Computer Programming

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Sorting and Searching Recap Quiz and Problems

Recap Quiz

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Q1. Which of the following is true of the implementations of selectionSort and mergeSort *taught in class:*

A. Both implementations were recursive

B. Only the implementation of selectionSort was recursive

C. Only the implementation of mergeSort was recursive

D. None of the implementations was recursive

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Q2. Consider an integer array A of size n. The ratio

$$\frac{\text{Number of “basic steps” to sort A by selectionSort}}{\text{Number of “basic steps” to sort A by mergeSort}}$$

grows linearly with

A. $(n / 2^n)$

B. $(n / \log_2 n)$

C. $(\log_2 n / n)$

D. $(n^2 / \log_2 n)$

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Q3. By using an appropriate comparison operator, mergeSort or selectionSort can be used to sort an array of:

A. integers

B. characters

C. strings

D. double

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Q4. Binary search can be used to efficiently search for an element in

A. An unsorted array

B. An array sorted in ascending order

C. An array sorted in descending order

D. All of the above

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Q5. In a recursive implementation of binarySearch (as taught in class), the termination case

A. Always finds the searched element in the array

B. May not find the searched element in the array

C. May happen when the size of the sub-array being searched is > 1

D. None of the above

Practice Questions

Search in 1-D Array

Searching in 1-D Array is easy. We have looked at two search algorithms so far.

- **Linear Search : Requires maximum “n” basic steps**
- **Binary Search : Requires maximum “ceil(log(n))” basic steps. But, there is an additional constraint on the array. The array must be sorted.**

Search in 2-D Array

- **How can we search for an element in a 2-D array of size nxn?**
- **What is the maximum number of "basic steps" needed to find the element?**

Improve Search in 2-D Array

- **That's too much! Let's say we impose a constraint on the input array, particularly on the order of elements in a each row. Can you search faster?**

- **What would that constraint be?**

Improve Search in 2-D Array

- **What would be the algorithm to search given such an input array? Write a program to search in such an array.**

- **What is the maximum number of "basic steps" needed to search in this case?**

Improve Search in 2-D Array

- **Let's say you are allowed to impose more restrictions on the input array.**
  Can you speed up the algorithm to search in atmost 2*log(n) "basic steps" ?

- **What is the constraint? Describe the new algorithm.**

Improve Search in 2-D Array (optional)

- **Given any 2-D array of size nxn. Can you think of some pre-processing on this input array to perform search in at most 2*ceil(log(n)) "basic steps"?**

- **What is the pre-processing? What is the extra information stored and the cost of this pre-processing step?**