Institut for Matematik og Datalogi
Syddansk Universitet

February 28, 2011
JFB

DM508 – Algorithms and Complexity – 2011
Lecture 9

Lecture, February 28

We finished Fibonacci heaps and began on string matching from chapter 32, covering up through the finite automata algorithm.

Lecture, March 7

We will finish string matching from chapter 32, covering the KMP algorithm. We will also talk about the exam. This will be the last lecture.

Problems to be discussed on March 16

1. 32.4-1, 32.4-3, 32.4-6 (32.4-4 in 2nd edition), 32.4-7 (32.4-5 in 2nd edition).
2. 32.4-4 and 43.4-5 in 3rd edition.

Assignment due Monday, March 14, 8:00

Note that this is part of your exam project, so it must be approved in order for you to take the exam in April, and you may not work with or get help from others not in your group (though you may talk with an "instruktor" or myself). You may work in groups of two or three. You may write your solutions in English or Danish, but write very neatly if you do it by hand. Submit the assignment via Blackboard as one PDF file.

Consider the problem keeping current information about a tournament for all of the contestants. Suppose that each contestant wants a list of all of the contestants they have shown themselves better than (by directly winning over the contestant or by winning over someone else who has shown themselves better than the contestant). Thus, if A has won over B, who has won over C and D, and D has won over E and F, A should have all of B, C, D, E, and F in his/her list. Assuming that no one ever plays again after losing, this can be done using linked lists. When player A wins over player B, the contents of B's linked list is copied to the end of A's linked list. This takes time linear in the length of B's list.

1. Design a tournament for n contestants (do not make any assumptions on what values n may have, other than begin a positive integer, at least 2), where the total time for copying lists is at most $O(n\lceil\log_2(n)\rceil)$.

2. How many matches are played in your tournament, and how many copies are done after one of these matches in the worst case?

3. Use amortized analysis with the accounting method to prove that at most $O(n\lceil\log_2(n)\rceil)$ copies are done during your entire tournament.

4. Design a tournament and use an adversary argument to show that there are tournaments where the worst case number of copies is $\Omega(n^2)$.

5. What is the prefix function computed by the KMP algorithm for the string $P = ccaabccaaccaabccaac$. Document your calculation by showing enough of your steps to prove that you understand it.