COMP 4030/6030: Assignment 5
Due date: 03/28/2016

   Email programming solutions to the TA (Quang Tran, qmtran@memphis.edu). Put "COMP 4030/6030 assignment 5" on the subject line.

1. Programming assignment: in this problem, you need to implement different strategies to determine the majority item in a list of items. There's a special constraint that you can not compare items using less than or greater than operators. You can only compare if two items are the same. An item is a majority element if its frequency is greater than $\frac{n}{2}$, where n is the number of items in the list. For example, in the list [C, C, T, T, C, T, C, C], C is the majority item, because the frequency of C is 5, which is greater than $4 = \frac{8}{2}$. Another example, the list [C, C, T, C, C, S, T, T] has no majority item.

   (a) (20 points) Use a brute-force strategy to determine the majority item in $O(n^2)$ time. Hint: compute the frequency of each item and determine the majority if there is one.

   (b) (20 points) Use a divide-and-conquer strategy to determine the majority item in $O(n \log n)$ time. Hint:

      • Majority(L, i, j) returns the majority element for the interval [i, j] in L.
      • Split the problem of size n into two subproblems of size $\frac{n}{2}$ (left half and right half).
      • After the majority elements of the left half and right half are determined, you will want to compute the majority element for the entire interval [i,j] in O(n) time.

2. (20 points) Use the Master's theorem to find the complexity (in terms of Θ) for the following equation: $T(n) = 2n + 9T(\frac{n}{3})$. Assuming $T(1) = 1$.

3. (20 points) Use the Master's theorem to find the complexity (in terms of Θ) for the following equation: $T(n) = 4n^2 + 9T(\frac{n}{3})$. Assuming $T(1) = 1$.

4. (20 points) Use the Master's theorem to find the complexity (in terms of Θ) for the following equation: $T(n) = 4n + 4T(\frac{n}{3})$. Assuming $T(1) = 1$.