**Problem Set 9**
CSCE 411
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**The assignment is due on Friday, Dec 2, 2011, before class.**

**Exercise 1** (20 points)**.** *Improve your implementation of comparative Sudoku. You can use a refinement of backtracking, some partial solving using deduction followed by some other method, a constraint based solver, or some other method (or combination of methods). You are allowed to use C, C++, C#, Java, or Ruby in your implementation.*

*Please describe briefly the main algorithmic ideas behind your new comparative Sudoku solver.*

**Exercise 2** (20 points)**.** *Print out your source code. Make sure that it is well-documented.*

**Exercise 3** (20 points)**.** *Solve the challenge problems that will be posted. Give a table that compares the time of your solver from Problem Set 7 with the solver from this problem set. Include a printout of the solutions produced by your new comparative Sudoku solver.*

**Exercise 4.** *Let $\phi$ be a boolean formula in 3-CNF. An $\neq$-assignment to the variables of $\phi$ is one where each clause contains two literals with unequal truth values. In other words, an $\neq$-assignment satisfies $\phi$ without assigning three true literals in any clause.*

*(a) Show that the negation of a $\neq$-assignment to $\phi$ is also a $\neq$-assignment.*

*(b) Let $\neq SAT$ be the collection of boolean formulas in 3-CNF that have an $\neq$-assignment. Show that $3-SAT \leq_P \neq SAT$, and that $\neq SAT$ is NP-complete. [Hint: Replace each clause $(y_1 \vee y_2 \vee y_3)$ by two clauses $(y_1 \vee y_2 \vee z_i)$ and $(\neg z_i \vee y_3 \vee b)$, where $z_i$ is a new varable for each clause and $b$ is a single additional new variable.]*

**Exercise 5** (20 points)**.** *Problem 34-3 d,e,f (that is, prove that 3-COLOR is NP-complete using the reduction 3-SAT$\leq_P$ 3-COLOR) on page 1103 of our textbook.*