

Quiz-1

T.Y. (Honours - Computer Engineering)
Advanced Data Structures

Date: 18/9/2017

Maximum Marks: 20

Q.1 Suppose we're doing a sequence of operations (numbered 1, 2, 3,...) such that the i^{th} operation:

- costs 1 if i is *not* a power of 2, and
- costs i if i *is* a power of 2.

Find the amortized cost of n operations using Aggregate method.

[4 marks]

Q.2 You are to maintain a collection of lists and support the following operations. (i) insert(item, list): insert item into list (cost = 1). (ii) sum(list): sum the items in list, and replace the list with a list containing one item that is the sum (cost = length of list). Use either Accounting Method or Potential Function method to show that the amortized cost of an insert operation is $O(1)$ and the amortized cost of a sum operation is $O(1)$. First state the method you have used and then provide the rest of the details.

[4 marks]

$$\begin{aligned} & n - k + 2^1 + \dots + 2^k \\ &= n - k + 2(2^k - 1) \\ &= n - \log n + 2n - 2 \end{aligned}$$

- Q.3 Consider a $n \times n$ array of integers. We have to find the maximum of all elements at the boundary. If the array is stored in row-major form and a cache line can hold n integers, answer the following:
- (a) Suppose we traverse the array in clock-wise fashion (row 1, column n , row n and finally column 1), how many cache-misses will be there?
 - (b) Describe briefly a strategy that can improve the performance. What is the number of cache-misses in your proposed strategy? [4 marks]
- Q.4 Assume that main memory has 5 blocks and a data file on the disk has size 108 blocks. Assuming 4-way merge strategy is used in the merge pass for sorting the data using external merge sort, answer the following (details of calculations how you arrived at the answers are expected):
- (a) Number of runs and sizes of the runs in each pass
 - (b) Number of passes [4 marks]
- Q.5 Draw a max winner tree for players [3, 5, 6, 7, 20, 8, 2, 9]. Then draw a separate max winner tree that result when 20 is changed to 1. Highlight the changes in the new tree with respect to the original tree. [4 marks]

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