# CSC 503 Homework Assignment 1

Out: August 24, 2015
Due: August 31, 2015
MISSING-ID

1. Use $\neg$, $\rightarrow$, $\wedge$, and $\vee$ to express the following declarative sentences in propositional logic over independent atomic propositional statements $p$, $q$, $r$, etc. First state what your propositional atoms mean in self-contained English sentences, then give the translation of the sentence.

   (a) [4 points] Jack and Jill ran up the hill.

   (b) [4 points] Real Madrid FC ran up the hill.

   (c) [4 points] NC State has a red and white logo.

   (d) [4 points] If Jack did not fall down, he did not break his crown.

   (e) [4 points] Jack fell down and broke his crown, and Jill came tumbling after.

2. The formulas of propositional logic implicitly assume the binding priorities of the logical connectives put forward in Convention 1.3. Make sure that you fully understand those conventions by reinserting all omitted parentheses in the following abbreviated statements.

   (a) [10 points] $\neg\, p \vee q \rightarrow \neg\neg\, q \wedge \neg\, r$

   (b) [10 points] $r \rightarrow \neg q \vee p \rightarrow (q \rightarrow \neg\, p \vee r)$

3. [10 points] List all subformulas of the formula $((p \rightarrow \neg q) \vee (p \wedge s) \rightarrow r) \wedge \neg r$.

4. [10 points] Why is the expression $p \vee q \wedge r$ problematic? Use truth tables to justify your answer.

5. [10 points] Compute the complete truth table of the formula $((p \rightarrow \neg q) \rightarrow (q \rightarrow p)$.

6. [10 points] A formula is valid iff each of its valuations assigns it T; it is satisfiable iff at least one of its valuations assigns it T. Is the formula $(p \rightarrow q) \vee (\neg q \wedge \neg r)$ valid? Is it satisfiable? Justify your answers.

7. [10 points] Show that the entailment claim $\neg p \rightarrow (r \vee q), \neg q \wedge p \models p \rightarrow q$ is not correct by finding a valuation in which the truth values of the formulas to the left of $\models$ are T and the truth value of the formula to the right of $\models$ is F.

8. [10 points] Does $\models (p \vee q) \wedge (\neg q \vee r) \rightarrow (p \vee r)$ hold? Justify your answer.