University of Washington
Department of Computer Science and Engineering
CSE 321, Winter 2008

January 8, 2008

Homework 1, Due Wednesday, January 16, 2008

Problem 1:
Section 1.1, Exercise 10.

Problem 2:
Section 1.1, Exercise 16. (Fifth edition, 1.1, Exercise 14)

Problem 3:
Section 1.1, Exercise 20, a, c, e, g. (Fifth edition, 1.1, Exercise 18, a, c, e, g)

Problem 4:
Section 1.1, Exercise 34 (Fifth edition, 1.1, Exercise 30).

Problem 5:
The following two statements form the basis of the most important methods of 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: $((p \wedge (p \rightarrow q)) \rightarrow q)$

Problem 6:
Show that Modus ponens is a tautology without using a truth table. Show each step and indicate which logical equivalences you use.

Problem 7:
Show that $(p \rightarrow r) \wedge (q \rightarrow r)$ and $(p \vee q) \rightarrow r$ are logically equivalent.

Problem 8:
Define the NAND operator, denoted $|$, as follows $(p \mid q)$ is true when either p or q, or both are false; and $(p \mid q)$ is false when p and q are true.

a) Show that the NAND operator is commutative.

b) Show that the NAND operator is not associative.

c) Give an expression that is equivalent to $p \rightarrow q$ that only uses the logical connective $|$.

Extra Credit 9:

Show that you can swap a pair of memory registers using exclusive-or without any temporary storage. To be precise, suppose that your machine has two memory registers R_1 and R_2 with the same number of bits. The instruction XOR_1 makes the assignment $R_1 \leftarrow R_1 \oplus R_2$ and the instruction XOR_2 makes the assignment $R_2 \leftarrow R_1 \oplus R_2$. Describe how you swap a pair of values and explain why your solution works.