CSE 311: Foundations of Computing I
Assignment #1
September 25, 2013
Due: October 2, 2013

Reading assignment: Read Sections 1.1-1.3 of 7th edition (1.1-1.2 of 6th edition). Make sure you understand the examples. Also read the Grading Guidelines on the course homepage.

Problems

1. Write each of these statements in the form "if p, then q" in English. [Hint: Refer to the list of common ways to express conditional statements provided in Sec. 1.1 of the text.]

   (a) An entry appears in the log file whenever a user enters their password correctly.
   (b) You will get spam unless you click on unsubscribe.
   (c) To be a good musician, you must practice daily.
   (d) I will give you lessons, if you send me a check for $100.

2. The **NAND** connective takes two propositions and evaluates to false when both propositions are true and evaluates to true otherwise. NAND of p and q is written $p \mid q$. In circuit diagrams, the gate for NAND is denoted by  .

   Show how to write propositional formulas *using the NAND connective and the variables p and q but no other constants or connectives* that are equivalent to each of the following:

   (a) $\neg p$
   (b) $p \vee \neg q$
   (c) $p \leftrightarrow q$
   (d) $p \wedge q$

3. Using **AND**  gates, **OR**  gates, and inverters (**NOT**  gates), draw the diagram of a circuit with two inputs that computes the same function as the single two-input XNOR  gate does (XNOR is the negation of XOR).

4. State in English the converse and contrapositive of each of the following implications:

   (a) If a is placed in the queue before b, then a gets processed before b.
   (b) If a law is broken and the judge finds you guilty, then you will go to jail. (Be sure to use De Morgan's Law to simplify the contrapositive so the statement reads more naturally in English.)

5. Show that $(p \rightarrow q) \leftrightarrow r$ and p $\leftrightarrow (q \rightarrow r)$ are not logically equivalent.

6. Find a compound proposition involving the propositional variables $\boldsymbol{p}$, $\boldsymbol{q}$, and $\boldsymbol{r}$ that is true when exactly two of the propositions $\boldsymbol{p}$, $\boldsymbol{q}$, and $\boldsymbol{r}$ is true.

7. **Extra credit:** You have two memory registers, each with the same number of bits. You have an operation, `XOR(R1,R2)`, which takes two registers, `R1` and `R2`, performs bitwise between them, and stores the result in `R1`. Show how you can swap the contents of the two registers using a sequence of `XOR`s without temporary memory registers. Explain why this works.