Sorting Models

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 ith smallest element in A and less than the jth 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