Institut for Matematik og Datalogi
Syddansk Universitet

Assignment 3 — Introduction to Computer Science 2014

This is your third assignment in DM534. The assignment is due at 8:15 on Tuesday, November 4. You may write this either in Danish or English. It must be made in LaTeX. Write your full name, your section number, and your "instruktor"s name (Magnus Gausdal Find or Christian Kudahl) clearly on the first page of your assignment (on the top, if it's not a cover page). You should turn it in as a PDF file via Blackboard through your DM534 course. The assignment hand-in is in the menu for the course and is called "SDU Assignment". Choose the correct one for your section number, D1 or D2. Keep the receipt it gives you proving that you turned your assignment in on time. Blackboard will not allow you to turn in an assignment late.

Cheating on this assignment is viewed as cheating on an exam. You are allowed to talk about course material with your fellow students, but working together on this assignment is cheating. If you have questions about the assignment, come to Joan Boyar, Rolf Fagerberg or your "instruktor" for DM534.

Please note that you must have this assignment approved in order to pass DM534. If it is not turned in on time, or if you do not get it approved, it will count as one of your two retries in the course, and you must have it approved on your single allowed retry for this assignment. Recall that there are at most two retries allowed in all for assignments (the study start project does not count in this number).

Assignment 3

Do the following problems and write your solutions in LaTeX, including the LaTeX code at the end. Do not include the statements of the problems or other information not asked for in the problems.You are allowed to use algorithms for the textbook as subroutines if you refer to them clearly.

Suppose that company, FavoriteCompany, has a database listing N customers at the beginning of the day, and this database is stored as a list, `Cust`. Suppose that at the beginning of the day, the database is sorted according to customer number, so the ith record in `Cust` has a lower customer

number than the $i+1$st record in `Cust`. Suppose that FavoriteCompany adds m new customers on this day. Assume that there is always enough empty space at the end of the list to hold records for these new customers.

Suppose when new customers come (and this only happens during the day), records for them are initially added to the end of the list, and during the night the list is sorted. Suppose that N is known.

Do all three of the following problems:

1. Write pseudocode for an algorithm to search for a customer (you are given the customer number as input) in the database during the day (i.e. before the list is sorted at night). Do not use Sequential Search for the entire list; do something more efficient (assuming m is much smaller than N). Note that the new customers are not added all at once, so you need to have a variable, c saying how many new customers from that day are currently in the list (assume that this variable is available and has the correct value, which will be m when the day is over). How many comparisons does your algorithm do in the worst case? (Use $\Theta()$ notation.)

2. Now assume that both N and m are known. Write pseudocode for an algorithm to sort the list at night. Your algorithm should do $\Theta((N+m)\cdot m)$ comparisons and use ideas from Insertion Sort. Explain why your algorithm does this number of comparisons in the worst case.

3. Assume that both N and m are known. Write pseudocode for an algorithm to sort the list at night. Your algorithm should do $\Theta(N+m^2)$ comparisons or less. Explain why it does this number of comparisons in the worst case. Hint: Consider merging.