Quiz 2

Name: ____

(10 points) Selection in Bitonic lists

You are working for an investment firm that prides on its analysis of the past. (You have heard this before!) You have been regularly asked to analyze historical data, which are being updated every minute and hence result in huge lists (of the order of several millions). One of the problems you repeatedly face is to find the minimum, maximum, or median value in such a list.

Of course, you know that the maximum, the minimum, or, in fact, element of any given rank, in any list can be computed in linear time. But since the lists are huge, even linear time is prohibitively large. Fortunately, most of the lists you analyze are *bitonic*: that is, the list is composed of two contiguous (possibly empty) segments, the first is an increasing segment and the second is a decreasing segment.

Formally, an array $A[1 \ldots n]$ is bitonic if there exists an integer k , $1 \leq k \leq n$ such that for $1 \leq i < k$, $A[i] < A[i+1]$, and for $k \leq i < n$, $A[i+1] < A[i]$. For example, the lists $[2, 4, 6, 7, 5, 3, 2]$ and $[1, 2, 5, 6, 8]$ are bitonic while the list $[9, 10, 12, 10, 7, 8]$ is not bitonic.

For each of the following parts, *give an efficient algorithm for finding the desired element of an n-element bitonic list, and state the worst-case running time (as a function of n) of your algorithm.* Note that the running-time is measured by the number of basic arithmetic and logical operations and the number of list entries that your algorithm accesses in the worst case. For each part, make your algorithm as efficient as you can, in terms of its worst-case running time. (You need not prove the correctness of your algorithm or give an analysis of its running time.)

(a) (6 points) Maximum element.

(b) (2 points) Minimum element.

(c) (2 points) Median element.