rightarrow P$  are both true.

Claim:  $P \rightarrow Q$  is the same as  $\neg P \vee Q$ .

How can we convince ourselves of this?

Make a truth table, see if they are the same in every possible scenario.

P	Q	$P \rightarrow Q$	$\neg P$	$\neg P \vee Q$
T	T	T	F	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

Same

Claim:  $P \wedge (Q \vee R)$  is same as  $(P \wedge Q) \vee (P \wedge R)$ .

P	Q	R	$Q \vee R$	$P \wedge (Q \vee R)$	$(P \wedge Q)$	$(P \wedge R)$	
T	T	T	T	T	T	T	T
T	T	F	T	T	T	F	T
T	F	T	T	T	F	T	T
T	F	F	F	F	F	F	F
F	T	T	T	F	F	F	F
F	T	F	F	F	F	F	F
F	F	T	T	F	F	F	F
F	F	F	F	F	F	F	F

