CSE 321: Discrete Structures
Assignment #1
September 29, 2006
Due: Friday, October 6

Reading Assignment: Read Sections 1.1-1.4 carefully (make sure that you understand the examples).

Problems:

1. Both editions: Section 1.1, exercise 10.
2. 6th edition: Section 1.1, exercise 20, parts (a), (c), (f), (g)
   5th edition: Section 1.1, exercise 18, parts (a), (c), (f), (g).
3. State in English the converse and contrapositive of each of the following impliations:
   (a) If a is pushed onto the stack before b, then b is popped before a.
   (b) If the input is correct and the program terminates, then the output is correct. (Be sure to use De Morgan's Law to simplify the contrapositive.)
4. 6th edition: Section 1.1, exercise 60
   5th edition: Section 1.1, exercise 56.
5. The following two statements form the basis of the most important methods for automated theorem proving. Use truth tables to prove that they are tautologies.
   (a) Resolution: $((p \vee q) \wedge (\neg q \vee r)) \rightarrow (p \vee r)$
   (b) Modus ponens: $((p \wedge (p \rightarrow q)) \rightarrow q$
6. Show that Modus ponens is a tautology without using a truth table. Show each step and indicate which logical equivalences you use.
7. Show that $(p \rightarrow q) \vee (p \rightarrow r)$ and $p \rightarrow (q \vee r)$ are logically equivalent.
8. Give the negation of each of the following statements:
   - All good students study hard.
   - No males give birth to their young.
   - No students in mathematics are unable to use a computer.
   - $\forall x \exists y\ x = y^2$
9. **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 $\oplus$ 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.