1.1: Formal Logic
Logical Equivalences and Examples

Definition 1. Two statements are logically equivalent if they have the same T/F values for all cases; i.e. if they have the same truth tables.

Example 1. Consider the following high school geometry theorem.

If a quadrilateral has a pair of parallel sides, then it has a pair of supplementary angles.

Definitions 2-3. Not only is the truth table for an implication statement $(p \to q)$ the most unintuitive, but there are also many ways to rearrange it. For instance, by negating both and flipping the order we get the contrapositive $(\neg q \to \neg p)$, which is logically equivalent to $(p \to q)$. On the other hand, by simply flipping the order we get the converse $(q \to p)$, which is not logically equivalent.

Exercise 1. If Aaron is late, then Bill is late, and, if both are late, then class is boring. Suppose that class is not boring. What can you conclude about Aaron?

Row #	p	q	r	$p \to q$	$p \wedge q$	$(p \wedge q) \to r$	S
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Exercise 2. Let the following statements be given.

$p =$ "You can vote."
$q =$ "You are under 18 years old."
$r =$ "You are from Mars."

(a) Translate the following statement into symbols of formal logic.

You can't vote if you are under 18 years old or your are from Mars.

(b) Give the contrapositive of this statement in the symbols of formal logic.

(c) Give the contrapositive in English.

De Morgan's Laws.

$\neg(p \vee q)$ is logically equivalent to $\neg p \wedge \neg q$
$\neg(p \wedge q)$ is logically equivalent to $\neg p \vee \neg q$

Homework. (Due Sept 10, 2018) Section 1.1: 4, 6

Practice Problems. 5, 7-11, 13-14, 18-21, **22-30**