COSC 030, Fall 2019: Problem Set $\#1$

Assigned: .
Due: Tuesday 9/10, at the beginning of class (hand in hard copy).
Lectures Covered: Weeks 1 and 2.
Academic Integrity: You must work alone on the problem set and not consult outside sources (with the exception of the professor and teaching assistants). See the syllabus for details on the academic integrity policy for problem sets.

Problems

1. Let proposition $p =$ "it is raining today," proposition $q =$ "it is a holiday today", and proposition $r =$ "the traffic is bad today." Describe in words the following compound proposition: $\neg r \rightarrow p \oplus q$.

2. Consider the proposition $\neg r \rightarrow p \oplus q$ where p, q, and r are defined as in the previous problem. Assume you check and it turns out that the traffic is bad, but it is not raining, and it is not a holiday. Is this proposition true or false?

3. Prove that $(p \wedge q) \vee q \equiv (q \vee p) \wedge q$ by drawing the relevant truth table.

4. Prove that $(p \wedge q) \vee q \equiv (q \vee p) \wedge q$ by using the method of replacing propositions with known equivalent propositions. (Hint: Your answer should use one of the distributive laws learned in class as well as the following equivalence: $s \vee s \equiv s$.)

5. Provide an assignment that proves the following argument form is *not* valid:

   $\neg(p \wedge q) \rightarrow r$
   $r \leftrightarrow s$
   $\overline{}$
   $\therefore s$

6. Add an additional premise to the argument form from above that makes it valid. Your premise *cannot* include r or s.

7. Consider the following theorem:

   > **Theorem.** Assume that if someone is tall then they are confident, and if someone is shy then they are not confident. My friend bob is shy, therefore he is not tall.

   Prove this theorem using the direct proof method. In providing your proof for this problem and the *proof-related problems that follow*, you can use any rules of inference or propositional equivalences discussed in class. In all cases, you should be using the formal method we introduced in the class in which you grow a list of *true propositions*, providing a label for each proposition establishing why it is true. Less formal presentations of your proofs will not be accepted.

8. A *prime* number is whole number greater than 1 that is only divisible by 1 and itself (e.g., 2,3,5,7,11,13,17...). A useful property of prime numbers is that they are always odd.

   - Prove this property using a proof by *contraposition*.
   - Prove this property using a proof by *contradiction*.