MAD 2104 Aug 30, 2012
Quiz I and Key Prof. S. Hudson

1) Construct a combinatorial circuit using inverters, OR gates and AND gates that produces the output $(p \wedge \neg q) \vee \neg p$ from input bits p and q.

2) Find a compound proposition in disjunctive normal form that is logically equivalent to $(p \to q) \bigoplus r$.

3) Answer each part with "True" or "False". You don't have to explain (but it doesn't hurt, and might help if we decide later that a question was not totally clear).

a) $\neg p \to (p \to q)$ is a tautology.
b) $(p \to q) \vee (p \to \neg q)$ is a tautology.
c) $p \to \neg q$ is logically equivalent to $(\neg p \wedge q)$.
d) The contrapositive of $p \to \neg q$ is $q \to \neg p$.
e) $0101 \vee 1100 = 1111$.

Bonus (approx 5 pts): Show that $\{\wedge, \neg\}$ is functionally complete.

Remarks and Answers: The average grade was 81 out of 100, based on the top 25 scores. This is fairly normal for Quiz 1, which is usually easier than the others. The scale now is higher than the one on the syllabus, but it usually comes down by the end of the term. The highest scores were 101 and 98. The lowest scores were probably on part 2).

A's 90 to 100
B's 80 to 89
C's 70 to 79
D's 60 to 69

1) [30 pts] See me, if needed (or HW in Ch. 1.2, 40 to 43). Most answers were mostly correct, though some peoples' OR gates looked a lot like their AND gates. An OR gate should have three curves and 3 angles.

2) [30 pts] $(p \wedge q \wedge \neg r) \vee (p \wedge \neg q \wedge r) \vee (\neg p \wedge q \wedge \neg r) \vee (\neg p \wedge \neg q \wedge \neg r)$

The work: make a truth table with 8 rows. The last column, labeled $(p \to q) \bigoplus r$, should contain 4 T's. One of these 4 gives $(p \wedge q \wedge \neg r)$, etc. This problem is similar to the HW in Ch.1.3: 40 to 42, and to an example from class.

3) [40 pts] TTFTF

Bonus) See Ch.1.3.43-45 (only 43 was assigned). The basic idea is that anything can be written in DNF, using only $\{\vee, \ \wedge, \ \neg\}$. Any $\vee$ can be replaced, using DeMorgan's laws, so we really only need $\{\wedge, \ \neg\}$.