

Fundamental Algorithms, Assignment 5

Due March 4/5, in Recitation

I wasn't sure anymore and I will tell you, it is a strange process to feel one's mind changing, allowing ideas into your brain which it had once considered unthinkable. I cannot say it's painful, or particularly pleasurable, but that it requires a certain relaxation of the hold one keeps over oneself, and is to that degree both a thrill and a horror.

– from *The Chess Garden*, by Brooks Hansen

1. Some exercises in which n is NOT the data size but we want the answer in terms of n . (Answers in Θ -land.)
 - (a) How long does MERGE-SORT on n^2 items take?
 - (b) Suppose that when $n = 2^m$, ANNA takes time $\Theta(m^2 2^m)$. How long does it take as a function of n .
 - (c) Suppose that when $n = 2^m$, BOB takes time $\Theta(5^m)$. How long does it take as a function of n .
 - (d) How long does COUNTING-SORT take to sort n^2 items with each item in the range 0 to $n^3 - 1$.
 - (e) How long does RADIX-SORT take to sort n^2 items with each item in the range 0 to $n^3 - 1$ and base n is used.
2. Consider hashing with chaining using as hash function the sum of the numerical values of the letters ($A=1, B=2, \dots, Z=26$) mod 7. For example, $h(\text{JOE}) = 10+15+5 \bmod 7 = 2$. Starting with an empty table apply the following operations. Show the state of the hash table after each one. (In the case of Search tell what places were examined and in what order.)
 - Insert COBB
 - Insert RUTH
 - Insert ROSE
 - Search BUZ
 - Insert DOC
 - Delete COBB
3. Consider a Binary Search Tree T with vertices a, b, c, d, e, f, g, h and $ROOT[T] = a$ and with the following values (N means NIL)

| | | | | | | | | |
|--------|----|-----|-----|-----|-----|-----|-----|----|
| vertex | a | b | c | d | e | f | g | h |
| parent | N | e | e | a | d | g | c | a |
| left | h | N | N | e | c | N | f | N |
| right | d | N | g | N | b | N | N | N |
| key | 80 | 170 | 140 | 200 | 150 | 143 | 148 | 70 |

Draw a nice picture of the tree. Illustrate `INSERT[i]` where `key[i]=100`.

If you want to have good ideas you must have many ideas. Most of them will be wrong, and what you have to learn is which ones to throw away.

– Linus Pauling