Tecnológico de Monterrey

Fundamentos de computación

Homework 5

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1 Problems

Solve the following problems:

1. Implement algorithms quicksort, mergesort and heapsort in any programming language, and investigate their performance in arrays of size 10^2, 10^3, 10^4, 10^5 and 10^6. For each of those sizes, consider files of randomly-generated integers, files with integers already sorted in ascending order, and files with integers already sorted in descending order. Hand in a report with your investigation containing the analysis, discussion of results and the conclusions.

	QS Random	QS Ordered	QS Reverse	Merge Random	Merge Ordered	Merge Reverse	Heap Random	Heap Ordered	Heap Reverse
10^2	$1.75e^{-5}$s	$1.29e^{-5}$s	$1.38e^{-5}$s						
10^3	$1.98e^{-4}$s	$1.52e^{-4}$s	$1.58e^{-4}$s						
10^4	$2.22e^{-3}$s	$1.6e^{-3}$s	$1.67e^{-3}$s						
10^5	$2.42e^{-2}$s	$1.67e^{-2}$s	$1.75e^{-2}$s						
10^6	0.257s	0.178s	0.184s						

2. Consider the 3-ary heap, similar to the binary heap, except that a no-leaf node has 3 siblings
   (a) How would you represent a 3-ary heap in an array?
   (b) What is the height of a 3-ary heap with n elements, in terms of $d = 3$ and n?
   (c) For an element in position i in the heap, determine the position of its parent and siblings.
   (d) In general terms, determine the complexity of a heap algorithm with these features.
3. Show how a set of n positive integers between 1 and n^2 can be sorted in linear time
4. Describe and algorithm that makes 42 comparisons for sorting 15 elements in the worst case (Donald Knuth, The Art of Computer Programming, Vol. 3). Show how the algorithm works using an example.