CS 240: Data Structures and Data Management **Fall 2020**

Tutorial 3: October 5

1. Let $0 < \epsilon < 1$. Suppose that we have an array A of n items such that the first $n - n^\epsilon$ items are sorted. Describe an $O(n)$ time algorithm to sort A.

2. Give the best-case, worst-case, best-case expected and worst-case expected runtime of the following function:

Algorithm 1: IsSortedGuess$(A, 0)$

Input: Array A of n nonnegative integers, integer $currmax$ which is initially set to 0
Output: A guess on whether A is sorted or not.

```
1 if n == 0 then
2 |  Return "Probably Sorted";
3 end
4 i ← random(n);
5 if A[i] ≥ currmax then
6 |  currmax ← A[i];
7 |  Return IsSortedGuess(A[i + 1 ... n], currmax);
8 end
9 Return "Definitely Not Sorted";
```

3. We have an array A of n non-negative integers such that each integer is less than k. Give an $O(n + k)$ time preprocessing algorithm such that queries of the form "how many integers are there in A that are in the range $[a, b]$?" can be answered in $O(1)$ time. Note that a and b are not fixed; they are parameters given to the query algorithm.