CMSC 351: Extra Practice Questions for Midterm Exam

These are practice problems for the upcoming midterm exam. You will be given a sheet of notes for the exam. Also, go over your homework assignments. **Warning:** This does not necessarily reflect the length, difficulty, or coverage of the actual exam.

**Problem 1.** Show that for any real constants $a$ and $b$, where $b > 0$,

$$ (n + a)^b = \Theta(n^b). $$

**Problem 2.**

(a) Is $2^{n+1} = O(2^n)$?  
(b) Is $2^{2n} = O(2^n)$?

**Problem 3.** Show that $n^2 - 7n + 1 = \Theta(5n^2 + 6n - 10)$ using the definition of $\Theta$ given in class (do not use limits).

**Problem 4.** Let $A[1, ..., n]$ be an array of $n$ numbers (some positive and some negative).

(a) Give an algorithm to find which three numbers have sum closest to zero. Make your algorithm as efficient as possible. Write it in pseudo-code.

(b) Analyze its running time.

**Problem 5.** *(HARD)* Analyze the average number of exchanges in (standard) bubble-sort.