

## 1 3-Wise Comparisons

Assume you have a function called 3-sort that takes as input an array of size 3 of comparable objects and returns them in sorted order. You want to sort an array of size  $n \geq 3$  objects only using calls to 3-sort. How many function calls of 3-sort are required to sort an array of size  $n$ ? Choose the asymptotically largest applicable lower bound.

- $\Omega(\log n)$
- $\Omega(\sqrt{n})$
- $\Omega(n)$
- $\Omega(n \log n)$

Correct

## 2 Possible or Impossible

Is it possible to implement the following algorithms or data structures?

A data structure that stores comparable objects and supports the following operations:

- Insert new objects in  $O(1)$  time per insertion.
- Remove objects in  $O(1)$  time per removal.
- Return the smallest object currently in the collection in  $O(1)$  time.

Is it possible to implement such a data structure?

- Possible
- Impossible

Correct

An algorithm that runs in  $O(n)$  time and takes an array  $A$  of size  $n$  of comparable objects,  $i$ , and  $j$  ( $1 \leq i < j \leq n$ ) as inputs and returns all the elements that are greater than the  $i$ th smallest element in  $A$  and less than the  $j$ th smallest element in  $A$ ?

- Possible
- Impossible

Correct

Which algorithm would be a good choice to use for the last part?

- $k$ -Select
- Radix Sort
- Quick Sort
- Merge Sort

Correct

An algorithm that runs in  $O(n)$  time and takes an array  $A$  of size  $n$  of comparable objects and partitions  $A$  into  $\frac{n}{\log n}$  groups of size  $\log n$  each, where for every  $i < j$ , members of group  $i$  are smaller than or equal to members of group  $j$ .

- Possible
- Impossible

Correct

## 3 Radix Sort and Counting Sort

Assume you have an array  $A$  of size  $n$  with positive integer element with all elements in the range  $[1, n^3]$ .

What is the runtime of Counting Sort run on  $A$ ?

- $\Theta(n)$
- $\Theta(n \log n)$
- $\Theta(n^2)$
- $\Theta(n^3)$

Correct

What is the runtime of Radix Sort, using base 10, run on  $A$ ?

- $\Theta(n)$
- $\Theta(n \log n)$
- $\Theta(n^2)$
- $\Theta(n^3)$

Correct

Which base for Radix Sort will result in the fastest Radix Sort algorithm to sort  $A$  with?

- 2
- 10
- $n$
- $n^2$

Correct