CS 520: Theory of Computation	**Homework 1**
Out: 02/05/08	**Due: 02/19/08**

Ground Rules

- **(Grading)** You will be graded on the correctness as well as clarity of your solutions. Please state and prove any assumptions or claims that you make.
- **(Collaboration)** You are allowed to discuss questions with other people in the class. However, **you must solve and write your answers yourself without any help**. You must also give explicit citations to any sources besides the textbook and class notes, including discussions with classmates.
- **(Lateness)** Late submissions do not get any credit.
- Start working on your homework early. Plan your work in such a way that you have the opportunity to put some problems on the back burner for a while and revisit them later. Good luck!

Problems

1. **(12 pts)** Design (deterministic or non-deterministic) finite automata for the following languages:
   (a) The set of strings over the alphabet $\{a, b\}$ containing at least two occurrences of three consecutive b characters, with overlaps permitted (e.g., the string $bbbb$ should be accepted).
   (b) The set of strings over the alphabet $\{a, b\}$ containing at least two occurrences of three consecutive b characters, with overlaps not permitted (e.g., the string $bbbb$ should not be accepted).
   (c) The set of strings over the alphabet $\{a, b\}$ that do not contain the substring $abab$.
   (d) The language C in problem 1.33 in the book (pg. 89).
2. **(10 pts)** Give regular expressions for each of the following subsets of $\{a, b\}$. Simplify as much as possible.
   (a) $\{x | x$ contains an even number of a's$\}$.
   (b) $\{x | x$ contains an even number of a's and one or two b's$\}$.
   (c) $\{x | x$ contains an even number of a's and an odd number of b's$\}$.
3. **(8 pts)** Let A and B be any languages. Prove or disprove the following identities:
   (a) $(A \cup B)^* = A^* \cup B^*$
   (b) $(AB \cup A)^* A = A(BA \cup A)^*$
4. **(10 pts)** Problem 1.42 in the book (pg. 89).
5. **(10 pts)** Problem 1.45 in the book (pg. 90).
6. **(Extra credit, 10 pts)** Prove that if A is *any* language (not necessarily regular) over the alphabet $\{0\}$, then A^* is regular.