Homework 1: Propositional logic.
Due: 9:05am, 27th Aug.

1. Paul, Quincy, and Rachel are in class together. Let $p$ represent the proposition “Paul will pass,” $q$ represent “Quincy will pass,” and $r$ represent “Rachel will pass.” Translate each of the following into English:
   a. $p \land q \land r$
   b. $(p \land \neg q \land \neg r) \lor (\neg p \land q \land \neg r) \lor (\neg p \land \neg q \land r)$
   c. $(q \lor r) \rightarrow p$

2. Let $p$ represent “You drive over the speed limit,” and let $q$ represent “You get a speeding ticket.”
   a. If you do not drive over the speed limit, then you will not get a speeding ticket.
   b. Driving over the speed limit is sufficient for getting a speeding ticket.
   c. Whenever you get a speeding ticket, you are driving over the speed limit.

3. For each of the following propositions, indicate whether it is a tautology, a contradiction, or neither. If neither, provide two truth value assignments which demonstrate that this is the case (i.e., provide one set of assignments that makes the proposition true and one that makes it false). You can use a truth table to decide which of these categories the proposition belongs.
   a. $(p \land (p \rightarrow q)) \rightarrow q$
   b. $p \land \neg p$
   c. $(p \land q) \leftrightarrow (p \lor q)$

4. Give the converse and the contrapositive of each of the following English sentences:
   a. If you study, you learn.
   b. If you have more than two suitcases, then you need to pay extra.
   c. If I have a choice, I don’t eat meat.

5. For each of the following pairs of propositions, show that the two propositions are logically equivalent by finding a chain of equivalences from one to the other. State which definition or law of logic justifies each equivalence in the chain.
   a. $p \land (q \land p)$, $p \land q$
   b. $(p \lor q) \land \neg q$, $p \land \neg q$
   c. $(p \rightarrow r) \land (q \rightarrow r)$, $(p \land q) \rightarrow r$