CS 240: Data Structures and Data Management **Winter 2024**

Tutorial 04: Feb 5

1. **Hoare's Partition** Assume that you call *QuickSort* on an array of size n where all elements are the same. Derive (with an explanation) an asymptotically tight bound on the run-time, presuming you use Hoare's partition-algorithm from class.

2. **Multiplicity Sorting** Consider the problem of sorting an array A of n elements with multiplicity n/k. That is, A consists of k distinct elements $(y_1, y_2, \ldots, y_k)$, where each y_i occurs n/k times in A. Prove that any algorithm in the comparison model requires $\Omega(n \log k)$ comparisons to sort A in the worst-case.
   Note: $\forall m \geq 0, \left(\frac{m}{e}\right)^m \leq m! \leq m^m$.

3. **Bounded Digit Sorting** Given an array A of n positive integers such that the total number of decimal digits in all integers combined is ℓ, design an algorithm to sort A in $O(\ell)$ time.