ESO207A Mid-Semester Examination

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Questions

Q1. Prove or disprove the following statement.

"$\boldsymbol{(log\ n)!}$ is not $\boldsymbol{\mathcal{O}(n^k)}$, for any constant $\boldsymbol{k}$."

(3 points)

Q2. Suppose we wish to support operation $Merge(A, B, C)$, on heaps. Here A, B are arrays containing two disjoint heaps. $Merge(A, B, C)$ stores set $A \bigcup B$, as a heap in C. It is assumed that C has enough space to store the union. Outline an efficient time algorithm for this operation.

(3 points)

Q3. Suppose a set of English words is to be stored in a computer. We wish to support dictionary operations on this set. One can, of course, use any dictionary data structure to represent this set. But we wish to exploit the fact that these words are finite strings from alphabet $\{a, \ldots, z\}$.

Think of a tree based representation for set of words which supports $Member(A, x), Insert(A, x)$ and $Delete(A, x)$ operations in time $O(|x|)$. Here $|x|$ is length of the word x, that is, the number of letters in word x. Note that time taken by these operations is independent of the size of set A.

Show your representation for the set of words, $\{ash, ashine, vir, virat\}$. Briefly sketch the dictionary operations, $Member(A, x)$ and $Insert(A, x)$ with justification for the time required.

(5 points)

Q4. Consider an application which requires *matrix* operations but each *matrix* has many *zero* entries. We wish to represent each matrix in space proportional to number of non-zero entries in it. Give a data structure for such a representation of a *matrix*. Show your representa-tion for a concrete $\mathbf{3 \times 3}$ *matrix*.

Show that in your representation, complexity of accessing/ updating the element in row $\boldsymbol{i}$ and column $\boldsymbol{j}$ is $\mathcal{O}(\boldsymbol{i + j})$.

(5 points)