In addition to the words "and" and "or," the word "not" is an important word in logic. If p is a statement, then the statement "p is not true," usually shortened to "not p" and written $\sim p$, is called the **negation** of p.

Example 2   Statement: p Will is sleeping in class.

Negation: $\sim p$ It is not true that Will is sleeping in class.

or $\sim p$ Will is not sleeping in class.

Truth table
for negation

p	$\sim p$
T	F
F	T

The truth table for negation shows that when p is true, $\sim p$ is false. When p is false, $\sim p$ is true. Note that it is impossible for a statement and its negation to be both true or both false at the same time. The conjunction $p \wedge \sim p$ would have Fs in both rows of its truth table. Such a statement is called a *contradiction*.

An example will show how to make truth tables for some other compound statements.

Example 3   Make a truth table for $\sim p \vee \sim q$.

Solution

1. Make a column for p and a column for q. Write all possible combinations of T and F in the standard pattern shown.

p	q	$\sim p$	$\sim q$	$\sim p \vee \sim q$
T	T	F	F	F
T	F	F	T	T
F	T	T	F	T
F	F	T	T	T

2. Since $\sim p$ is a part of the given statement, add a column for $\sim p$. To fill out this column, use the first column and refer to the truth table for negation above. Similarly, add a column for $\sim q$.

3. Using the columns for $\sim p$ and $\sim q$, refer to the truth table for disjunction on the preceding page in order to fill out the column for $\sim p \vee \sim q$. Remember that a disjunction is false only when both of its statements are false.

To make a truth table for a compound statement involving three simple statements p, q, and r, you would need an eight-row table to show all possible combinations of T and F. The standard pattern across the three columns headed p, q, and r is as follows: TTT, TTF, TFT, TFF, FTT, FTF, FFT, FFF.

Exercises

Suppose p stands for "I like the city," and q stands for "You like the country." Express in words each of the following statements.

1. $p \wedge q$ 2. $\sim p$ 3. $\sim q$ 4. $p \vee q$ 5. $p \vee \sim q$

6. $\sim(p \wedge q)$ 7. $\sim p \vee \sim q$ 8. $\sim p \wedge q$ 9. $\sim(p \vee q)$ 10. $\sim p \wedge \sim q$