Technische Universität München
Fakultät für Informatik
Lehrstuhl für Effiziente Algorithmen
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Wintersemester 2013
Assignment 8
9 December 2013

Efficient Algorithms and Datastructures I

Question 1 (10 Points)

In hashing with chaining, if we modify the chaining scheme so that each list is kept in sorted order, how does it affect the running time for successful searches, unsuccessful searches, insertions, and deletions?

Question 2 (10 Points)

A forest is an undirected cycle-free graph, i.e. a forest is a graph, all of whose connected components are trees. A random graph is obtained by starting with a set of n vertices and adding edges between them at random. In the $G(n,p)$ model, for every pair of vertices $\{a,b\}$, the edge (a,b) occurs independently with probability p. Your goal is to show that for suitable value of p, the probability that G is not a forest is at most a constant (say $\leq \frac{1}{2}$). Note that G not being a forest means that $\exists$ a set $S \subseteq V, |S| = k$, such that the graph induced by S contains at least k edges. Of course, this trivially holds if for example you choose $p = 0$. You should aim for $p = \Omega\left(\frac{1}{n}\right)$. For example, $p = \frac{1}{4e^2 n}$ might be a good choice.

Question 3 (10 Points)

We traverse a binomial tree B_k as follows - visit the root (r) of B_k and recursively traverse the subtrees(binomial) rooted at the following level 1 nodes (children of r): traverse B_0 (rooted at the rightmost child of r), then succesively traverse B_i for $1 \leq i \leq k-2$, and finally traverse B_{k-1} (rooted at the leftmost child of r). We give every node a label as follows: r is labelled $(0 \cdots 0)$ (k-times). Every other node is given a label the first time we visit a node, by incrementing the previous label by 1 (when the label is considered as a number in binary). Consider a node x labeled l at depth i. Show that x has i 1's in its binary label l. Also show that the number of children of x is equal to the number of 0's to the right of the rightmost 1 in the binary representation of l (except for the root).