Problem Set #1

Quiz, 5 questions

1
point

1.

3-way-Merge Sort : Suppose that instead of dividing in half at each step of Merge Sort, you divide into thirds, sort each third, and finally combine all of them using a three-way merge subroutine. What is the overall asymptotic running time of this algorithm? (Hint: Note that the merge step can still be implemented in $O(n)$ time.)

○ $n^2 \log(n)$

○ $n \log(n)$

○ $n(\log(n))^2$

○ n

1
point

2.

You are given functions f and g such that $f(n) = O(g(n))$. Is $f(n) * log_2(f(n)^c) = O(g(n) * log_2(g(n)))$? (Here c is some positive constant.) You should assume that f and g are nondecreasing and always bigger than 1.

○ Sometimes yes, sometimes no, depending on the functions f and g

○ False

○ True

○ Sometimes yes, sometimes no, depending on the constant c

1
point

3.

Assume again two (positive) nondecreasing functions f and g such that $f(n) = O(g(n))$. Is $2^{f(n)} = O(2^{g(n)})$? (Multiple answers may be correct, you should check all of those that apply.)

□ Yes if $f(n) \leq g(n)$ for all sufficiently large n

□ Sometimes yes, sometimes no (depending on f and g)

□ Always

□ Never

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4.

k-way-Merge Sort. Suppose you are given k sorted arrays, each with n elements, and you want to combine them into a single array of kn elements. Consider the following approach. Using the merge subroutine taught in lecture, you merge the first 2 arrays, then merge the 3^{rd} given array with this merged version of the first two arrays, then merge the 4^{th} given array with the merged version of the first three arrays, and so on until you merge in the final (k^{th}) input array. What is the running time taken by this successive merging algorithm, as a function of k and n? (Optional: can you think of a faster way to do the k-way merge procedure ?)

○ $\theta(nk)$

○ $\theta(nk^2)$

○ $\theta(n\log(k))$

○ $\theta(n^2k)$

1
point

5.

Arrange the following functions in increasing order of growth rate (with $g(n)$ following $f(n)$ in your list if and only if $f(n) = O(g(n))$).

a)2^{2^n}

b)2^{n^2}

c)$n^2 \log(n)$

d)n

e)n^{2^n}

Write your 5-letter answer, i.e., the sequence in lower case letters in the space provided. For example, if you feel that the answer is a->b->c->d->e (from smallest to largest), then type abcde in the space provided without any spaces before / after / in between the string.

You can assume that all logarithms are base 2 (though it actually doesn't matter).

WARNING: this question has multiple versions, you might see different ones on different attempts!

Preview

Enter math expression here

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